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Effect of fear on dental utilization behaviors and oral health outcome

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Abstract – *Objectives:* This paper assesses the effect of fear on a number of dental utilization behaviors and oral heath outcome in a sample of adult Floridians. *Methods:* A telephone survey was conducted in 2004 among 504 adult Floridians. Data collected included sociodemographic factors, specific fear of dental pain (FDP), global FDP, global dental fear, three measures of dental utilization behaviors, and one measure of oral health outcome. Chi-squared tests and logistic regression analyses were conducted to quantify the individual and multivariate associations between fear factors and four behavior and outcome measures. *Results:* Global FDP was significantly associated with putting off making a dental appointment and approach to dental treatment. Global dental fear showed an independent negative impact on all four behavior and outcome measures; reports regarding specific fear of painful dental events were not significantly associated with four behavior and outcome measures. *Conclusions:* Our findings suggest that: (i) dental fear and FDP have independent negative effects on dental utilization behaviors and oral health outcome after controlling for other sociodemographic and general health factors; and (ii) global dental fear encompasses broader components than FDP.

Key words: behavioral science; dental fear; dental services research; oral health; pain

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Although the issues of dental fear and its impact on oral health have been intensively studied for decades (1), a number of questions remain unanswered regarding the causes and consequences of dental fear and anxiety. Several factors have been documented to be associated with the development of dental fear. A number of studies (2–7) have suggested that dental fear is a conditioned reaction to previous aversive dental experiences. These negative dental experiences include both the painful or traumatic experiences during dental treatment and unpleasant dentist contacts (2–5). General fearfulness is another commonly reported etiological factor in the literature, which predisposes people to the onset of dental fear (4, 6–8).

In addition to its multifactorial causes, dental fear is a complex phenomena consisting of different components, with fear of pain identified as a major contribution of dental fear (9–11). McNeil and Berryman (11) found that in addition to fear of pain, fear of being closed-in (claustrophobia) and fear of mutilation (tissue damage) were also important components of dental fear. Other concomitant factors included fear of powerlessness, fear of loss of control, fear of unpredictable events, embarrassment or shame about poor dental status, economic excuses, etc. (3, 9, 12).

It is well documented that dental fear has a significant impact on dental care utilization behaviors (8, 13, 14). Many studies have identified dental fear as a major obstruction to the seeking of dental care. For example, a population-based study revealed that a majority of dental fear participants had avoided necessary dental care (8). A study conducted among Swedish women aged 38–84 years old showed that high dental fear was associated with irregular dental utilization behaviors (13). In a sample of Norwegian adolescents,

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dental fear was indicated as a prime reason for missed and canceled dental appointments (14).

On the other hand, a study conducted by Hakeberg et al. (15) found that many self-identified high dental fear individuals were still regular attenders. Vassend (16) also reported that high dental anxiety did not necessarily impede regular dental care visits and conventional dental treatment. Schuller et al. (17) found that many dental fear participants visited dentists regularly, and there were no differences between the high and low dental fear groups in daily personal dental care practices, such as the use of toothbrush, dental floss, or toothpicks. There was a tendency, however, for individuals with high dental fear to use professional dental care less often, and these patients were more likely not to have used professional dental care services in the past 3 years (17).

The consequences of dental fear on oral health outcomes have also been reported in many studies. In general, dental fear is associated with the reduced oral health status (18), poorer oral health-related quality of life (19), and compromised psychosocial health, such as lower self-esteem and lower morale (8). McGrath and Bedi (19) reported that people with the poorest oral health-related quality of life were most commonly found among those with high levels of dental anxiety. Schuller et al. (17) indicated that compared with persons with low dental fear, persons with high dental fear had a higher number of decayed tooth surfaces, decayed teeth, and missing teeth, but a lower number of filled and sound teeth (17). Similarly, Hägglin et al. (20) noted that high dental anxiety was associated with a higher number of missing teeth.

In addition to dental fear, a number of sociodemographic factors have been reported to affect the dental services utilization behaviors and oral health outcomes. For example, blacks and poor people are less likely to receive dental care of certain type in a given period of time (21–23), whereas persons with a higher level of education are more likely to have a regular dental visiting pattern (22). Gender differences in dental care utilization and dental fear have been frequently reported in the extant literature. An interesting and consistent finding from the previous studies is that females generally have more dentist visits, are more likely to be regular dental attenders, and have better compliance with dental appointments and better oral hygiene practices than males (21, 22, 24, 25), despite the fact that dental fear is more prevalent and severe among females (12, 26, 27). It was suggested that gender difference in dental care utilization and oral health might be affected by factors other than the gender differences in dental fear (28).

Clearly, it is in the interest of public dental health to determine the extent to which dental fear independently affects oral health behaviors and outcomes in a general population, controlling for general health factors and sociodemographic factors. Therefore, the objective of the present investigation was to assess the independent effects of reported dental fear on dental care utilization behaviors and oral heath outcome in a sample of adult Floridians. We hypothesized that dental fear would have a negative impact on multiple measures of dental care utilization behaviors and oral health outcome after controlling for sociodemographic and general health factors.

Methods

Sampling procedures

Data were collected from a monthly telephone survey conducted by the Survey Research Center in the Bureau of Economic and Business Research at the University of Florida. The sample was selected using random digital dialing techniques and covered approximately 500 households in the July 2004 cycle. All respondents were at the age of 18 years or older and were selected as the household member who most recently had a birthday. Telephone numbers were released as a percentage of the regional population (counties). Sampling continued until quotas for 500 were reached. A total of 4750 telephone contacts were attempted and 1322 respondents were eventually reached. Among them, 755 respondents refused to participate in the survey; 43 were not eligible; nine were physically or mentally unable to engage in a telephone conversation; eight were unable or unavailable for miscellaneous reasons; three partially completed the survey; and, finally, 504 respondents completed the survey, yielding an estimated response rate about 38% of the reached subjects. The informed consent of all subjects who participated in the investigation was obtained verbally during the call. The protocol was approved by the Institutional Review Board of the University of Florida.

A total of 504 adult respondents aged 18 years or older were interviewed. According to the 2004

American Community Survey (29), almost 52% of Florida's adult population are females, about 11% are young adults aged 18–24 years, and approximately 19% are Hispanic. Compared with Florida's adult population, the current sample was composed of a higher percentage of females (60%), and a lower percentage of young adults (6%) and Hispanics (10%).

Measures

Specific fear of dental pain

Specific fear of dental pain (FDP) measures a number of fears related some specific painful dental events. In this study, it was assessed by six items from the Fear of Pain Questionnaire III (FPQ-III) (30) and the FDP questionnaire (31). The FPQ-III (30) is a 30-item self-report questionnaire designed to evaluate an individual's fear of a variety of painful events. Three subscales are derived including fear of severe pain, minor pain, and medical pain, comprising 10 items each. Four items in the FPQ-III are related to dental procedures and were included in the current study: 'receiving an injection in your mouth', 'receiving stitches in your lip', 'having a tooth pulled', and 'having one of your teeth drilled'. The FDP (31) is an 18-item questionnaire, which is designed specifically to measure fear of various types of dental pain. Two items ('receiving a root canal treatment' and 'a severe toothache') were selected from this questionnaire as additional measures of specific FDP. Items in FPQ-III and FDP are rated on a 5-point Likert-type scale: '1 = not at all', '2 = a little', '3 = a fair amount', '4 = very much', and '5 = extremely' (30, 31).

These six items were selected from the two questionnaires because previous studies (2, 6, 32) found that they represented the moderate-to-severe painful dental stimuli expected by patients and were concomitant with the levels of dental anxiety. Face-validity of these items has been demonstrated (30, 31). Internal consistency reliability was measured and found to be satisfactory (Cronbach's alpha = 0.87).

Global fear of dental pain

Global FDP assesses the overall fearfulness of pain invoked in any type of dental treatment. It was measured by a single-item question. Participants were asked if they 'strongly agree', 'somewhat agree', 'somewhat disagree', or 'strongly disagree' with the statement 'I am afraid of dental visits because of possible pain'.

Global dental fear

Global dental fear refers to the overall fearfulness of dentistry. It was measured by the single item used by Gatchel (33), in which participants were asked to rate their fear of dentistry on a scale ranging from 1 (no fear) to 10 (extreme fear), with five indicating moderate fear.

Dental utilization behaviors and oral health outcome

There were three measures of dental care utilization behaviors: (i) participants were asked whether or not fear of dental work had caused them to put off making an appointment; (ii) they were also asked to report their 'typical approach' to dental care as 'I never go to a dentist', 'I go to a dentist when I have a problem or when I know that I need to get something fixed', 'I go to a dentist occasionally, whether or not I have a problem', or 'I go to a dentist regularly'; and (iii) participants were then asked whether or not they went to a dentist for a check-up over the past 5 years. There was one measure of oral health outcome: participants were asked to rate their overall oral health as 'excellent', 'very good', 'good', 'fair', or 'poor', compared with others their age.

Demographic variables and other variables

Data were collected regarding the gender, age, Hispanic origin, race, number of years of formal education, household income, ability to pay an unexpected $500 dental bill, and self-rated general health [more information regarding these variables are available in a submitted manuscript (34)]. Approximately, 40% of participants were male and 60% were female. The mean age of the whole sample was 49.4 years (SD = 16.8), and 20% of the participants were the elderly aged 65 years or older. Almost 81% of respondents were Whites, and 10% were Blacks. Asian or Pacific Islander, Native American Indians, and other racial groups altogether accounted for the remaining 9%. Almost 10% of participants were of Hispanic origin. Household income ranged from <$19 999 per year (19% of respondents) to more than $100 000 per year (13%). Forty-three percent of respondents reported that they were able to pay an unexpected $500 dental bill comfortably, and 85% rated their general health as 'excellent', 'very good', or 'good'.

Statistical analysis

Some of the variables were recoded for analytic purpose. The original responses of six items of

specific FDP were on a 5-point ordinal scale. Preliminary analyses indicated that small numbers in certain responsive categories were problematic for regression, and the six items were then recoded into dichotomous variables, in which the responses of 'not at all' or 'a little' were classified as low specific fear ('0') and the responses of 'a fair amount', 'very much', or 'extremely' were classified as high-specific fear ('1').

Global FDP was recoded by classifying the responses of 'strongly agree' or 'somewhat agree' with the statement 'I am afraid of dental visits because of possible pain' as high global FDP and the responses of 'somewhat disagree' or 'strongly disagree' as low global FDP. Global dental fear was measured on a scale ranging from 1 to 10 (33). Both Gatchel (33) and Locker (8) used a score of 8 to identify people who experienced significant degree of dental fear from people who experienced low level of dental fear; thus, participants who scored 8 or more on the Gatchel scale were considered to belong to a high dental fear group, and who scored 1–7 were considered to be in a low fear group.

Three variables regarding the dental utilization behaviors and oral health outcome were recoded because of low numbers in some responsive categories. Participants were asked to describe 'putting off making an appointment because of fear of dental work' as 'never', 'once or twice', 'a few times', 'often', or 'nearly all the time'. For the purpose of this report, persons who responded 'never', 'once or twice', or 'a few times' were re-classified as 'not often', and coded as '0'; and persons who responded 'often' or 'nearly all the time' were re-classified as 'often', and coded as '1'. In the Florida Dental Care Study (23), from which the 'typical approach to dental care' question was adopted, persons who reported never going to a dentist or going to a dentist only when they had a problem were pooled as 'problem-oriented attenders' and coded as '0', and those who reported occasional use and regular use were pooled as 'regular attenders' and coded as '1'. In the current study, we classified participants in the same manner. We also recoded self-rated overall oral health into a dichotomous variable by grouping 'excellent', 'very good', and 'good' together as '1', and grouping 'fair' and 'poor' together as '0'.

Age was categorized into five groups: 18–24, 25–34, 35–49, 50–64, and ≥65 years. Those who self-identified as Asian or Pacific Islander, American Indians or Alaska native, or multi-racial or mixed race were pooled as 'other' because of the small numbers in these racial groups. The number of years of formal education was dichotomized as 'secondary education or less' and 'postsecondary'. Annual household income was recoded into four categories: ≤$19 999, $20 000–$49 999, $50 000–$99 999, and ≥$100 000. Self-rated general health was dichotomized from the original measure which included five responsive categories into two categories: '1 = excellent/very good/good', and '0 = fair/poor'.

Spearman's correlation coefficients were used to assess the relationships between the measures of specific FDP, global FDP, and global dental fear. Chi-squared analyses were used to test the individual relationships between measures of fear and measures of behaviors and outcome. Multiple logistic regression was conducted for each behavior and outcome measure. The multiple logistic regression analyses assessed the relationships between fear factors and behavior and outcome factors after controlling for demographic variables (age, gender, Hispanic origin, race, and education), financial measures (household income and ability to pay an unexpected $500 dental bill) and self-rated general health. The multiple logistic regression analyses were undertaken using the forward selection procedure (a less stringent entrance criterion $P < 0.20$ was used). Diagnostics to assess model goodness of fit and multicollinearity were conducted. All of the four logistics regression models were fit and there were no multicollinearity problems detected in the models.

All analyses were conducted by using SAS statistical software version 9.1 (35). In this study, each analysis addresses an individual preplanned hypothesis. Therefore, we have used a pre-analysis Type 1 error rate of 0.05 for each of these hypotheses.

Results

Correlations between the measures of dental fear and FDP

The Spearman's correlation coefficients between the six items of specific FDP varied between 0.43 and 0.71. The items measuring specific FDP were moderately but significantly associated with global FDP and global dental fear (γ_s ranging from 0.37 to 0.55 and 0.26 to 0.44, respectively). Global FDP and global dental fear were more closely associated ($\gamma_s = 0.60$) (Table 1).

Table 1. Spearman's correlation coefficients among specific fear of dental pain (SFDP), global FDP (GFDP), and global dental fear (GDF)

	SFDP_1	SFDP_2	SFDP_3	SFDP_4	SFDP_5	SFDP_6	GFDP	GDF
SFDP								
SFDP_1: having a tooth pulled	1.00	0.55 (<0.001)	0.57 (<0.001)	0.43 (<0.001)	0.52 (<0.001)	0.47 (<0.001)	0.49 (<0.001)	0.44 (<0.001)
SFDP_2: receiving stitches in your lip	–	1.00	0.62 (<0.001)	0.50 (<0.001)	0.47 (<0.001)	0.47 (<0.001)	0.40 (<0.001)	0.32 (<0.001)
SFDP_3: receiving an injection in your mouth	–	–	1.00	0.43 (<0.001)	0.50 (<0.001)	0.56 (<0.001)	0.47 (<0.001)	0.39 (<0.001)
SFDP_4: a severe toothache	–	–	–	1.00	0.51 (<0.001)	0.47 (<0.001)	0.37 (<0.001)	0.26 (<0.001)
SFDP_5: receiving a root canal treatment	–	–	–	–	1.00	0.71 (<0.001)	0.51 (<0.001)	0.33 (<0.001)
SFDP_6: being drilled in a tooth	–	–	–	–	–	1.00	0.55 (<0.001)	0.43 (<0.001)
GFDP	–	–	–	–	–	–	1.00	0.60 (<0.001)
GDF	–	–	–	–	–	–	–	1.00

Individual relationships between fear and behaviors/outcome

As shown in Table 2, all six measures of specific FDP were significantly associated with 'putting off making a dental appointment'. Compared with the participants who reported high fear of the six dental painful events, those who reported low fear were less apt to put off making a dental appointment. Problem-oriented attenders were more common among participants who reported high-specific fear of pain related to some dental procedures (i.e. receiving an injection in the mouth and being drilled in a tooth). Participants who reported high fear of pain related to receiving a root canal treatment or being drilled in a tooth were more likely not to get a regular check-up over the past 5 years. Compared with the participants who reported high-specific fear of pain related to having a tooth pulled, receiving an injection in the mouth, or being drilled in a tooth, those who reported low fear were less likely to rate their overall oral health negatively.

Global FDP and global dental fear were significantly associated with all four measures of behaviors and outcome. Participants reporting high global FDP and those belonging to the high global dental fear group were more likely to put off making a dental appointment, to be a problem-oriented attender, not to get a regular dental check-up for the past 5 years, and to rate their overall oral health negatively.

Effect of fear on dental care utilization behaviors

Tables 3–6 present the significant results from the forward selection multiple logistic regression. Table 3 shows the odds ratio (OR) and 95% CI with 'putting off making an appointment' as the dependent variable. Participants reporting high fear of dentistry in general were nearly four times more often to put off making an appointment than those reporting low fear. Moreover, participants who reported high global FDP were nearly three times more often to put off making an appointment than those who reported low global FDP. Compared with the participants of non-Hispanic origin and people with poor self-rated general health, those of Hispanic origin and those with good general health were less likely to put off making an appointment because of fear of dental work. Blacks were significantly more often than whites to put off making an appointment.

Table 2. Individual relationships between measures of fear and measures of behaviors and outcome

Measure of fear	% of participants who often put off making a dental appointment	% of participants who were problem-oriented attenders	% of participants who did not have a regular check-up	% of participants who rated their overall oral health as poor
SFDP				
Having a tooth pulled				
Low fear (n = 325)	6*	35^{ns}	28^{ns}	16*
High fear (n = 173)	26	40	27	24
Receiving stitches in your lip				
Low fear (n = 270)	7*	37^{ns}	28^{ns}	18^{ns}
High fear (n = 225)	20	37	27	21
Receiving an injection in your mouth				
Low fear (n = 328)	6*	33*	26^{ns}	16*
High fear (n = 167)	28	44	31	25
A severe toothache				
Low fear (n = 207)	7*	35^{ns}	27^{ns}	16^{ns}
High fear (n = 287)	17	38	28	21
Receiving a root canal treatment				
Low fear (n = 174)	4*	33^{ns}	21*	18^{ns}
High fear (n = 313)	19	39	31	20
Being drilled in a tooth				
Low fear (n = 244)	4*	30*	23*	16*
High fear (n = 252)	22	44	32	23
GFDP				
Low fear (n = 319)	5*	30*	24*	15*
High fear (n = 173)	27	51	33	26
GDF				
Low fear (n = 427)	8*	32*	24*	17*
High fear (n = 73)	45	62	47	32

*Statistically significant, $P < 0.05$ from chi-squared tests.
NS, not statistically significant.

Table 3. Significant results of the multiple logistic regression in the analysis of 'putting off making an appointment (1 = often, 0 = not often)'[a]

Significant explanatory variable	Odds ratio (OR) (95% CI)	P-value
GDF		
High fear	5.33 (2.73–10.41)	<0.001
Low fear	–	
GFDP		
High fear	4.34 (2.23–8.47)	<0.001
Low fear	–	
Ethnicity		
Hispanic origin	0.19 (0.04–0.90)	0.037
Non-Hispanic origin	–	
Race		
Black (Africa American)	2.72 (1.20–6.16)	0.017
Other	1.64 (0.47–5.76)	0.442
White (Caucasian)	–	
Self-rated general health		
Good	0.46 (0.22–0.98)	0.043
Poor	–	

[a]Adjusted R^2 = 0.31.

Table 4 shows the OR and 95% CI when analyzing the reports of dental attendance. Compared with their respective counterparts, participants reporting high fear of dentistry and those reporting high global FDP in general were significantly less likely to be regular dental attenders. Blacks were less likely than whites to be regular attenders. Participants whose annual household income was $50 000–$99 999 or $100 000 or more were more likely to be regular attenders than those whose household income was $19 999 or lower. Participants who were able to pay an unexpected $500 dental bill comfortably were also significantly more likely to be regular attenders than those who were not able to pay.

Table 5 shows the results of the logistic regression analysis when analyzing the regularity of dental check-ups. Participants in the high global dental fear group were less likely to see a dentist for a check-up over the past 5 years. Participants of Hispanic origin were more likely than those of non-Hispanic origin to get a regular check-up over the past 5 years. Participants whose annual household income was in the higher brackets were more likely to see a dentist for a check-up than those whose household income was $19 999 or lower.

Table 4. Significant results of the multiple logistic regression in the analysis of 'typical approach to dental care (1 = regular attenders, 0 = problem-oriented attenders)'[a]

Significant explanatory variable	OR (95% CI)	*P*-value
GDF		
High fear	0.40 (0.21–0.77)	0.006
Low fear	–	
GFDP		
High fear	0.52 (0.32–0.84)	0.008
Low fear	–	
Race		
Black (Africa American)	0.47 (0.24–0.93)	0.031
Other	0.60 (0.29–1.21)	0.149
White (Caucasian)	–	
Income		
≥ 100 000	8.45 (2.97–24.07)	<0.001
50 000–99 999	2.51 (1.33–4.75)	0.005
20 000–49 999	1.74 (0.97–3.10)	0.062
≤19 999	–	
Ability to pay an unexpected $500 dental bill		
Able to pay comfortably	2.09 (1.06–4.11)	0.034
Able to pay, but with difficulty	1.44 (0.77–2.68)	0.255
Not able to pay	–	

[a]Adjusted R^2 = 0.23.

Table 5. Significant results of the multiple logistic regression in the analysis of 'regular check-up (1 = yes, 0 = no)'[a]

Significant explanatory variable	OR (95% CI)	*P*-value
GDF		
High fear	0.39 (0.22–0.70)	0.002
Low fear	–	
Ethnicity		
Hispanic origin	2.61 (1.12–6.09)	0.026
Non-Hispanic origin	–	
Income		
≥100 000	11.87 (3.86–36.53)	<0.001
50 000–99 999	3.83 (2.03–7.21)	<0.001
20 000–49 999	1.73 (0.98–3.05)	0.057
≤19 999	–	

[a]Adjusted R^2 = 0.16.

Effect of fear on oral health outcome

Table 6 shows the logistic regression results in the analysis of oral health. Participants in the high global dental fear group were less likely to rate their overall oral health as good. Compared with the participants who were not able to pay an unexpected $500 dental bill, participants who were able to pay, either comfortably or with difficulty, were more likely to rate their overall oral health positively. Participants who reported good general health were more likely than those who reported poor general health to rate their overall oral health positively.

Table 6. Significant results of the multiple logistic regression in the analysis of 'self-rated overall oral health (1 = good, 0 = poor)'[a]

Significant explanatory variable	OR (95% CI)	*P*-value
GDF		
High fear	0.43 (0.24–0.76)	0.004
Low fear	–	
Ability to pay an unexpected $500 dental bill		
Able to pay comfortably	3.07 (1.53–6.16)	0.002
Able to pay, but with difficulty	1.90 (1.02–3.55)	0.043
Not able to pay	–	
Self-rated general health		
Good	2.63 (1.47–4.70)	0.001
Poor	–	

[a]Adjusted R^2 = 0.13.

Discussion

Previous studies (14, 36) have reported that dental fear could lead to delay or avoidance in seeking dental treatment, resulting in irregular dental attendant behavior and poor oral health outcomes. Our study confirmed these findings. Controlling for other factors, global dental fear (Gatchel's single item) showed an independent negative impact on all four behavior and outcome measures. Global FDP ('being afraid of dental visit because of dental pain') was also significantly associated with the behavior of putting off making a dental appointment and the dental approach types. Although some measures of specific FDP were significantly associated with dental care behaviors and oral health outcome at the individual level (the chi-squared test results), none of the measures regarding the fear of specific dental procedures showed an independent effect with sociodemographic factors, global FDP, and global dental fear taken into account. Moreover, the Spearman's correlation coefficients indicate that specific FDP, global FDP, and global dental fear were only moderately, but significantly, correlated. These findings suggest that global dental fear is a multidimensional phenomenon. Global FDP could be composed of fears of other specific pain-invoking dental events in addition to the six procedures included in this study, and FDP is only one of the multiple components of fear of dentistry in general. These results may also imply that the impact of dental fear on dental utilization behaviors could attribute

to a synergetic effect caused by many components of dental fear, such as fear of pain, fear of powerlessness, fear of loss of control, fear of being close-in, etc. (3, 9, 11, 12).

The results of the previous studies have suggested that the relationships fear of pain and dental fear may be reciprocal (9–11, 37, 38). On one hand, fear of pain has a unique contribution to dental fear (9–11). On the other hand, dental fear and anxiety may influence how people expect and experience dental pain and exacerbate their fearfulness of dental pain (37, 38). Therefore, in order to reduce the level of dental fear and fear-related dental avoidance and irregular utilization behaviors, dentists need to help patients to establish a realistic expectation of pain and to minimize the actual pain associated with dental treatment. With the advances in dental equipment and pain control technology, many invasive procedures such as extraction, injection, root canal treatment, etc. are not as painful as they once were. However, self-reported dental anxiety levels have remained stable within the USA throughout the past 50 years (1). This trend is consistent with our findings and the previous notes (3, 9, 11, 12) that the underlying constructs of dental fear are multifactorial. In future studies, it will be important to examine how other components, such as fear of loss of control, fear of being close-in, fear of inconsiderate dentists, relate the dental fear. It is also important to take these components of dental fear into consideration when planning an effective strategy to ameliorate its negative effect on dental care utilization and oral health outcome.

Other sociodemographic factors interfere with dental utilization behaviors and oral health outcomes as well and these factors should also be considered when investigating the effect of dental fear. For instance, many researchers (21, 22, 24, 25, 39) report that women have more regular dental visiting patterns and engage in more dental care-seeking behaviors than men, although the prevalence and level of severity of dental fear are higher among women and dental fear has been identified as a major impediment to the use of dental care (12, 26, 27). Skaret et al. (28) noted that the predicators of dental care use might be different for women and men, with men's behaviors being more likely to be affected by their attitudes toward dental care and oral health. The logistic regression results in the current paper indicate that there were no gender differences in all four measures of behaviors and outcome. This area merits future investigations.

Other investigators (13, 22) observed that a regular visiting pattern was more common among persons with a higher level of education. However, the current study did not observe significant associations between education and any dental utilization behaviors and oral health outcome. We found that self-rated general health was decisive in affecting the putting off making a dental appointment and the ratings of overall oral health. Many studies have reported that race and financial situations are significantly associated with the use of dental care services and oral health outcomes (21, 40, 41). The current study confirmed their findings.

In general, dental fear plays an important but negative role in a person's dental care utilization and oral health. It is well known that without an effective intervention or treatment of dental fear, high fearful dental patients with dental avoidance behavior are likely to fall into a 'vicious cycle', in which dental fear, negative dental utilization behaviors, and deteriorated oral health reinforce each other (8, 42). Meanwhile, dental fear interferes with the provision of dental care services from dentists' perspective. It takes longer and is more challenging to treat fearful dental patients. Reportedly, many dentists have identified treating dental fearful patients as one of the major professional stressors (9, 43, 44). Therefore, breaking the 'vicious cycle' calls for efforts of both clinicians and patients. The provision of dental care services to patients with dental fear requires dentists' understanding, patience, empathy, and a higher degree of knowledge and skill in the behavior management. At the same time, appropriate education and intervention will help people recognize and control over their fear of dental treatment, and modify their dental utilization behaviors.

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