

EXAMINATION OF DENTAL DISTRESS AND ANXIETY-RELATED  
VULNERABILITY FACTORS

by  
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## **Abstract**

Apprehension towards dental services has been documented for decades, and despite modern scientific advances, dental anxiety and phobia continue to adversely affect individuals' oral and mental health. Furthermore, the prevalence of dental distress is estimated to range from 8% to nearly 30% among community samples. Given the prevalence and impairment of dental distress, understanding the underlying mechanisms is pertinent to finding more effective treatments. In particular, transdiagnostic processes that may be implicated in dental distress include anxiety sensitivity (AS), pain sensitivity (PS), and distress tolerance (DT). As such, the aims of the current study were 1.) to characterize dental distress and 2.) to examine transdiagnostic vulnerabilities in this population. The results indicated that female students and individuals with a prior traumatic dental experience reported significantly higher dental distress. In addition, dental distress was significantly associated with higher levels of AS, greater PS, and less DT. Furthermore, data showed that both AS and DT were unique predictors of dental distress after accounting for sex and history of a traumatic dental experience. The results suggest that treatments that target reductions in anxiety sensitivity and increases in the ability to tolerate psychological and physiological distress may be beneficial in easing dental distress.

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## Introduction

Apprehension towards dental services has been documented for decades (Coriat, 1946), and despite modern technological and medical advances, dental anxiety and dental phobia continue to adversely affect individuals' oral and mental health. The prevalence of dental anxiety is estimated to range from 8% to nearly 30% among community samples (Appukuttan, Tadeballi, Cholan, Subramanian, & Vinayagavel, 2013; Åström, Skaret, & Haugejorden, 2011; Eitner, Wichmann, Paulsen, & Holst, 2006; Kirova, Atanasov, Lalabonova, & Janevska, 2010; Viinikangas et al., 2007; Wide Boman, Carisson, Westin, Hakeberg, 2013). Notably, 5% of the general population experiences severe dental anxiety (Wide Boman et al., 2013). Moreover, the prevalence of dental anxiety has been shown to be similar across different cultures, indicating that signs and symptoms are ubiquitous regardless of country, culture, or other living conditions (Armfield, Spencer, & Stewart, 2006; Hakeberg, Berggren, & Carlsson, 1992; Ost & Skareet, 2013; Stouthard & Hoogstraten, 1990).

The range of prevalence rates of dental anxiety may be attributed to use of discrepant terminology. Specifically, Gordon and Heimberg (2013) argue that the dental literature has been complicated due to the improper usage of the terms “fear,” “anxiety,” and “phobia.” In general, these terms describe intense negative feelings and related physiological responses (Öhman, 2008). Specifically, *dental fear* is conceptualized as a biologically based response to a specific, immediate threat and results in either a flight, fight, or freeze response, and in the context of dental situations, describes “poststimulus”

responses to dental stimuli (e.g., becoming fearful after seeing the dental instruments; Davis, Walker, Miles, & Grillon, 2010; Gordon & Heimberg, 2013; Öhman, 2008). *Dental anxiety* is characterized by the anticipation of a potential future threat and is a conditioned response to a stimulus (e.g., becoming anxious when thinking about an upcoming appointment; Gordon & Heimberg, 2013). Lastly, *dental phobia* typically refers to a clinical condition that is classified as a subcategory of specific phobia, under the category of blood injection/injury phobia, and is defined by the Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition) as an excessive, irrational, or unreasonable fear of the dentist or dental related stimuli (American Psychiatric Association [APA], 2013). Dental phobia is differentiated from dental fear and anxiety by the degree to which symptoms interfere with an individual's daily routine, and/or if they are accompanied by severe distress and impairment (APA, 2013; Gordon & Heimberg, 2013).

The literature contrasting and comparing the syndromes of dental anxiety and dental phobia is relatively limited. Nevertheless, some studies suggest that fainting and disgust sensitivity, the propensity to experience disgust, are more characteristic of dental phobia than dental anxiety, suggesting that the two constructs are different (Merckelbach, Muris, de Jong, & de Jongh, 1999; Van Houtem, Laine, Boomsma, Ligthart, Van Wijk, & De Jongh, 2013). For the purposes of the current paper, *dental distress* will be used to encompass both dental anxiety and dental phobia, whereas the independent use of *dental anxiety* or *dental phobia* will be used to describe studies that examine dental anxiety and dental phobia, respectively.

There are a myriad of unique negative consequences of dental distress, including but not limited to, avoidance of the dentist, poor oral health (e.g., greater number of cavities, higher risk of oral diseases), poor health-related quality of life (e.g., sleep problems, eating impairments, impaired occupational and social functioning), and more referrals for specialty dentists to receive treatment under sedation or general anesthesia (Boyle, Newton, & Milgrom 2009; Ost & Skareet, 2013; Potter & Kinner, 2014). Moreover, epidemiological studies suggest that patients with dental anxiety have more oral diseases than those without dental anxiety, and that the degree of deterioration is proportionate to the degree of dental anxiety reported, such that increased dental anxiety is associated with worse oral deterioration (Hägglin, Berggren, & Margaretha, 1996; Ng & Leung, 2008). Furthermore, individuals with dental anxiety also report experiencing low self-esteem, shame, embarrassment, and feelings of inferiority from not regularly attending appointments due to fear and/or from the resulting social consequences of the appearance or condition of their teeth (Öst & Skareet, 2013; Schuurs, Duivenvoorden, VanVelzen, & Verhage, 1984). Additionally, these psychosocial consequences can affect work and personal relationships (Berggren, 1984), and can lead to other mental health issues, such as depression (Abrahamsson, Berggren, Hallberg, & Carlsson, 2002).

To better understand dental distress, the factors and mechanisms contributing to the development of the distress must be evaluated. Anxiety and fear are posited to develop through classical conditioning and social learning (Wolpe, 1981) and are maintained by operant conditioning (Mowrer, 1951). Classical conditioning theory involves behavior learning through the process of association. Through this process, the neutral stimulus (e.g., bell) is presented at the same time or immediately prior to an



emotionally evocative stimulus (e.g., food), and then over time or in extreme cases, the previously neutral stimulus elicits the emotional reaction solicited by the evocative stimulus. Furthermore, Mowrer's two-factor theory (1951) suggests that fears are learned via classical conditioning but maintained by operant conditioning, as avoidance of the anxiety-provoking stimulus negatively reinforces the behavior of avoidance. In the case of dental distress, the dentist or dental office (neutral stimulus) is associated with a painful, distressing, or traumatic dental experience (fear-evoking stimulus), and subsequently, dental-related stimuli may trigger distress. The repetition of negative experiences can strengthen the association thereby increasing distress (Wolpe, 1981), and avoidance of the dentist may maintain dental fears via negative reinforcement (Mowrer, 1951). In addition to classical and operant learning, individuals may develop fears through witnessing or receiving second-hand reports of others' traumatic or distressing dental experiences. Namely, social/vicarious learning occurs when information is provided to an individual through information or observation, rather than direct experiences. In the dental setting, negative preconceptions about dental care may be due to misinformation provided by distressed family members (Berggren, 1984). In a sample of dental phobics, Öst and Hugdahl (1985) found that 68.9% ascribed their phobia to conditioned experiences, 11.8% to vicarious learning, and 5.9% to instruction/information.

Berggren and Meynert (1984) developed a model that illustrates how the effects of initial dental fear can contribute to greater dental anxiety and avoidance in the long term. In this model, initial dental fear leads to infrequent dental care (e.g., missing appointments, fewer check-ups, or check-ups when only necessary) or complete

avoidance of dental treatment (Berggren & Meynert, 1984; Öst & Skareet, 2013). Infrequent dental care could detrimentally affect oral health, resulting in greater levels of deterioration in dental state such as higher number of decayed surfaces/teeth, missing teeth, a lower number of filled surfaces/teeth, and functional surfaces/teeth (Öst & Skareet, 2013; Schuller, Willumsen, & Holst, 2003). Greater levels of deterioration are often met with more invasive procedures, which add to the vicious cycle (Ooesterick, de Jongh, & Aartman, 2009; Öst & Skareet, 2013). In addition to the aforementioned physical effects, the psychosocial consequences of dental anxiety mentioned previously can also maintain the cycle.

Avoidance of dental treatment significantly contributes to the maintenance of dental anxiety (Armfield & Ketting, 2015). Studies have found that patients with dental anxiety are more likely than patients without dental anxiety to skip appointments or forego dental treatment completely (Armfield & Ketting, 2015; Quteish Taani, 2002). Furthermore, avoidance of dental treatment results in greater levels of deterioration, such as excess plaque, missing surfaces/teeth, and cavities are associated with more oral diseases and can cause cardiovascular diseases, diabetes, early and preterm birth (Genco & Williams, 2010), and problems with cognitive functioning (Kaye, Valencia, Baba, Spiro, Deitrich, & Garcia, 2010). In addition, when patients with severe dental anxiety finally attend their appointments, they are often accompanied by distress and poor patient compliance to treatment (Potter & Kinner, 2014). As such, these individuals experience more complications and pain associated with dental care than those without dental anxiety (Agdal et al., 2008; Agdal et al., 2011; Davey, 1989; De Jongh et al., 1998; Öst & Skareet, 2013).

Given the frequency and impact of dental anxiety, identifying factors that may increase one's vulnerability to experience dental distress is important. Dental anxiety in individuals has been suggested to be impacted by negative dental experiences (Locker, Shapiro, Liddell, 1996) and sex differences (Mohammed et al., 2014). In addition, transdiagnostic anxiety processes that may be implicated in dental distress include anxiety sensitivity, pain sensitivity, and distress tolerance.

Negative or traumatic dental experiences are defined as experiences that are painful, or elicit a negative emotional (e.g., feeling frightened or embarrassed) or physiological (e.g., feeling faint; Locker et al., 1996) response. Locker and colleagues (1996) examined a sample of Canadian adults to determine which types of traumatic dental experiences (i.e., painful, embarrassing, or frightening) predicted dental anxiety. Patients reporting all three types of traumatic experiences were 22.4 times more likely to be dentally anxious than those reporting no traumatic experiences (Locker et al., 1996). Similarly, those reporting painful and frightening experiences were 10 times more likely to be dentally anxious than those with no such experiences. Furthermore, although pain was a predictor of dental anxiety, those reporting only pain were dentally anxious only 8.2% of the time, suggesting that other negative experience types (alone or in combination with pain) are better predictors of dental anxiety than pain alone (Locker et al., 1996). Additionally, Oosterick and colleagues (2009) found that dental patients who reported a previous traumatic dental experience during treatment were 16 times more likely to have dental anxiety than individuals without traumatic dental experiences. Furthermore, the authors concluded that negative experiences can further result in a patient avoiding the source of the traumatic experience (i.e., the dentist; Oosterick et al.,

2009). Sex differences are often discussed in dental distress literature. A number of studies suggest that there are sex differences with dental anxiety (Hittner & Hemmo, 2009; Humphries et al. 2013; Oosterink et al., 2009; Schienle et al., 2011). Specifically, females are found to be more dentally anxious than males. Additionally, females are more likely to be diagnosed with anxiety and phobia disorders (Hittner & Hemmo, 2009; Kessler et al., 1994).

Anxiety sensitivity is the fear of the physical, social, and cognitive consequences of anxiety related sensations, arising from the belief that these sensations are harmful (Reiss & McNally, 1985). Furthermore, Reiss and McNally's (1985) theorize that those with heightened anxiety sensitivity are more at risk for anxiety disorders. Therefore, anxiety sensitivity may play a similar role in dental distress. For instance, patients with elevated anxiety sensitivity levels prior to a dental appointment could experience increased levels of distress in the dental environment that could make the experience especially aversive.

Another vulnerability factor related to dental anxiety is pain sensitivity (Gross, 1992; Keough, Riccardi, Timpano, Mitchell, & Schmidt, 2010; Litt, 1996). In this study, pain sensitivity refers to the patient's pain threshold (i.e., elevated pain sensitivity means low threshold to dental pain). Anxiety is thought to be the most important nonsensory component of pain (Gachel, 1992). Pain, whether felt or anticipated, increases anxiety; conversely, anxiety both lowers the pain threshold and makes individuals more sensitive to the sensation of pain (Litt, 1996). Studies have demonstrated that elevated pain sensitivity is common among individuals who experience dental anxiety (Litt, 1996; Forgione & Clark, 1974). Moreover, individuals with dental anxiety have been found to

have a lower pain threshold for dental pain than individuals without dental anxiety (Klepac, Dowling & Hauge, 1982; Forgione & Clark, 1974). Pain sensitivity has also been linked to anxiety sensitivity (Gross, 1992) in that individuals with higher anxiety sensitivity levels will theoretically be more sensitive to pain sensations, which can exacerbate the level of distress experienced and contribute to the maintenance of the dental distress.

Lastly, distress tolerance is the perceived ability or inability to experience and cope with distress and/or other negative emotional states (Simons & Gaher, 2005). Considering that numerous dental procedures have been shown to be particularly distressing (e.g. scaling, teeth extractions; Litt, 1996), individuals with the inability to properly cope with the negative emotions (i.e., distress, anxiety, fear, disgust) accompanied by dental procedures may find dental visits extremely unpleasant. This aversion and increased sensitivity to anxiety could cause the individual to avoid the dentist in order to avoid the negative emotional state. Distress tolerance has been previously studied in relation to other anxiety disorders, such as social anxiety disorder, and obsessive-compulsive disorder (OCD; Laposa, Collimore, Hawley, & Rector, 2015; Timpano, Buckner, Richey, Murphy, & Schmidt, 2009). A study by Laposa and colleagues (2015) demonstrated that distress tolerance scores predicted symptoms of generalized anxiety disorder, social anxiety disorder, and OCD. s Indeed, research has indicated that distress tolerance is negatively related to anxiety sensitivity, such that as the ability to tolerate stress increases, anxiety or fear of a particular stimulus decreases (Keough et al., 2010, Timpano et al., 2009).

Addicks and colleagues (2017) conducted a similar study to the present study, where they examined a mixed sample of dental phobics and healthy participants. The results indicated that distress tolerance was a predictor of dental phobia. Additionally, authors found that lower distress tolerance was correlated with higher anxiety sensitivity, pain sensitivity (fear of pain), and dental fear in a mixed sample of community members and patients with dental phobia. Furthermore, the study illustrated that low levels of distress tolerance may exacerbate anxiety sensitivity and pain sensitivity, making the dental experiences especially aversive (Addicks et al., 2017).

In the current study, anxiety related to dental procedures will be referred to as dental distress, as anxiety ratings were provided via self-report measures and not by a clinical interview, and as such cannot be referred to as dental phobia. Considering there is limited research pertaining to anxiety sensitivity, distress tolerance, and pain sensitivity and its relation to dental distress, this study serves to add to the literature in investigating these constructs. Specifically, the first aim was to examine the relationship between prior traumatic dental experiences and sex differences and dental distress. It was predicted that higher dental anxiety would be associated with the presence of a traumatic dental experience, and that it would be more prevalent among females than males. The second aim was to examine associations between dental distress and its relation to the transdiagnostic constructs of anxiety sensitivity, pain sensitivity, and distress tolerance. It was predicted that higher self-reported dental distress would be correlated with higher anxiety sensitivity, pain sensitivity, and lower distress tolerance. Furthermore, and extending the work of Addicks and colleagues, it was hypothesized that these variables

would account for greater dental distress after controlling for sex and traumatic dental experiences.

## Method

### Participants and Procedure

The University of Mississippi's Department of Psychology Sona Systems research pool was used to recruit undergraduate students enrolled in psychology courses. Participants were also recruited through several media outlets, including the Phi Mu Fraternity Facebook group, the Sally McDonnell Barksdale Honors College listserv, and through Facebook. Any entire battery of self-reported measures with less than 98% completed were excluded from subsequent data analysis. Participants were community volunteers and undergraduate students aged 18 years or older. Of the 534 questionnaires completed, 68 participants were omitted due to missing data. The final sample was comprised of 466 participants (79% female). The mean age was 20.94 years ( $SD = 7.03$ ), and the sample was predominantly White (82.4%; 11.6% African American).

The study protocol was approved by the University of Mississippi's Institutional Review Board. Data collection began October 16, 2017 and was completed on December 1, 2017. After reviewing and consenting to study procedures, participants completed an online battery of self-report measures (see Appendices) via Qualtrics, an online data collection tool. At the end of the study, participants were asked to indicate the environment in which they completed the questionnaire packet, and the level attention given to their responses. Participants reported their attention level on a Likert scale 1 (a great deal) to 5 (none at all). Data from participants who were inattentive, answering 4 (a little) or 5 (none at all), were not analyzed ( $n = 9$ ). Upon completion of the survey, participants who were recruited via the University Sona Systems Pool received 0.5 credit for their participation.



## Measures

**Anxiety Sensitivity Index – 3 (ASI-3).** The ASI-3 (Taylor et al., 2007) consists of 18 items that assess beliefs about perceived catastrophic physical, cognitive, and social consequences of anxiety (e.g., “It is important for me not to appear nervous”). The ASI-3 measures the severity and frequency of anxiety sensitivity by asking participants to indicate the extent to which they agree or disagree with each item on a 5-point Likert scale ranging 0 (“very little”) to 4 (“very much”). There is a total possible score of 72, with higher scores indicating greater anxiety sensitivity. The ASI-3 has demonstrated excellent overall internal consistency (Cronbach’s  $\alpha = .93$ ) in clinical samples and undergraduate students (Wheaton, Deacon, McGrath, Berman, & Abramowitz, 2012). The ASI-3 has also been found to have good convergent validity, as it has been shown to be highly correlated with the original ASI ( $r = .85$ ) and adequately correlated with the trait anxiety subscale of the State-Trait Anxiety Inventory ( $r = .68$ ; Mantar, Yemez, & Alkin 2010). Mantar and colleagues (2010) also demonstrated that the ASI-3 had excellent overall internal consistency ( $\alpha = .93$ ) and good test-retest reliability ( $r = .64$ ). Lastly, the ASI-3 demonstrated excellent internal consistency in the present study (Cronbach’s  $\alpha = .92$ ).

**Corah’s Dental Anxiety Scale – Revised (DAS-R).** The DAS-R (Corah, 1969) is composed of four items that measure anxiety experienced at various stages of a dental visit. Specifically, items assess anxiety the day before appointment, in the waiting room, before having teeth drilled, and before having teeth scaled/polished. Each item is rated on a 5-point Likert type scale ranging from 1 (“relaxed”) to 5 (“so anxious that I sometimes break out in a sweat or almost feel physically sick”), with higher scores indicating more

severe anxiety. There is a total possible score of 20, with a score of 15-20 indicating severe anxiety, 13-14 indicates high anxiety, 9-12 indicates moderate anxiety, and a score of less than 8 indicates little to no anxiety. Moore and colleagues (1991) also demonstrated that the DAS-R had convergent validity by correlating with the Dental Fear Survey ( $r = .72$ ). The DAS-R has demonstrated good internal consistency in the present study ( $\alpha = .88$ ).

**Distress Tolerance Scale (DTS).** The DTS (Simons & Gaher, 2005) is a 15-item self-report measure including items that measure one's perceived (in)ability to tolerate and handle distress. Participants indicate the extent to which they agree with each item on a 5-point Likert scale ranging from 1 ("strongly agree") to 5 ("strongly disagree"), with higher scores indicating a greater ability to tolerate distress. The DTS has been found to have adequate test-retest reliability in undergraduate samples ( $r = .61$ ; Simons & Gaher, 2005). Furthermore, Simons and Gaher (2005) showed that the DTS demonstrated convergent and divergent validity, by negatively correlating with affective distress ( $r = -.59$ ) and dysregulation ( $r = -.51$ ), such that similar measures (mood acceptance;  $r = .47$ ) more significantly correlated than dissimilar measures (mood typicality;  $r = .17$ ). The DTS has also demonstrated excellent internal consistency in an undergraduate sample (Keough et al., 2010) and in the present study (Cronbach's  $\alpha = .91$ ).

**Pain Sensitivity Questionnaire (PSQ).** The PSQ (Ruscheweyh et al., 2009) is a 17-item measure assessing anticipated pain in response to daily life situations, such as "burning your tongue on a very hot drink". Pain sensitivity is rated on an 11-point Likert scale from 0 ("not painful at all") to 10 ("worst pain imaginable"). Fourteen items relate to situations that are deemed painful by healthy (i.e., non-sensitive) patients (e.g.,

“picking up a hot pot by grabbing its equally hot handles”), and cover a range of intensity (e.g., “scraping knee while falling off a bike” vs. “having a mild sunburn on your shoulders”), type of pain (e.g., hot, cold, blunt, sharp), and body location (e.g., upper body, lower body, head). The remaining three items relate to situations that are not typically rated as painful by healthy patients (e.g., “shaking hands with someone who has a normal grip”). The PSQ has demonstrated both convergent and divergent validity as scores were significantly correlated with experimental pain intensity ratings (Pearson’s  $r = .71$ ) and moderately negatively correlated with experimental pain thresholds ( $r = -.52$ ; Ruscheweyh et al., 2012). The PSQ demonstrates good test-retest reliability ( $r = .82$ ) and excellent internal consistency overall in a community sample (Cronbach’s  $\alpha = .92$ ; Ruscheweyh et al., 2009) and in the present study (Cronbach’s  $\alpha = .91$ ).

**General Oral Health/Dental History Questionnaire.** Participants reported oral hygiene and dental health habits (e.g., brushing, flossing), including questions about frequency, instrument used, and where/how they learned basic oral hygiene. Participants reported their dental history, which included the number of cavities, frequency and purpose of dental appointments, and prior dental procedures. Dental avoidance behaviors were assessed in this questionnaire, such as whether or not they trust their dentist (i.e., “yes” or “no”) and history of traumatic dental experiences.

**Sociodemographic Questionnaire.** Participants reported their age, sex, race and ethnicity, highest level of education completed, and household income (parents’ income if not financially independent).

## Results

### Descriptive Statistics: Dental Hygiene

Data were cleaned and data properties were examined. Of the 466 participants in the final sample, 63.3% ( $n = 295$ ) reported they had a dental appointment in the last six months and 25.3% ( $n = 118$ ) reported they had a dental appointment in the last 6-12 months. Further, 6.4% ( $n = 30$ ) of participants reported not going to the dentist in the last year, and 4.6% ( $n = 23$ ) reported not going to the dentist in the last 2 years. With regard to dental avoidance, all participants were asked to report other reasons for not going to the dentist; the most common answers, inclusively, were, not having enough time (25.3%), being afraid of the dental needle (18.5%), and pricey treatment costs (15.5%). When asked whether or not they trust their dentist (i.e., “yes” or “no”), majority of participants (97.4%;  $n = 454$ ) reported that they trust their dentist. In this sample, participants were asked about prior history of dental experience and only 12% ( $n = 56$ ) participants reported having a previous traumatic dental experience.

The mean dental anxiety score of participants was 8.78 ( $SD = 3.76$ ). The mean of this sample is typical of mild to moderate dental anxiety (mild = 4-8, moderate = 9-12), with high dental anxiety endorsed with scores of 13 or higher (Corah, Gale & Illig, 1979). In this sample, 17.3% of the participants had high dental anxiety.

### Examination of Study Hypotheses

To test the hypothesis that higher dental distress would be associated with traumatic experiences and sex differences, independent sample t-tests were conducted. Results indicated that women ( $M = 9.005$ ,  $SD = 3.739$ ) had significantly higher dental distress than men ( $M = 7.906$ ,  $SD = 3.731$ ;  $t = -2.566$ ,  $p = .011$ , Cohen’s  $d = 0.294$ ). The

effect size of this test was small. Additionally, the analyses indicated that individuals with a traumatic dental experience ( $M = 11.873$ ,  $SD = 5.099$ ) had significantly higher dental distress than individuals reporting no prior traumatic dental experience ( $M = 8.360$ ,  $SD = 3.335$ ;  $t = -6.817$ ,  $p < .001$ , Cohen's  $d = 0.815$ ). This analysis had a large effect size.

To test the hypothesis that dental distress and would be positively correlated with anxiety vulnerability factors, bivariate correlations were conducted. These analyses revealed that dental distress was positively correlated with anxiety sensitivity and pain sensitivity, and negatively correlated with distress tolerance ( $r = -.354 - .330$ ; all  $ps < .01$ ). See Table 1.

To test the hypothesis that transdiagnostic vulnerabilities would account for higher dental distress, after controlling for sex and presence of a traumatic experience, a hierarchical regression analysis was conducted (see Table 2). In step one of the regression, it was found that sex differences and the presence of a traumatic experiences predicted dental distress ( $R^2 = .103$ ,  $F = 26.400$ ). In the second step after controlling for sex and traumatic experiences, dental distress was predicted by anxiety sensitivity and distress tolerance, but not predicted by pain sensitivity ( $R^2 = .192$ ,  $F = 21.781$ ).

## Discussion

The present study sought to examine the associations between dental distress, prior traumatic dental experience, and sex differences. Consistent with rates observed in other studies, 17.3% of the sample reported high dental distress. The results supported the hypothesis that individuals with a prior traumatic dental experience would report higher dental distress and that women would have higher dental distress than men. Consistent with other studies (de Jongh, 2006; Oosterink et al., 2008), individuals with high dental anxiety were significantly more likely to report a prior traumatic experience than those with lower dental distress. Additionally, as expected and indicated by previous studies (Hittner & Hemmo, 2009; Humphries et al. 2013; Oosterink et al., 2009; Schienle et al., 2011), dental distress significantly differed in terms of sex, such that women reported higher dental distress than men.

The second aim of the study was to examine the relations between dental distress and transdiagnostic constructs (anxiety sensitivity, pain sensitivity, and distress tolerance). As expected, dental anxiety was positively correlated with both anxiety sensitivity and pain sensitivity, while being negatively correlated with distress tolerance. The results suggest that individuals with higher dental distress are more sensitive to the sensations of anxiety and pain and less able to tolerate distress than individuals with low dental distress. This is consistent with previous studies that found dental anxiety to be positively correlated with anxiety sensitivity (Locker et al., 1997) and pain sensitivity (Locker et al., 1997). However, the results of the current study do not support the findings of Kiliç and colleagues (2014), who suggested that anxiety sensitivity is not

correlated with dental anxiety, and may be used to separate dental anxiety from similar disorders.

Additionally, the current study partially replicates a study conducted by Addicks et al. (2017), who found that distress tolerance was negatively correlated with anxiety sensitivity, pain sensitivity, and dental distress scores, such that individuals with greater distress tolerance reported less anxiety sensitivity, pain sensitivity, and dental distress. However, the data from the current study differs from the results of the Addicks et al. (2017) study in the extent of the relationship. The results of the current study indicate a more modest relationship between variables than those found in the previous study. To this end, the final hypothesis was supported as this study replicates the findings of the study conducted by Addicks et al. (2017), which illustrated that anxiety sensitivity (ASI-3 scores) and distress tolerance (DTS scores) are significant predictors of dental distress. Unlike the current study, The Fear of Pain Questionnaire-III (McNeil & Rainwater, 1998) was used to measure pain sensitivity in the previous study. The differences in the study conducted by Addicks and colleagues and the current study can be partially explained by the use of different measures and definitions for pain sensitivity, as pain threshold and fear of pain are different constructs (Gross, 1991).

However, not consistent with previous studies is the non-significant relationship between pain sensitivity and dental distress in the linear regression analysis. Specifically, previous studies indicate that pain sensitivity is a significant predictor of dental distress (Addicks et al., 2008; Locker et al., 1996), whereas the current study did not find the same significant relationship. This suggests that pain sensitivity may not a unique predictor of dental distress when accounting for relevant variables.

Gordon and Heimberg (2013) suggested that dentist lack insight into their patient's anxiety. The implication of this is that dentists are not effectively helping their anxious patients with viable treatment options. The associations discovered in the current study suggest that a questionnaire on anxiety sensitivity, pain sensitivity, and distress tolerance may be beneficial to identify patients that are more at risk for dental anxiety-related symptoms. Being able to identify dental anxious individuals before treatment could help dentist lessen the experienced anxiety during treatment by identifying patients to treat more delicately. Furthermore, knowing that patients with high dental anxiety are more likely to be more vulnerable to distressing situations, anxiety symptoms, and pain, could help dentist with patient interactions by reminding providers to be more courtesy of these sensitivities.

The results suggest that implementing anxiety-reducing techniques could be beneficial when treating dentally anxious individuals. For instance, a study by Wiederhold, Gao, and Wiederhold (2014) found that virtual reality distraction systems were beneficial at reducing anxiety and pain felt in dental treatment by allowing patients to relax and mentally travel to another, less frightening location. Similarly, music distraction techniques have also been shown to be effective at reducing anxiety in the dental office (Lahmann et al., 2008). Furthermore, Breggren and colleagues (2000) illustrated that relaxation techniques, (i.e., learned muscular relaxation), resulted in a significant reduction in dental anxiety, as well as anxiety and fear. Another study demonstrated that brief relaxation techniques are beneficial and effective at reducing dental distress in a single intervention (Lahmann et al., 2008). This brief treatment is a promising option for patients given that no prior experience or therapy is required for



dentally anxious individuals to benefit from this treatment option. Future studies should look at other anxiety reducing techniques, as a treatment for dental anxiety. Additionally, future studies should examine the effect of exposure therapy on dental distress as exposure therapy has shown to be affective in other phobias (Garcia-Palacios et al., 2007).

The study had several limitations that warrant discussion. First, the study relied on online retrospective self-reported measures, and dental information was not verified by a dentist. Online measures allow for the possibility that participants could have responded carelessly, or dishonestly. Additionally, when using retrospective questionnaires, there are potential reliability issues that could influence the results of the study, as the questions are asking participants to remember how they felt in the past, and do not always reflect raw emotions felt at the time. Furthermore, verified dental records would be more reliable in looking at oral health, visit patterns, and avoidance, instead of relying on self-reported information. These findings should be replicated in a dental setting, or with medical records so that dental records are verified. Second, the study did not screen for participants with dental phobia or high dental anxiety. As a result, “dental phobia” cannot be assessed and the mean and median DAS scores were moderately low. This put the “high dental distress” cutoff much lower than the standard (high DA = 13+; Corah, Gale & Illig, 1979). Future studies should select for participants with high dental anxiety so that further associations can be made. Another limitation in the study is the limited diversity in the sample and the small number of participants in the prior dental trauma and male groups. Specifically, the use of a predominately female (79%) and white (82.4%) young adult sample limits the generalizability of the results. This is important

considering studies illustrate dental distress being more predominant in females (Hittner & Hemmo, 2009; Humphries et al. 2013; Oosterink et al., 2008; Schienle et al., 2011), and the high female population in the current study limits the generalization across sexes. The study should be replicated in a sample with more diverse sociodemographic characteristics, including ethnicity, age, and education.

Future studies should focus on the relationship between distress tolerance and dental distress, as the current study illustrated a moderate correlation between the variables. Very few studies have examined this relationship, but better understanding this construct could help in developing more effective treatment options. The current study illustrated that perhaps psychological forms of distress could be more influential on dental distress than physiological forms of dental distress. Objective behavioral measure should be used to examine these relationships.

## References

- Abrahamsson, K. H., Berggren, U., Hallberg, L., & Carlsson, S. G. (2002). Dental phobic patients' view of dental anxiety and experiences in dental care: a qualitative study. *Scandinavian Journal of Caring Sciences, 16*(2), 188-196.
- Addicks, S. H., McNeil, D. W., Randall, C. L., Goddard, A., Romito, L. M., Sirbu, C., ... & Weaver, B. D. (2017). Dental care-related fear and anxiety: distress tolerance as a possible mechanism. *JDR Clinical & Translational Research, 2*, 304-311.
- Agras, S., Sylvester, D., & Oliveau, D. (1969). The epidemiology of common fears and phobia. *Comprehensive Psychiatry, 10*(2), 151-156.
- Agdal, Maren L., Kvale, Gerd, Raadal, Magne, and Skaret, Erik (2008). Oral health and oral treatment needs in patients fulfilling the DSM-IV criteria for dental phobia: Possible influence on the outcome of cognitive behavioral therapy. *Acta Odontologica Scandinavica, 66*: 1-6.
- Agdal, Maren L., Öst, Lars-Göran, Raadal, Magne, and Skaret, Erik (2011). Quality-of-life before and after cognitive behavioral therapy (CBT) in patients with intra-oral injection phobia. *Acta Odontologica Scandinavica*, Early online, 1-8.
- Allan, N. P., Korte, K. J., Capron, D. W., Raines, A. M., & Schmidt, N. B. (2014). Factor mixture modeling of anxiety sensitivity: A three-class structure. *Psychological Assessment, 26*(4), 1184-1195.
- Allan, N. P., Raines, A. M., Capron, D. W., Norr, A. M., Zvolensky, M. J., & Schmidt, N. B. (2014). Identification of anxiety sensitivity classes and clinical cut-scores in a sample of adult smokers: Results from a factor mixture model. *Journal of Anxiety Disorders, 28*, 696-703.

- Ameral, V., Palm Reed, K. M., Cameron, A., & Armstrong, J. L. (2014). What are measures of distress tolerance really capturing? A mixed methods analysis. *Psychology Of Consciousness: Theory, Research, And Practice*, 1(4), 357-369.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.
- Appukuttan, D. P., Tadepalli, A., Cholan, P. K., Subramanian, S., & Vinayagavel, M. (2013). Prevalence of dental anxiety among patients attending a dental educational institution in Chennai, India-A Questionnaire based study. *Oral Health and Dental Management*, 12(4), 289-294.
- Armfield, J. M. (2008). A preliminary investigation of the relationship of dental fear to other specific fears, general fearfulness, disgust sensitivity and harm sensitivity. *Community Dentistry and Oral Epidemiology*, 36(2), 128-136.
- Armfield, J. M. (2010). Development and psychometric evaluation of the Index of Dental Anxiety and Fear (IDAF-4C+). *Psychological Assessment*, 22(2), 279-287.
- Armfield, J. M. (2011). Australian population norms for the Index of Dental Anxiety and Fear (IDAF-4C). *Australian Dental Journal*, 56(1), 16-22.
- Armfield, J. M., Spencer, A. J., & Stewart, J. F. (2006). Dental fear in Australia: who's afraid of the dentist?. *Australian Dental Journal*, 51(1), 78-85.
- Armfield, J. M., & Ketting, M. (2015). Predictors of dental avoidance among Australian adults with different levels of dental anxiety. *Health Psychology*, 34(9), 929 - 940.

- Åström, A, Skaret, E & Haugejorden, O (2011). Dental anxiety and dental attendance among 25-year-olds in Norway: Time trends from 1997 to 2007. *BMC Oral Health*, 11: 10.
- Berggren, Ulf (1984). *Dental fear and avoidance: A study of Aetiology, consequences and treatment*. Göteborg University.
- Berggren, U., & Meynert, G. (1984). Dental fear and avoidance: causes, symptoms, and consequences. *The Journal of the American Dental Association*, 109(2), 247-251.
- Berggren, U., Carlsson, S. G., Gustafsson, J. E., & Hakeberg, M. (1995). Factor analysis and reduction of a FearSurvey Schedule among dental phobic patients. *European Journal of Oral Sciences*, 103, 331–338.
- Bernstein, A., Zvolensky, M. J., Vujanovic, A. A., & Moos, R. (2009). Integrating Anxiety sensitivity, distress tolerance, and discomfort intolerance: A hierarchical model of affect sensitivity and tolerance. *Behavior Therapy*, 40, 291–301.
- Boyle, C. A., Newton, T., & Milgrom, P. (2009). Who is referred for sedation for dentistry and why?. *British Dental Journal*, 206(6), E12-E12.
- Corah, N. L. (1969). Development of a dental anxiety scale. *Journal of Dental Research*, 48(4), 596-596.
- Corah, N. L., Gale, E. N., & Illig, S. J. (1978). Assessment of a dental anxiety scale. *The Journal of the American Dental Association*, 97(5), 816-819.
- Coriat, I. H. (1946). Dental anxiety: fear of going to the dentist. *Psychoanalytic Review*, 33, 365-367.

- Davey, G. C. (1989). Dental phobias and anxieties: evidence for conditioning processes in the acquisition and modulation of a learned fear. *Behaviour Research and Therapy*, 27(1), 51-58.
- Davis, M., Walker, D. L., Miles, L., & Grillon, C. (2010). Phasic vs sustained fear in rats and humans: role of the extended amygdala in fear vs anxiety. *Neuropsychopharmacology*, 35(1), 105-135.
- De Jongh, A., Muris, P., ter Horst, G., & Duyx, M. P. (1995). Acquisition and maintenance of dental anxiety: the role of conditioning experiences and cognitive factors. *Behaviour Research and Therapy*, 33, 205–210.
- De Jongh, A., Bongaarts, G., & Vermeule, I. (1998). Blood–injury–injection phobia and dental phobia. *Behaviour Research and Therapy*, 36, 971–982.
- Eitner, S., Wichmann, M., Paulsen, A., & Holst, S. (2006). Dental anxiety – An epidemiological study on its clinical correlation and effects on oral health. *Journal of Oral Rehabilitation*, 33, 588–93.
- Fredrikson, M., Annas, P., Fischer, H., & Wik, G. (1996). Gender and age differences in the prevalence of specific fears and phobias. *Behaviour Research and Therapy*, 34, 33-39.
- Freeston, M. H., Rhe´aume, J., Letarte, H., Dugas, M. J., & Ladouceur, R. (1994). Why do people worry? *Personality and Individual Differences*, 17, 791–802.
- Forgione, A. & Clark, E. (1974). Comments on an empirical study of dental fears. *Journal of Dental Research*, 53, 496.
- Freidson, E & Feldman, J. (1958). The public looks at dental care. *Journal of the American Dental Association*, 57, 325–35.

- Garcia-Palacios, A., Botella, C., Hoffman, H., & Fabregat, S. (2007). Comparing acceptance and refusal rates of virtual reality exposure vs. in vivo exposure by patients with specific phobias. *Cyberpsychology & behavior, 10*(5), 722-724.
- Gatchel, R. J. (1992). Dealing with discomfort managing anxiety and pain during dental treatment. *The Journal of the American Dental Association, 123*(6), 37-41.
- Genco, R. J., & Williams, R. C. (2010). Periodontal disease and overall oral health: A clinician's guide. Yardley, PA: Professional Audience Communications.
- Gordon, D., Heimberg, R. G., Tellez, M., & Ismail, A. I. (2013). A critical review of approaches to the treatment of dental anxiety in adults. *Journal of Anxiety Disorders, 27*(4), 365-378.
- Gross, P. R. (1992). Is pain sensitivity associated with dental avoidance?. *Behaviour Research and Therapy, 30*(1), 7-13.
- Hägglin, C, Berggren, U, Hakeberg, M & Ahlqwist, M (1996). Dental anxiety among middle-aged and elderly women. *Journal of Dental Research, 75*: 509–9.
- Hakeberg, M., Berggren, U., & Carlsson, S. G. (1992). Prevalence of dental anxiety in an adult population in a major urban area in Sweden. *Community Dentistry and Oral Epidemiology, 20*(2), 97-101.
- Humphris, G. M., Morrison, T., & Lindsay, S. J. (1995). Modified Dental Anxiety Scale: validation and United Kingdom norms. *Community Dental Health, 12*, 143–150.
- Kaye, E. K., Valencia, A., Baba, N., Spiro, A., Dietrich, T., & Garcia, R. I. (2010). Tooth loss and periodontal disease predict poor cognitive function in older men. *Journal of the American Geriatrics Society, 58*(4), 713-718.
- Kent, G. (1985). Memory of dental pain. *Pain, 21*(2), 187-194.

- Keough, M. E., Riccardi, C. J., Timpano, K. R., Mitchell, M. A., & Schmidt, N. B. (2010). Anxiety symptomatology: The association with distress tolerance and anxiety sensitivity. *Behavior Therapy, 41*(4), 567-574.
- Kessler, R. C., McGonagle, K. A., Zhao, S., Nelson, C. B., Hughes, M., Eshleman, S. et al. (1994). Lifetime and 12- month prevalence of DSM-III-R psychiatric disorders in the United States. *Archives of General Psychiatry, 51*, 8–19.
- Kılıç, C., Ak, S., & Ak, H. B. (2014). Anxiety sensitivity: Another reason to separate dental fears from blood–injury fears?. *Journal of Anxiety Disorders, 28*(2), 280-282.
- Kirova, D., Atanasov, D., Lalabonova, C., & Janevska, S. (2010). Dental anxiety in adults in Bulgaria. *Folia Medica, 52*(2), 49-56.
- Klepac, R. K., Dowling, J. & Hauge, G. (1982). Characteristics of clients seeking therapy for the reduction of dental avoidance: reactions to pain. *Journal of Behavior Therapy and Experimental Psychiatry, 13*, 293-300.
- Lahmann, C., Schoen, R., Henningsen, P., Ronel, J., Muehlbacher, M., Loew, T., ... & Doering, S. (2008). Brief relaxation versus music distraction in the treatment of dental anxiety: a randomized controlled clinical trial. *The Journal of the American Dental Association, 139*(3), 317-324.
- Laposa, J. M., Collimore, K. C., Hawley, L. L., & Rector, N. A. (2015). Distress tolerance in OCD and anxiety disorders, and its relationship with anxiety sensitivity and intolerance of uncertainty. *Journal of Anxiety Disorders, 33*, 8-14.
- Litt, M. D. (1996). A model of pain and anxiety associated with acute stressors: distress in dental procedures. *Behaviour Research and Therapy, 34*(5), 459-476.



- Locker, D., Shapiro, D., & Liddell, A. (1996). Negative dental experiences and their relationship to dental anxiety. *Community Dental Health, 13*(2), 86-92.
- Locker, D., Shapiro, D., & Liddell, A. (1997). Overlap between dental anxiety and blood–injury fears: psychological characteristics and response to dental treatment. *Behaviour Research and Therapy, 35*, 583–590.
- Mantar, A., Yemez, B., & Alkin, T. (2010). The validity and reliability of the Turkish version of the anxiety sensitivity index-3. *Turk Psikiyatri Dergisi, 21*(3), 1.
- Merckelbach, H., Muris, P., de Jong, P. J., & de Jongh, A. (1999). Disgust sensitivity, blood–injection–injury fear, and dental anxiety. *Clinical Psychology & Psychotherapy, 6*(4), 279-285.
- Moore, R., Birn, H., Kirkegaard, E., Brødsgaard, I., & Scheutz, F. (1993). Prevalence and characteristics of dental anxiety in Danish adults. *Community Dentistry and Oral Epidemiology, 21*(5), 292-296.
- Mowrer, O. H. (1951). Two-factor learning theory: summary and comment. *Psychological Review, 58*(5), 350.
- Mohammed, R. B., Lalithamma, T., Varma, D. M., Venkata Sudhakar, K. N., Srinivas, B., Krishnamraju, P. V., & Shaik, A. B. (2014). Prevalence of dental anxiety and its relation to age and gender in coastal Andhra (Visakhapatnam) population, India. *Journal Of Natural Science, Biology & Medicine, 5*(2), 409-414.
- Naragon-Gainey, K. (2010). Meta-analysis of the relations of anxiety sensitivity to the depressive and anxiety disorders. *Psychological Bulletin, 136*(1), 128.

- Ng, Sam K.S. and Leung, W. Keung (2008). A community study on the relationship of dental anxiety with oral health status and oral health-related quality of life. *Community Dentistry and Oral Epidemiology* 36: 347–56.
- Öhman, A. (2008). Fear and anxiety. *EMOTIONS*, 709-729.
- Oosterink, F. M. D., de Jongh, A., & Aartman, I. H. A. (2009). Negative events and their potential risk of precipitating pathological forms of dental anxiety. *Journal of Anxiety Disorders*, 23, 451–457.
- Öst, L. G., & Hugdahl, K. (1985). Acquisition of blood and dental phobia and anxiety response patterns in clinical patients. *Behaviour Research and Therapy*, 23(1), 27-34.
- Öst, L. G., & Skaret, E. (Eds.). (2013). Cognitive behavioral therapy for dental phobia and anxiety. John Wiley & Sons.
- Öst, L. G., Sterner, U., & Lindahl, I. L. (1984). Physiological responses in blood phobics. *Behaviour Research and Therapy*, 22(2), 109-117.
- Potter, C. M., Kinner, D. G., Tellez, M., Ismail, A. I., & Heimberg, R. G. (2014). Clinical implications of panic symptoms in dental phobia. *Journal of Anxiety Disorders*, 28(7), 724-730.
- Quteish Taani, D. S. M. (2002). Dental anxiety and regularity of dental attendance in younger adults. *Journal of oral rehabilitation*, 29(6), 604-608.
- Reiss, S., & McNally, R. J. (1985). Expectancy model of fear. In S. Reiss & R. R. Bootzin (Eds.) *Theoretical Issues in Behavior Therapy*, 107–121.

- Ruscheweyh, R., Marziniak, M., Stumpfenhorst, F., Reinholz, J., & Knecht, S. (2009). Pain sensitivity can be assessed by self-rating: Development and validation of the Pain Sensitivity Questionnaire. *Pain, 146*(1), 65-74.
- Ruscheweyh, R., Verneuer, B., Dany, K., Marziniak, M., Wolowski, A., Çolak-Ekici, R., ... & Evers, S. (2012). Validation of the pain sensitivity questionnaire in chronic pain patients. *Pain, 153*(6), 1210-1218.
- Schuller, A. A., Willumsen, T., & Holst, D. (2003). Are there differences in oral health and oral health behavior between individuals with high and low dental fear? *Community Dentistry and Oral Epidemiology, 31*, 116–121.
- Schuurs, A. H., Duivenvoorden, H. J., VanVelzen, S. K. T., & Verhage, F. (1984). Dental anxiety, the parental family and regularity of dental attendance. *Community dentistry and oral epidemiology, 12*(2), 89-95.
- Simons, J. S., & Gaher, R. M. (2005). The Distress Tolerance Scale: Development and validation of a self-report measure. *Motivation and Emotion, 29*(2), 83-102.
- Stouthard, M. E. A., & Hoogstraten, J. (1990). Prevalence of dental anxiety in the Netherlands. *Community Dentistry Oral Epidemiology, 18*, 139–142.
- Taylor, S., Zvolensky, M. J., Cox, B. J., Deacon, B., Heimberg, R. G., Ledley, D. R., ... & Coles, M. (2007). Robust dimensions of anxiety sensitivity: development and initial validation of the Anxiety Sensitivity Index-3. *Psychological Assessment, 19*(2), 176.
- Timpano, K. R., Buckner, J. D., Richey, J. A., Murphy, D. L., & Schmidt, N. B. (2009). Exploration of anxiety sensitivity and distress tolerance as vulnerability factors for hoarding behaviors. *Depression and Anxiety, 26*, 343–353.

- Thomson, W. M., Locker, D., & Poulton, R. (2000). Incidence of dental anxiety in young adults in relation to dental treatment experience. *Community Dentistry and Oral Epidemiology*, 28, 289–294.
- Van Houtem, C. M. H. H., Laine, M. L., Boomsma, D. I., Ligthart, L., Van Wijk, A. J., & De Jongh, A. (2013). A review and meta-analysis of the heritability of specific phobia subtypes and corresponding fears. *Journal of Anxiety Disorders*, 27(4), 379-388.
- van Overveld, M., de Jong, P. J., & Peters, M. L. (2011). The Multi-Dimensional Blood/Injury Phobia Inventory: Its psychometric properties and relationship with disgust propensity and disgust sensitivity. *Journal of Anxiety Disorders*, 25(3), 319-325.
- Viinikangas, Aki, Lahti, Satu, Yuan, Siyang, Pietila, Ilpo, Freeman, Ruth and Humphris, Gerry (2007). Evaluating a single dental anxiety question in finnish adults. *Acta Odontologica Scandinavia*, 65, 236–240.
- Wheaton, M. G., Deacon, B. J., McGrath, P. B., Berman, N. C., & Abramowitz, J. S. (2012). Dimensions of anxiety sensitivity in the anxiety disorders: Evaluation of the ASI-3. *Journal of Anxiety Disorders*, 26(3), 401-408.
- Wide Boman, U., Carlsson, V., Westin, M., & Hakeberg, M. (2013). Psychological treatment of dental anxiety among adults: a systematic review. *European Journal of Oral Sciences*, 121(3pt2), 225-234.
- Wiederhold, M. D., Gao, K., & Wiederhold, B. K. (2014). Clinical use of virtual reality distraction system to reduce anxiety and pain in dental procedures. *Cyberpsychology, Behavior, and Social Networking*, 17(6), 359-365.

- Wolpe, J. (1981). The dichotomy between classical conditioned and cognitively learned anxiety. *Journal of Behavior Therapy and Experimental Psychiatry*, 12(1), 35-42.
- Zvolensky, M. J., Schmidt, N. B., Bernstein, A., & Keough, M. E. (2006). Risk-factor research and prevention programs for anxiety disorders: A translational research framework. *Behaviour Research and Therapy*, 44, 1219–1239.

Table 1: Correlations between study variables

	1	2	3	4
1. ASI-3	-			.
2. DTS	-.354*	-		
3. PSQ	.330*	-.201*	-	
4. DAS	.328*	-.215*	.167*	-
Mean	13.667	47.826	49.157	8.778
Standard Deviation	12.305	13.054	20.725	3.760
Range of Scores	0 - 72	15 - 75	0 - 165	4 - 20

*Note.* ASI-3 = Anxiety Sensitivity Index-3; DAS = Dental Anxiety Scale; DTS = Distress Tolerance Scale; PSQ = Pain Sensitivity Questionnaire.

\* =  $p < .01$  (2-tailed).

Table 2: Regression examining predictors of dental distress

Variable	$\Delta R^2$	B	SE (B)	<i>p</i>
Step 1	.103			<.001
Sex		.990	.409	.016
Traumatic experience		3.463	.513	<.001
Step 2	.089			<.001
ASI-3		.070	.014	<.001
DTS		-.027	.013	.041
PSQ		.012	.008	.135

*Note.* ASI-3 = Anxiety Sensitivity Index-3; DTS = Distress Tolerance Scale; PSQ = Pain Sensitivity Questionnaire. The variable “sex” was coded 1= male, 2 = female. The variable “traumatic experiences” was coded 1 = traumatic experience, 0 = no traumatic experience.

Appendix A

**Anxiety Sensitivity Index – 3**

Please circle the number that best corresponds to how much you agree with each item. If any items concern something that you have never experienced (e.g., fainting in public) answer on the basis of how you think you might feel *if you had* such an experience. Otherwise, answer all items on the basis of your own experience. Be careful to circle only one number for each item and please answer all items.

	<b>Very little</b>	<b>A little</b>	<b>Some</b>	<b>Much</b>	<b>Very much</b>
1. It is important for me not to appear nervous.	0	1	2	3	4
2. When I cannot keep my mind on a task, I worry that I might be going crazy.	0	1	2	3	4
3. It scares me when my heart beats rapidly.	0	1	2	3	4
4. When my stomach is upset, I worry that I might be seriously ill.	0	1	2	3	4
5. It scares me when I am unable to keep my mind on a task.	0	1	2	3	4
6. When I tremble in the presence of others, I fear what people might think of me.	0	1	2	3	4
7. When my chest feels tight, I get scared that I won't be able to breathe properly.	0	1	2	3	4
8. When I feel pain in my chest, I worry that I am going to have a heart attack.	0	1	2	3	4
9. I worry that other people will notice my anxiety.	0	1	2	3	4
10. When I feel "spacey" or spaced out I worry that I may be mentally ill.	0	1	2	3	4
11. It scares me when I blush in front of people.	0	1	2	3	4



12. When I notice my heart skipping a beat, I worry that there is something seriously wrong with me.	0	1	2	3	4
13. When I begin to sweat in a social situation, I fear people will think negatively of me.	0	1	2	3	4
14. When my thoughts seem to speed up, I worry that I might be going crazy.	0	1	2	3	4
15. When my throat feels tight, I worry that I could choke to death.	0	1	2	3	4
16. When I have trouble thinking clearly, I worry that there is something wrong with me.	0	1	2	3	4
17. I think it would be horrible for me to faint in public.	0	1	2	3	4
18. When my mind goes blank, I worry there is something terribly wrong with me.	0	1	2	3	4

*Appendix B*

**Corah's Dental Anxiety Scale – Revised**

1. If you had to go to the dentist tomorrow for a check-up, how would you feel about it?
  - a. I would look forward to it as a reasonably enjoyable experience.
  - b. I wouldn't care one way or the other.
  - c. I would be a little uneasy about it.
  - d. I would be afraid that it would be unpleasant and painful.
  - e. I would be very frightened of what the dentist would do.
  
2. When you are waiting in the dentist's office for your turn in the chair, how do you feel?
  - a. Relaxed.
  - b. A little uneasy.
  - c. Tense.
  - d. Anxious.
  - e. So anxious that I sometimes break out in a sweat or almost feel physically sick.
  
3. When you are in the dentist's chair waiting while the dentist gets the drill ready to begin working on your teeth, how do you feel?
  - a. Relaxed.
  - b. A little uneasy.
  - c. Tense.
  - d. Anxious.
  - e. So anxious that I sometimes break out in a sweat or almost feel physically sick.
  
4. Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist or hygienist is getting out the instruments which will be used to scrape your teeth around the gums, how do you feel?
  - a. Relaxed.

- b. A little uneasy.
- c. Tense.
- d. Anxious.
- e. So anxious that I sometimes break out in a sweat or almost feel physically sick.

*Appendix C*

**Distress Tolerance Scale**

**Directions:** Think of times that you feel distress or upset. Select the item that best describes your beliefs about feeling distressed or upset.

	Strongly Agree	Mildly Agree	Agree and Disagree Equally	Mildly Disagree	Strongly Disagree
1. Feeling distressed or upset is unbearable to me.	1	2	3	4	5
2. When I feel distress or upset, all I can think about is how bad I feel.	1	2	3	4	5
3. I can't handle feeling distressed or upset.	1	2	3	4	5
4. My feelings of distress are so intense that they completely take over.	1	2	3	4	5
5. There's nothing worse than feeling distressed or upset.	1	2	3	4	5
6. I can tolerate being distressed or upset as well as most people.	1	2	3	4	5
7. My feelings of distress or being upset are not acceptable.	1	2	3	4	5
8. I'll do anything to avoid feeling distressed or upset.	1	2	3	4	5
9. Other people seem to be able to tolerate feeling distress or upset better than I can.	1	2	3	4	5
10. Being distressed or upset is always a major ordeal for me.	1	2	3	4	5
11. I am ashamed of myself when I feel distressed or upset.	1	2	3	4	5
12. My feelings of distress or being upset scare me.	1	2	3	4	5
13. I'll do anything to stop feeling distressed or upset.	1	2	3	4	5
14. When I feel distressed or upset, I must do something about it immediately.	1	2	3	4	5
15. When I feel distressed or upset, I cannot help but concentrate on how bad the distress actually feels.	1	2	3	4	5

Appendix D

**Pain Sensitivity Questionnaire**

**Directions:** This questionnaire contains a series of questions in which you should imagine yourself in certain situations. You should then decide if these situations would be painful for you and if yes, how painful they would be. Let 0 stand for no pain; 1 is an only just noticeable pain and 10 the most severe pain that you can imagine or consider possible. Please mark the scale with a cross on the number that is most true for you. Keep in mind that there are no "right" or "wrong" answers; only your personal assessment of the situation counts. Please try as much as possible not to allow your fear or aversion of the imagined situations affect your assessment of painfulness.

	Not painful at all									Most severe pain imaginable
1. Imagine you bump your shin badly on a hard edge, for example, on the edge of a glass coffee table. How painful would that be for you?	1	2	3	4	5	6	7	8	9	10
2. Imagine you burn your tongue on a very hot drink.	1	2	3	4	5	6	7	8	9	10
3. Imagine your muscles are slightly sore as the result of physical activity.	1	2	3	4	5	6	7	8	9	10
4. Imagine you trap your finger in a drawer.	1	2	3	4	5	6	7	8	9	10
5. Imagine you take a shower with lukewarm water.	1	2	3	4	5	6	7	8	9	10
6. Imagine you have mild sunburn on your shoulders.	1	2	3	4	5	6	7	8	9	10
7. Imagine you grazed your knee falling off your bicycle.	1	2	3	4	5	6	7	8	9	10
8. Imagine you accidentally bite your tongue or cheek badly while eating.	1	2	3	4	5	6	7	8	9	10
9. Imagine walking across a cool tiled floor with bare feet.	1	2	3	4	5	6	7	8	9	10
10. Imagine you have a minor cut on your finger and inadvertently get	1	2	3	4	5	6	7	8	9	10

lemon juice in the wound.										
11. Imagine you prick your fingertip on the thorn of a rose.	1	2	3	4	5	6	7	8	9	10
12. Imagine you stick your bare hands in the snow for a couple of minutes or bring your hands in contact with snow for some time, for example, while making snowballs.	1	2	3	4	5	6	7	8	9	10
13. Imagine you shake hands with someone who has a normal grip.	1	2	3	4	5	6	7	8	9	10
14. Imagine you shake hands with someone who has a very strong grip.	1	2	3	4	5	6	7	8	9	10
15. Imagine you pick up a hot pot by inadvertently grabbing its equally hot handles.	1	2	3	4	5	6	7	8	9	10
16. Imagine you are wearing sandals and someone with heavy boots steps on your foot.	1	2	3	4	5	6	7	8	9	10
17. Imagine you bump your elbow on the edge of a table ("funny bone").	1	2	3	4	5	6	7	8	9	10

*Appendix E*

**General Oral Health/Dental History Questionnaire**

1. How would you rate your general oral health?
  - a. Very good
  - b. Good
  - c. Regular
  - d. Bad
  
2. Were you ever taught how to brush your teeth?
  - a. If yes, who taught you?
    - i. Parents
    - ii. Dentist
    - iii. Teacher
    - iv. Other (specify)
  
3. How often do you brush your teeth?
  - a. Less than once a day
  - b. Once a day
  - c. Twice a day
  - d. More than twice a day
  
4. What do you use to brush your teeth?
  - a. Regular tooth brush
  - b. Electric tooth brush
  
5. What type of brush do you use?
  - a. Soft
  - b. Medium
  - c. Hard
  
6. Duration of teeth brushing?
  - a. Less than a min
  - b. ~ 1 min
  - c. ~ 2 minutes
  - d. more than 2 min
  
7. How often do you change your tooth brush?
  - a. Once a month
  - b. Every 3 months
  - c. Every 6 months
  - d. Every year
  - e. Longer than a year

8. Do you clean your tongue? (Y/N)
9. Do you floss? (Y/N)
  - a. How often do you floss your teeth?
    - i. Once a day
    - ii. More than once a day
    - iii. Once a week
    - iv. More than once a week
    - v. Less than once a week
10. Which oral health tools do you use regularly besides your toothbrush? (check all that apply)
  - a. Mouthwash
  - b. Floss
  - c. Whitening products
  - d. Toothbrush only
  - e. None of the above
  - f. Others.. (specify) \_\_\_\_\_
11. How often do you go for a dental check-up?
  - a. Every 6 months
  - b. Once a year
  - c. Only when there is a problem
  - d. Never
12. When is the last time you went to the dentist?
  - a. Less than 6 months ago
  - b. 6-12 months ago
  - c. More than a year ago
  - d. More than 2 years ago
13. What was the reason for your last dental visit?
  - a. Routine check up
  - b. Pain
  - c. Other (specify)
14. Did your parents encourage good oral hygiene? (Y/N) explain
15. As a child, how often did your parents make you/remind you to brush your teeth?
  - a. In the morning
  - b. Before bed
  - c. Multiple times a day



- d. Multiple times a week
  - e. Rarely
  - f. never
16. If you have children, do you encourage good oral hygiene? (Y/N) explain
17. How many cavities would you say you have you had in your lifetime? \_\_\_\_\_
18. If you had the choice, how would you solve a tooth problem?
- a. Have a dentist fix the tooth
  - b. Have the tooth pulled
19. Which procedures have you had? (check all that apply)
- a. Cavity filled
  - b. Teeth scaled
  - c. Gums treated
  - d. Xrays taken
  - e. Fluoride treatment
  - f. Bridge/implants
  - g. Crown/capping
  - h. Had braces
  - i. Had a tooth pulled
  - j. Root canal
  - k. Wisdom teeth removal
  - l. Oral surgery (specify) \_\_\_\_\_
20. Have you ever had a traumatic dental experience? (Y/N) (if yes, please specify)
21. Do you trust your dentist? (Y/N)
22. If you do not go to the dentist or are afraid of him/her, the reason(s) is (are):
- a. I am afraid of the handpiece
  - b. I am afraid of dental needle
  - c. Treatment cost is too high
  - d. No dental clinics nearby
  - e. Not enough time
  - f. Other (please specify)
23. I avoid/put off going to the dentist out of fear
- a. Strongly agree
  - b. Agree
  - c. Disagree
  - d. Strongly disagree
24. Are you happy with the appearance of your teeth?
- a. If no, why not

- i. Discoloration
- ii. Not straight
- iii. Large gaps (no teeth missing)
- iv. Missing teeth

25. Approximant lifetime number of cavities? \_\_\_\_\_

26. How many cavities have you had filled? \_\_\_\_\_

*Appendix F*

**Sociodemographic Questionnaire**

1. Age:
2. Gender:
3. Race:
4. Education level:
  - a. Some high school
  - b. Graduated high school
  - c. Some college
  - d. Bachelors
  - e. Masters
  - f. Higher than masters
5. Household income (parent's income if not financially stable):
  - a. 100,000 or more
  - b. 90,000 - 99,999
  - c. 80,000 - 89,999
  - d. 70,000 - 79,999
  - e. 60,000 - 69,999
  - f. 50,000 - 59,999
  - g. 40,000 - 49,999
  - h. 30,000 - 39,999
  - i. 20,000 - 29,999
  - j. 10,000 - 19,999
  - k. less than 10,000
6. Are any immediate family members licensed health care professionals? (if yes, specify)
7. Where are you from? (Where have you spent most of your life)
8. Where are your parents from?
9. Do you have dental insurance? (Y/N)
10. What type of environment are you completing this?
  - a. Home
  - b. Library or other quiet area
  - c. Coffee shop or other loud/public area
  - d. Other (specify)
- 11. To what extent did you pay attention?**