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Association between dental anxiety, state anxiety and procedural pain during maxillary local anesthesia: a cross-sectional study

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Aim: This study aimed to assess the correlation between dental anxiety, state anxiety and pain after dental injection.
Materials and methods: 120 children with positive rating according to Frankle behavior scale were enrolled in this cross-sectional study, each child received a maxillary injection prior treatment. Dental anxiety was assessed by Children Fear Scale, and state anxiety was assessed by the Children Anxiety Questionnaire. The Wong Baker Scale and FLACC Scale were used to measure pain after dental injection.
Results: No statistically significant differences were found in anxiety level scores between genders and age groups with p-value > 0.05. A statistically significant difference in the postoperative pulse rate between males and females, with females having a greater mean pulse rate (p value= 0.024). A positive correlation was found between each dental anxiety and procedural pain and state anxiety and procedural pain.
Conclusion: Decreasing anxiety levels in young patients reduce the expected pain and procedural pain experienced by children which results in a better health care and quality of life.

Keywords: dental fear and anxiety, procedural pain, sex, age, state anxiety.

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Introduction

Dental Fear and Anxiety (DFA) is a definition of a reaction to an unknown risk for the patient, causing a state of fear that something serious is about to happen during dental treatment, often linked to a sense of loss of control.[1] The prevalence of dental anxiety is high in pediatric patients, and is estimated to be between 5.7% and 20.2%, with multiple factors playing an important role in its prevalence.[2]

Morgan and Porritt[3] stated that dental fear and anxiety are natural parts of a child's cognitive development, but usually have a decreased effect on a growing old child. The multifactorial etiology of children's dental fear and anxiety involves the influence of several, personal and environmental interacting factors on the development of fear and anxiety in a dental care situation.[4] Age and gender are controversial factors that contribute to the development of dental anxiety. Shindova & Belcheva[5] reported the lack of role for age in the development of dental fear and anxiety, as they did not find any relationship between age at the first visit and the development of dental fear. A systematic review conducted by Murad et al[6] revealed a correlation between age and DFA levels, whereas younger children showed higher levels of DFA than older patients did. In terms of gender, research has typically revealed that females have increased levels of DFA compared to males and tend to report greater specific fear and anxiety about drilling, local anesthesia and pain than their male counterparts.[3]

A main factor considered a high risk factor for developing dental anxiety is pain, which is identified by the IASP as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.[7,8] However, the relationship between anxiety and pain is reciprocal due to the multifactorial etiology of DFA and the multiple dimensions of pain.[9, 10] Increased DFA levels are related to previous painful dental experiences, and patients suffering from severe dental pain tend to report higher levels of DFA.[11]

Moreover, several studies have concluded that anxious patients tend to have worse pain perception than non-anxious patients when invasive treatment is received.[12-14] A systematic review by Heaton reported that dental anxiety has a significant impact on expected pain, pain during dental treatment and pain after treatment, while state anxiety has a significant impact on pain perception and pain during the procedures only, although, anxiety levels did not differ between surgical and nonsurgical procedures.[15] In pediatric patients, studies have indicated a significant correlation between procedural anxiety and procedural pain,[16, 17] Regarding dental treatment, studies have shown that reducing dental anxiety through various methods, such as the buzzy system, virtual reality, and procedural sedation can effectively decrease pain perception during dental procedures.[18]

Therefore, the aim of the study was to assess the relationship between dental anxiety, state anxiety and procedural pain in school-aged children during dental anesthesia administration.

Materials and methods

Study design and setting:

This observational study was designed as a cross-sectional study to investigate the correlation between dental anxiety and pain during local anesthesia administration. These occurred from June 2023 until March 2024. The children who were recruited for the study were randomly selected patients who visited the pediatric dentistry department at Damascus University. All methods were carried out in accordance with all relevant guidelines and regulations and Declaration of Helsinki, also,

ethical approval was obtained from the institutional ethics committee of Damascus University (No. 4066). In addition, a written informed consent was obtained from all participant guardians prior to the start of the data collection.

Sample collection:

The sample size was determined with G-power software v3.1.9.7 and based on similar previous studies.[15, 16] A total of 120 children aged 6-10 years who visited the dentist for the first time and needed dental treatment in the maxillary arch including administration of local anesthetic, were included in this study. Patients with communication disabilities, or medical or psychological disorders that may have an effect on the pain threshold were excluded. Moreover, patients with severe dental pain or acute abscess and children with a negative or absolutely negative ranking according to the Frankle Behavior Rating Scale were also excluded.

Study protocol:

Each patient was seated in the dental chair, and then 20% benzocaine gel was applied at the injection site prior to anesthesia for 1 minute via a sterile cotton swab. Afterwards, a 1:80000 lidocaine infiltration injection was administered in the maxillary arch.

Pain and anxiety were assessed using several measures: children's state anxiety was assessed by the Child Anxiety Questionnaire (CAQ) developed by Nilson et al,[19] a tool driven by the State –Trait Anxiety Scale. This accumulative scale was used to measure state anxiety before and after treatment. 4-6 points referred to no anxiety or mild anxiety, while 7-9 points described moderate anxiety, with 10-12 points indicating severe anxiety or phobia. For dental anxiety, the Children Fear Scale (CFS) was used to assess pre- and postoperative fear among patients undergoing a painful medical procedure.[20] this is a self-reported assessment tool consisting of 5 faces representing different levels of fear, with 0 indicating no fear and 4 indicating the worst feeling of fear. Additionally, changes in the physiological pulse rate were recorded before and after the administration of anesthesia using a finger pulse oximeter the first time was 5 minutes after the patient was seated in the dental chair, second time was 5 minutes after the dental injection. Regarding pain, the child was asked to choose a face from the Wong-Baker scale (WB that matches his feelings after receiving the injection). In addition, the child's behavior during the administration of local anesthesia was recorded on video using a mobile phone camera attached to the dental chair (Xiaomi Redmi note 11 pro plus©), and was subsequently assessed by two external observers according to the Faces-Legs-Activity-cry-consolability scale (FLACC).

Statistical analysis:

In this study, descriptive data, including means, frequencies and percentages, were calculated for boys and girls. For the quantitative variables, the Kolmogorov-Smirnov test was used to assess normality. Normality was found for the pulse rate scores.

The collected data were analyzed using IBM SPSS software v. 23 (IBM Corp., Armonk, USA). A P value of less than 0.05 was considered significant, and the power of the study was set at 95%. The Mann-Whitney U test was performed to compare CFS, and CAQ scores and WB, and FLACC scores between males and females, while simple t-test was used to compare pulse rate mean between gender and age groups. Moreover, the correlations between CAQ score, CFS scores and FLACC, and WB scores were studied using Spearman's rank correlation with a level of significance of 0.01.

Results

A total of 120 patients were recruited for this study.60 males and 60 females with a

mean age of 7.7 ±1 years. No statistically significant difference was found between males and females with regard to mean age (p value =1.34).

No statistically significant difference was found between males and females in CFS scores (p value=0.349), as 46.66% of male patients and 33.33% of female patients had no fear at all (table 1). CFS scores were evaluated for the following age groups: 6- <8 years and 8≤ -10 years. There was no statistically significant difference between these age groups (p value= 0.621) (Table1), in addition, there was no correlation between age and anxiety level (p value > 0.05).

Table 1: Mann-Whitney results for CFS scores for gender and age groups.

	gender			age		
CFS	Male	Female	Total	*6- <8*	*8≤ -10*	Total
0	46.66 %	33.33%	40%	43.4%	37.31%	40%
1	35%	51.66%	43.33%	39.6%	46.2%	43.33 %
2	11.66 %	10%	10.83%	11.3%	10.44%	10.83 %
3	5%	1.66%	3.33%	3.7%	2.9%	3.33 %
4	1.66%	3.33%	2.5%	1.8%	2.9%	2.5%
N	60	60	120	53	67	120
p-value	0.349			0.621		

* p- Value is significant at < 0.05

CAQ scores did not differ between male and female patients (p value=0.642), with 87.5% of the total patients diagnosed with mild state anxiety and 2.5% of patients suffering from high state anxiety (p value= 0.062) (table 2).

Table 2: Mann-Whitney results for CAQ scores for gender and age groups.

	GENDER			AGE		
CAQ	Male	Female	Total	6- <8	8≤ -10	Total
MILD (4-6)	86.63%	88.33%	87.5 %	92.45 %	8.5%	87.5 %
MODERATE (7-9)	10%	10%	10%	1.88 %	16.41 %	10%
HIGH (10-12)	3.33%	1.66%	2.5%	5.66 %	0%	2.5%
N	60	60	120	53	67	120
P-VALUE	0.642			0.062		

* p- Value is significant at < 0.05

The mean FLACC scores were 0.88 for males and 0.97 for females, but no statistically significant difference was found between gender groups (p value =0.753), or between age groups (p value= 0.836), as the mean score for those aged 6- <8 years was 0.91 and for those aged 8≤ -10 years was 0.94 (Table 3).

Table 3: Mann-Whitney results for FLACC scores for gender and age groups.

	FLACC					
	gender			age		
	male	female	Total	6- <8	8≤ -10	total
Mean	0.88	0.97	0.92	.91	.94	.92
N	60	60	120	53	67	120
Std. Deviation	.783	.901	.842	.838	.851	.842
P VALUE	0.753			0.836		

* p- Value is significant at < 0.05

For the Wong Baker scale, more male patients reported greater pain levels than female patients did but no statistically significant difference was found (p value= 0.701), additionally, older patients reported greater pain levels than younger patients did,

with no statistically significant difference between them (p value= 0.836) (table 4).

Table 4: Mann-Whitney test for the Wong Baker scores for gender and age groups.

	Wong Baker					
	gender			age		
	male	female	Total	6- <8	8≤ -10	total
No pain (0)	22	23	45	18	27	45
Hurts little bit (2)	32	33	65	31	34	65
Hurts little more (4)	6	4	10	4	6	10
N	60	60	120	53	67	120
P VALUE	0.701			0.836		

* p- Value is significant at < 0.05

Postoperatively, there was a statistically significant difference in the pulse rate between males and females, with females having a greater mean pulse rate (p value= 0.024). During anesthesia, the pulse rates did not differ significantly between males and females (p value= 0.981). Moreover, no significant differences in pulse rates were observed between the age groups either preoperatively or during anesthesia (Table 5).

Table 5: t-test results for pulse rate mean for gender and age groups

	Pulse rate mean					
	gender			age		
	male	female	P value	6- <8	8≤ -10	P value
Preoperative	95.42	97.02	0.024*	96.62	95.90	0.615
During anesthesia	99.08	99.77	0.981	100.36	98.69	0.192

* p- Value is significant at < 0.05

The relationships between patients' pain responses to dental injection, indicated by the Wong Baker scale and FLACC scale, and their dental anxiety and state anxiety scores were evaluated by Spearman's rank correlation coefficient. There was a statistically significant correlation between the WB, and FLACC scores and both the CFS and CAQ scores (P < 0.01) (Table 6).

Table 6: correlation between dental anxiety, state anxiety and procedural pain measures

Spearman Correlation				
	Male		Female	
	Correlation coefficient	P-value	Correlation coefficient	P-value
CAQ/ FLACC	0.382	0.003**	0.589	0.000**
CFS/Wong-baker	0.501	0.000**	0.435	0.001**
CFS/ FLACC	0.386	0.002**	0.636	0.000**
CAQ/ Wong-Baker	0.390	0.002**	0.454	0.000**

** Correlation is significant at 0.01 level.

Discussion

Dental fear and anxiety arises from painful previous experiences, and high levels of DFA increase patients' perception of pain, as a positive correlation between anxiety and pain perception was found among adult patients.[21] Moreover, this relationship has not been assessed clearly in pediatric patients, even though many studies have indicated the efficacy of DFA in alleviating pain during dental treatment.[22] This study aimed to evaluate the correlation between dental anxiety, state anxiety and procedural pain while receiving a local anesthetic prior to dental treatment.

Pain and anxiety are difficult to measure due to their intertwined physical and psychological aspect.[23] Therefore, a standardized and controlled environment is essential for the assessment of anxiety and

pain. In the present study, one experienced pediatric dentist treated all patients in the same dental chair in a quiet, distraction-free environment.

School-aged children were chosen for the study because they have a competent cognitive growth that can facilitate the expression of their emotions and the ability to report them more adequately than younger children. [24] also according to Abdelrazk et al[25], at this age range, the child is known to develop its first attitudes toward dental care. Local anesthesia and fear of needles are a significant concern in pediatric dentistry, they impact children's cooperation and treatment outcomes and increases anxiety levels.[26] Therefore, this procedure was chosen because it can affect both anxiety and pain.

The relationship between dental anxiety and sex is considered controversial in the literatures.[27, 28] However, dental anxiety has been linked more to females than males, as reported by some studies.[27, 29] In the current study, the CFS and CAQ scores did not differ between girls and boys, which is in accordance with Popescu et al[30] and Abanto et al.[31]

The anxiety scores were similar in both age groups, with no significant differences. This could be attributed to the fact that all patients were positive according to the Frankl behavior rating scale. Additionally, no correlation was found between age and anxiety levels, whereas the relationship between DFA and age itself cannot be considered stable because it can be affected by oral health status and exposure to various social and cultural event.[32]

No significant differences were found between genders in regard to reported pain, which is in accordance with the findings of Ghanei et al[33] and Naoumova et al.[34]

A positive correlation was found between both dental anxiety and procedural pain, and between state anxiety and procedural pain in both genders, and anxious patients reported greater pain levels than non anxious patients did. A relevant result in adult patients was reported by Sanikoop et al[21] where patients expected more pain than they experienced when they had higher dental- anxiety scores. This result indicates the importance of DFA management in alleviating pain, which eventually improves children's perception of dental treatment and treatment outcomes.

Study limitations:

The first limitation of this study is that the sample was from a single medical institution, as different environments might have had an effect on state anxiety.

The second limitation of this study was that the children included in the present study were selected from among those who had their first dental visit. Therefore, the effect of previous dental visits on anxiety levels was not evaluated.

Conclusion

Dental fear and anxiety is mutually related to procedural pain, and decreasing anxiety reduces the pain experienced by children and enhances their dental experience, which results in better oral health and quality of life.

Authors' contributions

B J: A - Research concept and design, Collection and/or assembly of data, Data analysis and interpretation, Writing the article; L M: Research concept and design, Final approval of the article research, A D: Collection and/or assembly of data, Data analysis and interpretation; M S: Research concept and design, Final approval of the article.

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Conflicts of interests:

The authors declare no conflict of interests

Data availability:

All data generated or analyzed during this study are included in this published article.

Ethical approval:

Ethical approval was obtained from the institutional ethics committee of Damascus University (No. 4066). All methods were carried out in accordance with all relevant guidelines and regulations and Declaration of Helsinki,

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