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Assessment of the Multidimensional Nature of Dental Fear and Anxiety Among Children and Adolescents in Bosnia and Herzegovina

SUMMARY

Background: *The aim of the present study was to determine whether differences exist in the expression of the multidimensional components of DFA among school-aged children in Bosnia and Herzegovina.* ***Subjects and Methods:*** *This cross-sectional observational study included mentally and physically healthy participants of both sexes, aged 8–15 years, attending a scheduled dental appointment involving either invasive or non-invasive procedures. Prior to treatment, participants completed IDAF-4C core module and the IDAF-S stimulus module independently. Behavioral responses during treatment were assessed using the Frankl Behavior Rating Scale by an independent observer.* ***Results:*** *The findings were presented descriptively in tables. Differences were identified in the expression of the multidimensional components of DFA assessed with the IDAF-4C module. The behavioural component demonstrated the lowest level of expression, followed by the cognitive and physiological components, whereas the emotional component demonstrated the highest level of expression (Friedman test = 238.963; p < 0.0005). Differences were also observed according to the invasiveness of dental procedures, with all components demonstrating higher (more negative) scores during invasive dental treatments: emotional component (Mann–Whitney U = 21,894.000; p = 0.004), behavioural component (Mann–Whitney U = 21,211.500; p = 0.009), physiological component (Mann–Whitney U = 23,570.500; p < 0.0005), and cognitive component (Mann–Whitney U = 20,749.500; p = 0.048).* ***Conclusion:*** *There were no statistically significant differences in the expression of the multidimensional components of the DFA among school-aged children in BiH between the younger and older age groups of respondents. A statistically higher level of DFA components was observed in association with invasive treatments, indicating a link between the intensity of dental fear and the presence of specific stimuli.*

Keywords: children; DFA; IDAF-4C.

Katana Elma[1], Bajrić Elmedin[2], Zukanović Amila[2], Marković Nina[2]

[1] Dental Clinical Center of the University of Sarajevo
[2] Faculty of Dentistry, University of Sarajevo

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Introduction

The foundations of lifelong oral health are established through the prevention and timely treatment of oral diseases during early childhood and adolescence, which represents one of the primary objectives of paediatric dentistry[1]. Accordingly, one of the fundamental responsibilities of paediatric dentistry is to facilitate children's acceptance of dental treatment while preventing the development of dental fear and anxiety (DFA)[1]. According to the principles of modern psychology, children and adolescents should be regarded as individuals who exhibit considerable variation in maturity, personality, temperament, and emotional development[1]. For most children, a dental visit represents exposure to a potentially stressful situation. Consequently,

uncooperative behaviour and fear are common responses encountered in everyday dental practice[1]. Fear is an emotion that is present from the first months of life. Children generally experience a greater number of fears than adults, and these fears are perceived with greater intensity. Anxiety develops gradually and typically emerges later, predominantly during adolescence[2]. The literature consistently recognises childhood as a critically important developmental period during which numerous psychological, cognitive, and emotional changes occur. Children therefore require considerable attention, care, and protection from sources of stress, while the long-term consequences of stressful experiences provide an additional rationale for continued research in this field[3,4].

Paediatric dentistry provides care for patients from birth until adulthood. Understanding the behaviour of children and adolescents in the dental setting requires comprehensive knowledge of their psychological development[2]. Such knowledge is particularly important for understanding the development of DFA, selecting appropriate approaches for its management, and recognising behaviour management problems that may arise during dental treatment[2]. Dental fear and anxiety is a common condition and has been identified as the fifth most prevalent fear among all specific fears[2,5]. Consequently, DFA represents a major obstacle, first to the prevention of oral diseases and subsequently to their successful treatment. In Bosnia and Herzegovina, the prevalence of DFA among children aged 9–12 years has been reported to be 17.5%, highlighting the magnitude of this problem within the country[6]. These findings indicate that fear and anxiety related to dental treatment continue to represent an important reason for neglecting oral health.

Several psychological theories and approaches provide systematic explanations of different aspects of psychological development, including cognitive, social, and emotional development, throughout successive developmental stages, whereas others focus on more specific aspects of development[2]. Such approaches are essential for understanding how different developmental domains interact during the formation of a fully developed individual[7,8].

The chronological classification of human development is one of the few areas in psychology in which all major theoretical perspectives demonstrate broad agreement, recognising seven developmental periods extending from conception to death. These include the prenatal period (from conception to birth), infancy, early childhood, middle childhood, adolescence, adulthood, and old age[4,8]. Early school-age childhood corresponds to the stage of concrete operational thinking. During this period, children gradually develop a stronger interest in the external world, and their capacity for analytical thinking increases with age. At the beginning of this developmental stage, children tend to perceive people and situations in absolute terms, considering someone entirely good or bad, pleasant or unpleasant. Toward the end of this period, they become capable of evaluating multiple characteristics simultaneously, including those that appear contradictory[3]. Progressive cognitive development enables children to understand events occurring around them, respond appropriately, and provide logical explanations for these experiences[4]. Adolescents enter the final stage of cognitive development, known as formal operational thinking. Early adolescence is characterised by heightened emotional responsiveness, which strongly influences behaviour, resulting in emotional reactions that frequently outweigh rational judgement. This developmental period is also characterised by rapid intellectual growth and the formation and evaluation of personal values[3]. Adolescents develop opinions by considering multiple possible alternatives and establishing relationships among them. They acquire the capacity for abstract thinking and hypothetical reasoning, enabling them to evaluate available information before reaching logical conclusions. As a result, adolescents frequently demonstrate questioning, oppositional, or critical patterns of behaviour[3]. Toward the end of adolescence, both the number and intensity of fears decrease substantially, particularly fears associated with social situations and interpersonal interactions, whereas fear of death and serious illness commonly persists throughout adulthood[3].

In addition to direct factors associated with the dental team, the clinical environment, and dental procedures, the influence of indirect factors should also be recognised. These include age, sex, personality, cultural background, geographical environment, and, particularly, the impact of negative experiences transmitted by parents or other individuals who play an important role in the child's life.

Assessment of the presence of DFA constitutes an essential component of the clinical evaluation of paediatric patients because identifying the severity of DFA may improve treatment outcomes, reduce procedures likely to provoke anxiety, and assist clinicians in planning the most appropriate management strategies, particularly for invasive dental procedures. Various methods are available for assessing DFA. The most widely used approaches are self-report questionnaires, also referred to as psychometric instruments, designed to measure the presence of DFA. Furthermore, identifying latent (subclinical) forms of DFA supports the need for more accurate assessment methods capable of detecting these conditions in children and adolescents[6].

Due to the limitations of several existing instruments

for measuring DFA, the past fifteen years have witnessed the development of a multidimensional assessment scale specifically designed to evaluate dental fear and anxiety[9]. The Index of Dental Anxiety and Fear (IDAF-4C+) is a modular instrument developed to assess DFA across multiple dimensions and is based on well-established psychological and theoretical principles. It was designed to overcome the shortcomings of previously available assessment tools. The IDAF-4C+ was originally developed for adults and evaluates four dimensions of DFA: cognitive, behavioural, emotional, and physiological components[9]. This multidimensional structure represents one of its principal advantages over most existing instruments. Importantly, the standardised format enables its application not only in research but also in routine clinical practice for the identification and assessment of DFA. The predominance of a particular component within the overall score provides valuable information, both scientifically and clinically, regarding the dimension of fear that contributes most substantially to the patient's difficulties.

Although this modular instrument was originally developed and validated for adults, its author emphasised both the possibility and the importance of applying it in paediatric populations. Consequently, the IDAF-4C+ has increasingly been used to assess DFA among children[9,10–13]. In its complete version (indicated by the "+" symbol), the Index of Dental Anxiety and Fear (IDAF-4C+) consists of three modules[9]:

- The Core Module (IDAF-4C): assesses four dimensions of dental fear, namely the emotional, behavioural, physiological, and cognitive components. It consists of eight items.
- The Stimulus Module (IDAF-S): assesses potential stimuli capable of eliciting dental anxiety. It consists of ten items.
- The Phobia Module (IDAF-P): evaluates the presence of dental phobia using diagnostic criteria based on the DSM-IV, including differential diagnosis from other conditions. It consists of five items.

Responses to the IDAF-4C and IDAF-S modules are recorded using a five-point Likert scale ranging from 1 to 5, with participants indicating their level of agreement with each statement, from "strongly disagree"[1] to "strongly agree"[5]. Total scores range from 8 to 40 for the IDAF-4C core module and from 10 to 50 for the IDAF-S stimulus module[9]. Responses to the IDAF-P module are recorded as dichotomous variables indicating the presence ("Yes") or absence ("No") of the assessed characteristic. The practicality of this instrument, together with the additional information it provides, has contributed to its increasing use in studies investigating DFA among children and adolescents.

The aim of the present study was to determine whether differences exist in the expression of the multidimensional components of DFA among school-aged children in Bosnia and Herzegovina.

Materials and Methods

Participants

This cross-sectional observational study was conducted at the Faculty of Dentistry, University of Sarajevo, in collaboration with the Dental Clinical Center of the University of Sarajevo, at the Clinic of Preventive and Pediatric Dentistry. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki for medical research involving human subjects[14]. Eligible participants were mentally and physically healthy children and adolescents of both sexes, aged 8–15 years, who attended the aforementioned Clinic for a previously scheduled dental procedure, either invasive or non-invasive, as determined by the attending dentist. Exclusion criteria included patients with delayed psychomotor development or a previously diagnosed psychiatric disorder, patients presenting with symptoms or signs of acute odontalgia or other dental emergency conditions (bleeding, swelling, or orodental trauma), and patients whose parents or legal guardians did not provide written informed consent for participation in the study. Participants were divided into two age groups: the first group comprised individuals aged 8–11 years, whereas the second group comprised individuals aged 12–15 years. The minimum number of participants within each age and sex category was determined according to the methodological principles for establishing normative values of instruments (scales) used to assess the presence of dental anxiety and fear (DAF) within the study sample[15,16]. The purpose of the study was explained to all participants and their parents or legal guardians in an age-appropriate manner. As all participants were minors, written informed consent was obtained from their parents or legal guardians prior to enrolment in the study.

Methods

Before the dental procedure, the multidimensional characteristics of dental anxiety and fear were assessed using the IDAF-4C Core Module and the IDAF-S Stimulus Module. Both instruments were completed independently by the participants before the initiation of treatment[9]. Participants' behaviour during treatment was assessed by an independent observer dentist using the Frankl Behaviour Rating Scale. The Frankl Scale is a categorical instrument that classifies behaviour during

dental treatment into four categories: definitely negative, negative, positive, and definitely positive behaviour[17].

The results were presented descriptively in tabular form. Data distribution was evaluated using the Kolmogorov–Smirnov test. Owing to the non-normal distribution of the data, statistically significant differences between variables were analysed using the non-parametric Mann–Whitney U test for independent samples and the Friedman test for related samples, followed by post hoc analysis. Statistically significant associations between variables were assessed using Spearman's rank correlation coefficient. All statistical analyses were performed at a significance level of $p < 0.05$.

Results

Following the application of the study eligibility criteria, a total of 388 participants were enrolled. The first group consisted of 190 participants (49% of the total sample) aged 8–11 years, whereas the second group consisted of 198 participants (51% of the total sample) aged 12–15 years. Regarding sex distribution, there were 199 female participants (51.3%) and 189 male participants (48.7%). Table 1. presents the descriptive characteristics of the IDAF-4C module.

Table 1. Descriptive characteristics of the IDAF-4C module components

IDAF-4C Module	N	Mean	Standard Deviation
1) I feel anxious shortly before going to the dentist	388	2.1959	1.27094
2) I generally avoid going to the dentist because I find the experience unpleasant or distressing	388	1.5335	1.00459
3) I get nervous or edgy about upcoming dental visits	388	1.8840	1.16559
4) I think that something really bad would happen to me if I were to visit a dentist	388	1.3634	0.84413
5) I feel afraid or fearful when visiting the dentist	388	2.0129	1.23361
6) My heart beats faster when I go to the dentist	388	1.8969	1.25535
7) I delay making appointments to go to the dentist	388	1.3557	0.92191
8) I often think about all the things that might go wrong prior to going to the dentist	388	1.7423	1.18804
Emotional Component	388	4.2088	2.29486
Behavioral Component	388	2.8892	1.65518
Physiological Component	388	3.7809	2.12429
Cognitive Component	388	3.1057	1.77309
Total Score	388	13.9845	6.51373

Differences were observed in the expression of the multidimensional components of dental anxiety and fear as assessed by the IDAF-4C module. The behavioural component demonstrated the lowest level of expression, followed by the cognitive and physiological components, whereas the emotional component demonstrated the highest level of expression (Friedman test = 238.963; $p < 0.0005$). Post hoc analysis revealed significant differences between lower and higher expressed components, specifically between the behavioural and physiological components ($p < 0.0005$), behavioural and emotional components ($p < 0.0005$), cognitive and physiological components ($p < 0.0005$), and cognitive and emotional components ($p < 0.0005$). The behavioural component demonstrated a weak but statistically significant correlation with participant behaviour assessed using the Frankl Behaviour Rating Scale (Spearman's $\rho = 0.332$; $p = 0.01$).

The same pattern of expression of multidimensional components observed in the overall sample was also identified in both younger (8–11 years) and older (12–15 years) participants, both in terms of ranking and statistical significance. However, no statistically significant differences were observed in the expression of multidimensional components of dental anxiety and fear between younger and older age groups, although a tendency toward higher mean scores for most components (except the cognitive component) was observed among younger participants. An isolated difference was identified in the mean score for Question 7 (part of the behavioural component), with higher (more negative) values recorded among younger participants (Mann–Whitney U = 17,217.500; $p = 0.029$).

Differences in the expression of multidimensional components were also observed according to the invasiveness of dental procedures. All components demonstrated higher (more negative) values among participants undergoing invasive dental treatments, including the emotional component (Mann–Whitney U = 21,894.000; $p = 0.004$), behavioural component (Mann–Whitney U = 21,211.500; $p = 0.009$), physiological component (Mann–Whitney U = 23,570.500; $p < 0.0005$), and cognitive component (Mann–Whitney U = 20,749.500; $p = 0.048$). The presence of stimuli associated with the development of dental anxiety and fear among participants was assessed using the IDAF-S module. The obtained results are presented in Table 2.

Table 2. Descriptive characteristics of the IDAF-S module components

IDAF-S Module	N	Mean	Standard Deviation
1. Painful or uncomfortable procedures	388	2.3686	1.22030
2. Feeling embarrassed or ashamed	388	1.5349	0.95532
3. Not being in control of what is happening	388	1.6314	1.08585
4. Feeling sick, queasy, or disgusted	388	1.6443	1.05031
5. Numbness caused by the anesthetic	388	1.8119	1.21070
6. Not knowing what the dentist is going to do	388	1.9304	1.24838
7. The cost of dental treatment	388	1.3015	0.81921
8. Needles or injections	388	2.5619	1.47811
9. Gagging or choking	388	1.6082	1.08126
10. Having an unsympathetic or unkind dentist	388	1.8325	1.32372
Total Score	388	18.2216	7.32433

On average, participants ranked needles or injections and painful or unpleasant dental procedures (sources of dental fear), together with uncertainty regarding the dentist's actions (a source of dental anxiety), as the most prominent stimuli. Younger participants demonstrated greater distress in response to needles or injections in general (Mann–Whitney U = 15,775.500; p = 0.005), as well as within the subgroup undergoing invasive treatments (Mann–Whitney U = 3,623.000; p = 0.016). No other statistically significant differences were identified, although a tendency toward higher mean scores among younger participants was observed.

Female participants generally reported greater distress associated with numbness caused by local anaesthesia (a source of dental fear) (Mann–Whitney U = 20,996.000; p = 0.025). In addition, among older participants, females demonstrated greater distress related to feelings of confusion or embarrassment (a source of dental anxiety) (Mann–Whitney U = 6,017.500; p < 0.0005), uncertainty regarding the dentist's actions (Mann–Whitney U = 5,892.000; p = 0.005), and an unfriendly or unsympathetic dentist (a source of dental anxiety) (Mann–Whitney U = 5,574.500; p = 0.041).

Participants scheduled to undergo invasive dental procedures according to the established treatment plan reported greater distress associated with a lack of control over the situation (a source of dental anxiety) (Mann–Whitney U = 20,780.500; p = 0.031), as well as needles or injections (Mann–Whitney U = 16,555.500; p = 0.037). Older participants undergoing invasive procedures reported greater distress associated with painful or unpleasant treatments (Mann–Whitney U = 5,821.000; p = 0.014).

A statistically significant correlation was identified between the IDAF-4C and IDAF-S module scores in the overall sample (Spearman's ρ = 0.696; p = 0.01). The correlation was slightly stronger among younger participants (Spearman's ρ = 0.709; p = 0.01) and somewhat weaker among older participants (Spearman's ρ = 0.641; p = 0.01), indicating the presence of factors associated with the development of dental anxiety and fear, with a higher level of expression among younger children. Statistically significant correlations were also observed among male participants (Spearman's ρ = 0.683; p = 0.01) and female participants (Spearman's ρ = 0.737; p = 0.01). These findings indicate the presence of factors associated with the development of dental anxiety and fear among child participants, with a somewhat higher level of expression among females.

Discussion

To the authors' knowledge, this study represents the first investigation of the multidimensional nature of dental anxiety and fear (DAF) among children in a Bosnian and Herzegovinian population using the IDAF-4C scale, while simultaneously evaluating its validity and reliability. The study included younger participants aged 8–11 years and older participants aged 12–15 years, as these age ranges represent distinct developmental periods with respect to oral and dental development (mixed dentition and permanent dentition) as well as psychological maturation. Accordingly, these groups were selected based on the relative homogeneity of cognitive development, perception, and expression of DAF (3,4,17,18). The relatively recent psychometric instrument IDAF-4C+ was originally developed to assess the multidimensional characteristics of DAF through a structured set of questions[8].

The present study demonstrated differences in the expression of multidimensional components of DAF as assessed by the IDAF-4C module. The emotional component exhibited the highest level of expression, which is consistent with the conceptual model of dental anxiety that emphasizes the primary role of emotional responses[9]. In a similar study conducted among children in India[12], the emotional component contributed equally to both low and high levels of DAF, whereas a study conducted in Türkiye also identified the emotional component as the most prominent dimension[11]. The predominance of the emotional component may be explained by the tendency of children to internalize feelings of fear and discomfort, while behavioural manifestations may be regulated or modified by external influences, including parental presence or the authority of the dentist.

In the present study, the behavioural component demonstrated the lowest level of expression in the overall sample as well as in both age groups. This finding differs from the results of a similar study in which the behavioural component represented the most prominent dimension[12]. The weak but statistically significant correlation between the behavioural component and behaviour assessed using the Frankl Behaviour Rating Scale suggests a limitation of the IDAF-4C module in evaluating behavioural manifestations of DAF. Consequently, information relevant to behavioural management strategies in clinical practice may not be fully captured by this instrument. Furthermore, this finding supports the notion that behaviour during treatment may not always represent a reliable indicator of the internal experience of fear, as reported in previous studies[19].

Although no statistically significant differences were identified in the expression of individual DAF components between younger and older participants, a tendency toward higher scores among younger children was observed. This

finding is consistent with the literature indicating that younger children often exhibit higher levels of dental anxiety due to less developed coping mechanisms and greater uncertainty regarding dental procedures[20]. The isolated difference identified in the behavioural component (Question 7) further supports the greater sensitivity of younger participants in specific clinical situations.

Significantly higher levels of all DAF components were observed among participants undergoing invasive dental procedures, with the highest scores recorded for the emotional and behavioural components and the lowest scores for the cognitive component. These findings confirm the important role of treatment type in determining the intensity of DAF. Invasive procedures involve elements of pain, discomfort, and loss of control, which have been identified as primary triggers of dental anxiety and fear[21]. These results have important clinical implications and highlight the need for behavioural and communication-based approaches when preparing children for invasive dental procedures.

The findings obtained using the IDAF-S module indicated that needles/injections, painful or unpleasant treatments, and uncertainty regarding the dentist's actions were the most significant stimuli associated with DAF. These results are consistent with previous studies identifying pain and uncertainty as major etiological factors in the development of dental fear[22,23]. Younger participants demonstrated greater sensitivity to needles and injections, as well as a tendency toward higher mean scores across stimuli, supporting the greater vulnerability of younger children.

The differences observed between boys and girls indicate that female participants exhibited greater sensitivity to specific aspects of DAF, particularly sensations associated with local anaesthesia and psychosocial factors such as embarrassment, confusion, and interpersonal interactions with the dentist. These findings are consistent with previous reports demonstrating a higher prevalence of anxiety among girls[19], as well as stronger expression of DAF among female participants in studies conducted in Bosnia and Herzegovina[24] and Türkiye[11]. Participants undergoing invasive procedures also reported a greater sense of loss of control, which represents one of the key psychological factors involved in the development of anxiety[25]. Among older participants, pain perception emerged as an additional influential factor, potentially reflecting the impact of previous experiences and established expectations.

The strong positive correlation between the IDAF-4C and IDAF-S modules confirms the association between the intensity of DAF and the presence of specific stimuli. The slightly stronger correlation observed among younger participants suggests that external factors may be more directly associated with emotional responses in younger children, whereas cognitive processes and previous experiences may play a more substantial role among older participants, which is consistent with psychological development and maturation. Furthermore, the stronger correlation observed among girls suggests a closer relationship between perceived stimuli and emotional responses.

A study conducted in Malaysia[10] reported a strong correlation between Question 6 (uncertainty regarding what the dentist would do) and the IDAF-4C module among older female participants, which is consistent with the findings of the present study. In contrast, a study conducted in India[12] reported a strong influence of dental stimuli among older participants, with a more pronounced effect among males, differing from the findings observed in the present investigation.

The results of this study confirm that DAF in children is a complex and multifactorial phenomenon influenced by age, sex, type of dental procedure, and specific dental stimuli. These findings emphasize the need for individualized approaches in pediatric dentistry, particularly for younger children and during invasive procedures, incorporating appropriate psychological and communication strategies aimed at reducing fear and improving patient cooperation.

This study has several limitations. The cross-sectional design does not permit conclusions regarding causal relationships between identified stimuli and levels of DAF. In addition, the assessment of DAF relied substantially on self-reported measures obtained through the IDAF-4C and IDAF-S modules, which may be subject to response bias. This limitation may be particularly relevant among younger participants, whose cognitive and verbal abilities for accurately expressing emotions are still developing. These considerations should be taken into account in future studies investigating DAF in pediatric populations.

Conclusion

No statistically significant differences were observed in the expression of multidimensional components of DAF among school-aged children in BiH between younger and older age groups of respondents. Significantly higher levels of DAF components were identified among participants undergoing invasive dental procedures, indicating an association between the intensity of DAF and the presence of specific dental stimuli. These findings highlight the need for the development and evaluation of intervention programs aimed at reducing DAF in children, particularly prior to invasive dental procedures, with special attention directed toward younger age groups.

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Correspondence

Dr. Elma Katana
Dental Clinical Center in Sarajevo, Bosnia and Herzegovina
Email: katanaelma@gmail.com
Mobile: 00387 61 398 211