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Mathematical procedure for prediction of dental anxiety in children with inherited bleeding disorders

Matematička procedura za predviđanje dentalne anksioznosti kod dece sa urođenim poremećajima koagulacije

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Abstract

Background/Aim. The dental anxiety in children is commonly measured applying the Dental Anxiety Scale (DAS) and the level is statistically treated. However, there are no studies on prediction of development of dental anxiety. The aim of this study was to develop a mathematical procedure for dental anxiety prediction based on the statistical values. **Methods.** Mathematical relation between the dental anxiety and aging was developed using the interpolation method based on the statistical values. It was supposed that the anxiety level is a polynomial function of the age. The obtained function was tested on the healthy children and those with inherited bleeding disorders. By mathematical fitting procedure using statistical data, the analytical relation for prediction of dental anxiety as a function of aging was developed. **Results.** According to prediction function, it was found that for healthy population the dental anxiety has the tendency to increase quite slowly or to remain almost constant after the age of 18. In the patients with inherited bleeding disorders, the DAS score would increase even after age of 18. The treatment of the anxiety in children with inherited bleeding disorders is optimal at about the age of 12 when they become aware of their illness. **Conclusion.** The introduced prediction function gives the tendency of DAS score development which enables timely adequate action in reducing dental anxiety. The predicted DAS score may be used as a control measure of oral health.

Key words:
blood coagulation disorders, inherited; forecasting; child; dental anxiety; models, theoretical.

Apstrakt

Uvod/Cilj. Dentalna anksioznost kod dece meri se primenom skale dentalne anksioznosti (DAS), a nivo se statistički obrađuje. Međutim, ne postoje istraživanja koja predviđaju razvoj dentalne anksioznosti. Cilj rada je bio da se razvije matematička procedura za predviđanje dentalne anksioznosti na osnovu statističkih podataka. **Metode.** Matematička relacija između dentalne anksioznosti i godina starosti je razvijena korišćenjem interpolacione metode statističkih veličina. Pretpostavljeno je da je nivo anksioznosti polinomijalna funkcija godina starosti. Izračunata funkcija je testirana na zdravoj deci i na deci sa urođenim poremećajima krvarenja. Postupkom matematičkog prilagođavanja statističkih podataka, razvijena je analitička relacija za predikciju dentalne anksioznosti kao funkcije životne dobi. **Rezultati.** Na osnovu funkcije predviđanja zaključeno je da je porast dentalne anksioznosti kod zdrave populacije veoma spor ili nepromenljiv posle 18. godine života. Kod dece sa koagulopatijom, vrednosti DAS skora rastu i posle 18. godine života. Lečenje anksioznosti kod dece sa urođenim poremećajima krvarenja je optimalno u uzrastu od 12 godina, kada ona postaju svesna svoje bolesti. **Zaključak.** Navedena funkcija predviđanja pokazuje tendenciju razvoja vrednosti DAS skora koja omogućava pravovremeno lečenje u cilju smanjenja dentalne anksioznosti. Predviđena vrednost DAS skora može se koristiti kao kontrolni parameter oralnog zdravlja.

Ključne reči:
poremećaji koagulacije, nasledni; predviđanje; deca; anksioznost, stomatološka; modeli, teorijski.

Introduction

Most people have some anxiety about going to the dentist, a sense of uneasiness, exaggerated or unfound worries or fears [1]. Dental anxiety is a common global problem and has been studied: in Australia [2], in Europe (Great Britain [3], France [4], Finland [5], Portugal [6], Ukraine [7], Turkey [8]), in Asia (Jordan [9], Iran [10], Saudi Arabia [11], Chi

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na [12], Taiwan [13], Malaysia [14], India [15], Pakistan [16], Sri Lanka [17]), in Africa (Ghana [18]), and etc. In presented papers, the results on dental anxiety are quite different. It is found that significant number of factors like age, gender, education, socioeconomic status (number of siblings in family, for example), parental/maternal anxiety, ethnicity and culture, previous dental and medical experiences, frequency of visits to dentists, clinical environment, personal traits and psychological status are crucial for the dental anxiety [19].

People develop dental anxieties for many different reasons. When researchers interview patients, a few common themes emerge: pain, feeling of helplessness and loss of control when staying still in the dental chair, embarrassment and negative past experience connected with pain or discomfort during previous dental procedures. In a survey by the British Dental Health Foundation, 36% of those who did not see a dentist regularly said that fear was the main reason [20].

Dental anxiety is a problem, which appears to develop mostly in childhood [21] and adolescence [22, 23] and is straightening with ages: in student ages [24], also in middle years [25] and even in old years [26]. Published studies [27, 28] suggest that just under half of children report low to moderate general dental anxiety and between 10% and 20% of them report extremely high levels of dental anxiety (e.g. dental phobia). Parents whose children constantly fail to attend the children dental appointments report that their children's dental anxiety is one of the influencing factors for their avoidance behavior [29].

Dental anxiety is the prime reason discouraging children to receive appropriate dental treatment [30, 31]. Rantavuori et al. [32] reported about various factors which cause dental fear among children. Folayan and Idehen [33] found that the information has an effect on dental anxiety and behaviour ratings in children. The role of child personal characteristics [34], family related factors [35], affect of birth order [36], previous childhood traumatic experiences, life events, and parental bonding [37], parental rearing style [38], the fathers' mediating role in parental transfer of fear [39] have important influence on the dental anxiety. It is found that the congenital hemorrhagic chronic disease causes an additional dental anxiety in children [40], due to the tendency of increased bleeding during and after dental treatment [41], which can be modified in blood phobia [42]. Dogan et al. [43] studied the anxiety during dental treatment among boys with hemophilia. It was found that pain is a predictor for dental fear and anxiety for male children with hemophilia and healthy ones.

In this paper a mathematical procedure for the Dental Anxiety Scale (DAS) score prediction based on the statistical values is developed. The investigation occupied 80 children. The study group (SG) included children with inherited bleeding disorders (hemophilia A, hemophilia B, Morbus Von Villebrand, etc). The control group (CG) included healthy children. The results allowed the comparison of anxiety trends in both groups of children.

Methods

The most often applied anxiety and pain measure in dentistry is the DAS which was introduced fifty years ago [44]. Since that time it is modified [45] and the text is translated into some foreign languages, for example, Turkish [46], Chinese [47], etc. In our investigation DAS for children is given in Serbian.

The questionnaire consisted of 4 questions pertaining to dental treatment situations to which the respondents answered how they felt in a given situation, by circling the number in front of the offered answers (1 = not anxious, 2 = slightly anxious, 3 = fairly anxious, 4 = very anxious, 5 = extremely anxious).

Thus, responses are scored from 1 to 5 points, with a higher score indicating more anxiety. The questions were the following: 'How anxious are you feeling at the moment when you need to go to a dentist?', 'How anxious are you feeling waiting for your turn in the waiting room of a dentist?', 'How anxious are you feeling in the dental chair waiting on the treatment?' and 'How anxious are you feeling in the dental chair when your dentist is examining your teeth?'

The total number of points on the test ranges from 4 points (no anxiety) to 20 points (extreme fear) which is the maximal achievable score. A score between 4 and 8 showed no anxiety, 9–12 moderate anxiety, 13 and 14 high anxiety and between 15 and 20 showed severe anxiety. In the study, respondents were divided by age into children younger than 6 years (with primary dentition), 6–12 years (with mixed dentition) and older than 12 years (with permanent dentition).

The obtained data were statistically analyzed using the Wilcoxon signed rank test. In addition, the descriptive statistics methods, the measure of central tendency (arithmetic mean), the measure of variability (standard deviation) and the frequency (proportion) for attributive features were applied for analysis. Means and standardized deviations were used to compare the current data with existing norms. By mathematical fitting procedure using statistical data, the analytical relation for prediction of dental anxiety as a function of aging was developed.

The investigation occupied 80 children who entered the Dental Clinics of Vojvodina in Novi Sad (Serbia): 40 of them have the inherited bleeding disease (IDB) (study group – SG) and 40 were healthy children (control group – CG).

In the SG, 35 participants identified as males and 5 as females, while in the CG there were 32 males and 8 females. The children up to 18 years were retrieved. Child's health-related information was collected through a questionnaire. The obtained data about the underlying disease of children with IBDs is given in Table 1. The questionnaire gives the information about the type of the IBD, severity of the disease, reasons for receiving coagulation factors and of presence of coagulation inhibitors.

It was found that among the children in the SG the most were those with haemophilia A (n = 26) and there were 7 with haemophilia B, 6 with Morbus Von Willebrand and 1 with rare coagulopathy. It was shown that in 31 children, concentrated coagulation factors were used for therapeutic

Table 1

Data about the inherited bleeding disorder in the study group of patients

Data	Haemophilia A	Haemophilia B	Morbus Von Willebrand	Rare coagulopathy
	n (%)	n (%)	n (%)	n (%)
Number of children	26 (65)	7 (17.5)	6 (15)	1 (2.5)
Severity of disease				
mild	4 (10)	2 (5)	44 (10)	0 (0)
moderate	4 (10)	0 (0)	1 (2.5)	1 (2.5)
sever	18 (45)	5 (22.5)	1 (2.5)	0 (0)
Previous transfusions	5 (12.5)	0 (0)	1 (2.5)	0 (0)
Number of actions with FVIII/IX				
0	4 (10)	3 (7.5)	3 (7.5)	1 (2.5)
1–3	12 (30)	11 (2.5)	3 (7.5)	0 (0)
> 3	10 (25)	3 (7.5)	0 (0)	0 (0)
Reasons to receive coagulation factor concentrates				
prophylactic	8 (20)	1 (2.5)	0 (0)	0 (0)
therapy	18 (45)	6 (15)	6 (15)	1 (2.5)
Presence of coagulation inhibitors	3 (7.5)	0 (0)	0 (0)	0 (0)

purposes, while for prophylactic reasons they were given in 9 patients (Table 1).

Coagulation factor inhibitors were identified in 3 patients with severe haemophilia A, representing a frequency of 7.5% of the total sample. If an analysis was performed on the number of patients with severe haemophilia A, the presence of inhibitors was detected in 16.7% of patients.

For better understanding of the dental anxiety of children with inherited bleeding disorder, an additional questionnaire was applied.

This is questionnaire that was filled in by the CG and SG subjects, and the values obtained were compared to determine whether there was an increased level of dental anxiety in patients with congenital coagulopathies. For comparison of results for the SG and CG, the χ^2 test, which gives the dependence of the individual pairs of observed attribute characteristics, was applied. The *t*-test based on the difference between the mean values in the numerical characteristics was applied for gender difference data analyses. The probability level of $p < 0.05$ was selected for statistical significance.

It was assumed that DAS score variation during the time is a continual function. It was also assumed that the DAS score is the polynomial type function of ages (A):

$$DAS = \sum_{i=0}^{n} a_i A^i DAS = \sum_{i=0}^{n} a_i A^i \quad \text{Eq. (1)}$$

where $a_i a_i$ are constants. Parameters $a_i a_i$ in Eq.(1) had to be determined using the DAS score values for certain ages. The number of terms i which is included into Eq. (1) depends on the number of statistical data for ages. Thus, for 'n' known values of DAS score obtained for 'n' ages, 'n' equations of the form (1) with i = n terms was written.

Solving the system of 'n' linear algebraic equations the constants a_i (i =1,2,..,n) were obtained. The higher the number of the known DAS score, the higher the number of terms in Eq. (1) and the function of prediction (1) was more appropriate.

If there are three statistical data $(DAS)_6(DAS)_6$, $(DAS)_{12}(DAS)_{12}$ and $(DAS)_{12}(DAS)_{12}$ for ages 6, 12 and 18, respectively, the DAS score has three terms:

$$DAS = a_0 + a_1 A + a_2 A^2$$
$$DAS = a_0 + a_1 A + a_2 A^2$$

Eq. (2)

where

$$a_0 = 3(DAS)_6 + 3(DAS)_{12} - 2(DAS)_{18}$$
$$a_0 = 3(DAS)_6 + 3(DAS)_{12} - 2(DAS)_{18}$$

Eq. (3)

$$a_1 = (5(DAS)_{18} - 8(DAS)_{12} - 5(DAS)_6)/12$$
$$a_1 = (5(DAS)_{18} - 8(DAS)_{12} - 5(DAS)_6)/12$$

Eq. (4)

$$a_2 = (2(DAS)_{12} - (DAS)_{18} + (DAS)_6)/72$$
$$a_2 = (2(DAS)_{12} - (DAS)_{18} + (DAS)_6)/72$$

Eq. (5)

which satisfied the relations

$$(DAS)_6 = a_0 + 6a_1 + 36a_2$$
$$(DAS)_6 = a_0 + 6a_1 + 36a_2$$

Eq. (6)

$$(DAS)_{12} = a_0 + 12a_1 + 144a_2$$
$$(DAS)_{12} = a_0 + 12a_1 + 144a_2$$

Eq. (7)

$$(DAS)_{18} = a_0 + 18a_1 + 324a_2$$
$$(DAS)_{18} = a_0 + 18a_1 + 324a_2.$$

Eq. (8)

The analytical result was tested on the healthy children and those with coagulopathy.

Results

The results of an additional questionnaire are shown in Table 2. Using the methodology presented in the previous section, the average age of children in the SG and CG was compared. It was found that the average age in the SG was 11.5 ± 5.6 and in the CG, it was 10.1 ± 4.3 years.

It is concluded that there was no main statistical difference in gender (χ^2 = 0.827, p > 0.05), nor in age, in total sample (t = 1.467, p > 0.05) and in separate groups (χ^2 = 2.259, p > 0.05).

It was seen that there was no statistical difference between the CG and SG (p < 0.05, Mann-Whitney test). Using suggestion of Sonbol et al. [48] and Alpkilic et al. [49], the stratification on the DAS scores was made by using the dependence on the oldness divided into three groups: children with primary dentition (< 6 years), with mixed dentition (6–12 years) and permanent dentition (> 12 years). In Table 3, results of DAS scores for the CG and SG in primary dentition are presented.

The score was obtained using the answers on all four questions separately (DAS1, DAS2, DAS3 and DAS4) and finding the total DAS score. For the primary dentition we calculated the following: DAS 1 (U = 95.0, z = 0.129, p = 0.45, p > 0.05, Mann-Whitney test), DAS 2 (U = 95.0, z = 0.129, p = 0.45, p > 0.05, Mann-Whitney test), DAS 3 (U = 13.5, z = 1.16, p = 0.13, p > 0.05, Mann-Whitney test), DAS 4 (U = 10.5, z = 0.38, p = 0.35, p > 0.05, Mann-Whitney test), and DAS total (U = 10.5, z = 0.38, p = 0.35, p > 0.05, Mann-Whitney test).

DAS scores in mixed dentition for the CG and SG are given in Table 4 [DAS 1 (U = 134.0, z = 0.14, p = 0.44, p > 0.05, Mann-Whitney test), DAS 2 (U = 162.0, z = 1.179, p = 0.12, p > 0.05, Mann-Whitney test), DAS 3 (U = 148.0, z = 0.663, p = 0.262, p > 0.05, Mann-Whitney test), DAS 4 (U = 160.5, z = 1.123, p = 0.13, p > 0.05, Mann-Whitney test), DAS total (U = 131.0, z = 0.03, p = 0.49, p > 0.05, Mann-Whitney test)].

There were no values on the SG and CG for which the statistical difference was evident.

Results of DAS scores in the CG and SG for patients in permanent dentition are given in Table 5 [DAS 1 (U = 159.0, z = 2.159, p = 0.01, p < 0.05, Mann-Whitney test), DAS 2 (U = 149.0, z = 1.566, p = 0.06, p > 0.0 5, Mann-Whitney test), DAS 3 (U = 157.5, z = 2.095, p = 0.01, p < 0.05, Mann-Whitney test), DAS 4 (U = 154.5, z = 1.501, p = 0.06, p >

Table 2

Dental experiences of the study group of patients

Data	Haemophilia A	Haemophilia B	Morbus Von Willebrand	Rare coagulopathy
	n (%)	n (%)	n (%)	n (%)
Has a dentist	18 (45)	5 (12.5)	2 (5)	1 (2.5)
Bad experience with the dentist because of the underlying disease	4 (10)	0 (0)	0 (0)	0 (0)
Prolonged bleeding after tooth extraction	7 (17.5)	1 (2.5)	0 (0)	0 (0)
Bleeding when brushing teeth	14 (35)	4 (10)	5 (12.5)	1 (2.5)

Table 3

Dental Anxious Scale (DAS) scores in the study group (SG) and control group (CG) of children with primary dentition

Group	DAS 1	DAS 2	DAS 3	DAS 4	DAS
	mean values ± SD				
SG	4.16 ± 1.60	4.33 ± 1.21	4.83 ± 0.40	4.83 ± 0.40	18.16 ± 2.99
CG	4.66 ± 0.57	4.33 ± 0.57	4.33 ± 0.57	4.66 ± 0	18.00 ± 2.00

Table 4

Dental Anxious Scale (DAS) scores in the study group (SG) and control group (CG) of children with mixed dentition

Group	DAS 1	DAS 2	DAS 3	DAS 4	DAS
	mean values ± SD				
SG	2.61 ± 1.04	1.84 ± 1.51	2.30 ± 1.31	2.61 ± 1.26	9.38 ± 3.92
CG	2.60 ± 0.94	2.40 ± 1.31	1.95 ± 0.99	2.10 ± 1.11	9.05 ± 3.34

Table 5

Dental Anxious Scale (DAS) scores in the study group (SG) and control group (CG) of children with permanent dentition

Group	DAS 1	DAS 2	DAS 3	DAS 4	DAS
	mean values ± SD				
SG	2.89 ± 0.90*	2.00 ± 1.23	2.83 ± 1.50*	2.72 ± 1.74	10.44 ± 4.52*
CG	2.08 ± 0.90*	1.17 ± 0.39	1.58 ± 0.99*	1.50 ± 0.67	6.41 ± 2.23*

***statistically significant difference between the SG and CG (p < 0.05, Mann-Whitney test).**

0.05, Mann-Whitney test), and DAS total (U = 164.0, z = 2.37, $p = 0.008$, $p < 0.05$, Mann-Whitney test)].

Based on the previous results, the DAS score distribution for the CG and SG are shown in Table 6. The obtained results showed that the dental anxiety was statistically higher for the SG than for the CG for the first DAS1, second DAS2 and fourth DAS4 scores, and also the total DAS score, except for DAS2 score where was no statistically significant difference between two groups [DAS 1 (U = 983.0, z = 1.76, $p = 0.03$, $p < 0.05$, Mann-Whitney test), DAS 2 (U = 908.0, z = 1.03, $p = 0.14$, $p > 0.05$, Mann-Whitney test), DAS 3 (U = 1103.0, z = 2.91, $p = 0.001$, $p < 0.05$, Mann-Whitney test), DAS 4 (U = 1075.0, z = 2.64, $p = 0.003$, $p < 0.05$, Mann-Whitney test), DAS total (U = 1,067.0, z = 2.56, $p = 0.004$, $p < 0.05$, Mann-Whitney test)]. It was found that up to 12 years, there was no difference in dental anxiety between the two groups of patients. However, for older children, the dental anxiety was much higher for patients with coagulopathy.

The result could be explained with the fact that older patients with IBD are aware of possible effects and are afraid of bleeding during dental intervention, especially of application of local anesthesia or extraction therapy. It was found that even 70% of patients with IBD needed hematological preparation before dental intervention and it was extremely high percentage.

Based on the statistically obtained values, the suggested analytical prediction procedure was applied. The interpolation DAS score – age functions, which give the quantitative measure of dental anxiety during time, were calculated.

Using the data for DAS1, DAS2, DAS3, DAS4 and total DAS scores, the corresponding DAS score – time history diagrams are plotted in Figure 1. In Figure 1a, the DAS1 and total DAS scores and in Figure 1b, the DAS2, DAS3 and DAS4 scores for the SG and CG as aging functions are plotted.

Using the statistical values for the total DAS score, the interpolation functions DAS_{CG} and DAS_{SG} for the CG and SG, respectively, were calculated as

$$DAS_{CG} = 33.4 - 3.100\,A + 0.089A^2$$
$$DAS_{CG} = 33.4 - 3.100\,A + 0.089A^2,$$
$$DAS_{SG} = 36.5 - 3.875A + 0.135A^2$$
$$DAS_{SG} = 36.5 - 3.875A + 0.135A^2$$

Eq. (9)

where A is aging.

The relations were of parabolic type with the minimum which was different for the SG and CG: the minimal value of DAS score was smaller for the CG than for the SG. From Figure 1a, it is evident that the total values of DAS score are approximately equal for children up to 12 years, but after that there is a strong difference in fear level in children with IBD in comparison to healthy children.

Namely, the dental anxiety decreased after the age of 12 years in healthy children, while in children with IBD it increased since approximately of the age of adolescence. The

Table 6

Averaged Dental Anxious Scale (DAS) scores in the study group (SG) and control group (CG)

Group	DAS 1	DAS 2	DAS 3	DAS 4	DAS
	mean values ± SD				
SG	3.05 ± 1.19*	2.45 ± 1.51	3.05 ± 0.70*	3.10 ± 1.59*	11.65 ± 5.10*
CG	2.52 ± 1.13*	2.08 ± 1.30	2.02 ± 1.21*	2.12 ± 1.28*	8.78 ± 4.18*

***statistically significant difference between the SG and CG ($p < 0.05$, Mann-Whitney test); SD – standard deviation.**

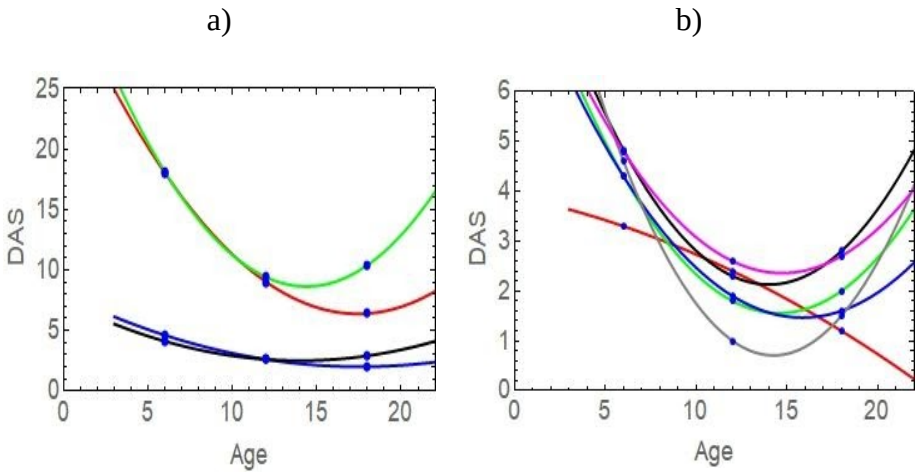

Fig. 1 – a) Dental Anxious Scale (DAS) – Age curves for the control group (CG) (red line) and study group (SG) (green line); DAS1 – Age curves for the CG (blue line) and SG (black line); b) DAS2 – Age curves for the CG (red line) and SG (green line); DAS3 – Age curves for the CG (blue line) and SG (black line); DAS4 – Age curves for CG (grey line) and SG (magenta line).

prediction is that after the age of 18 years, the dental anxiety in patients with coagulopathy would increase, while in healthy persons, the increase would be quite small tending to a constant level.

In Figure 1a, the DAS1 scores for the CG and SG as aging functions are plotted. It is seen that the scores in early childhood are similar for both groups of children. However, increasing the aging, difference in DAS1 score is also increasing: for persons in the CG the dental anxiety remains at an almost constant level, while for those in the SG it has the tendency of increase. Analytical relations which describe variation of DAS1 score are:

$$\begin{matrix}(DAS1)_{CG} = 8.0 - 0.683A + 0.019A^2 \\ (DAS1)_{CG} = 8.0 - 0.683A + 0.019A^2 \\ (DAS1)_{SG} = 7.4 - 0.7A + 0.025A^2 \\ (DAS1)_{SG} = 7.4 - 0.7A + 0.025A^2\end{matrix}, \quad \text{Eq. (10)}$$

where A is aging. The prediction is that for both groups of patients after their age of 18 years, the DAS1 score would tend to a constant value. Analyzing the DAS2 score for the CG (red line) and the SG (green line), it is obvious that the curves are quite different (Figure 1b).

Tendency of curve for the CG was to decrease in time, while for the SG it was to increase.

Mathematical description of the curves are:

$$\begin{matrix}(DAS2)_{CG} = 3.9 - 0.075A - 0.004A^2 \\ (DAS2)_{CG} = 3.9 - 0.075A - 0.004A^2 \\ (DAS2)_{SG} = 9.5 - 1.091A + 0.037A^2 \\ (DAS2)_{SG} = 9.5 - 1.091A + 0.037A^2\end{matrix}, \quad \text{Eq. (11)}$$

Based on Eq. (3), the prediction of the anxiety score would be calculated. Due to the result, it is obvious that the time spent in the waiting room of dentist has different influence on the SG and CG.

DAS3 score for the CG (blue line) and the SG (black line) curves are shown in Figure 1b.

Comparing the curves:

$$\begin{matrix}(DAS3)_{CG} = 8.8 - 0.925A + 0.029A^2 \\ (DAS3)_{CG} = 8.8 - 0.925A + 0.029A^2 \\ (DAS3)_{SG} = 10.4 - 1.179A + 0.04A^2 \\ (DAS3)_{SG} = 10.4 - 1.179A + 0.04A^2\end{matrix}, \quad \text{Eq. (12)}$$

it is obvious that they have the same character. Both curves are of parabolic type where with aging the increase of anxiety occurs. The gradient of the score increase was approximately equal, but the initial anxiety in children with IBD was higher. Finally, in Figure 1b, the DAS4 scores for the CG (gray line) and the SG (magenta line) as aging functions are plotted.

The analytical description of curves is:

$$\begin{matrix}(DAS4)_{CG} = 12.3 - 1.625A + 0.057A^2 \\ (DAS4)_{CG} = 12.3 - 1.625A + 0.057A^2 \\ (DAS4)_{SG} = 9.3 - 0.941A + 0.032A^2 \\ (DAS4)_{SG} = 9.3 - 0.941A + 0.032A^2\end{matrix} \quad (13)$$

Both curves have the same property: the minimal value is for 14 years. After that, the DAS4 score increases for both groups. However, the DAS4 score for the SG is higher than for the CG, but with tendency of slower increase than for the CG.

Discussion

Haemophilia and other IBDs are very rare diseases, probably this is the reason why there is a little literature about dental anxiety and dental fear in this group of patients.

For the prediction of dental anxiety in our study, we used the age as a predictor. The same predictor was used in the study of Lee et al. [13]. They found out that level of dental fear and clinical anxiety have different predictors, but age and cooperativeness in the first dental visit are important predictors for dental fear and clinical anxiety. The other predictors were maternal dental fear, unbearable pain during the first dental visit and the visiting dentist in a regular dental clinic.

Findings of the present study indicate that there is a high prevalence of dental anxiety among the children. After statistical analyses of the DAS score, it is obtained that the score depends on the general health and age of children included into the investigation.

This study showed that age differences have an influence on dental anxiety and fear. Namely, the level of DAS score difference depends on the oldness of children. The same results were found out in other studies about dental anxiety [19–22, 26].

In the age up to 6 years (children with primary dentition) and age group of 6–12 years (children with mixed dentition), the DAS score for children with inherited bleeding disorders and healthy children is almost equal. The highest difference in the score value is obtained in children older than 12–18 years. In our study dental anxiety decreased after the age of 12 in healthy children, while in children with IBDs dental anxiety increased since the age of 18.

Kakkar et al. [21] in their study of prevalence of dental anxiety in 10–14 years old children also found high prevalence of dental fear in the same age group, and that the dental fear score decreases with increasing age and experience of the children. The influence of the age could be explained by the immature psychological development of the children.

The difference in the level of dental anxiety of the SG and CG at the age of 12–18 years could be explained with the Poti et al. [40] study of subjective experience of living with haemophilia in 20 young adults with haemophilia, aged 11–25 years. Transition from adolescence to adulthood is a complex process, especially for patients with chronic disease like haemophilia. Reasons for that are problems imposed by the disease and by the therapy, the assumption of responsibility for care and progressive awareness that the disorder will accompany them throughout their life. While in childhood, parents are personally responsible for their child and treatment, at that age, the patient becomes progressively more independent and needs to transfer personal responsibility from parental to self care. This taking of responsibility proves dif-

ficult for young people, confirming poor adherence to treatment in adolescence, a common issue in haemophilia. Vika et al. [42], in their study about relationship of dental anxiety and fear of blood, injury and injections among 18-years olds in Norway, showed that 20% of subjects were classified as having dental anxiety, and 11% of adolescents with dental anxiety reported a high probability of avoiding necessary dental treatment when a dental injection was needed.

Higher level of dental anxiety in children with IBD aged 12–18 years could be explained with awareness of possible bleeding during and after the dental procedures.

In our study, a significantly higher degree of dental anxiety was found in the overall sample in patients with IBDs, the SG compared to the CG. The DAS score of children with IBDs in the SG compared with that of healthy children in the CG is obtained to be higher. Namely, children with bleeding disorder, expect anxiety due to dental treatment, have an additional fear caused by bleeding during or after dental intervention.

Dogan et al. [43] in their study about dental anxiety related to the first dental intervention for children with haemophilia aged 7–12 years and healthy controls, did not find significant difference in level of dental anxiety between the groups. But, in both group, the dental anxiety score was higher in children who had experienced dental pain before the treatment.

For patients with haemophilia and other bleeding disorders access to dental treatment is an issue, resulting with neglected dental health and urgent treatment need. Therefore, appropriate prevention and dental treatment is required in this group of children to prevent them to develop dental anxiety.

Conclusion

Mathematical procedure for DAS score prediction based on the statistical values is developed. The analytical results allowed the comparison of anxiety trends in both groups of children: healthy and those with IBDs.

We concluded that dental anxiety in both groups of children was lower in the older age than in younger one (minimum is for ages of adolescence). The gradient of dental anxiety increase in time would be more significant in the SG patients than in the CG group. The dental anxiety in the healthy patients after 18 years is predicted to be of moderate level, while for those with IBDs it tends to severe anxiety.

This may be due to increased exposures over time allowing children to develop a tolerance to treatment, and therefore have less anxiety as they age. Childhood dental anxiety is not only distressing for the child and their family but is also associated with poor oral health outcomes and an increased reliance on costly specialist dental services.

The analytical prediction, based on the statistical data, is that the dental anxiety would increase in time in both groups of patients, those with IBDs and healthy. The predicted DAS score may be used as a control measure of oral health.

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