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Dental Discomfort Questionnaire: assessment of dental discomfort and/or pain in very young children

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Abstract – *Objective:* To present and analyse the Dental Discomfort Questionnaire (DDQ) for very young children and to assess the possible differences in pain-related behaviours displayed by children with or without reported toothache, and by children with or without decayed teeth. *Methods:* Based on parental interviews of toddlers referred to a dental care practice 12 pain-related behaviours were identified which formed the DDQ. The DDQ was filled out by parents on behalf of their children ($n = 146$; mean age 47 months). Two-third ($n = 94$) of the children were referred to a special dental care centre and one-third ($n = 52$) were controls from a day care centre. *Results:* The results show that the 12 items of the DDQ seem to measure one dimension. However, four items do not correlate with the presence of reported toothache, when these items are removed the DDQ-8 has a satisfactory reliability. All eight behaviours from the DDQ-8 occur significantly more often in children with decayed teeth and toothache than in children without decayed teeth or toothache. Especially behaviours concerning eating or brushing teeth are found to be more often present in children with decayed teeth and toothache. *Conclusions:* It seems useful to take the child behaviour into account in assessing toothache. The DDQ has shown to be a reliable instrument, which could be helpful in the future for both parents and dentists in identifying toothache in young children.

Key words: children; pain; toothache

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Pain is a complex, multidimensional phenomenon and the objective assessment of children's pain constitutes a challenge for health professionals (1). Whereas an adult is usually able to verbalize feelings of pain, children often are unable to do so. Moreover, variations in children's cognitive abilities affect how they perceive, understand, remember, and report pain. Their understanding of pain is hypothesized to follow a sequence of stages similar to the general cognitive sequence described by Piaget (2). This sequence begins with the preoperational stage (3–6 years), children in this stage are assumed to describe pain in global, phenomenological terms and to start using descriptive adjectives and attach associated emotions (e.g. 'sad', 'mad'). Having passed several stages in which children gradually improve their understanding of pain (6–11 years), the cognitive sequence ends in the formal operational stage in which children (12 years and older) use sophisticated psychophysiological concepts to describe pain. These children generally understand why pain hurts and can explain its value (2).

In line with these assumptions, specific pain assessment tools were developed for different age groups. In neonates and infants we are forced to use behavioural and physiological variables to assess pain. Children between 4 and 7 years of

age often can provide self-report assessment of their pain using a 'facial' scale, although the validity and reliability is limited (3). In older children we can rely primarily on verbal reports, e.g. use a 0 to 10 verbal rating scale (VRS) (1).

Pain is always a subjective experience, therefore self-report pain measures represent the golden standard for assessing children's perceptual or psychological experience of pain. As explained, in young children this is not an option. In case of young children, parents are an important source of information for the assessment of pain. Some research has been done to see which cues parents use to assess pain in their children (3). Based on these cues, a list of specific behaviours children exhibit following surgery was constructed. These behaviours are considered easily identifiable and can assist parents in the assessment of their children's postoperative pain (4). Based on these and other behavioural variables several behavioural measures of pain have been developed to be used by health professionals and trained coders, for example, the COMFORT scale and the Toddler-Preschooler Postoperative Pain scale (TPPPS). The COMFORT scale consists of nine behaviours that have been found to occur in young children with bodily pain, e.g. cry, body movement or muscle tension (5). The TPPPS is a scale developed as a clinical measure of postoperative pain in children which consists of seven items divided over three pain behaviour categories: vocal pain expression, facial pain expression and bodily pain expression. The items were derived from observational studies on children's pain behaviour (6).

Pain caused by decayed teeth can manifest itself in different ways: children may eat less, sleep less, and/or exhibit negative behaviour. One treatment session under general anaesthesia allowing complete elimination of the caries and return of the oral cavity into good health showed subsequent improvement in the quality of life in children (e.g. eating, sleeping, pain) as reported by their parents (7). Yet some children do not appear to complain verbally at all, even with rampant caries. In paediatric dentistry this makes the recognition of toothache in preverbal children, toddlers and preschoolers very difficult. A study on the effects of dental caries on the quality of life in children (mean age 44 months) showed that only 48% of the children with carious lesions indicated that they had pain or discomfort; however they did manifest effects of pain by changing their eating and sleep habits (8). One of the possible reasons of the limited prevalence figures might be that parents are likely to look for other causes when toddlers are demonstrating signs of pain in the area of the head and mid-face.

In the Netherlands sound teeth are not normative for 5-year-old children, in fact only half of them still have a caries-free dentition (9). Dental caries experience at a young age is said to be predictive for caries development later in the permanent dentition (10).

Furthermore, retrospective research on a pain prediction model for unrestored carious deciduous teeth showed a higher risk of subsequent pain or infection when the caries developed in patients at younger age (11). An early recognition of toothache can be helpful in a preventive and restorative climate. Through the recognition of toothache, caries can possibly be detected at an earlier stage, before more teeth have been affected. This could prevent an invasive treatment or the use of general anaesthesia; which, in turn, could possibly reduce the chance of fear acquisition. Children who experience a painful treatment at an early age have a higher risk to develop dental anxiety compared with children who have a history of positive or neutral dental experience before their first painful treatment (12, 13).

For that reason, indirect ways of assessing pain, through habits or behaviour are of great importance. The use of an instrument to recognize behaviour indicative for toothache in toddlers is needed to underline the importance of prompt treatment of this group of children.

The aim of the present study is first to present and analyse the Dental Discomfort Questionnaire (DDQ) for very young children and second to assess the possible differences in pain-related behaviours displayed by children with or without toothache, and by children with or without decayed teeth.

Materials and methods

Participants

This study was conducted among 146 children (47% girls) between 30 and 59 months of age (mean 46.8, SD 8.3). The study population consisted of two groups, 94 children (51% girls) who were referred to a special dental care centre (SBT) in Amsterdam or to a similar private dental clinic specialized in treating children. All these children had decayed teeth. The control group consisted of

52 children (41% girls) from a day-care centre. Only subjects without active and untreated deceased teeth could participate in this control group.

Dental Discomfort Questionnaire

Based on extensive interviews with parents of referred toddlers, a group of experienced dentists specialized in treating children generated a list of behaviours that occur in young children with caries and toothache. The information gathered resulted in the DDQ (see Table 1). The children in our study are very young, therefore the parents were asked to fill out the DDQ on behalf of their children.

The questionnaire consists of two parts. The first part includes a question concerning the occurrence of toothache. The parent is asked if he/she ever noticed that the child had toothache, this question could be answered with: 'never', 'sometimes', 'often' or 'I do not know'. If the parent answered 'sometimes' or 'often', they were asked when: either during meals, during daytime or nighttimes (several alternatives possible). The second part of the DDQ consists of 12 questions about different behaviours possibly associated with toothache or discomfort due to caries, e.g. crying during meals or chewing problems. For each item the parent was asked to rate how often their child showed a given specific behaviour. The questions could be answered on a three-point scale: 0 'never', 1 'sometimes', and 2 'often'. Total scores ranged from 0 to 24.

Dental history

The children were examined following diagnostic criteria recommended by the World Health Organisation (14) to assess the occurrence of dental caries.

Data analysis

The reliability (internal consistency) of the DDQ was assessed by Cronbach's α. Chi-square tests were conducted to compare our samples with regard to the reported occurrence of the 12 different pain-associated behaviours. Furthermore, predictors of toothache were determined using a binary logistic regression analysis.

Table 1. Occurrence of decayed teeth and reported prevalence of toothache ($n = 146$)

	Toothache	No toothache	Total
Decayed teeth	50 (53)	44 (47)	94 (100)
No decayed teeth	3 (6)	49 (94)	52 (100)

Values are expressed as *n* (%).

Results

Subjects that participated in this study were divided into four groups according to reported toothache (never versus sometimes or often) and presence of decayed teeth (yes versus no). The frequencies of the different groups are shown in Table 1.

According to their parents children with decayed teeth have clearly more often toothache than children without decayed teeth (53% versus 6%). In case of decayed teeth the proportion of children with toothache equals the proportion of children without toothache (53% versus 47%). In case of toothache, parents indicate that 79% has toothache during the day, 43% during the night and 80% during eating.

Psychometric analysis

A psychometric analysis was performed on the 12 items of the DDQ to examine the reliability of the questionnaire (Table 2). The table shows that all corrected item-total correlations are positive and the α is satisfactory (α 0.74). Results indicate that the DDQ can be seen as a one-dimensional scale. The mean total DDQ score was 3.53 (SD 3.07). No significant difference was found between boys and girls on the mean DDQ score (3.71 versus 3.33) and there was no association between age and the mean total DDQ score. Furthermore, most DDQ items have a positive correlation with toothache (never, sometimes, often), except for the items 8, 10–12.

Table 3 shows the number of children from the different groups: 1) children with decayed teeth and toothache, 2) children with decayed teeth but without toothache, and 4) children without decayed teeth or toothache, demonstrate a specific DDQ behaviour ('sometimes' or 'often'). Group 3, children without decayed teeth but with toothache, is considered too small to be included in further analysis.

The behaviours 1–7 and 9, displayed in Table 3, appear to be more often present in children from group 1 than in children from group 4. The behaviours 1, 2, 5, 6, 7 and 9 appear to be more often present in children from group 1 than in children from group 2. In line with these results, the children from group 1 (mean total score of 5.73) display on average more behaviours than the children from group 2 or 4 [mean 2.93 and 1.93; $F(2.140) = 27.64$, $P < 0.001$].

Between group 2 and 4 (Table 3) there was no significant difference in the mean total DDQ score. However, the mean total DDQ score of group 2 is

Table 2. Psychometric analysis DDQ

DDQ item (n = 134[a])	Never	Sometimes	Often	Corrected item-total correlation	Alpha if item deleted	Correlation toothache (r)
1. Problems with brushing upper teeth	71 (49)	51 (35)	23 (16)	0.62	0.69	0.33[b]
2. Puts away something nice to eat	96 (66)	44 (30)	6 (4)	0.47	0.71	0.42[b]
3. Problems with brushing lower teeth	80 (58)	44 (31)	14 (10)	0.36	0.73	0.28[b]
4. Bites with molar instead of front teeth	87 (60)	41 (28)	17 (12)	0.20	0.76	0.21[b]
5. Chewing at one side	107 (75)	30 (21)	5 (4)	0.60	0.69	0.48[b]
6. Problems chewing	117 (81)	24 (17)	4 (3)	0.45	0.72	0.39[b]
7. Reaching for the cheek while eating	123 (85)	19 (13)	3 (2)	0.58	0.70	0.50[b]
8. Crying at night	99 (68)	43 (30)	3 (2)	0.38	0.73	0.11
9. Crying during meals	125 (86)	18 (12)	2 (1)	0.45	0.72	0.42[b]
10. Earache at night	121 (88)	16 (12)	1 (1)	0.07	0.75	−0.11
11. Earache at daytime	124 (93)	9 (6)	0	0.09	0.75	−0.00
12. Earache during eating	131 (97)	3 (2)	1 (1)	0.21	0.74	−0.05
Total DDQ score	–	–	–	–	0.74	0.50[b]

Values are expressed as n (%).
[a]Not all items were always completed.
[b]Significant correlation: $P < 0.01$.

Table 3. Children from the different groups who demonstrate the specific behaviours

Behaviours from the DDQ ('sometimes' or 'often')	Children with decayed teeth and toothache (group 1) (n = 50)	Children with decayed teeth without toothache (group 2) (n = 44)	Children without decayed teeth or toothache (group 4) (n = 49)	Total[a]
1. Problems with brushing upper teeth	37 (74)[bc]	20 (47)	15 (31)	142
2. Puts away something nice to eat	30 (60)[bc]	9 (21)	8 (16)	143
3. Problems with brushing lower teeth	28 (60)[c]	16 (39)	14 (30)	135
4. Bites with molar instead of front teeth	26 (52)[c]	18 (42)	13 (27)	142
5. Chewing at one side	25 (53)[bc]	7 (16)	3 (6)	139
6. Problems chewing	20 (40)[bc]	5 (12)	3 (6)	142
7. Reaching for the cheek while eating	19 (38)[bc]	2 (5)	1 (2)	143
8. Crying at night	18 (36)	9 (21)	18 (37)	142
9. Crying during meals	15 (30)[bc]	4 (9)	1 (2)	143
10. Earache at night	4 (8)	6 (15)	7 (15)	134
11. Earache at daytime	3 (6)	2 (5)	4 (9)	130
12. Earache during eating	1 (2)	1 (3)	2 (4)	131
Mean DDQ score (SD)	5.73 (3.41)[bc]	2.93 (2.37)	1.93 (1.82)	144
Proportion of children with a score 4 or higher on the DDQ	35 (70)[bc]	15 (34)	9 (18)	144

Values are expressed as n (%). Group 3 was excluded because of low numbers.
[a]Not all questionnaires were completed fully.
[b]Significant difference between group 1 and 2 ($0.001 < P < 0.012$).
[c]Significant difference between group 1 and 4 ($0.001 < P < 0.010$).

somewhat higher and includes more children with a relative high score of 4 or higher than group 4 (34% versus 18%).

Combining the results presented in Tables 2 and 3 it is clear that the items considering earache and crying at night are outliers. These behaviours have a relatively low corrected item-total correlation and/or no significant correlation with reported toothache. When these four items are deleted the DDQ, left with eight items (DDQ-8), has an α of 0.75 and the total score ranges from 0 to 16.

Regression analysis

The DDQ-8 total score explained 41% of the variance in toothache [$F(1,141) = 107.84$, $P < 0.001$]. To see which DDQ-8 items contribute significantly to the prediction of toothache, a binary

Table 4. Results of binary logistic regression analysis

	OR	Wald	*P*
1. Problems with brushing upper teeth	1.00	0.00	0.992
2. Puts away something nice to eat	2.89	5.37	0.020*
3. Problems with brushing lower teeth	1.80	1.05	0.305
4. Bites with molar instead of front teeth	1.65	2.16	0.142
5. Chewing at one side	2.81	3.79	0.051
6. Problems chewing	1.42	0.28	0.595
7. Reaching for the cheek while eating	9.05	4.78	0.029*
9. Crying during meals	0.51	0.43	0.511
All items DDQ-8	$R^2 = 0.43$		

OR, odds ratio.
*Significant at $P < 0.05$.

logistic regression analysis was performed. The analysis revealed that three of the eight behaviours are positive predictors of toothache: Puts away something nice to eat, Chewing at one side, and Reaching for the cheek while eating. The results are given in Table 4.

Discussion

The results of the present study show that the 12 items of the DDQ seem to measure one dimension. However, four items do not correlate with the existence of toothache and with these items removed the DDQ-8 has a satisfactory reliability.

Furthermore, most of the behaviours from the DDQ-8 occur significantly more often in children with decayed teeth and toothache than in children without toothache with or without decayed teeth.

Altogether, these findings give a preliminary validation of the questionnaire and show we might better continue with eight of the total 12 items. Especially behaviours concerning eating or brushing teeth are found to be more often present in children with decayed teeth and toothache. In other studies also, problems eating were reported as a consequence of the presence of carious lesions or toothache (7, 8).

The result of the present study shows that 53% of the children with decayed teeth suffer from toothache according to the parent. This is in line with the 48% found in an earlier study where a parental questionnaire was used (8). As a consequence of using a parental report this percentage might be an underestimation of the actual proportion of young children who suffer from toothache. One-third of children with decayed teeth without toothache according to the parent had a relative high score on the DDQ, suggesting there might be children in this subsample with unrecognized toothache. This in contrast with children without decayed teeth or toothache of whom only 18% had a relatively high score.

Toddlers with dental disease do not necessarily complain of pain, in part because they do not have a full concept of toothache, however they do manifest behavioural effects of pain by changes in their eating and sleep habits. Very young children depend for a great part on behavioural cues in their communication. Possibly parents with young children do not expect their child to have toothache and therefore might overlook, in their communication, the cues indicative for the presence of toothache. This study shows that the behaviours: Puts away something nice to eat, Chewing at one side, and Reaching for the cheek while eating are predictive for the presence of toothache. These three behaviours could possibly be used as cues by the parent, caregiver or teacher to help them recognize toothache in young children.

Furthermore, identifying and treating young children with decayed teeth is of great importance because these children are at risk of getting further toothache. When decay is left unrestored and it is presented before 4 years and the worst tooth is affected at multiple surfaces 21% of these children reported pain within 1 year and 67% reported pain in any tooth before exfoliation (13). It seems however important to avoid children from having a period of life that is punctuated by pain and inability to eat. Some research even suggests that caries can lead to retardation in growth (15).

The limitation of this study, that our samples were referred samples, needs to be acknowledged. In future research a confirmative study in a larger sample from the general population seems advisable.

In conclusion, the DDQ has shown to be a reliable instrument, which could be helpful in the future for parents, nondental healthcare workers, dentists and researchers in identifying toothache in young children. It seems useful to take the child's behaviour into account in assessing toothache and to inform parents, and nondental healthcare workers about which behaviours to look for so they can recognize when a child has toothache.

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