Validation of a novel behavior prediction scale: A two-center trial

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Abstract

Context: Prediction of the child's behavior can adequately equip the dentist in rendering effective and efficient dental treatment.

Aim: This study was planned to evaluate and validate a specially prepared questionnaire as a child behavior prediction scale.

Design: A two-center cross-sectional study was done to validate the new scale.

Materials and Methods: Children aged 3–12 years (n = 296), from two different centers participated in this study. The questionnaire used was a 10-point observational scale. Observations involved perceiving overt and subtle behavioral characteristics of a child, to assess the child's behavior in the dental office before treatment. An independent observer approached the children and their parents in the waiting room. The child's behavior was then evaluated by the dentist using Frankl behavior rating scale during and after treatment. The prediction of behavior compared to the Frankl scale was assessed and validated.

Statistical Analysis: Sensitivity, specificity tests, and receiver operating curve analysis were used to validate the new scale and calculate the cut-off score for positive and negative behavior. All data were processed by SPSS software (16.0, SPSS Inc., Chicago, Ill, USA).

Results: The best cut-off score to predict a positive Frankl rating was ≥ 8.0 in both the centers. The sensitivity and specificity scores were 93.4% and 62.5% in center 1; 83.1% and 59.6% in center 2 respectively.

Conclusion: This novel prediction scale can be of great importance in predicting children's behavior in the dental environment.

Keywords: Behavior prediction, child behavior, validation

Introduction

Successful pediatric dentistry depends not only on the dentist's technical skills but also on his/her ability to acquire and maintain the child's cooperation. The dentist should have a good understanding of the factors that might affect the behavior of the child. Proper assessment of children's behavior can help the dentist to plan appointments and render effective and efficient dental treatment. A child's behavior in the dental environment can be influenced by the psychological developmental factors; previous medical and dental experiences; maternal and other social influences and personality factors.[1‑3] Children can acquire their parent's emotional reaction to dentistry.[4] The following measurement techniques have been used to assess the behavior/dental fear/anxiety in children: (1) Observations of behavior and ratings by dentists (2) questionnaires, self-reports, and psychometric scales (3) physiological measures (4) maternal anxiety as a predictor of child behavior and (5) attitudes of mothers/questionnaires filled by mothers about their opinion on expected child behavior. Behavioral assessment by the dentist using Frankl scale, Houpt scale or North Carolina Behavior Rating scale is done during/after the dental treatment. Questionnaires and scales like Modified Child Dental Anxiety, Venham picture Test, Children's Fear Survey Schedule-Dental Subscale, Children's Dental Fear Picture Test have been used to assess the attitude of the child before the treatment. Physiological measures like pulse rate, basal skin response, muscle tension has been suggestive of the child's anxiety level. Maternal dental anxiety and attitudes have also been used as a predictor of child behavior. But there is still a need for proper behavior prediction scale which relies on the attitude and behavior of the child in the dental environment. Prediction of the child's behavior outside the dental operatory (waiting room) could provide clues as to how the child could be managed by the dentist and his team. There are no scales in the current literature which can predict the child's behavior in the dental operatory based on his behavior in the waiting room. There are no behavior prediction scales created by Indian authors based on our children's behavior in Indian dental setting. Hence, this study was planned to design and validate a novel behavior prediction scale.

Materials and Methods

The study was planned in two dental colleges from Tamil Nadu (center 1) and Andhra Pradesh (center 2) states of India.
The study protocol was analyzed by the Institutional Review Board and Ethical Committee approval was obtained. A total of 296 children (n1 = 184; n2 = 112) in the age group of 3–12 years (mean age = 6.8 years) was included in the study. Children who had no past dental experience were included in the study to avoid the influence of past dental experience on their behavior. A questionnaire was specially prepared by a focus group which included eminent professors and consultant pediatric dentists only from India. The questions were created based on the views and experiences of each participant in assessing child behavior in their own dental setting (college or private practice). The initial questionnaire prepared had 15 questions under 3 broad categories. A pilot trial was carried out to assess the content and criterion validity. The questions were reassessed and then reduced to 10 under 2 categories and approved in the focus group before it was used for the main study [Table 1].

The child and the parent were approached in the waiting room by a single trained calibrated independent observer in each center. Observation involved perceiving overt and subtle behavioral characteristics of the child. The questionnaire was assessed by noting the waiting room behavior of the child including the interaction with the parent. The questionnaire was divided into two: Positive predictors and negative predictors. Each of these predictors included observations to be noted, and a scoring criterion was assigned. For the positive predictors, presence was given a score of 1 and for the negative predictors’ absence was given a score of 1. The maximum score that can be obtained was 10. The child’s behavior in the dental operatory was evaluated by the dentist and another calibrated independent observer using the gold standard Frankl behavior rating scale. For convenience and ease, the Frankl rating was reduced to either positive or negative. This reduced the chance error between the two observers and also helped in tabulation of results. The predicted behavior compared to the Frankl scale was assessed and validated. The behavior rating of the children based on the treatment type, age and gender was also analyzed. Children who needed emergency management on the first visit with local anesthesia were clubbed as the injection group, and the others were categorized as noninjection group.

Table 1: Sharath’s behavior prediction scale

| Number | Observation                                      | Yes (1) | No (0) |
|--------|--------------------------------------------------|---------|--------|
| 1      | Establish eye to eye contact                     |         |        |
| 2      | Smile and/or shake hands                         |         |        |
| 3      | Answers questions on name, class, school         |         |        |
| 4      | Explores clinic, play area himself               |         |        |
| 5      | Plays with other children/siblings               |         |        |
| 6      | Shy, sticks around parents and they provoke answers |     |        |
| 7      | Has short attention span-overactive or restless  |         |        |
| 8      | Demands and expects constant attention (overprotective parent) | | |
| 9      | Cries/whines on entering room                   |         |        |
| 10     | Throws temper tantrums                           |         |        |

Statistical methods

All data were processed by SPSS software (16.0, SPSS Inc., Chicago, Ill, USA). Sensitivity, specificity, and receiver operating curve analysis were used to validate the new scale and calculate the cut-off score for positive and negative behavior. The Frankl score based on the treatment, gender and age was evaluated with the Chi-square and t-test, respectively. P ≤ 0.05 was considered as statistically significant.

Results

Center 1

There were 103 boys and 81 girls who participated in this center. A total of 136 (73.9%) children was rated as Frankl positive (boys: 73 [70.9%], girls: 63 [77.8%]). Of the 184 children, 114 children belonged to the noninjection group. Cut-off point to classify as positive Frankl rating based on the maximum sensitivity and specificity is shown in Table 2. The cut-off value was 8 in the injection group and the overall group. In the noninjection group, the score was reduced to 7. The sensitivity ranged from 92.5% to 96.9% and the specificity ranged from 53.3% to 77.8%. Table 3 shows that the positive Frankl rating score was 84.2% and 57.1% in the noninjection group and injection group, respectively. The difference in the proportion was statistically significant (P < 0.001). Table 4 shows that the positive Frankl rating score was not statistically significant (P = 0.29) between the girls (77.8%) and boys (70.9%). The mean total behavioral score was 8.43 for positive rating of Frankl behavior rating scale and 6.69 for negative rating in Frankl scale. This indicated that a high total behavioral score can lead to positive Frankl rating and hence, better behavior. The difference between the mean values was found to be statistically significant (P < 0.001) as shown in Table 5. A similar trend was observed when age was compared with the Frankl rating. With the increase in mean age, the children displayed a more positive and cooperative behavior (P = 0.023).

Center 2

In this center, there were 64 boys and 48 girls. A total of 65 (58%) children was rated as Frankl positive (boys: 34 [53.1%], girls: 31 [64.6%]). Of the 112 children, 48 children belonged to the injection group. The cut-off value for positive Frankl rating in noninjection, injection, and overall groups was the same as center 1, as shown in Table 2.
Asokan, et al.: Novel behavior prediction scale

In the subsequent visit, the dentist already has

sensitivity ranged from 80% to 88% and the specificity ranged from 50% to 69.6%. The positive Frankl rating score was 62.5% and 52.1% in the noninjection group and injection group, respectively. The difference in the score was not statistically significant (\( P = 0.269 \)). The positive Frankl rating score was not statistically significant (\( P = 0.224 \)) between the girls (64.6%) and boys (53.1%) as seen in center 1. The mean total behavioral score was 8.14 for positive rating of Frankl scale and 6.19 for negative rating. The difference between the mean values was found to be statistically significant (\( P < 0.001 \)). Children displayed a more positive behavior (\( P = 0.04 \)) as their age increased. This study showed that children with the mean age of 7.29 ± 2.472 years showed a positive behavior.

### Table 2: Cut-off point to classify as positive Frankl behavior rating based on the maximum sensitivity and specificity in both the centers

| Variable                         | Cut-off point | Sensitivity | Specificity |
|----------------------------------|---------------|-------------|-------------|
|                                  | Centre 1      | Centre 2    | Centre 1%   | Centre 2%   |
| Total behavioral score in both groups | 8.0 (≥8.0)  | 8.0 (≥8.0)  | 93.4        | 83.1        |
| In injection group               | 8.0 (≥8.0)  | 8.0 (≥8.0)  | 92.5        | 88.0        |
| In noninjection group            | 7.0 (≥7.0)  | 7.0 (≥7.0)  | 96.9        | 80.0        |

### Table 3: Comparison of Frankl behavior rating in different treatment groups of center 1

| Group (n (%)) | Injection | Noninjection | Total n (%) | \( P^* \) |
|---------------|-----------|--------------|-------------|-----------|
| Frankl behavior rating | Injection | Noninjection | Total n (%) | \( P^* \) |
| Negative      | 30 (42.9) | 18 (15.8)    | 48 (26.1)   | <0.001    |
| Positive      | 40 (57.1) | 96 (84.2)    | 136 (73.9)  |           |
| Total         | 70 (100)  | 114 (100.0)  | 184 (100)   |           |

*\( P^* \) value calculated using the Chi-square test

### Table 4: Comparison of Frankl behavior rating in different gender groups of center 1

| Gender (n (%)) | Total n (%) | \( P^* \) |
|---------------|-------------|-----------|
| Frankl behavior rating | Male | Female | Total n (%) | \( P^* \) |
| Negative      | 30 (29.1)  | 18 (22.2) | 48 (26.1)   | 0.290     |
| Positive      | 73 (70.9)  | 63 (77.8) | 136 (73.9)  |           |
| Total         | 103 (100)  | 81 (100)  | 184 (100)   |           |

*\( P^* \) value calculated using the Chi-square test

### Table 5: Comparison of Frankl behavior rating with the total behavioral score and age in center 1

| Frankl behavior rating | \( n \) | Mean±SD | \( P^* \) |
|-----------------------|--------|---------|-----------|
| Total behavioral score | Negative | 48 | 6.69±1.626 <0.001 |
|                       | Positive | 136 | 8.43±0.891   |
| Age (years)           | Negative | 48 | 6.35±2.334  0.023 |
|                       | Positive | 136 | 7.29±2.472   |

*\( P^* \) value calculated using t-test. SD: Standard deviation

### Discussion

**Need for the study**

A visit to the pediatrician in the past 1 year, prior history of hospital admission, previous visit to the dentist, experience at the first dental visit, and age of the child are the major factors found to be contributing to dental fear and anxiety. Townend et al. have shown that the nature of past dental and medical experiences are important factors that contribute to the child’s behavior. Conditioning appears to be largely responsible for the development of children’s fears of dental treatment. In the subsequent visit, the dentist already has a preknowledge of how the child could probably behave. Hence, this scale was designed to assess the behavior of first timers, who can take their dentists by surprise or make them spend a lot more time than needed. Anticipation and preparation to receive the first timer can be made easy if behavior prediction is possible.

**Need for 2 centers**

To evaluate the applicability and generalizability of the scale, this study was conducted as a two-center trial in dental colleges located in different states of the country. Center 1 is located in the capital city of a state which has a diverse socioeconomic group of people and a mosaic of Indian cultural background. Center 2 is in a smaller city with a totally different cultural and ethnic background. The results of the two-centers are shown separately for better understanding of the details. The results were similar in both the centers for all the factors assessed in spite of their diversity.

**Need for a new scale**

Attitude and behavior are two quite different concepts in psychology. Attitude reflects a person’s inner thoughts, beliefs, feelings, and perceptions. The concept of attitude refers to the evaluation of an object, event, or idea. Behavior is usually an outward expression of the attitude, and it includes a wide variety of actions. Most of the existing behavior prediction scales have been based on the attitude of the child (showing pictures or questions), attitude of the mother or her dental anxiety. The general anxiety of the child has also been used to predict behavior. Bankole et al. shown that there was a direct association between behavior predicted by the mother and the actual behavior manifested by the child during dental appointments. Klaassen et al. have concluded that the child’s anxious behavior during actual dental treatment is not so much related to its own
anticipatory dental anxiety or the anxiety of the mother.\textsuperscript{[6]} Klingberg and Broberg have shown that a clear distinction should be made between general fearfulness (trait anxiety) and fears in general. They have also pointed out that using the accompanying parent as a proxy for the child and collection of information about anxiety in the same situation (dentist’s waiting room) might inflate the relation between dental fear and fears in general.\textsuperscript{[10]} This novel scale has attempted to involve both the attitude and behavior of the child in a dental reception/waiting area to predict his behavior in the dental operatory. The questions were created in the focus group based on the opinions of the experienced pediatric dentists. The questions were based on the components of different existing temperament scales:\textsuperscript{[7]} (1) Nonverbal communication (2) approach or withdrawal (3) quality of mood (4) attention span, and (5) intensity of reaction.

**Discussion of the Results**

Children in the noninjection group displayed more positive behavior in this study. The positive prediction cut-off value dropped from 8 to 7 in the noninjection group. This showed that a score of 7 in the reception could be suggestive of a successful positive appointment, provided the child needed no emergency treatment. The results from both the centers show that a score of 7–8 in the scale is suggestive of a positive Frankl behavior. The sensitivity scores obtained were good indicators of true positive prediction using this scale. Based on the gender, it has been generally shown that girls display more anxiety and general anxiety usually decreases with age.\textsuperscript{[11–12]} Milgrom \textit{et al.} have shown that there is no direct effect of gender on childhood dental fear.\textsuperscript{[13]} According to Davey, the conditioning process and learned responses play a major role in one’s anxiety quotient.\textsuperscript{[14]} Eli \textit{et al.} have shown that the individual personality traits may be the final decisive factor to indicate the development of anxiety in a person.\textsuperscript{[15]} In both the centers of this study, as the mean age of the children increased, the Frankl score was more positive. Positive Frankl score was also more common among the girls, in contrast to the generally proven results. The girls and the older children predominantly belonged to the noninjection group in this study. This could be the probable reason for less anxiety and more positive behavior.

**Conclusion**

The ultimate aim of this study was to find out whether a novel scale can be created to predict the child behavior as positive (cooperative) or negative (uncooperative) in the dental operatory based on his behavior in the waiting room. Irrespective of the age, gender, location, and treatment option, this scale was an effective tool in behavior prediction. This novel behavior prediction scale was simple to use and less time-consuming. A trained receptionist could predict the behavior of the child, and it helped increase the productivity of the dentist in terms of time and energy. This scale could cause a major break-through in pediatric dentistry if proven to work across the globe.

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