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Prediction of Preoperative Anxiety in Children: Who is Most Accurate?

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Abstract

Background—In this investigation, we sought to assess the ability of pediatric attending anesthesiologists, resident anesthesiologists and mothers to predict anxiety during induction of anesthesia in 2 to 16-year-old children (n=125).

Methods—Anesthesiologists and mothers provided predictions using a visual analog scale and children's anxiety was assessed using a valid behavior observation tool the Modified Yale

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IMPLICATIONS Results of this study indicate that attending anesthesiologists' predictions have the strongest relation to children's actual anxiety at induction of anesthesia. This finding has important clinical implications in that, while anesthesiologists work collaboratively with parents to determine the most appropriate intervention for children's anxiety (i.e. sedative premedication), the final decisions regarding treatment may be best left to the anesthesiologist.

Preoperative Anxiety Scale (mYPAS). All mothers were present during anesthetic induction and no child received sedative premedication. Correlational analyses were conducted.

Results—A total of 125 children aged 2 to 16 years, their mothers, and their attending pediatric anesthesiologists and resident anesthesiologists were studied. Correlational analyses revealed significant associations between attending predictions and child anxiety at induction (r_s= 0.38, p<0.001). Resident anesthesiologist and mother predictions were not significantly related to children's anxiety during induction (r_s = 0.01 and 0.001, respectively). In terms of accuracy of prediction, 47.2% of predictions made by attending anesthesiologists were within one standard deviation of the observed anxiety exhibited by the child, and 70.4% of predictions were within 2 standard deviations.

Conclusions—We conclude that attending anesthesiologists who practice in pediatric settings are better than mothers in predicting the anxiety of children during induction of anesthesia. While this finding has significant clinical implications, it is unclear if it can be extended to attending anesthesiologists whose practice is not mostly pediatric anesthesia.

INTRODUCTION

Preoperative anxiety is a common occurrence among children undergoing surgery [1] and can result in adverse physiological and psychological reactions.[2] Children with high levels of preoperative anxiety are more likely to exhibit signs of emergence delirium and to develop maladaptive behavioral changes postoperatively.[3,4] These children also present with more postoperative pain and require more pain control medication.[2]

Research has shown that social adaptability, cognitive ability, temperament (sociability and activity) and age of the child to be predictors of preoperative anxiety.[1,5] Other predictors for these clinical phenomena include previous negative medical encounters[1] and the state anxiety [6,7] and coping style of parents.[8]

Unfortunately, research on predictors of perioperative anxiety has relied on lengthy tools to ascertain various psychological constructs and other contributing factors. The clinical setting renders such tools impractical when time constraints and patient overload are considered. Indeed, in clinical settings, both health care personnel and families rely on their own judgment and nonspecific factors to make decisions about the need for a preoperative intervention, such as sedative premedication, for a particular child. No empirical work has been done to examine this issue. As such, the purpose of the current study is to assess the ability of mothers and health care providers to predict the anxiety of children during induction of anesthesia. Also, this study will examine the agreement between mothers and health care providers in this regard. Given that there is no literature examining this issue, this study is considered exploratory and no directional hypotheses were made.

MATERIALS AND METHODS

Children age 2-16 years with ASA Physical Status I and II who were scheduled to undergo elective outpatient surgery under general anesthesia and their mothers were considered for enrollment in this study. Those children who had a history of chronic illness, prematurity or developmental delay were not recruited. The IRB approved the study and all mothers and children 6 years and older provided written informed consent/assent. All mothers were present during anesthesia induction and no child received sedative premedication.

Baseline and Outcome Measures

Trained research personnel administered all measures. Personnel undergo a standardized training process, requiring them to achieve inter- and intra-rater reliability of at least 95%

agreement when rating measures, such as the Modified Yale Preoperative Anxiety Scale (mYPAS). New personnel are trained by and must shadow seasoned staff until they reach the above-mentioned level of rater reliability.

Emotionality, Activity, Sociability and Impulsivity (EASI) Instrument of child temperament[9]

The EASI is a standardized tool that assesses emotionality, activity, sociability and impulsivity in children. Mothers rate 20 items representing individual behavioral patterns and responses to daily events on a 5-point scale. Scores range from 5 to 25 for each category, with higher scores denoting higher baseline emotionality, activity, sociability or impulsivity. The instrument has good validity when compared with other temperament measures for preschool children and high test-retest reliability in adjacent months.[10]

mYPAS[11]

The mYPAS is an observational measure of children's preoperative anxiety consisting of 27 items divided into 5 categories: Activity, Vocalizations, Emotional Expressivity, State of Arousal and Use of Parent. All mYPAS categories have been demonstrated to have good to excellent inter- and intra-observer reliability (0.73-0.91). When validated against other global behavioral measures of anxiety, the mYPAS has also demonstrated good validity (r=0.64).[11] Scores range from 22.5 to 100 with higher scores indicating greater anxiety. This measure was developed and validated in previous investigations and has since been used in multiple experimental protocols.

Visual Analog Scale (VAS)

The VAS is a 100mm horizontal line that pictorially represents 2 behavioral extremes at either end of a continuum (anchored with not anxious and very anxious). Anesthesiologists and mothers placed a mark on the line to indicate how anxious they thought the child would be when s/he entered the operating room (OR). Scores ranged from 0 to 100, with higher scores indicating higher levels of predicted anxiety. The VAS has been widely used to assess subjective states, such as general anxiety,[12] preoperative anxiety [13,14] and pain,[15] and does not show the clustering of responses that is typical of Likert-type scales.

State-Trait Anxiety Inventory (STAI)[16]

This self-report anxiety assessment contains 2 20-item, rating scales for measuring trait and state anxiety. Mothers respond on a 4-point scale and total scores for each questionnaire range from 20 to 80, with higher scores indicating higher levels of anxiety. Test-retest correlations for the STAI are high, ranging 0.73 to 0.86.[17] Validity of the instrument was examined in two studies in which the STAI was given under high- and low-stress conditions to large samples of students. The r value ranged from 0.83 to 0.94,[17] suggesting very good validity.

Study Protocol

It is important to note that the provision of prediction ratings by attending and resident anesthesiologists was embedded within other ongoing study protocols, thus reducing the chance for criterion contamination (i.e., anesthesiologists' behavior changing toward a patient on the basis of the prediction rating assigned to the patient). That is, children in this study were also part of other ongoing studies that involved anxiety assessments.

Recruitment Phase—Subjects were recruited before the day of surgery by phone or at a voluntary orientation to the surgery center or on the morning of surgery in the preoperative holding area. Written consent, demographic data, and baseline measures (EASI, STAI) were obtained after recruitment.

Day of Surgery, Preoperative Holding Area—Maternal state anxiety (STAI) and child anxiety (mYPAS) were evaluated. Mothers and attending and resident anesthesiologists used the VAS to predict the child's level of anxiety in the OR. Children did not receive a premedication.

Induction of Anesthesia—Mothers accompanied their children into the OR for anesthesia induction. Behavior of the child was rated upon introduction of the mask using the mYPAS. Upon exit from the OR, maternal state anxiety was again evaluated using the STAI.

Statistical Analyses

Statistical analyses were conducted in stages. First, relations between predictions of child anxiety (by attending and resident anesthesiologists and mothers) and child anxiety at induction were examined using correlations. Given that mYPAS scores were not normally distributed, nonparametric Spearman rho correlations are reported. Relations between attending anesthesiologists' predictions of child anxiety and mother and child demographic and personality variables were examined via correlation or chi-square analyses.

Accuracies of prediction were then examined for attending anesthesiologists. Given that prediction and actual anxiety were measured on different scales, their scores were converted to z-scores to allow for their comparison. Z score transformations allow the comparison of measures on different scales by converting raw scores to scores with a mean of 0 and a standard deviation of 1. Z scores were used to calculate prediction accuracy for attending anesthesiologists. Specifically, accuracy of predictions was calculated by subtracting the standardized actual anxiety scores (z score) from the standardized prediction (z score).

On the basis of this equation, perfect accuracy is represented as 0, with positive scores indicative of predicted anxiety over-estimating actual anxiety and negative scores indicative of predicted anxiety under-estimating actual anxiety. Analyses of variance were used to examine differences in prediction accuracy across anesthesiologists, and 1-sample t-tests were used to examine whether the means of attending anesthesiologists' ratings differed significantly from 0 (perfect accuracy). Correlations and t-tests were then used to examine the relations between child and mother factors and attendings' accuracy of prediction.

Continuous data are presented as mean and standard deviation. P values of less than 0.05 were considered significant. In the cases of multiple tests, Bonferroni-corrected p-values were used to control for inflated type I error.

RESULTS

Participants were 125 children aged 2 to 16 years, (6.4 ± 3.1) their mothers, and their attending and resident anesthesiologists. Demographic and personality characteristics of children and mothers are shown in Table 1. Children in this study underwent the following surgical procedures: general surgery (n = 24, hernia), urological surgery (n = 9, circumcision, hydrocele, orchiopexy), ear-nose-throat (ENT) (n=59, tonsillectomy and adenoidectomy, tympanostomy, pressure equalization tubes), plastic surgery (n=10, dermoid cyst, benign skin lesion), orthopedic surgery (n=6, thumb trigger release, heel cord lengthening), and other minor procedures (n=16, endoscopy, colonscopy). All mothers were present at anesthesia induction and no children were offered sedative premedication. A subset of children participated in a preadmissions visit (34 children, 27.2%). Mothers' predictions of child anxiety were missing from 7 (5.6%) children and were not replaced.

Ten attending anesthesiologists and 34 anesthesiology residents provided prediction ratings in this study. Prediction data were collected from attending anesthesiologists for 92 child

participants (73.6%) and from resident anesthesiologists for 72 child participants (57.6%). There were no differences in child anxiety at induction between children who had attending and resident ratings and those who did not (p=ns). Missing data were not replaced; analyses for attending and resident predictions include the sub-sample of child participants for which prediction ratings were available.

Demographic data were collected from all anesthesiologists. Eight of the 10 attending anesthesiologists were female, and attendings ranged in age from 37 to 53 years (45.7 ± 4.8). Years of practice including fellowship ranged from 3 to 18 years (10.4 ± 5.9). The reader should note that all attending anesthesiologists underwent fellowship training in pediatric anesthesiology and most only practice pediatric anesthesia.

Relation Between Predicted and Actual Anxiety across Raters

Correlational analyses revealed a moderate to good association between attending anesthesiologist predictions of child anxiety and actual child anxiety at induction (mYPAS) ($r_s = 0.38$, $p < 0.001$). In contrast, resident anesthesiologist predictions were poor and not significantly related to actual children's anxiety ($r_s = -0.037$, $p > .05$). There was also no relation between resident's ability to predict a child's anxiety and number of years in residency. Also, mother prediction of child's anxiety and actual child anxiety at induction were not significantly related ($r_s = -0.046$, $p > 0.05$).

Factors Related to Anesthesiologists' Predictions

Given that attending anesthesiologists' predictions had the strongest relations to children's displayed anxiety, further analyses were conducted to explore these predictions. Correlations among attendings' predictions, child age, anxiety in the holding area (mYPAS-holding), child temperament (EASI), and mother trait (STAI-Trait) and state anxiety in holding (STAI-holding) were examined and are shown in Table 2. Of these variables, anesthesiologists' predictions were significantly related to child age ($r = -0.28$, $p < .01$) and child's anxiety in holding ($r = 0.38$, $p < 0.01$). That is, anesthesiologists predicted that younger children and children displaying more anxiety in holding would be more anxious at induction than older children and children displaying less anxiety in holding.

Accuracy of Attending Anesthesiologists' Predictions

Although the correlations discussed above provide information on the overall relation between predictions of anxiety and actual anxiety, we were also interested in the absolute accuracy of predictions. For example, correlations between attendings' predictions and actual anxiety may have been high, but this may have been because anesthesiologists were consistently under-estimating or over-estimating children's anxiety. Thus, we were interested in examining accuracy of predictions and factors that affected this variable. Accuracy scores for attending anesthesiologists were calculated by subtracting standardized prediction ratings from standardized child observed anxiety at induction; thus negative scores indicated under-estimation of child anxiety and positive scores indicated over-estimation of child anxiety (see Statistical Analysis section for more detailed explanation). Accuracy scores ranged from -3.79 (underestimation) to 2.20 (over-estimation) and showed a relatively normal distribution (0.02 ± 1.04; Figure 1, histogram). In terms of accuracy of prediction, 47.2% of predictions made by attending anesthesiologists were within 1 standard deviation of the actual anxiety exhibited by the child, and 70.4% of predictions were within 2 standard deviations of the actual anxiety exhibited by the child. With regards to direction of prediction, 51.1% of predictions by anesthesiologists underestimated children's actual anxiety and 48.9% of predictions by anesthesiologists over-estimated children's actual anxiety.

Factors Related to Anesthesiology Attendings' Accuracy

Relations between accuracy of attendings' predictions and child and mother characteristics were also examined. There were no differences in accuracy when comparing predictions made on male and female children, t (76) = 0.166, $p > .05$; children who had preadmission visits and those who did not, t (90) = 0.092, $p > .05$; and those with previous experience with surgery or not, t (76) = 0.429, $p > .05$. There was also no difference in attendings' accuracy depending on type of procedure (general, urological, ear-nose-throat, plastic, orthopedic, other minor), F (5, 85) = 0.38, $p > .05$. There was also no significant relation between child age and attendings' accuracy of predictions, r = -.07, $p > .05$, or between mother trait anxiety and attendings' accuracy, r = .17, $p > .05$.

Mothers' Predictions

Although mothers' predictions were not related to children's anxiety at anesthesia induction (r_s = -0.046, $p > 0.05$), we were interested in further exploring these predictions given the role of mothers in decision-making for sedative premedication. Correlations among mothers' report of own anxiety in holding, after separation, mothers' predictions of child anxiety at induction, child anxiety in holding and at induction were nonsignificant (r's ranged from -0.04 to 0.16, all p's > .05). Separate correlations between mothers' predictions and children's anxiety at induction were conducted for children who had previous surgical experience (n = 43) and those who did not (n = 63). Previous surgical experience was not available for 19 children. Although the correlation was higher for mothers of children who had previous surgery than for mothers of children who had not had previous surgery (r = 0.28, -0.05, respectively, both p's > 0.05), neither correlation was statistically significant.

Discussion

The purpose of this study was to evaluate how well attending anesthesiologists, resident anesthesiologists, and mothers can predict children's anxiety at anesthesia induction in real-world settings. Results indicate that attending anesthesiologists' predictions have the strongest relation, sharing 23% of the variance in children's actual anxiety at induction. Relations between resident anesthesiologists' and mothers' predictions and children's anxiety are not significant, sharing only 1% and less than 1% of the variance in child anxiety, respectively. It is interesting to note that attendings tended to be similarly accurate regardless of child characteristics, mother characteristics, or even having previously met the child at a preadmissions visit.

Given that attending anesthesiologists' ratings are the most strongly predictive of children's anxiety at induction, we conducted further analyses to explore what child or maternal factors were related to these predictions. Not surprisingly, child age and children's anxiety in holding were related to attending anesthesiologists' ratings, suggesting that they may use these variables to make their predictions. Attendings' ratings were not related to mother anxiety or child temperament; these findings are also not particularly surprising as mother anxiety and child temperament are not as salient or as easy to assess as child age or child anxiety in holding.

Attending anesthesiologists' ability to predict children's anxiety may come from additional training and experience, since it was found that predictions by resident anesthesiologists at any level of training were not significantly related to children's anxiety at induction. Because all attending anesthesiologists who were part of this study underwent fellowship training in pediatric anesthesia and practiced mostly with children, it is unknown whether our findings would generalize to attendings whose practice is not primarily pediatric anesthesia. Future research is needed to better address this issue.

Also of note, findings showed that mothers' predictions were not related to children's anxiety at induction. Although mothers' predictions were slightly better for children who had undergone previous surgery, they were still not significantly related to children's anxiety at anesthesia induction. It is notable that the sample size for both children previously undergoing surgery was relatively small (n = 43) and thus the failure to demonstrate a significant correlation may have been due to low power.

Mothers did not appear to consider their child's behavior in holding when making their predictions. Thus, it appears that mothers may not have been able to recognize their children's anxiety in holding and in turn, were unable to predict their children's overt anxiety at induction. It is notable that, in contrast to previous findings, maternal anxiety was not related to children's anxiety at anesthesia induction. Maternal anxiety was also not related to their predictions of children's distress suggesting that anxiety was not the “active component” in mothers' predictions. Further research on the relation between maternal anxiety and child perioperative anxiety is warranted. Overall, these maternal findings have important clinical implications as the final decisions regarding treatment for children's anxiety are typically left to parents; indeed maternal perception and pressure often drives decisions on whether to provide premedication or parental presence at anesthesia induction.

A few methodological considerations about this study should be mentioned. First, the study included a wide age range with a range of scores on measures of temperament, child and parent anxiety thus increasing the generalizability of the results. It is notable that, although measures, such as coping style, trait anxiety and cognitive ability, have been found to be related to children's anxiety at induction, they were not controlled for in this study. The purpose of this study was to evaluate the ability of health care personnel and mothers to accurately predict children's anxiety at anesthesia induction as they do in a typical environment. Given that measures of such variables are long and are typically not available on which to base predictions, they were not included in this study. Second, as discussed above, the sample of attending anesthesiologists included in this study is fairly homogenous. All are pediatric anesthesiologists and have a significant amount of experience in these settings. Furthermore, this group of anesthesiologists interacts with each other on a daily basis and participates together in training experiences, thus suggesting that their ratings of children might be more similar to each other than to those of anesthesiologists outside of their practice. Future research should validate these findings with attending anesthesiologists from a variety of practices with different practice patterns. Finally, given that the same anesthesiologists making the predictions also brought the children into the OR and completed the induction, it is possible that anesthesiologists' behavior changed as a result of their ratings, in turn affecting children's behavior (and subsequently observer ratings). In other words, it is possible that anesthesiologists' ratings became selffulfilling prophecies. Although this may have been an issue, it is important to note that measures were taken to reduce the likelihood of this outcome. Specifically, anesthesiologists' predictions were provided in the context of other multiple ongoing studies in which many other measures were completed. Thus, predictions were embedded in other measures to reduce attention to these ratings specifically. Furthermore, anesthesiologists were not informed about the purpose of this additional item and were asked to provide ratings only as a baseline indicator. Of note, anesthesiologists were debriefed as to the purpose of this study at the completion of data collection.

Findings of this study highlight several future research directions. First, given that attending anesthesiologists made predictions that were more closely related to children's observed anxiety than resident anesthesiologists, it will be important to ascertain what factors are most salient to attending anesthesiologist in their predictions. Once these salient factors are identified, it will be possible to train residents in their assessment. Second, given that other predictors of children's anxiety have been identified in the literature (i.e., child temperament,

previous medical experience), it will be interesting to compare anesthesiologists' predictions to predictions based on these measures. If these measures are more accurate than anesthesiologists, we should advocate their regular clinical use. Alternatively, it will be interesting to examine whether anesthesiologists' predictions add to the accurate identification of anxiety in children in combination with these predictors. Finally, future research should consider the interaction between predictions of children's anxiety and treatment decisions on children's outcomes. Although attending anesthesiologists were most accurate in their predictions, over half of predictions were outside 1 standard deviation of children's observed anxiety. Premedication was not used in the current study, but it would be interesting to evaluate how anesthesiologists incorporate their predictions with other variables to determine what treatment (if any) is delivered.

In conclusion, findings suggest that anesthesiologists may be able to accurately identify those children who are in need of interventions to address anxiety at induction. Furthermore, given that mothers' ratings were not correlated with children's anxiety, it is suggested that anesthesiologists collaborate with parents in decision-making about anxiolytic interventions rather than providing parents with sole decision-making roles.

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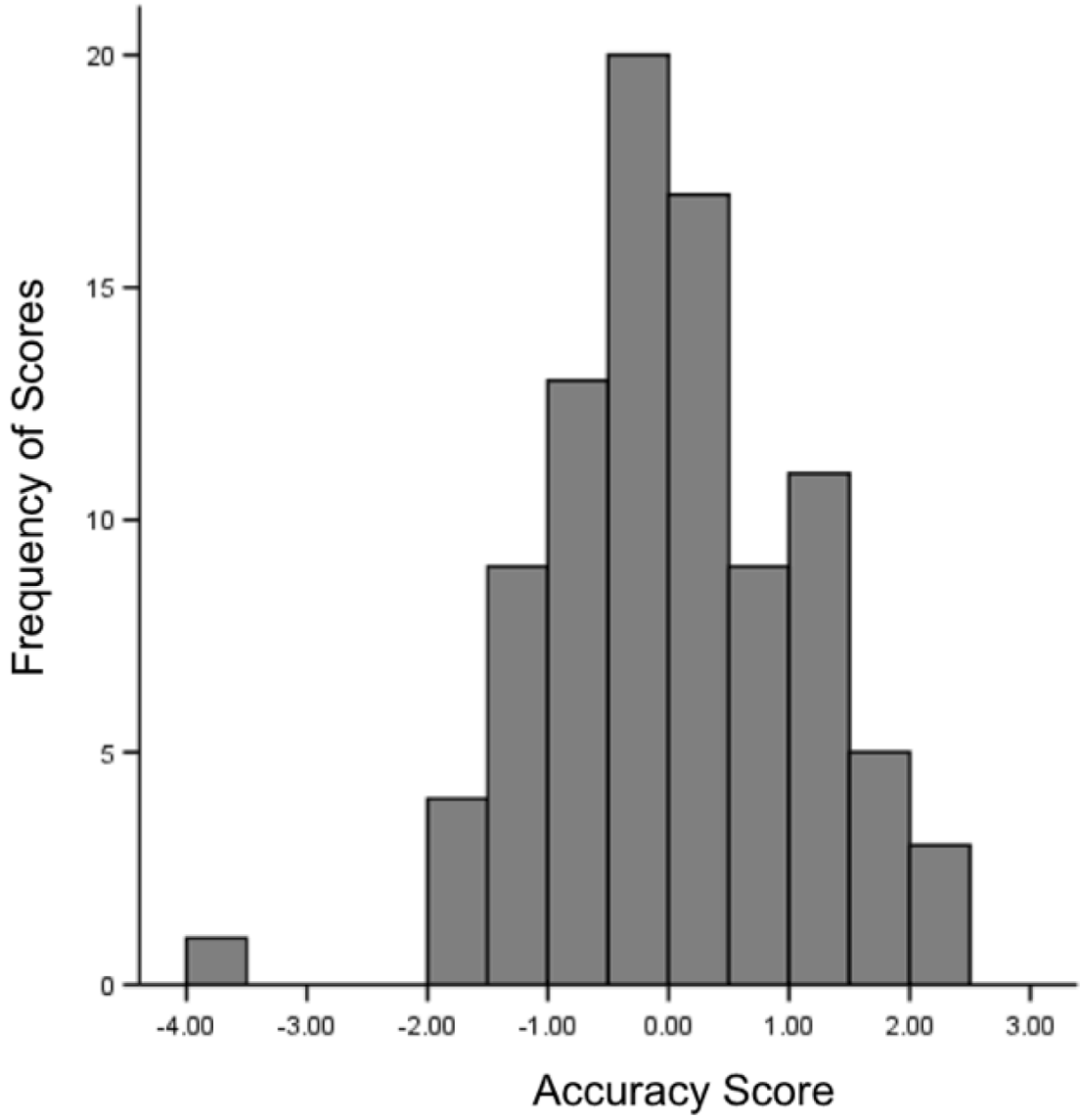

Figure 1.
Distribution of Accuracy Scores for Attending Anesthesiologists
Note: Scores of 0 indicate perfect accuracy in prediction of child anxiety Negative scores indicate underestimation of child anxiety and Positive scores indicate overestimation of child anxiety.

Table 1

Demographic Characteristics of Children and Mothers

Demographic Characteristic	Study Subjects (n=125)
Child's age	6.43 ± 3.10 (2-16)
Child Gender [% Male]	49.1
Ethnicity	
Caucasian (%)	70.80
African-American (%)	16.00
Hispanic (%)	9.40
Other (%)	3.70
Child Temperament [Mean ± SD (range)]	
Emotionality	9.72 ± 3.73 (5-18)
Activity	15.00 ± 4.31 (7-25)
Sociability	18.69 ± 2.65 (11-23)
Impusivity	11.23 ± 3.50 (5-23)
Mother Age	38.50 ± 5.83 (23-54)
Mother Anxiety (STAI)	39.22 ± 7.72 (23-54)
Trait Anxiety [Mean ± SD (range)]	36.97 ± 7.78 (24-57)
State Anxiety in Holding [Mean ± SD (range)]	39.22 ± 9.58 (20-62)

Note: all data with the exception of ethnicity and gender are shown as Mean ± Standard Deviation

STAI = State Trait Anxiety Inventory

Table 2

Correlations among Attending Predictions of Child Anxiety and Child and Parent Variables

Variable	Child Age	Child Anxiety in Holding (mYPAS)	Child Anxiety at Induction (mYPAS)	EASI Emotionality	EASI Activity	EASI Sociability	EASI Impulsivity	Mother Anxiety Trait (STAI)	Mother Anxiety State in Holding (STAI)
1. Prediction (VAS)	-0.28*	0.38	0.48*	0.11	-0.07	-0.14	0.07	0.09	0.04
2. Child Age	1	-0.33*	-0.31	0.12	-0.17	-0.09	-0.27	-0.07	-0.17
Child Anxiety									
3. in Holding (mYPAS)		1	0.41	0.18	-0.06	-0.11	-0.11	0.05	0.03
4. at Induction (mYPAS)			1	0.01	-0.07	-0.36*	0.03	-0.04	-0.10
EASI									
4. Emotionality				1	0.13	0.47*	0.5*	0.3	0.06
5. Activity					1	0.07	0.55*	-0.31	-0.44*
6. Sociability						1	-0.33*	-0.03	-0.06
7. Impulsivity							1	0.01	0.08
Mother Anxiety (STAI)									
8. Trait								1	0.41*
9. State in Holding									1

EASI = EASI Temperament Scale

mYPAS = modified Yale Preoperative Anxiety Scale

STAI = State Trait Anxiety Inventory

VAS = Visual Analog Scale

* = Correlation significant at $p < .01$