Child Behavior and Quality of Life in Pediatric Obstructive Sleep Apnea

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**Objective:** To assess behavior and quality of life in children with obstructive sleep apnea (OSA) undergoing tonsillectomy and adenoidectomy compared with control children.

**Design:** Prospective controlled study.

**Setting:** Hospital-based pediatric otolaryngology practice.

**Participants:** Forty-two children (25 boys and 17 girls; mean [SD] age, 5.8 [2.5] years) with OSA confirmed by positive findings on polysomnography undergoing tonsillectomy and adenoidectomy and 41 control children (29 boys and 12 girls; mean [SD] age, 7.3 [3.8] years) with no history of snoring undergoing unrelated elective surgery.

**Interventions:** Parents completed the standardized Child Behavior Checklist and a validated pediatric OSA quality-of-life survey before and 3 months after surgery.

**Main Outcome Measures:** Child Behavior Checklist T scores and score classifications and quality-of-life survey mean scores.

**Results:** Change in mean total problem T score was significantly greater in the OSA group (from 51.6 at baseline to 48.3 at follow-up) than in controls (from 45.5 at baseline to 46.7 at follow-up) \((P=.03)\). The improvement in total T score classification (normal vs borderline or abnormal) was significant for children with OSA compared with control children \((P=.009)\). Children with OSA had significant improvements in the quality-of-life survey mean total score and all individual domain scores compared with controls \((P<.001)\).

**Conclusions:** Behavioral and emotional difficulties are found in children with documented OSA compared with control children, and they improve after treatment. Large improvements in disease-specific quality of life are also found. Scores on a standardized measure of behavior assessment demonstrated significant correlation with scores on a validated quality-of-life instrument.

The objective of the present study was to assess child behavior and QOL using the CBCL and the OSA-18 before and after T&A in children with OSA documented by polysomnography compared with control children without sleep-disordered breathing undergoing unrelated elective surgery. Correlation was also sought between CBCL and OSA-18 scores.

### METHODS

**PARTICIPANTS**

Parents of children aged 2 to 14 years scheduled for T&A for the treatment of OSA were recruited from the pediatric otolaryngology clinics at the Long Island College Hospital, State University of New York Downstate Medical Center, and Kings County Hospital Center in Brooklyn, NY, between October 1, 2002, and November 30, 2003. For all of these children, results of sleep studies were positive for OSA, as defined by a respiratory disturbance index (RDI) of 5 or greater or an apnea index of 1 or greater. The control group consisted of children aged 2 to 14 years scheduled for elective surgery unrelated to any otolaryngologic, ophthalmologic, or neurosurgical diseases and with no history of snoring. In both groups, children with craniofacial abnormalities, behavioral disorders, neuromuscular diseases, learning disabilities, or psychiatric diseases or whose parents did not read or understand English were excluded. The protocol was approved by the institutional review boards of the Long Island College Hospital and the State University of New York Downstate Medical Center, informed consent was obtained from the parents, and a convenience sample was recruited.

**COMPLETION OF QUESTIONNAIRES**

Parents or caretakers completed the OSA-18 and the CBCL for ages 2 through 3 years (CBCL/2-3) or ages 4 through 18 years (CBCL/4-18) before surgery and at a planned 3-month follow-up visit. At entry, parents also completed a standard questionnaire that recorded demographic information and guardian education level.

The CBCL/2-3 is a 100-item survey and the CBCL/4-18 is a 113-item survey of specific childhood behaviors. Each item is scored as follows: 0, not true; 1, somewhat or sometimes true; and 2, very true or often true. The CBCL/4-18 also has 35 questions regarding children’s competencies in school, activities, and social contexts, which are scored on the basis of the amount and quality of participation for children 6 years and older (total competence). Raw scores are converted to normalized T scores, which are compared with scores of children in normative samples. Scores are then divided into normal (<95th percentile), borderline (≥95th percentile but <98th percentile), and abnormal (≥98th percentile) ranges.13,14 The CBCL/2-3 is scored to obtain a total problem score, which provides a global index of the child’s behavioral and emotional function. The responses can be further divided into scores for internalizing (anxious and depressed and withdrawn) and externalizing (aggressive behavior and destructive behavior) groupings and scores for the individual syndrome scales (anxious and depressed, withdrawn, sleep problems, somatic problems, aggressive behavior, and destructive behavior). The CBCL/4-18 is scored to obtain a total problem score, scores for internalizing (withdrawn, somatic complaints, and anxious or depressed) and externalizing (delinquent behavior and aggressive behavior) groupings, and scores for the individual syndrome scales (withdrawn, somatic complaints, anxious or depressed, social problems, thought problems, attention problems, delinquent behavior, and aggressive behavior). The CBCL/4-18 total competence score is reported separately and is not included in the total problem score calculation. Except for the scores for total competence, lower scores indicate more normal behavior and higher scores indicate more abnormal behavior.

The OSA-18 consists of 18 survey items divided into 5 domains (sleep disturbance, physical symptoms, emotional symptoms, daytime functioning, and caregiver concerns). The 18 items are scored using a 7-point ordinal scale that assesses the frequency of specific symptoms, scored as follows: 1, none of the time; 2, hardly any of the time; 3, a little of the time; 4, some of the time; 5, a good bit of the time; 6, most of the time; and 7, all of the time. The scores on each of the 18 items are summed to produce a total score, which can range from 18 to 126. An OSA-18 total score less than 60 suggests a small impact on health-related QOL, a score between 60 and 80 suggests a moderate impact, and a score greater than 80 suggests a large impact.13 A mean score and individual domain mean scores are also calculated.

The OSA-18 change scores are calculated by subtracting the postoperative mean score and the individual domain mean scores from the preoperative mean and individual domain mean scores. Negative numbers indicate deterioration, and positive numbers indicate improvement. A QOL change score of less than 0.5 indicates trivial change; 0.5 to 0.9, small change; 1.0 to 1.4, moderate change; 1.5 or greater, large change.14

**SAMPLE SIZE ESTIMATION**

In a previous study of 64 children with sleep-disordered breathing undergoing T&A, the mean (SD) change in the total problem T score was 7.3 (10.0) points. The known practice effect, improvement in CBCL scores found with repeated survey completion, is 2 points from time 1 to time 2.2 Estimating that the mean change in the total problem score would be 5 for the T&A and control groups, assuming 80% power and α = .05 using a 2-tailed t test.

**STATISTICAL ANALYSIS**

Comparisons of the CBCL T scores and mean OSA-18 scores between the T&A and control groups on the postoperative and preoperative surveys were performed using a mixed linear model, with fixed factors corresponding to group and time and the random factor of patient identification. Simple effects of time within group were conducted to investigate significant interactions of...
Because previous studies have demonstrated that parent education level may affect CBCL scores, the analyses were repeated controlling for the level of guardian education by including the number of years of education as a covariate in the mixed linear models. Spearman correlation was used to correlate the total problem T score with the number of years of guardian education. Generalized mixed linear models were also used to compare the CBCL T score classifications (normal vs borderline or abnormal) for the T&A and control groups on the postoperative and preoperative surveys; fixed and random factors were the same as those for the mixed linear models. The Fisher exact test was used to compare the groups in terms of change in health-related QOL impact based on OSA-18 scores. Pearson correlation was used to correlate the initial CBCL total problem T score with the RDI, the change in CBCL total problem T score with the change in OSA-18 total score, the change in CBCL total problem T score with the RDI, the initial OSA-18 mean score with the RDI, and the change in mean OSA-18 score with the RDI. A statistical software package (SAS; SAS Institute Inc, Cary, NC) was used for this analysis.

### RESULTS

The parents of 99 children who were invited to take part in the study agreed to participate. Complete preoperative and postoperative surveys were available for 83 children (42 with OSA and 41 controls), who made up the study sample. Patient demographics, sleep study results, surgical procedures, and duration of follow-up are given in Table 1.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>OSA Group (n = 42)</th>
<th>Control Group (n = 41)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, No. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>25 (60)</td>
<td>29 (71)</td>
</tr>
<tr>
<td>F</td>
<td>17 (40)</td>
<td>12 (29)</td>
</tr>
<tr>
<td>Age, mean (SD) [range], y</td>
<td>5.8 (2.5) [2.0-11.5]</td>
<td>7.3 (3.6) [2.1-14.0]</td>
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<tr>
<td>Race, No. (%)</td>
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<tr>
<td>African American</td>
<td>36 (86)</td>
<td>20 (49)</td>
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<tr>
<td>White</td>
<td>5 (12)</td>
<td>14 (34)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1 (2)</td>
<td>7 (17)</td>
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<td>Guardian education level, No. (%)</td>
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</tr>
<tr>
<td>Less than high school</td>
<td>1 (3)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>High school</td>
<td>16 (38)</td>
<td>11 (27)</td>
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<tr>
<td>Some college</td>
<td>14 (33)</td>
<td>10 (24)</td>
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<tr>
<td>College</td>
<td>6 (14)</td>
<td>7 (17)</td>
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<td>2 (5)</td>
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<tr>
<td>Unknown</td>
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<td>10 (25)</td>
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<td>Sleep study RDI, median (range)</td>
<td>13.9 (4.5-87.9)</td>
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<td>Surgical procedures, No. (%)</td>
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<td>T&amp;A</td>
<td>42 (100)</td>
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<td>Inguinal hernia repair</td>
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<td>Umbilical hernia repair</td>
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<td>Circumcision</td>
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<td>Videourodynamic</td>
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<td>5 (12)</td>
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<td>Orchiopexy</td>
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<td>Tooth extraction</td>
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<td>Esophagogastroduodenoscopy</td>
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<td>2 (5)</td>
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<tr>
<td>Others*</td>
<td>NA</td>
<td>12 (29)</td>
</tr>
<tr>
<td>Duration of follow-up, mean (SD) [range], mo</td>
<td>5.4 (1.9) [3.0-9.5]</td>
<td>5.3 (1.4) [3.0-8.7]</td>
</tr>
</tbody>
</table>

Abbreviations: NA, not applicable; OSA, obstructive sleep apnea; RDI, respiratory disturbance index; T&A, tonsillectomy and adenoidectomy.

*One child each underwent colonoscopy and biopsy, correction of chordee, dental rehabilitation, excision of breast mass, excision of dermoid cyst, excision of extra digit, excision of hymenal tag, excision of postauricular mass, hypospadias repair, inguinal and umbilical hernia repair, leg pin removal, and percutaneous endoscopic gastrostomy.

The effect of T&A on child behavior is given in Table 2. Sample sizes varied because some of the syndrome scales are applicable only to the CBCL/2-3 or the CBCL/4-18, and the total competence items are scored only for children 6 years and older. For children with OSA, the mean (SD) initial and final total problem T scores were 51.6 (11.3) and 48.3 (12.3), respectively. For the control group, the mean (SD) initial and final total problem T scores were 45.5 (9.6) and 46.7 (11.9), respectively. The mean change in total problem T score (postoperative score minus preoperative score) was significantly greater in children with OSA than in control children (3.2 [9.2] vs –1.2 [8.4]; P = .03). The mean change in the internalizing subgroup and the individual syndrome scales of thought problems and somatic complaints were also significantly greater in children with OSA than in control children (3.2 [9.2] vs –1.2 [8.4]; P = .03). Although there was no statistically significant effect in the externalizing subgroup and the other syndrome scales.

Complete data regarding guardian education level and CBCL scores were available for 65 patients. When the level of guardian education was incorporated into the regression model, the improvement in the total problem T score in patients with OSA compared with controls did not reach statistical significance.
The OSA-18 mean scores are given in Table 3. Incomplete responses were found on the postoperative survey of 1 child with OSA, on the preoperative surveys of 2 control children, and on the postoperative survey of 1 control child, so these surveys were excluded from the analysis. For patients with OSA, the mean (SD) initial and final total scores were 4.0 (1.2) and 1.6 (0.7), respectively. For control patients, the mean (SD) initial and final total scores were 4.6 (1.1) and 1.5 (0.8), respectively. The mean total survey and individual domain scores did not change significantly between groups (P = .03).

The OSA-18 mean scores are given in Table 3. Incomplete responses were found on the postoperative survey of 1 child with OSA, on the preoperative surveys of 2 control children, and on the postoperative survey of 1 control child, so these surveys were excluded from the analysis. For patients with OSA, the mean (SD) initial and final total scores were 4.0 (1.2) and 1.6 (0.7), respectively. For control patients, the mean (SD) initial and final total scores were 4.6 (1.1) and 1.5 (0.8), respectively. The mean total survey and individual domain scores did not change significantly between groups (P = .03).

Abbreviations: OSA, obstructive sleep apnea.

*Comparison of mean change scores between children with OSA and controls. Mixed linear model; group × time interaction.

†Mean of the items in the domain; range, 1.0 to 7.0; higher scores indicate poorer quality of life.

‡Preoperative score minus postoperative score; positive values indicate improvement, except for total competence, for which negative values indicate improvement.
change scores were significantly greater among children with OSA than among controls (P<.001 for all). For children with OSA, a large mean change in QOL was found for the total score and the individual domains of sleep disturbance, physical symptoms, daytime function, and caregiver concerns, and a moderate change was found for emotional symptoms. For the control children, trivial mean changes in QOL were found for the total score and all of the individual domains.

Complete data regarding guardian education level and OSA-18 scores were available for 67 children. When the level of guardian education was incorporated into the regression model, the mean total change score remained significantly greater in patients with OSA than in control patients (P<.001). For patients with OSA, there was no significant correlation between the mean initial OSA-18 total score and the RDI (r = 0.27; P = .09; n = 41), but there was a significant correlation between the OSA-18 mean total change score and the RDI (r = 0.35; P = .02; n = 41).

The health-related QOL impact of the children's sleep-disordered breathing was determined. For the OSA group, the preoperative QOL impact was small for 13 children (31%), moderate for 14 (33%), and large for 15 (36%), whereas the postoperative QOL impact was small for 40 children (98%) and moderate for 1 (2%). For the control group, the preoperative QOL impact was small for all 39 children, and the postoperative QOL impact was small for 38 children (95%), moderate for 1 (3%), and large for 1 (3%), since 2 children may have developed symptoms of sleep-disordered breathing. The change in health-related QOL impact differed significantly between groups (P<.001).

The preoperative CBCL total problem T score had fair to good correlation with the preoperative OSA-18 total score (r = 0.44; P < .001; n = 81). The change in the CBCL total problem score had fair to good correlation with the OSA-18 total change score (r = 0.34; P = .002; n = 81).

**COMMENT**

In this study of 42 children with documented OSA undergoing T&A for treatment and 41 children without OSA undergoing elective surgery, a high prevalence of behavioral and emotional problems was found in the OSA group (29% vs 10%). These results agree with those of previous studies, using the CBCL, in which 31% of children undergoing T&A for the treatment of sleep-disordered breathing also scored in the borderline or abnormal range. A significant improvement was found in the total problem score classification after T&A: only 12% of patients scored in the abnormal or borderline range compared with 20% of control children. These results also agree with those of the previous studies, in which 20% and 17% of the children who underwent T&A scored in the abnormal or borderline range on the postoperative surveys.

In the present study, the total problem T score was 3.2 points lower after T&A compared with 7.5 points and 7.3 points lower in the previous 2 studies. We also demonstrated significant improvements only in the internalizing subgroup and the individual syndrome scales of thought problems and somatic complaints. In the study of 36 children, significant improvements were found after T&A for the internalizing subgroup and most of the individual syndrome scales, whereas in the study of 64 children, significant improvements were found for the internalizing and externalizing subgroups and most of the individual syndrome scales. It is possible that our results were affected by the smaller sample size (42 patients with OSA) than in the study of 64 children. We did not correlate the severity of CBCL abnormalities with the RDI, suggesting that the severity of sleep-disordered breathing does not always predict the degree of behavioral and emotional problems.

For children with OSA, the mean (SD) initial and final OSA-18 total scores were 4.0 (1.2) and 1.6 (0.7), respectively, which agree with the results of the previous study, in which the mean (SD) initial and final OSA-18 total scores were 3.9 (1.5) and 1.6. As reported previously herein, statistically significant improvements were found for the total score and all of the individual domain scores after T&A. The OSA-18 has been validated as a discriminative measure of severity of sleep-disordered breathing among children with positive findings on nap polysomnograms and a responsive measure to longitudinal change. The present study further validates the OSA-18 as a discriminative measure of the severity of sleep-disordered breathing in children with OSA compared with children without sleep-disordered breathing. The health-related QOL impact of sleep-disordered breathing in children with OSA was large for 36% of the children and moderate for 33%, which agrees with the previous study, in which the QOL impact was large for 41% of the children and moderate for 25%. Significant improvements were found after T&A: the QOL impact was small for 98% of the children in both studies. Although the severity of the children's sleep-disordered breathing as demonstrated by the RDI did not correlate with the degree of abnormality of the initial OSA-18 mean scores, it correlated with the change in OSA-18 scores after T&A. Our results differ from those of Franco et al, who demonstrated significant correlation between the mean score and the RDI.

Sociodemographic variables have been shown to affect children's developmental performance. In the previous study of 36 children, there was no effect of family income or the level of parental education on the CBCL results. In the study of 64 children, there was no effect of patient sex, family income, or parental education level on the OSA-18 results; there was no effect of patient sex or family income on the CBCL results; and the level of guardian education had a weak effect on the CBCL results (parents who did not finish high school tended to report higher T scores than parents who finished high school). In the present analysis, including the level of guardian education in the model comparing patients with OSA and controls had no effect on the change in total problem score classification but did have a weak effect on the change in the total problem T score. The difference between the OSA and control groups now only approached significance. However, the correlation between the number of years of guardian education and the total problem T score was weak and not statistically significant. Because our sample size for these analyses was...
only 65 children, a selection bias may have occurred. As in the previous study, the level of guardian education had no effect on the OSA-18 results.

As demonstrated in the previous study, fair to good correlation was found between the preoperative CBCL total problem score and the OSA-18 total score and between the change in CBCL total problem score and OSA-18 total score after T&A. Four domains of the OSA-18 that evaluate the frequency of mood swings, aggression or hyperactivity, discipline, and inattention overlap with domains of the CBCL. Otherwise, the 2 survey instruments evaluate separate but related consequences of sleep-disordered breathing.

The strength of the present study is that all of the patients had documented OSA. Also, the survey scores were compared with those of control children without OSA who were undergoing a surgical procedure instead of with data from children in normative samples. The practice effect, the improvement in survey scores that occurs with the completion of multiple surveys, was eliminated by incorporating a control group. A weakness of this study is that without a true control group—children with OSA who do not undergo T&A—effectiveness or efficacy cannot be inferred. Although improvements in behavior and QOL occurred, we cannot be certain that they were the result of T&A. A true controlled trial would be difficult to perform because the standard of care for children with OSA is surgical treatment.

This study provides further evidence that behavioral and emotional problems are present in children with OSA and improve after treatment. Large improvements in disease-specific health-related QOL are also found. Scores on a standardized assessment of child behavior demonstrated significant correlation with scores on a validated QOL instrument. Additional work is needed to define the precise spectrum of behavioral abnormalities, to elucidate their pathophysiologic mechanism, and to provide diagnostic clues to facilitate their early recognition.

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REFERENCES