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Validation and Confirmatory Factor Analysis of the Pediatric Adherence Barriers to Continuous Positive Airway Pressure Questionnaire

Julia K. Carmody^{1,*}, Stacey L. Simon², Constance A. Mara^{1,3}, Kelly C. Byars^{1,3}

¹Division of Behavioral Medicine and Clinical Psychology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA

²Department of Pediatrics, University of Colorado Anschutz Medical Campus & Children's Hospital of Colorado, Aurora, CO, USA

³Department of Pediatrics, University of Cincinnati College of Medicine

Abstract

Objective—To evaluate and refine a newly proposed factor structure for the Adherence Barriers to Continuous Positive Airway Pressure Questionnaire (ABCQ) and to present psychometric data from a large, geographically diverse sample of children and young adults with sleep disordered breathing (SDB) treated with positive airway pressure (PAP).

Methods—A sample of 181 patients prescribed PAP for treatment of SDB, ages 8 – 21 years, and caregivers (n = 234) of patients ages 2–21 years, completed the ABCQ during routine sleep medicine clinic visits. Adherence data from participants' PAP machines were obtained via electronic download, providing objective data on PAP adherence immediately preceding the clinic visit during which the ABCQ was completed.

Results—A three-factor structure (1. Behavior, Beliefs, Environment, 2. Emotional Barriers, & 3. Physical Barriers) exhibited good model fit in confirmatory factor analysis. Results indicate that the ABCQ has strong psychometric properties, including good internal consistency among subscales and strong convergent validity with objectively measured PAP adherence. Analysis of the Receiver Operator Characteristic Curve (ROC) yielded an ABCQ total cut-off score of 46.5 for patient report and 53.5 for caregiver report. Scores above the cutpoint predicted nonadherence to PAP, defined as failure to use PAP for ≥ 4 hours on 70% of nights.

*Corresponding author: Julia K. Carmody, PhD, Boston Children's Hospital, 300 Longwood Avenue, Boston, MA 02115, phone: 617-919-6790, julia.carmody@childrens.harvard.edu.

CRedit Author Statement

Julia K. Carmody: Conceptualization, methodology, formal analysis, investigation, data curation, writing original draft, visualization, and project administration

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Conclusions—The three-factor ABCQ appears to be a useful patient- and caregiver-report instrument to measure barriers to PAP treatment in children and young adults with sleep disordered breathing.

Keywords

Pediatric; Adherence; continuous positive airway pressure (CPAP); bi-level positive airway pressure treatment (BiPAP); automatic positive airway pressure treatment (AutoPAP); Sleep disordered breathing (SDB)

1 INTRODUCTION

Positive airway pressure (PAP) therapies, including continuous positive airway pressure treatment (CPAP), bi-level positive airway pressure treatment (BiPAP), or automatic positive airway pressure treatment (AutoPAP) are often prescribed for pediatric patients with sleep disordered breathing (SDB) who are not candidates for adenotonsillectomy or who have residual SDB following surgery¹. PAP provides distending pressure to maintain a patent upper airway during sleep. When used appropriately, PAP effectively reduces the apnea hypopnea index (AHI), normalizes oxyhemoglobin saturation, and reduces cortical arousals associated with apneic/hypopneic events¹.

A significant limitation to the effectiveness of PAP treatment in children and adolescents is poor adherence². Studies show that up to one third of pediatric patients do not persist with treatment after it is prescribed^{2,3}. Moreover, youth demonstrate inconsistent use (i.e., not using CPAP every night) and low average nightly use, often less than half of the expected sleep period for age^{1,4,5}. Youth with untreated or undertreated SDB are at risk for a number of negative sequelae, including excessive daytime sleepiness, medical comorbidities such as hypertension, arrhythmia, and hormonal problems, behavioral difficulties such as inattention and hyperactivity, impaired school functioning, mood changes, and neurocognitive deficits⁶⁻⁸.

There are a number of potential barriers to PAP treatment. Barriers span a variety of domains, including, but not limited to, physical side effects of PAP treatment, beliefs or expectations about one's condition and treatment, insufficient understanding of how to use PAP, emotional factors (e.g., embarrassment, fear of mask), behavioral problems (e.g., resistance), and lack of social support^{3,9}. Importantly, barriers are specific to the individual and family, and it is not uncommon for patients to report experiencing multiple barriers at one time¹⁰. Research shows that those patients with obstructive sleep apnea (OSA) who endorse a greater number of barriers are more likely to exhibit poorer PAP adherence¹⁰.

The development and implementation of effective patient- and family-centered interventions to promote PAP adherence and mitigate physical and neurobehavioral consequences of SDB in youth requires that healthcare providers understand the unique individual and family barriers to PAP treatment. Simon and colleagues developed the Adherence Barriers to CPAP Questionnaire (ABCQ) to facilitate the identification of barriers to PAP from the perspective of pediatric patients and their caregivers (ABCQ)¹⁰. The ABCQ has parallel patient and caregiver forms. Each form includes 31 questions representing several conceptually derived

domains including treatment side effects, patient attitudes and beliefs about sleep apnea and PAP treatment, patient relationships with their healthcare providers, psychological and behavioral concerns, social and family support, equipment issues, and environmental factors. The original measure development study demonstrated that the ABCQ had excellent internal consistency (Cronbach's $\alpha = 0.89$ youth form; Cronbach's $\alpha = 0.90$ caregiver form) and test-retest reliability with correlations of 0.81 ($p = .001$) and 0.73 ($p = .001$) for youth and caregiver versions, respectively. The ABCQ displayed convergent validity with objective measures of adherence, such that endorsement of more barriers was associated with poorer adherence to PAP for the caregiver ($N = 48$; $r = -0.44$, $p = .002$) and youth ($N = 48$, $r = -0.44$, $p = .002$) forms¹⁰.

To date, no additional studies have examined the psychometric properties of the ABCQ and the measure has not yet been validated in patients using alternative forms of PAP treatment other than CPAP. Furthermore, due to the small sample size in the original development study, a factor structure was not proposed. While the original study by Simon and colleagues demonstrated the association between total barriers endorsed and adherence to PAP, the relationships between specific types of barriers (e.g., physical versus emotional) and adherence was not examined. Therefore, the objectives of the current study were as follows: (1) to evaluate and refine a newly proposed factor structure, based on the Theoretical Domains Framework of health behavior change¹¹, for the ABCQ using confirmatory factor analysis (CFA); (2) to examine the measure's psychometric properties in a larger, more diverse sample that included patients from two different geographical regions and patients treated with CPAP, BiPAP and AutoPAP; and (3) to assess associations between ABCQ scores with objectively measured PAP adherence.

2 METHODS

2.1 Participants and Procedures

Patients with sleep disordered breathing and their primary caregivers were recruited from two independent clinical settings. Group 1 participants were recruited from a pediatric sleep disorders clinic based in a southeastern U.S. academic medical center and served as the study sample for initial development and validation of the ABCQ¹⁰. The Group 1 study was approved by the university's IRB and caregiver consent and child assent were obtained from all study participants. Group 2 completed the ABCQ as part of routine clinical care within a pediatric sleep center housed in a Midwestern U.S. children's hospital. Group 2 data were collected via an IRB-approved protocol for retrospective chart review. Across both settings, inclusion criteria were: (1) confirmed diagnosis of obstructive sleep apnea, hypoventilation syndrome, or central sleep apnea confirmed by overnight diagnostic polysomnography in an accredited sleep laboratory, (2) physician-prescribed positive airway pressure treatment (PAP) for at least 30 days prior to baseline clinic visit when ABCQ was completed, and (3) English language proficiency. The age range for the Group 1 study was 8 to 17 years, and all patients and their caregivers completed the ABCQ. In the Group 2 study, patients aged 2–21 years were included. Primary caregivers completed the caregiver-version of the ABCQ for patients covering the age range of the study and patients ≥ 8 years old completed the patient-

report ABCQ. Children under age 8 years and youth with significant cognitive impairment did not complete the patient-report questionnaire.

2.2 Measures

2.2.1 Barriers to PAP—Patients and their caregivers were administered the original ABCQ¹⁰. Respondents indicated the extent to which each barrier impacted PAP treatment on a 5-point Likert scale, ranging from 1-Never to 5-Very Often. Ratings across the 31 items were summed, resulting in a total score for both patients and caregivers, with higher scores reflecting greater number and severity of barriers to PAP treatment.

The current study sought to evaluate and refine a proposed factor structure for the ABCQ using confirmatory factor analysis (CFA). A proposed five-factor structure was developed based on the Theoretical Domains Framework (TDF), an integrated theoretical model of health behavior change¹¹. The TDF was designed as an overarching framework to conceptualize health behavior change across a variety of patient populations. The TDF groups theoretical constructs relevant to behavior change into domains, and posits that improvements in health behavior result from changes in one or more of the identified domains. One advantage to using this framework is that it links theories of behavior change with individual behavior change techniques to inform intervention and improve implementation to bring about behavior change. In the current study, five domains from the model were selected based on the content of the ABCQ. Three experts (pediatric behavioral sleep medicine psychologists with experience in PAP adherence promotion) independently reviewed the existing ABCQ measure and assigned each survey item into one of the following TDF domains: Behavioral Regulation, Beliefs/Knowledge, Environmental Context/Resources, Emotional Barriers, and Physical Barriers. Discrepancies were resolved through discussion and consensus was achieved regarding domain assignment for all items.

Following initial domain assignments, the experts independently reviewed all items within each domain and flagged items that did not fit with the proposed factor model based on one or more of the following criteria: (1) item content was not fully consistent with the domain conceptualization, (2) item was semantically redundant with another item, (3) item content was too narrow to have universal applicability, or (4) item was confusing. This qualitative review system has been widely used to shorten and improve self-report measures, including the PROMIS measures¹². The experts determined that if a single item was flagged by two or more raters as having poor fit with the conceptualized factor structure, that item would be considered for removal if CFA indicated the item was cross-loading with other factors or was unrelated to the underlying construct.

2.2.2 Adherence to PAP—Adherence data from participants' PAP machines were obtained via electronic download and provided objective data on PAP adherence during the 30-day period immediately preceding the clinic visit when the ABCQ measures were completed. Objective adherence data were examined for the 30 day period as follows: (1) percent of nights PAP was used, (2) average number of PAP therapy hours per night (i.e., duration of PAP usage), and (3) percentage of nights PAP was used for ≥ 4 hours.

2.2.3 Participant, Condition, and Treatment Characteristics—The following information was abstracted from the electronic medical record for each patient: age, gender, primary SDB diagnosis (i.e., OSA, CSA, or hypoventilation syndrome), date PAP was initiated (i.e., date of initial setup), and treatment type (i.e., CPAP, BiPAP, or AutoPAP).

2.3 Statistical Analysis

Confirmatory factor analysis (CFA) was conducted in Mplus version 8.3 with mean- and variance-adjusted weighted least squares estimator (WLSMV; appropriate for ordered categorical response options) to assess overall validity of the factor structure. Following Hu and Bentler's guidelines, CFI and TLI 0.90, RMSEA 0.06, and SRMR 0.08 were interpreted to indicate good fit¹³. Reliability was assessed using Cronbach's alpha and interpreted as follows: 0.70–0.79 “adequate,” 0.80–0.89 “good,” and 0.90 “excellent” internal consistency¹⁴. Convergent validity of ABCQ with objective adherence rates (percent nights worn, average nightly duration, percent nights ≥ 4 hours) and with time since starting PAP were assessed using bivariate correlations, where a correlation coefficient of 0.30–0.49 demonstrated a moderate correlation and ≥ 0.50 indicated a strong correlation¹⁵.

Once the final model was determined, descriptive statistics were calculated for caregiver and patient-report ABCQ total and factor scores. Mean differences between caregiver and patient-report scores were evaluated using paired sample t-tests.

Sensitivity and specificity analyses were used to discriminate adherent versus nonadherent patients, using the area under the Receiver Operating Characteristics (ROC) curve. ROC analyses were conducted separately for patient and caregiver versions of the ABCQ. The area under the ROC curve describes the ability of a continuous measure to discriminate a dichotomous outcome. Patients were classified as “adherent” if they used PAP for ≥ 4 hours on at least 70% of nights during the period of observation. The study definition for adherence was chosen in order to consider both duration and frequency of PAP use which are critical to optimal management of sleep apnea and its impact on daytime functioning in youth¹. The continuous ABCQ total score was expected to be lower among those with the target outcome (i.e., adherent to PAP), meaning those who reported fewer barriers were expected to be adherent. Area under the curve (AUC) ranges from 0.5–1.0, with 0.5 indicating no systematic prediction (i.e., no better than chance), and 1.0 indicating the existence of a perfect cutoff. AUC < 0.70 is not considered a useful predictor, 0.70–0.79 demonstrates “fair” discrimination, 0.80–0.89 “good”, and 0.90–1.0 “excellent” discrimination¹⁶.

Lastly, ROC analysis was used to identify the optimal cutpoint on the ABCQ total score for predicting nonadherence. The evaluation of a cutpoint via ROC curves involves balancing sensitivity and specificity. The sensitivity of a test is the probability of a true positive and the specificity of a test is the probability of a true negative. While high sensitivity is important, a measure which classifies everyone as a “case” is uninformative. Thus, both sensitivity and specificity must be considered. Youden's Index was used to balance sensitivity and specificity because it calculates the value at which these two concepts are maximized¹⁷.

3 RESULTS

3.1 Descriptive Characteristics

Group 1 participants were 51 children with SDB, ages 8–17 years, and their caregivers (N = 51). Group 2 participants were 130 patients with SDB ages 8–21 years and their caregivers. An additional 53 caregivers of patients aged 2–21 years participated without corresponding youth-report surveys due to children under age 8 (n = 25) or child with developmental delay or cognitive impairments (n = 28). In total, the sample consisted of 181 patients prescribed PAP and 234 caregivers. Participant characteristics are detailed in Table 1. Approximately 94% of youth had a primary diagnosis of OSA and the majority were prescribed CPAP (62.9%). Time since PAP initiation ranged from one month to 12 years (M = 28 months). PAP adherence downloads for the period directly preceding the clinic visit were obtained for all participants, and for the majority of participants (75%), the download covered 30 nights.

On average, PAP was used on $70.3 \pm 32.4\%$ of nights. Average nightly use across nights used ranged from 0 to 12.8 hours and average nightly use was 5.5 ± 3.2 hours. On average, PAP use of 4 hours occurred on $49.6 \pm 37.0\%$ of nights.

3.2 Reliability and Validity Analysis

Validity of the factor structure was initially tested using the larger caregiver sample for the ABCQ response data. The caregiver sample included more surveys due to children <8 years and those with cognitive impairments not completing the self-report form. First, the original single factor structure (Simon, 2012) was tested (Model 1, Table 2). Next, the proposed 5-factor structure (Behavioral Regulation, Beliefs/Knowledge, Environment Context/Resources, Emotional Barriers, and Physical Barriers) was tested but the model did not converge as a result of high correlation among the Behavioral Regulation, Beliefs/Knowledge, and Environment Context/Resources factor scales ($r = 0.92\text{--}1.02$). Further, internal consistency for the Behavioral Regulation scale was low (Cronbach $\alpha = 0.61$). Given these findings, we combined Behavioral Regulation, Beliefs/Knowledge, and Environment Context/Resources into a single scale, yielding a 3-factor solution. The 3-factor model demonstrated adequate fit to the data and improved fit compared to the single factor model (Model 2, Table 2). Internal consistency for the Behavior, Beliefs, and Environment scale was good ($\alpha = 0.89$).

Modification indices indicated that items 3 (too much hassle to use PAP), 9 (embarrassed to use PAP), and 15 (worried my friends will find out) were cross loading on other factors. Based on qualitative item ratings, items 15 and 3 were deemed acceptable for removal based on redundancy with other items, while item 9 was retained due to the experts' unanimous agreement regarding the items clinical relevance. The 3-factor 29-item solution (items 15 and 3 removed) was tested, and the model demonstrated improved fit (Model 3, Table 2) over the 31-item 3-factor solution (Model 2). Modification indices indicated items 2 (Forget to use PAP) and 12 (No place to keep PAP) had potentially high cross-loadings on other factors. However, based on qualitative item review and clinical utility, both items were retained. Finally, we tested the factor structure model in the patient report form, and the model demonstrated adequate fit to the patient-reported data (Model 4).

In order to evaluate whether all the items could be explained by a higher order “total barriers” factor, we tested the final 3 factor 29-item model solution with a single higher order factor explaining all the sub-factors (Figure 1) with models for caregiver response data (Model 5; Table 2) and patient report data (Model 6; Table 2) demonstrating good fit to the data. Factor loadings from the final 3-factor 29-item model and internal consistency estimates for the revised subscales and total score are presented in Table 3. Descriptive statistics for patient and caregiver subscales and total ABCQ scores are presented in Table 4. Average patient scores were significantly higher than average caregiver scores for all three scales and total.

3.3 Convergent Validity

Bivariate correlations are presented in Table 5. Strong negative correlations were found between ABCQ scales and percent days used, such that higher scores on ABCQ scales (i.e., endorsing more barriers) were associated with lower frequency of PAP use. Patient and caregiver ABCQ scale scores were negatively and moderately correlated with average nightly use ($r = -0.41$ – -0.48). There was a strong negative correlation between patient Physical Barriers scale score and average nightly use ($r = -0.52$). Caregiver and patient total scores on the ABCQ were strongly and negatively correlated with percent nights used, average nightly use, and percent nights with usage ≥ 4 hours ($r = -0.52$ – -0.77). Time since initiating PAP was weakly and negatively correlated with caregiver and patient ABCQ total scores, such that more months on PAP was only weakly associated with endorsement of fewer problematic barriers. Similarly, for both caregiver and patient forms, ABCQ scale scores were weakly and negatively correlated with time since initiating PAP.

3.4 Receiver-Operating Characteristic and Cutpoint Analysis

Thirty-six percent of the sample was classified as adherent, defined as using PAP for ≥ 4 hours on $\geq 70\%$ of nights. Using objectively measured PAP adherence as the gold standard, we calculated the sensitivity, specificity, and area under the curve (AUC) for both caregiver and patient forms of the ABCQ. AUC was 0.749 (95% CI = 0.663–0.835) and 0.799 (95% CI = 0.701–0.898) for the caregiver and patient samples, respectively (Figure 2). Both models were significantly different ($p < .001$) from a random predictor (AUC = 0.500). For the patient sample, Youden’s index demonstrated an optimal cutpoint of 53.5, with a sensitivity of 0.963 and specificity of 0.490. For the caregiver sample, the optimal cutpoint was 46.5, with sensitivity of 0.778 and specificity of 0.627.

4 DISCUSSION

The current study extends previous findings with the ABCQ in several ways. This is the first study to examine the factor structure of the ABCQ using CFA in a sample of patients with SDB on PAP therapy and their caregivers. Findings revealed a three factor structure for barriers to PAP: (1) Behavior, Beliefs, and Environment; (2) Emotional Barriers; and (3) Physical Barriers. Findings from the current study demonstrated associations between objectively measured PAP adherence and ABCQ scale scores and defined a cutpoint for predicting nonadherence using the ABCQ total score.

The results of the current study support the ABCQ as a reliable and valid measure of barriers to PAP treatment. Results indicate that the ABCQ has strong psychometric properties, including good internal consistency among subscales and strong convergent validity. CFA results revealed a three-factor structure, suggesting that each factor may be considered independently when scoring the ABCQ patient and caregiver forms. The original measure and instructions for factor scoring and interpretation are available in the Supplemental section. Interpretation of factors may be used to indicate which type of provider and intervention would be most beneficial for each patient and family. For example, a high score on the Emotional Barriers scale would suggest a patient may benefit from cognitive behavioral intervention delivered by a psychologist or other mental health provider, whereas a high score on the Physical Barriers scale would suggest potential clinical need for additional assessment and intervention by a respiratory therapist or physician. Results from the CFA also demonstrate a higher order “total barriers” factor, which supports the calculation of total barriers scores for interpretation. Overall, results support the use of the ABCQ in clinical settings to reliably identify specific issues that are salient to each patient/caregiver and to aid in identifying appropriate patient and family-centered intervention targets to improve adherence.

It is noteworthy that CFA results did not support our initial conceptually driven five-factor structure due to high correlations among three of the initially proposed factors (1. Behavioral Regulation, 2. Beliefs/Knowledge, and 3. Environmental Context). While results do not support scoring these domains separately, we believe it is clinically useful to consider subgroups (Behavior, Beliefs, and Context) within this factor in order to guide appropriate intervention.

Our findings further extend clinical interpretation of the ABCQ by defining patient and caregiver total score cutpoints for predicting nonadherence. Of note, the cutpoint with the highest sensitivity and specificity for patients (53.5) was higher than the optimal cutpoint for caregivers (46.5). This aligns with our findings that patients reported significantly more barriers and greater difficulty with barriers compared to their caregivers. Therefore, it is recommended that both caregivers and patients complete the ABCQ separately and that both forms are used to inform further clinical assessment and intervention when possible. The patient version is suitable for those eight years and older with appropriate cognitive ability. Based on results from the current study, if a patient or caregiver scores above the cutpoint, this would indicate a critical need for further assessment and intervention around barriers.

4.1 Limitations and Future Directions

The current findings should be considered in light of several limitations. While our sample was comprised of both typically developing youth and those with developmental delays, we were not able to examine differences in the factor structure or psychometric properties of the ABCQ by developmental level due to our limited sample size. Future research should evaluate differences by groups, as barriers to using PAP for youth with developmental delays or cognitive impairment may differ from neurotypically developing children. Similarly, our sample was comprised of a wide age range. Due to sample size limitations, we were not able to conduct age-group comparisons. Such analyses are warranted in future studies with the

ABCQ. While our sample was heterogeneous in its inclusion of patients recently started on PAP and longer-term users, it did not include patients who were prescribed PAP and then discontinued treatment against medical advice or those who were lost to follow up. Future studies should seek to assess barriers in those who do not persist with treatment, as barriers in this group may be unique (e.g., barriers to accessing health care, cost of treatment). Another limitation is that our sample was restricted to English language speakers only. Future directions include translating the measure into other languages and evaluating its psychometric properties in non-English speaking populations.

There are also limitations with regard to how adherence was measured and defined in the current study. First, only adherence data from the period immediately preceding the clinic visit were used in analyses. These data do not account for inter-individual variation in PAP use over time. It is possible that for some patients the data obtained at the clinic visit were not representative of their typical adherence behavior (e.g., if a patient had a viral illness prior to their clinic visit, adherence rates for that month may have been lower than usual). Second, for the cutpoint analyses, patients who used PAP for 4 hours on 70% of nights were categorized as adherent. Nightly use of 4 hours is the most common adherence threshold used by medical equipment suppliers and insurance companies and is consistently reported as a benchmark for adherence. However, at this time there are no universally agreed upon measures to determine a threshold for optimum use of PAP in children²¹. As physiological sleep requirements vary across development, so does optimal use duration. Moreover, pediatric studies show that the longer PAP is worn, the better the outcomes. For example, Marcus and colleagues demonstrated that greater nightly duration of PAP use was associated with decreasing daytime sleepiness in children²². Therefore, providers, patients, and caregivers should work toward the goal of patients wearing PAP for as long as possible each night.

The lack of other standardized measures assessing pediatric barriers to PAP limits the conclusions that can be drawn regarding the construct validity of the measure. However, our results are consistent with a plethora of research across pediatric chronic illness groups demonstrating that youth who experience a greater number of barriers are more likely to have poor adherence^{18–20}. Finally, future investigations conducted with larger sample sizes across multiple sites are needed to replicate and expand upon the present findings. In addition to the future research directions that were previously mentioned, additional research examining the sensitivity of the ABCQ to measure treatment response for patients participating in adherence promoting interventions as well as changes in adherence over time is warranted.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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ABBREVIATIONS

PAP	positive airway pressure
CPAP	continuous positive airway pressure
BiPAP	bi-level positive airway pressure treatment
AutoPAP	automatic positive airway pressure treatment (AutoPAP)
SDB	sleep disordered breathing
ROC	receiver operator characteristic
ABCQ	Adherence Barriers to Continuous Positive Airway Pressure Questionnaire
AUC	area under the curve

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Highlights

- Confirmatory factor analysis of a measure assessing pediatric barriers to positive airway pressure adherence.
- Results supported a 3-factor structure (behavioral/environmental, emotional, and physical barriers).
- Results indicated strong psychometric properties among a large, geographically diverse sample.
- Receiver Operator Characteristic analysis yielded total score cutpoints predicting nonadherence.

Figure 1.
Final 3-factor structure for patient and caregiver forms.

Figure 2.

Receiver Operating Curves (ROC) are illustrated for patient and caregiver prediction models.

ABCQ = Adherence Barriers to CPAP Questionnaire; AUC = Area Under the Curve

Table 1.

Sample characteristics.

Variable	Percent or Mean $\pm$ SD
Patient Sex	
Male	55.8% (n = 101)
Female	44.2% (n = 80)
Total	N = 181
Patient Age (years)	14.1 $\pm$ 4.8
Race/Ethnicity	
White	76.0%
Black/African American	21.0%
Hispanic/Latino	2.0%
Asian	1.0%
Relationship of caregiver to patient	
Mother/Step-mother	71.0% (n = 166)
Father/Step-father	13.7% (n = 32)
Grandparent	11.5% (n = 27)
Other	3.8% (n = 9)
Total	N = 234
Primary SDB Diagnosis	
Obstructive Sleep Apnea	93.7%
Central Sleep Apnea	2.9%
Hypoventilation Syndrome	3.4%
Diagnostic Apnea-Hypopnea Index	17.7 $\pm$ 21.7
Treatment Modality	
CPAP	62.9%
BiPAP	19.0%
AutoPAP	18.1%
Time since starting PAP (months)	28.4 $\pm$ 27.7

SD = Standard Deviation; SDB = Sleep-Disordered Breathing; CPAP = Continuous positive airway pressure treatment; BiPAP = Bi-level positive airway pressure treatment; AutoPAP = automatic positive airway pressure treatment.

Table 2.

Model fit indices.

Model	χ^2	df	CFI	TLI	RMSEA	SRMR
1	1112.057	434	0.900	0.893	0.082	0.109
2	1047.988	431	0.909	0.902	0.078	0.106
3	802.692	374	0.923	0.917	0.070	0.096
4	739.963	374	0.931	0.925	0.074	0.089
5	632.463	347	0.949	0.940	0.059	0.078
6	586.213	347	0.955	0.947	0.062	0.072

Model 1: Single factor model.

Model 2: 3-factor 31-item model, caregiver response data.

Model 3: 3-factor 29-item model (items 15 and 3 removed), caregiver response data.

Model 4: 3-factor 29-item model, patient response data.

Model 5: 3-factor 29-item model with general factor, caregiver response data.

Model 6: 3-factor 29-item model with general factor, patient response data.

χ^2 = Model ChiSquare; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker Lewis index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.

Table 3.

Factor loadings and internal consistency for final ABCQ 3-factor structure.

Item/Scale	Loadings			Cronbach α	
	Patient	Caregiver	Patient	Caregiver	
Behavior, Beliefs, & Environment					
Item 2			0.887		0.869
Item 6	0.675	0.717			
Item 21	0.745	0.761			
Item 26	0.724	0.782			
Item 31	0.592	0.684			
Item 11	0.753	0.782			
Item 13	0.675	0.686			
Item 17	0.799	0.770			
Item 19	0.831	0.810			
Item 23	0.675	0.660			
Item 24	0.563	0.660			
Item 29	0.751	0.774			
Item 7	0.818	0.844			
Item 12	0.740	0.404			
Item 16	0.772	0.712			
Item 18	0.610	0.613			
Item 22	0.703	0.601			
Item 27	0.541	0.676			
	0.650	0.585			
Emotional Barriers					
Item 5			0.769		0.749
Item 9	0.865	0.774			
Item 25	0.573	0.718			
Item 30	0.792	0.754			
	0.702	0.781			
Physical Barriers					
Item 1			0.800		0.729
	0.319	0.357			

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Item/Scale	Cronbach α			
	Loadings			
	Patient	Caregiver	Patient	Caregiver
Item 4	0.640	0.688		
Item 8	0.596	0.462		
Item 10	0.591	0.619		
Item 14	0.694	0.777		
Item 20	0.485	0.507		
Item 28	0.793	0.762		
Total Barriers to PAP Adherence				
			0.901	0.921

PAP = Positive airway pressure treatment.

Table 4.

Descriptive statistics for ABCQ scales and total score.

Scale	Mean ± SD		Range		P value ^a
	Caregiver	Patient	Caregiver	Patient	
Behavior, Beliefs, & Environment	25.81 ± 7.81	32.23 ± 11.51	15–56	16–63	<.001
Emotional Barriers	7.38 ± 3.52	8.47 ± 4.0	3–20	4–20	<.001
Physical Barriers	14.07 ± 5.17	15.19 ± 5.66	6–31	6–31	.001
Total Score	51.07 ± 15.79	59.97 ± 21.29	30–100	29–118	.015

SD = Standard Deviation.

^aDifferences between caregiver and patient average scores were evaluated using paired sample t-tests.

Table 5.

Bivariate correlations among revised ABCQ scales, ABCQ total score, and adherence.

	Behavior, Beliefs, & Environment		Emotional		Physical		Total Score	
	Caregiver	Patient	Caregiver	Patient	Caregiver	Patient	Caregiver	Patient
% nights used	-0.56**	-0.71**	-0.57**	-0.62**	-0.53**	-0.66**	-0.67**	-0.77**
Average nightly use ^a	-0.44**	-0.52**	-0.48**	-0.45**	-0.42**	-0.41**	-0.53**	-0.52**
% nights with 4 hrs	-0.51**	-0.51**	-0.48**	-0.46**	-0.47**	-0.49**	-0.59**	-0.56**
Time since starting PAP	-0.15*	-0.20*	-0.27**	-0.28**	-0.10	-0.21*	-0.21**	-0.24**

* Indicates significant correlation at $p < .05$ level.

** Indicates significant correlation at $p < .01$ level.

^a Average nightly use, average hours per night across nights used.