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## Original Article

## Psychometric properties of the children's sleep habits questionnaire in children with autism spectrum disorder

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## ABSTRACT

**Background and purpose:** Sleep disturbances in autism spectrum disorder (ASD) are very common. Psychometrically sound instruments are essential to assess these disturbances. Children's Sleep Habit Questionnaire (CSHQ) is a widely used measure in ASD. The purpose of this study was to explore the psychometric properties of the CSHQ in a sample of children with ASD.

**Participants and methods:** Parents/caregivers of 310 children (mean age: 4.7) with ASD completed the CSHQ at study enrollment. Correlations between intelligence quotient (IQ) scores and the original CSHQ scales were calculated. Item endorsement frequencies and percentages were also calculated. A principal component analysis (PCA) was performed, and internal consistency was assessed for the newly extracted components.

**Results:** Correlations between IQ scores and CSHQ subscales and total scores ranged from .015 to .001 suggesting a weak, if any, association. Item endorsement frequencies were high for bedtime resistance items, but lower for parasomnia and sleep-disordered breathing items. A PCA suggested that a five-component solution best fits the data. Internal consistency of the newly extracted five components ranged  $\alpha = .87-.50$ .

**Conclusions:** Item endorsement frequencies were highest for bedtime resistance items. A PCA suggested a five-component solution. Three of the five components (Sleep Routine Problems, Insufficient Sleep, and Sleep-onset Association Problems) were types of sleep disturbances commonly reported in ASD, but the other two components (Parasomnia/Sleep-disordered Breathing and Sleep Anxiety) were less clear. Internal consistencies ranged from mediocre to good. Further development of this measure for use in children with ASD is encouraged.

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## 1. Introduction

The prevalence of sleep problems in the general pediatric population is estimated at 25% [1], but poorly regulated sleep patterns affect up to nearly 80% of children with autism spectrum disorder (ASD) independent of intellectual functioning [2–4]. The common sleep problems identified in this research include delayed sleep onset, night wakings after sleep onset, early morning wakings, decreased total sleep time, bedtime resistance, and sleep-onset association problems (eg, sleeping with a parent, sleeping in places other than the child's own bed, and requiring idiosyncratic objects

to initiate sleep onset). Sleep disturbances can interfere with cognition, attention, memory consolidation, and daytime behavioral adjustment in general [5–10]. In children with ASD, sleep disturbances may amplify already delayed social interactions, repetitive behaviors, affective problems, and inattention/hyperactivity [11–15].

Given the high prevalence of sleep disturbances in children with ASD, a low-cost, but psychometrically sound, instrument to assess sleep disturbances for intervention research and clinical practice is needed. In comparison to the well-established instruments measuring daytime behavioral problems in children with ASD, however, few psychometrically sound measures to assess sleep problems are available for pediatric populations [16,17]. One approach to instrument development in ASD is to adapt a measure used in the broader population for use in ASD [18–20].

One widely used pediatric sleep questionnaire is the Children's Sleep Habits Questionnaire (CSHQ) [21]. The CSHQ was developed

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to screen for sleep disorders for 4–10-year-olds based on the pediatric International Classification of Sleep Disorders (ICSD) [21]. The 33-item scale consists of eight subscales: 1) Bedtime Resistance, 2) Sleep Onset Delay, 3) Sleep Duration, 4) Sleep Anxiety, 5) Night Wakings, 6) Parasomnias, 7) Sleep-disordered Breathing, and 8) Daytime Sleepiness. These subscales range in length from 1 to 8 items (Sleep-onset Delay to Daytime Sleepiness). The initial publication on this measure described some psychometric properties, including internal consistency, test–retest reliability, and discriminated validity between a community sample ( $n = 1099$ ) and clinical sample ( $n = 154$ ) [21]. Test–retest reliability in a subset of 60 participants in the community sample over two weeks ranged from .62 to .79. Internal consistency for the CSHQ was .68 for the community sample and .78 for clinical sample. However, there was considerable variability in alphas for the subscales ranging from .36 to .83. The total score and subscales differentiated between the community sleep sample and a clinic sample of problem sleepers, supporting discriminate validity of the CSHQ. Results of a receiver operator characteristics (ROC) analysis suggested that a total score of 41 was considered the optimal clinical cutoff for sleep problems. A later study showed that the CSHQ discriminated between good and poor sleepers in a sample of 194 preschool children down to two years of age [22]. A review of the available pediatric sleep questionnaires examined whether the CSHQ met 11 steps toward psychometric validity [16]. The criteria applied included 1) purpose of the tool; 2) research question at hand; 3) response format; 4) generate items; 5) pilot; 6) item analysis and non-response analyses; 7) structure; 8) reliability; 9) validity; 10) confirmatory analyses; and 11) standardization and development of norms. The review concluded that the CSHQ met steps, 1, 2, 3, 8, and 9. Despite identifying several strengths, the review suggested that further refinement of the CSHQ is warranted. Moreover, assignment of some items to subscales can be questioned. For example, “child is afraid of sleeping alone” and “child needs parent in the room to fall asleep” are in both Bedtime Resistance and Sleep Anxiety subscales. Logically, such similar items should be included in only one subscale. Some items are also not developmentally appropriate for young children, particularly those with developmental delays (eg, the question on bedwetting in the Parasomnia subscale and the question of waking once a night on the Night Waking subscale). The bedwetting item was earlier highlighted as problematic in young children where bedwetting is commonplace and not likely associated with parasomnia [22], while waking once a night is common in young children [23]. As noted, the number of items in each subscale is highly variable, ranging from one item (Sleep Onset) to eight (Daytime Sleepiness). This raises questions about the adequacy of symptom coverage across subscales. It also raises concerns about reliability as it is axiomatic that reliability declines as the number of component items diminishes.

Several large-scale studies have examined the psychometric properties of non-English versions of the CSHQ. A factor analysis in a large sample of Chinese children ( $n = 20,457$ ) did not replicate the eight-factor structure of the CSHQ [24]. These authors proposed a three-factor structure: 1) Bedtime Behavioral Problems, 2) Sleep Disturbance, and 3) Sleep Duration and Daytime Sleepiness. As only the abstract for this publication was available in English, examination of the factor loadings of items was not possible. In a Dutch sample of children ( $n = 2385$ ), Waumans et al. [25] reported moderate to good test–retest reliability, interobserver reliability, and internal consistency. A confirmatory factor analysis again failed to confirm the original eight-factor instrument. These authors suggested a four-factor model, but three items loaded on two factors, and four items (“falls asleep in own bed,” “snores loudly,” “awakes once during night,” and “wakes by himself”) were removed. Unfortunately, the factors were not named in this publication, nor were the factor loadings presented. A German study of 298 nonclinical

and 45 clinically ascertained children evaluated the reliability and validity of a German version of the CSHQ [26]. For the total score, internal consistency was 0.68 and test–retest reliability was 0.76. Across subscales, internal consistency ranged from 0.23 to 0.70 (very poor, overall) and test–retest reliability from 0.46 to 0.81. However, they also conducted a principal component analysis (PCA), suggesting only one component with high loadings. Unfortunately, as the factor or component loadings and assignments were not available, it was not possible to evaluate or compare any of these studies. Taken together, nonetheless, these studies suggest that the CSHQ is a candidate for further development given the inconsistent psychometric findings.

Despite somewhat limited psychometric development, the CSHQ has been used extensively in research to document prevalence of and to characterize sleep disorders in various pediatric populations [27,28]. Further, it has been used widely in the emerging literature of sleep disturbances in children with ASD including its use as an outcome measure [13,29–31]. Indeed, the CSHQ is currently being used by the 17 sites of the Autism Speaks Autism Treatment Network (AS-ATN) to assess bedtime behavior and sleep patterns in its registry of children and adolescents with ASD in North America [12,32]. Spruyt & Gozal [17] reported another pediatric sleep questionnaire, that is, the Sleep Disturbance Scale for Children [33], which met all the 11 criteria and then the Behavior Evaluation of Disorders Sleep Scale (BEDS) [34]. These two measures have also been used in ASD [15,35,36].

Given the limited psychometric examination of the CSHQ in ASD and widespread use with this population, there is a need for further psychometric development of the CSHQ in the field of ASD. This study has two goals: 1) to describe the CSHQ results across three different groups of young children with ASD (with one group identified as having clinically significant sleep disturbances) and 2) to explore the component structure of the CSHQ for this sample and to determine the internal consistency of the newly identified principal components of the CSHQ in children with ASD.

## 2. Methods

### 2.1. Sample

A total of 310 children with ASD were enrolled from three studies. The 24-week, multisite randomized controlled trial of parent training (PT) versus parent education (PE) conducted at Emory University, Indiana University, Ohio State University, University of Pittsburgh, University of Rochester, and Yale University [37] included 177 children (57%; age: 3–7 years). In addition to ASD, eligible children had disruptive behavior as evidenced by a score of  $\geq 15$  on the irritability subscale of the Aberrant Behavior Checklist (ABC) [38] and a Clinical Global Impressions Severity (CGI-S) [39] score of  $\geq 4$  (at least moderate). Either participants were taking no medication or medication had to be stable for 6 weeks. Children with Rett's disorder or childhood disintegrative disorder, any serious medical conditions or psychiatric disorder, developmental level of  $< 18$  months, and current or past enrollment in structured PT program were excluded. The diagnosis of ASD was based on DSM-IV criteria [40] and corroborated by the Autism Diagnostic Observation Schedule (ADOS) [41, 42].

The second study enrolled 34 children (11%; age: 2–6 years) with ASD who participated in an 8-week randomized trial of a PT program designed to address sleep disturbances versus parent education [43]. The diagnostic assessment was similar to the inclusion to the multisite trial described earlier. In addition, eligible subjects with ASD had at least one sleep problem (bedtime resistance, delayed sleep disorders, sleep-onset association problem, night wakings, and/or early morning wakings) at a frequency of at least five days per week. Exclusions were similar to the RUBI study but with the

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