CHEST

Reliability of Home Respiratory Polygraphy for the Diagnosis of Sleep Apnea in Children

María Luz Alonso-Álvarez, MD; Joaquin Terán-Santos, MD; Estrella Ordax Carbajo, MD, PhD; José Aurelio Cordero-Guevara, MD; Ana Isabel Navazo-Egüia, MD; Leila Kheirandish-Gozal, MD; and David Gozal, MD, FCCP

OBJECTIVE: The objective of this study was to evaluate the diagnostic reliability of home respiratory polygraphy (HRP) in children with a clinical suspicion of OSA-hypopnea syndrome (OSAS).

METHODS: A prospective blind evaluation was performed. Children between the ages of 2 to 14 years with clinical suspicion of OSAS who were referred to the Sleep Unit were included. An initial HRP followed by a later date, same night, in-laboratory overnight respiratory polygraphy and polysomnography (PSG) in the sleep laboratory were performed. The apnea-hypopnea index (AHI)-HRP was compared with AHI-PSG, and therapeutic decisions based on AHI-HRP and AHI-PSG were analyzed using intraclass correlation coefficients, Bland-Altman plots, and receiver operator curves (ROCs).

RESULTS: Twenty-seven boys and 23 girls, with a mean age of 5.3 ± 2.5 years, were studied, and 66% were diagnosed with OSAS based on a PSG-defined obstructive respiratory disturbance index ≥ 3/h total sleep time. Based on the availability of concurrent HRP-PSG recordings, the optimal AHI-HRP corresponding to the PSG-defined OSAS criterion was established as ≥ 5.6/h The latter exhibited a sensitivity of 90.9% (95% CI, 79.6%-100%) and a specificity of 94.1% (95% CI, 80%-100%).

CONCLUSIONS: HRP recordings emerge as a potentially useful and reliable approach for the diagnosis of OSAS in children. However, more research is required for the diagnosis of mild OSAS using HRP in children. CHEST 2015; 147(4):1020-1028

Manuscript received August 8, 2014; revision accepted November 25, 2014; originally published Online First December 24, 2014.

ABBREVIATIONS: ENT = ear, nose, and throat; HRP = home respiratory polygraphy; ICC = interclass correlation coefficient; LRP = in-laboratory respiratory polygraphy; OAHI = obstructive apnea-hypopnea index; ORDI = obstructive respiratory disturbance index; OSAS = OSA-hypopnea syndrome; PSG = polysomnography; RDI = respiratory disturbance index; ROC = receiver operating characteristic; RP = respiratory polygraphy; Spo_2 = oxygen saturation using pulse oximetry; SU = Sleep Unit

AFFILIATIONS: From the Sleep Unit (Drs Alonso-Álvarez, Terán-Santos, Ordax Carbajo, Cordero-Guevara, and Navazo-Egüia), the CIBER of Respiratory Diseases (Drs Alonso-Álvarez and Terán-Santos), Instituto Carlos III, CIBERES, and the Hospital Universitario de Burgos (Drs Alonso-Álvarez, Terán-Santos, Ordax Carbajo, Cordero-Guevara, and Navazo-Egüia), Burgos, Spain; and the Section of Sleep Medicine (Drs Kheirandish-Gozal and Gozal), Department of Pediatrics, Comer Children's Hospital, Pritzker School of Medicine, Biological Sciences Division, The University of Chicago, Chicago, IL.

FUNDING/SUPPORT: Funded by the Spanish Respiratory Society (SEPAR) and Ministry of Health Castilla-Leon, Spain, and by National Institutes of Health [Grant HL-65270 to Drs Kheirandish-Gozal and Gozal].

CORRESPONDENCE TO: María Luz Alonso-Álvarez, MD, Sleep Unit, Hospital Universitario de Burgos, Avda, Islas Baleares SN, 09006 Burgos, Spain; e-mail: mlalonso@hubu.es

DOI: 10.1378/chest.14-1959

Respiratory sleep disorders, and particularly OSA-hypopnea syndrome (OSAS), are common during the pediatric age range. The true prevalence of OSAS in children is unclear, but is estimated to range between 0.2% and 4.1%.[1] Numerous studies have shown that OSAS in children is associated with significant morbidity,[2-11] and, therefore, it is critical to recognize and diagnose this condition in a timely manner to reduce the magnitude of OSAS-induced adverse consequences and the attendant increases in direct and indirect health-care costs.[12]

Overnight polysomnography (PSG) remains the gold standard for the diagnosis of OSAS.[6,11] Thus, the number of patients diagnosed with OSAS is critically dependent on the availability and accessibility of PSG. However, access to in-laboratory PSG is complicated not only by the inconvenience to children and their families but also by the insufficient capacity of most clinical sleep programs and the relative scarcity of professionals with the appropriate expertise in pediatric sleep disorders. Therefore, simpler diagnostic approaches are required and should preferentially allow for home-based diagnostic capabilities. Home respiratory polygraphy (HRP) is currently accepted and used as an effective diagnostic technique for OSAS in adults.[13] We have validated respiratory polygraphy (RP) in children by performing PSG and in-laboratory RP (LRP) simultaneously in the sleep laboratory and found LRP to provide a useful alternative to full-fledged PSG in the diagnosis of OSAS in children.[14] The major aim of the present study was to evaluate the potential usefulness of a diagnostic HRP in children by conducting simultaneous LRP and PSG as well as an HRP on a separate night in children being evaluated for suspected OSAS.

Materials and Methods

The present study was conducted using a prospective and blinded approach in which children being evaluated for clinical suspicion of OSAS were randomly selected to participate. Children included in the study were those who met inclusion criteria (see later) and who arrived to the Sleep Unit (SU) on the days of the week selected from a random number generator table.

The study included 50 children of both sexes, between the ages of 2 and 14 years, who were referred to the SU by their pediatricians for clinical suspicion of OSAS as suggested by the presence of habitual snoring and/or nocturnal respiratory pauses as reported by their parents or caretakers. All children included in the study lived in the urban area of Burgos, and their residential conditions were suitable for HRP studies. Those children suffering from serious chronic medical or psychiatric comorbidities, those who required urgent treatment, and those with symptoms suggestive of sleep disorders other than OSAS (eg, parasomnias, narcolepsy, or periodic leg movements) were excluded.

The study was approved by the Burgos University Hospital Clinical Research Ethics Committee (approval number CEIC 936), and an informed consent was obtained from the parents of all children included prior to their enrollment. The confidentiality of the data was guaranteed by using deidentification procedure-based codes and by completely dissociating all clinical and personal data from the recordings.

A clinical and sleep history was obtained on all children enrolled in the study as well as a general physical, and ear, nose, and throat (ENT) examination. An HRP was conducted, and an LRP and PSG were simultaneously performed in the sleep laboratory within a period of 1 to 2 weeks from the HRP. The results of each of the recordings were scored and interpreted by independent investigators not involved in the clinical management of the subjects and by sleep technologists who were blinded to the identity and aims of the study.

The information obtained from the clinical encounter included age, sex, height, BMI (weight in kg/height in m^2), and BMI percentile based on age and sex.[15] BP was also measured at rest during the morning following the nocturnal PSG.[16] ENT examination was performed by visual inspection. Tonsillar hypertrophy was classified according to the intertonsillar space, as previously described.[17]

Respiratory Polygraphy

The HRP was performed in the child's home using the eXim Apnea Polygraph (Bitmed, SIBEL Group). Oronasal flow was recorded by oronasal thermistor, and a nasal cannula was used to assess pressure (nasal pediatric size, Pro-Flow Plus, Pro-Tech), individual chest and abdomen movements and their sum by impedance plethysmography, body position by sensor position, snoring by microphone, and heart rate and blood oxygen saturation by means of pulse oximetry (3 Hz sampling rate with four-beat pulse rate averaging). A nurse trained in pediatric sleep techniques went to the child's home and explained to the child and caregiver how the polygraph recorder worked, as well as how to position, replace, and remove the sensors. The nocturnal HRP recording was performed unsupervised after the nurse placed the sensors, assessed the signals, and started recordings. The following morning, the caregiver removed the polygraph and returned it to the SU together with a nocturnal diary in which the sleep quality and any incidents during the night were documented.

An LRP as well as a simultaneously supervised PSG were performed in the sleep laboratory with the same HRP equipment. Scoring of LRP and HRP were performed independently by the same investigators, who were blinded to the identity of the recordings. The supervised nocturnal PSG and LRP were performed in the sleep laboratory. For the overnight PSG, the Deltamed Coherence 3NT Polysomnograph, version 3.0 system (Diagniscan S.A.U., Group Werfen) was used and recorded EEG, right and left electrooculogram, tibial and submental (leg and chin) electromyogram, ECG, oronasal flow by thermistor, chest-abdomen movements with bands, body position by a position sensor, oxygen saturation using pulse oximetry (Spo_2) (Nellcor Puritan Bennett, NPB-290), snoring and airflow by means of a nasal cannula, and a continuous transcutaneous recording of CO_2. The American Academy of Sleep Medicine criteria were used to evaluate sleep states and respiratory events[18] in the PSG. Both HRP and LRP were scored manually, with the American Academy of Sleep Medicine criteria being used to evaluate respiratory events. In this study, hypopnea in the RP was defined as a decrease $>$ 50% in the amplitude of the nasal pressure or alternative signal compared with the preevent baseline excursion and the fall in the nasal pressure signal amplitude lasting $\geq$ 90% of the entire respiratory event compared with the signal amplitude preceding the event, and accompanied by an Spo_2 decrease $\geq$ 3% for at least the duration equivalent to two respiratory cycles. Flow limitation events were defined as a discernible drop in the amplitude of the