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Agreement Between Results of Home Sleep Testing for Obstructive Sleep Apnea with and Without a Sleep Specialist

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ABSTRACT

BACKGROUND: Obstructive sleep apnea is a prevalent yet underdiagnosed condition associated with cardiovascular morbidity and mortality. Home sleep testing offers an efficient means for diagnosing obstructive sleep apnea but has been deployed primarily in clinical samples with a high pretest probability. The present study sought to assess whether obstructive sleep apnea can be diagnosed with home sleep testing in a nonreferred sample without involvement of a sleep medicine specialist.

METHODS: A study of community-based adults with untreated obstructive sleep apnea was undertaken. Misclassification of disease severity according to home sleep testing with and without involvement of a sleep medicine specialist was assessed, and agreement was characterized using scatter plots, Pearson's correlation coefficient, Bland-Altman analysis, and the κ statistic. Analyses were also conducted to assess whether any observed differences varied as a function of pretest probability of obstructive sleep apnea or subjective sleepiness.

RESULTS: The sample consisted of 191 subjects, with more than half (56.5%) having obstructive sleep apnea. Without involvement of a sleep medicine specialist, obstructive sleep apnea was not identified in only 5.8% of the sample. Analyses comparing the categorical assessment of disease severity with and without a sleep medicine specialist showed that in total, 32 subjects (16.8%) were misclassified. Agreement in the disease severity with and without a sleep medicine specialist was not influenced by the pretest probability or daytime sleep tendency.

CONCLUSION: Obstructive sleep apnea can be reliably identified with home sleep testing in a nonreferred sample, irrespective of the pretest probability of the disease.

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KEYWORDS: Diagnosis; Home sleep testing; Obstructive sleep apnea

It is well established that identifying modifiable risk factors for chronic diseases and intervening early can help slow disease progression and possibly even reduce associated morbidity and mortality.[1] Obstructive sleep apnea, which affects approximately 24% of adult men and 9% of adult women in the general population,[2] is an independent risk factor for incident hypertension and cardiovascular disease.[3,4] Yet, more than 80% of those with obstructive sleep apnea remain undiagnosed.[5,6] Given the available evidence that treatment of obstructive sleep apnea can decrease blood pressure and possibly mitigate adverse cardiovascular endpoints,[7,8] early case identification has clinical and public health merit. The advent of home sleep testing has been a useful addition to the diagnostic armamentarium for obstructive sleep apnea because it offers a simple, objective, and economical means for assessing those that may be affected. However, current guidelines recommend that home sleep testing be restricted to only those patients with a high pretest probability for obstructive sleep apnea and that a

sleep trained provider be involved in the review and interpretation of the recording. Although self- or interview-administered questionnaires, such as the Berlin[9] and the STOP-BANG[10] questionnaires, are useful in identifying those with a high pretest probability for obstructive sleep apnea, these instruments have varying levels of sensitivity, specificity, and predictive value depending on the specific population in which they are used, the underlying prevalence of disease in the study sample, and disease severity.[11,12] More importantly, self-reported data are inherently limited because many of those affected with obstructive sleep apnea underreport symptoms of snoring and cessation of breathing during sleep, or they do not have a bedpartner to aid in identifying signs or symptoms. Clinical prediction models and morphometric measures, which represent the next layer of techniques to assess risk, are simple to implement but have limited sensitivity and specificity.[11,12] Thus, many patients with obstructive sleep apnea remain undiagnosed and are at risk for the associated cardiometabolic sequelae. The present study sought to evaluate whether assessment of obstructive sleep apnea can be performed with home sleep testing independent of a sleep medicine specialist in a nonreferred sample that may have an admixture of low and high pretest probability for obstructive sleep apnea. It was hypothesized that there would be a high degree of agreement between the results derived from home sleep testing for obstructive sleep apnea with and without involvement of a sleep medicine specialist.

> ### CLINICAL SIGNIFICANCE
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> - Identification of obstructive sleep apnea using home sleep testing in a non-referred sample without involvement of a sleep specialist has not been routinely performed.
> - Obstructive sleep apnea was missed in less than 6% when home sleep testing was conducted without a sleep specialist.
> - Pretest probability of obstructive sleep apnea or subjective sleepiness does not alter diagnostic accuracy of home sleep testing when a sleep specialist is not involved.

METHODS

Study Sample and Screening Assessments

Case identification of undiagnosed obstructive sleep apnea was undertaken for the present study in a general community sample from the local Baltimore–Washington area. Recruitment was based on newspaper advertisements and mailed invitations using a commercially available electronic mailing list. A total of 827 respondents expressed interest in participating in the study and were screened by a telephone interview that was conducted by trained research assistants using a structured questionnaire. Eligibility criteria included age between of 21 and 80 years and no prior treatment for obstructive sleep apnea. Those with a history of prior upper airway surgery for obstructive sleep apnea (n = 45) or treatment with an oral appliance (n = 22) or positive pressure therapy (n = 557) were not eligible. Shift work, a preference for an early or delayed sleep schedule suggestive

of a circadian rhythm disorder, or restless legs syndrome were also considered exclusionary (n = 12). Thus, 636 people responding to the study advertisements were considered as screen failures. A total of 191 eligible subjects completed a telephone questionnaire that included demographic information, such as age, sex, and race, as well as the self-reported medical history on prevalent hypertension, high cholesterol, asthma, chronic obstructive lung disease, coronary artery disease, and hypothyroidism. The Epworth Sleepiness Scale, which assesses average sleep propensity with 8 questions on the likelihood of dozing in various situations on a 4-point scale (0-3), was administered to all those that enrolled in the study. An Epworth Sleepiness Scale score of ≥11 out of a maximum 24 is considered subjectively sleepy.[13] Finally, all those consented to the study completed the Berlin Questionnaire, a validated 3-part questionnaire used to assess obstructive sleep apnea risk (low vs high).[9] The research protocol was approved by the Johns Hopkins University institutional review board on human research (IRB approval number NA_00036672).

Assessment of Obstructive Sleep Apnea

To examine differences in detection of obstructive sleep apnea and severity classification with and without involvement of a sleep medicine specialist, the ApneaLink Plus (ResMed, San Diego, Calif), a type III portable monitoring device, was used for home sleep testing in volunteers who qualified for the study. Apnealink Plus (type III), which has been previously validated,[14] was given to study subjects by research assistants who were not registered polysomnologists. Nasal airflow was recorded with a nasal cannula connected to a pressure transducer. Pulse oximetry was used to assess oxyhemoglobin saturation, and respiratory effort was measured with a pneumatic sensor attached to an effort belt. At least 4 hours of interpretable recording time was required for inclusion in the study. The scoring software for ApneaLink Plus was configured to identify disordered breathing events according to standard criteria as follows. Apneas were identified if there was a 90% or greater reduction in airflow for at least 10 seconds, and hypopneas were identified if there was a ≥30% reduction in airflow for at least 10 seconds that was associated with an oxyhemoglobin desaturation of at least 4%. The apnea–hypopnea index, the disease-defining metric for obstructive sleep apnea, was the number of apneas and hypopneas per hour of recording time. Disease severity was