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Identification of obstructive sleep apnea syndrome and cardiovascular diseases risks in patients attending primary care and assessment of their association

Birinci basamağa başvuran hastalarda obstrüktif uyku apne sendromu ve kardiyovasküler hastalık risklerinin belirlenmesi ve aralarındaki ilişkinin değerlendirilmesi

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Abstract

Purpose: The aim of this study was to determine the risks of Obstructive sleep apnea syndrome (OSAS) and Cardiovascular diseases (CVD) in individuals applying to family health care center and to evaluate the relationship between risk levels of two conditions that are thought to be effective in the pathogenesis of each other.

Materials and methods: The research was designed as a descriptive and analytical study. A total of 204 participants who applied to five different family health centers in Denizli for any reason were included in our study. The data used in the research were obtained from the survey questions we created, the STOP-BANG scale and the SCORE risk calculation system.

Results: Of the participants, 25.5% are in the high-risk group for OSAS. In total 33.4% of the participants in the study have a high risk of CVD. There is a statistically significant relationship between the OSAS risk levels and CVD risk levels of the participants. Male gender, age, obesity, smoking and hypertension significantly increase both the risk of OSAS and the risk of CVD.

Conclusion: One in four patients who applied to primary care for any reason were found to be at risk for OSAS. The majority of those in the high risk group for OSAS are in the high and very high risk groups for the cardiovascular system. Screening in primary care in terms of OSAS and CVD, two diseases with high prevalence and significant complications, can make a great contribution to both the individual's health status and public health.

Keywords: Obstructive sleep apnea syndrome, cardiovascular diseases, primary care, family medicine, risk.

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Öz

Amaç: Bu çalışmanın amacı, birinci basamağa başvuran bireylerin Obstrüktif Uyku Apne Sendromu (OUAS) ve kardiyovasküler hastalık (KVH) risklerini belirlemek ve birbirinin patogenezinde etkili olduğu düşünülen iki durumun risk düzeyleri arasındaki ilişkiyi değerlendirmektir.

Gereç ve yöntem: Araştırma tanımlayıcı ve analitik tipte bir çalışma olarak tasarlandı. Çalışmaya Denizli'deki beş farklı aile sağlığı merkezine herhangi bir nedenle başvuran toplam 204 katılımcı dahil edildi. Araştırmada kullanılan veriler, oluşturduğumuz anket sorularından, STOP-BANG ölçeğinden ve SCORE risk hesaplama sisteminden elde edildi.

Bulgular: Katılımcıların %25,5'i OUAS açısından yüksek risk grubundadır. Çalışmaya katılanların %33,4'ü KVH açısından yüksek risk taşımaktadır. Katılımcıların OUAS risk düzeyleri ile KVH risk düzeyleri arasında istatistiksel olarak anlamlı bir ilişki vardır. Erkek cinsiyeti, yaş, obezite, sigara kullanımı ve hipertansiyon hem OUAS hem de KVH riskini önemli ölçüde artırır.

Sonuç: Herhangi bir nedenle birinci basamağa başvuran hastaların dörtte birinin OUAS riski altında olduğu bulundu. OUAS için yüksek risk grubunda olanların çoğunluğu kardiyovasküler sistem hastalıkları içinde yüksek ve çok yüksek risk gruplarındadır. Yüksek prevalans ve önemli komplikasyonlara sahip iki hastalık olan OUAS ve KVH açısından birinci basamakta taramaların yapılması ile hem bireyin sağlık durumuna hem de toplum sağlığına büyük katkı sağlanabilir.

Anahtar kelimeler: Obstrüktif uyku apne sendromu, kardiyovasküler hastalıklar, birincil basamak, aile hekimliği, risk.

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Introduction

Obstructive sleep apnea syndrome (OSAS), which is considered the most common type of sleep disorder, is a clinical picture that manifests with partial or complete upper respiratory obstruction that recurs during sleep [1]. Some scoring methods are used in conjunction with the gold standard method, i.e., polysomnography (PSG) [1, 2]. Among these scoring methods, the STOP-BANG questionnaire, with a sensitivity of 96.9% and a specificity of 6.4%, is a convenient and short-term screening tool for identifying patients with OSAS risk [3].

Untreated OSAS can cause many long-term complications and, above all, lead to cardiovascular complications and associated diseases [1]. Cardiovascular diseases (CVDs) are ranked first among causes of death worldwide. Estimating the risk of developing CVD in people who have reached adult age is important in terms of both preventive approaches and treatment. The World Health Organization (WHO) reports that the incidence of CVD can be halved by controlling the risk factors [4]. Many different calculation methods have been developed to calculate cardiovascular risk. Among them, SCORE (Systematic Coronary Risk Evaluation) was developed by the European Society of Cardiology (ESC) and enables calculation of CVD risk by dividing European countries, in which our country is included, into risk groups. As our country is considered a high-risk country according to the SCORE, the form designed for high-risk countries in SCORE has been utilized.

OSAS and CVDs were previously thought to accompany each other due to their common risk factors, and recent studies have shown them to be more frequent as a result of atherosclerosis accelerated due to oxidative stress caused by OSAS-driven hypoxia and reoxygenation cycles in the body [5]. It has been shown in studies that most cases of idiopathic hypertension have OSAS as an underlying condition, and OSAS increases the risk of myocardial infarction [6].

Preventive medicine represents one of the most important aspects of primary care physicians. Considering the serious consequences that sleep disorders can cause in society, OSAS should be given importance within the scope of preventive medicine. Despite its high prevalence and serious complications, OSAS is rarely recognized in primary care [7, 8]. Similarly, other sleep disturbances are common but often remain unaddressed by healthcare providers [9, 10]. Multiple studies have found that no screening for sleep disorders is done in primary care unless the patient complains [9, 11]. Another concerning result obtained from the conducted studies is that primary care providers are aware of the necessity to improve cardiovascular health but are not effective in screening and evaluating for OSAS [12, 13]. In addition, studies conducted on primary care physicians have revealed that their awareness and knowledge about breathing disorders in sleep were rather poor.

This research aimed to determine OSAS risk levels and CVD risk levels in individuals visiting a primary care clinic and to evaluate the relationship between risk levels for two conditions that are considered effective in the pathogenesis of the other.

Material and methods

Research structure

This study was conducted between 01/03/2022 and 30/05/2022 in 5 different Family Health Centers selected through random sampling in the city center, and data were collected from individuals applying to these centers. The study was designed as an epidemiological, cross-sectional and analytical study.

The study has obtained approval from the Pamukkale University Non-Interventional Clinical Research Ethics Committee (decision number 04 dated 22.02.2022), confirming that there is no ethical concern regarding the conduct of the research.

Population

Power analysis was performed in calculating the sample size to represent the population; assuming that the impact size of the relationship to be examined could be low (r=0.2), it was calculated that 80% power could be obtained at a 95% confidence level when at least 191 people participated in the study, and 204 volunteers were included. Volunteers over the age of 18 were included in our study, and those diagnosed with known OSAS, CVD, and pregnant women were not included in the study.

Data collection

We used a questionnaire form containing sociodemographic information, designed by the researchers based on a review of the relevant literature, to collect the data for the study, the STOP-BANG questionnaire and the SCORE risk calculation system. The survey form was filled by the researcher during face-to-face interviews with volunteers.

For the weight information required in the research, a calibrated weigher was placed on a flat floor and the participants were measured with light clothes and without shoes. During the measurement of height, participants were instructed to be barefoot, with feet together and the head positioned in the Frankfort horizontal plane, and the measurement was taken using an appropriate stadiometer. Body mass index (BMI) were calculated and classified as underweight (<18.5 kg/m²), normal (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), and obese (≥30 kg/m²). The obese class was also divided into subgroups. Neck circumference was measured using a 150 cm fiberglass tape measure. Participants were in an upright position, standing, facing forward, and the measurement was taken at the level of the superior border of the cricothyroid membrane. According to the STOP-BANG questionnaire, a neck circumference of 43 cm or above for males and 41 cm or above for females was considered an enlarged neck circumference. For blood pressure measurement, individuals were instructed to refrain from exercising, eating, smoking, and consuming caffeine within the last half hour. After a minimum of 5 minutes of rest, measurements were taken using a calibrated cuff-based digital blood pressure monitor. After obtaining participant approval for cholesterol levels, total cholesterol and HDL values in the last 6 months of health records were obtained.

The STOP-BANG questionnaire includes 8 questions asking about the main factors and symptoms that increase the OSAS risk. The first 4 items about snoring, daytime sleepiness, witnessed apnea and hypertension were questioned by detailed explanation and risk levels were calculated according to the updated STOP-BANG questionnaire by including other information about the participants.

In order to determine CVD risk levels, risk calculation was performed with the SCORE system using the information in the first part of the questionnaire. Calculation was performed using a risk table specific to the high-risk region category that includes Türkiye. Participants' age, sex, systolic blood pressure, cholesterol levels, and smoking status (active or non-smoker) were taken into account to calculate the 10-year mortality risk associated with CVD.

Statistical analysis

The data were analyzed using the SPSS 25.0 (IBM SPSS Statistics 25 software (Armonk, NY: IBM Corp.)) package program. Continuous variables are expressed as mean ± standard deviation, and minimum-maximum values; categorical variables are presented in numbers and percentages. The conformity of the data to normal distribution was examined by using the Kolmogorov Smirnov and Shapiro-Wilk tests. For examining independent group differences, when the assumptions of parametric tests were not met, the Kruskal-Wallis Analysis of Variance (post hoc: Bonferroni-corrected Mann-Whitney U test) was used. Chi-square analysis was used in the examination of differences between categorical variables. The correlations between the continuous variables were examined through Spearman correlation analyses. In addition, single-variable and multi-variable Linear Regression Analysis models were used to determine the factors that influence the dependent variable levels examined. A $p<0.05$ was taken to indicate statistical significance in all analyses.

Result

A total of 204 individuals participated in our study. Table 1 presents the sociodemographic characteristics of the participants.

Table 1. Sociodemographic characteristics of participants

Variables	n	%
Sex		
Female	126	61.8
Male	78	38.2
Age		
50 and below	81	39.7
50 and above	123	60.3
Marital Status		
Single	43	21.1
Married	161	78.9
Educational background		
Illiterate	6	2.9
Primary school	64	31.4
Elementary school	19	9.3
High school	50	24.5
University	65	31.9
Occupation		
Unemployed	65	31.9
Worker	40	19.6
Civil Servant	32	15.7
Freelancer	20	9.8
Retired	47	23.0
Smoking		
Smoker	59	28.9
Ex-smoker	15	7.4
Never smoked	130	63.7
Motor vehicle		
Driver	114	55.9
Non-Driver	90	44.1
Chronic disease		
Present	110	53.9
None	94	46.1
TOTAL	204	100.0

The mean age of individuals included in the study was 46.87±14.735 years. The mean BMI of the participants was 28.14±5.34 kg/m² (min15.2-max50.4). The mean neck circumference was 37.40±4.15 cm. The participants' systolic blood pressure mean was 123.67±17.08 mmHg, while the diastolic blood pressure mean was 76.77±11.52 mmHg. The mean total cholesterol value of the participants in the study was 180.70±33.60 mg/dL, and the mean HDL value was 49.64±10.77 mg/dL. One percent (n=2) of the participants were in the category of underweight, 25.5% (n=52) were normal weight, 44.1% (n=9) were overweight, and 29.4% (n=60) were obese.

In terms of the OSAS risk levels calculated with STOP-BANG, 25.5% of the participants were in the high-risk group. The participants' STOP-BANG risk status and their responses to the questionnaire are included in Table 2.

Table 2. Participants' OSAS risk levels determined based on the STOP-BANG scale

OSAS risk level	**n**	**%**
Low	118	57.8
Moderate	34	16.7
High	52	25.5
Questions	**n**	**%**
Snoring		
Yes	82	40.2
No	122	59.8
Fatigue		
Yes	101	49.5
No	103	50.5
Observation (Witnessed Apnea)		
Yes	34	16.7
No	170	83.3
Hypertension		
Yes	55	27.0
No	149	73.0
BMI >35		
Yes	21	10.3
No	183	89.7
Aged >50		
Yes	81	39.7
No	123	60.3
Enlarged neck circumference		
Yes	35	17.2
No	169	82.8
Male sex		
Yes	78	38.2
No	126	61.8
TOTAL	204	100.0

The mean BMI for those with high risk of OSAS was 32.35±6.02 kg/m², for those with moderate risk, it was 29.12±3.74 kg/m², and for those with low risk, the mean BMI was 26.01±4.11 kg/m². It was observed that the body mass index (BMI) values of the group with a low risk of OSAS were significantly lower compared to the groups with moderate and high risk (p=0.001 and p=0.0001, respectively). Statistically significant differences were not found between the moderate- and high-risk groups (p=0.186).

In total, 76.9% (n=40) of participants at high risk of OSAS had at least one chronic disease. As a result of the analysis, the risk of OSAS in participants with at least one chronic disease was higher than in those without chronic disease, and this was statistically significant (p=0.0001). Among the individuals participating in the study, those with hypertension had a higher risk of OSAS, and this difference was statistically significant (p=0.001). Also, those with diabetes had a higher risk of OSAS; this difference was again statistically significant (p=0.001).

Based on the CVD risk status calculated using the SCORE system for the participants, 16.7% were in the high-risk group and 16.7% were in the very high-risk group (Table 3).

Table 3. Participants' risk levels of CVD determined by the SCORE system

Risk level	n	%
Low	51	25.0
Moderate	85	41.8
High	34	16.6
Very High	34	16.6
TOTAL	204	100

In the univariate regression analysis based on the STOP-BANG, it was observed that male sex, age, chronic diseases, hypertension, diabetes, BMI, neck circumference, systolic and diastolic blood pressure values, and total cholesterol levels had an increasing effect on the OSAS risk levels. On the other hand, educational status, employment status, and HDL levels had a decreasing effect on the risk levels. The results of the multivariate model analysis showed that the factors affecting STOP-BANG risk levels were sex, age, hypertension and BMI (Table 4).

Table 4. Results of regression analysis with STOP-BANG multivariate model

	Std Beta	t	*p*	95% CI Lower-Upper
Sex	0.228	3.385	0.001*	0.167-0.634
Age	0.203	3.531	0.001*	0.005-0.018
Diabetes	-0.014	-0.26	0.795	-0.276-0.211
Hypertension	0.311	5.412	0.0001*	0.38-0.817
BMI	0.301	4.603	0.0001*	0.028-0.069
Neck circumference	0.104	1.216	0.226	-0.013-0.056
Total cholesterol	0.008	0.151	0.88	-0.002-0.003
HDL	0.024	0.437	0.662	-0.007-0.011

BMI: Body mass index, CI: Confidence Interval, * statistically significant levels

In the univariate regression analysis based on the SCORE system, it was observed that male sex, age, smoking, chronic diseases, hypertension, diabetes, asthma-COPD, BMI, neck circumference, systolic and diastolic blood pressure values, and total cholesterol levels had an increasing effect on the CVD risk levels, while educational status, employment status, and HDL levels had a decreasing effect on the risk levels. The results of the multivariate model analysis showed that the factors affecting SCORE risk levels were sex, age, smoking and BMI (Table 5).

Table 5. Results of regression analysis with SCORE multivariate model

	Std Beta	t	*p*	95% CI Lower-Upper
Sex	0.165	3.824	0.0001*	0.124-0.39
Age	0.745	20.768	0.0001*	0.035-0.042
Smoking	0.23	7.376	0.0001*	0.283-0.489
Diabetes	0.06	1.855	0.065	-0.008-0.255
Hypertension	0.025	0.669	0.504	-0.083-0.169
BMI	0.106	2.51	0.013*	0.003-0.027
Neck circumference	0.037	0.689	0.492	-0.013-0.026
Apnea	-0.008	-0.248	0.804	-0.146-0.113

BMI: Body mass index, CI: Confidence Interval, *: statistically significant levels

Participants at high risk according to the STOP-BANG scale, in terms of CVD, 69.2% (n=36) were in the high and very high risk groups, and among the participants with a high risk of OSAS, there were no participants with a low CVD risk. Participants with low risk of OSAS in terms of CVD: 42.4% (n=50) are in the low-risk group, and 8.5% (n=10) are in the high and very high-risk group. Participants had low OSAS risk levels and CVD risk. It was found that the levels were low and the levels were high, and the relationship between the risk status of these two diseases was statistically significant (p=0.0001). The correlation analysis revealed a statistically significant, positive, moderate relationship between STOP-BANG risk levels and SCORE risk levels (p=0.0001; r=0.644).

Discussion

OSAS is a common but not well-known condition. Studies have indicated that OSAS is associated with increased cardiovascular morbidity and mortality and CVDs are a leading cause of deaths worldwide [14, 15]. In our study 25.5% of the participants were at high risk for OSAS and 33.4% were in the high and very high-risk group for CVD. Participants who were in the high-risk group for OSAS were in the high and very high-risk groups in terms of CVD risk.

Although the prevalence of OSAS seems to be low, studies have demonstrated that there is a large number of high-risk patients in the community. A study of 4.118 individuals in Cyprus in 2019 found that 61.4% of the participants had a low risk of OSAS, 29.1% had a moderate risk and 6.7% had a high risk of OSAS [16]. In a Colombian study, the prevalence of those with a high risk of OSAS based on the STOP-BANG scale was 26.9% [17]. In another study, a high risk of OSAS in individuals visiting a primary care clinic was reported to be 35.8% in the U.S. and 26.3% in Europe [18]. A South Carolina study published in 2021 found that 18.5% and 25.5% of participants had a moderate and high OSAS risk based on STOP-BANG, respectively [19]. Based on the updated calculation of the STOP-BANG questionnaire, among the participants in our study, 57.8% were classified as low risk, 16.7% as moderate risk, and 25.5% as high risk for OSAS. The rates of our study were higher than the high-risk participant rate reported in the Cyprus study and were consistent with other studies.

The reason our results are higher than those of the Cyprus study may be due to differences in sample selection.

In addition to being a sleep disorder, OSAS is important in terms of the diseases for which it paves the way. There is also a mutual relationship between sleep and chronic diseases. Impaired sleep quality increases the risk or frequency of metabolic and rheumatic diseases, while having chronic disease also affects the quality and duration of sleep [20]. A study comparing individuals with and without OSAS showed a strong correlation between OSAS and insulin resistance, obesity and lipid profile [21]. In a study conducted on individuals with OSAS, 40.7% of the participants had additional chronic diseases, and the presence of comorbidities increased with the severity of the disease [22]. A study in patients diagnosed with OSAS in Türkiye reported that the co-existence of DM and HT was significantly higher than in the non-patient group [23]. In our study, 53.9% of the participants had at least one chronic disease, and this frequency increased to 76.9% in the group with a high risk of OSAS.

The global rise in obesity has been accompanied by a parallel increase in the incidence and severity of obstructive sleep apnea (OSAS), as obesity significantly contributes to the development and progression of OSAS, with weight control playing a key role in its treatment and prevention [24]. A prospective cohort study published in 2000 reported that a 10% weight gain increased the risk of OSAS by 6 times [25]. A study conducted in Türkiye reported that up to 60-90% of cases with OSAS were overweight or obese [26]. A community-based study in the USA found that 59% of obese participants had a high risk of OSAS, and obesity was a significant predictor of OSAS risk [27]. A Dubai study found that 70% of obese people had a high risk of OSAS and 75% of low-risk participants had a BMI below 30 [28]. In our study, 38.5% of the participants with a high risk of OSAS were overweight, 57.7% were obese, and 32.7% had a BMI of over 35 kg/m². Those with a BMI above 35 kg/m² present a high risk of OSAS and there is a correlation between BMI and OSAS risk level. Our findings were similar to the results of the available studies in the literature.

It is known that CVD-associated mortality and morbidity remain one of the leading and most significant health problems worldwide. In a prospective community-based study of 14,863 participants aged 40 to 65, covering different Asian ethnic groups, the SCORE system was used and 42% of the participants had low, 38% had moderate and 21% had high risk [29]. In a study conducted by Eray et al. [30] examining CVD risk using the SCORE system in patients visiting a primary care clinic, it was reported that 17.4% of the participants had low risk, 47.7% had moderate risk, 24.5% had high risk, and 10.3% had very high risk for CVD. According to the CVD risk states calculated using the SCORE system in our study, 25.0% of the participants had low, 41.7% had moderate, 16.7% had high and 16.7% had a very high risk of cardiovascular diseases. When high and very high risk are considered together, the rate is 33.4%. These results are broadly consistent with those of similar studies, although the proportion of participants at high and very high risk appears relatively elevated. This may be attributed to differences in sample characteristics or population profiles.

Although OSAS and CVD are two different disease groups, they have many common risk factors. This study showed that while male gender, age, obesity and hypertension affected the OSAS risk, male gender, age, obesity and smoking status affected the CVD risk. Obstructive sleep apnea syndrome (OSAS) is closely linked to cardiovascular disease through shared components of metabolic syndrome, including central obesity, hypertension, insulin resistance, and dyslipidemia. The severity of OSAS is further influenced by factors such as older age, high BMI, smoking, and physical inactivity, emphasizing the need for comprehensive risk management to reduce both OSAS and cardiovascular complications [31, 32].

The most important complications that occur as a result of OSAS are cardiovascular complications [1]. A 2019 study reported a significant correlation between the OSAS risk levels measured by STOP-BANG and cardiovascular risks (major cardiovascular events including cardiovascular mortality, acute coronary syndrome, and decompensated heart failure) among patients receiving treatment in a university hospital's internal medicine department [33]. This study, unlike our research, used the AHA (American Heart

Association) risk prediction score to calculate cardiovascular risk, and the scoring system calculates not only mortality risk but also the risk of major cardiological events. The results of a meta-analysis published in 2021 found that preexisting OSAS increased the risk of recurrent major cardiovascular events in newly diagnosed patients with acute coronary syndrome by two times [34]. The results of another meta-analysis published in 2021 by Salari et al. [35] showed that OSAS can significantly elevate the risk of CVD, stroke, coronary artery disease and mortality. In a Turkish study, the OSAS risk was investigated among patients undergoing coronary angiography, and based on the STOP-BANG questionnaire, it was found that 88.9% of those with a high OSAS risk had lesions in three or more vessels, while 86% had critical stenosis in a single vessel; however, more than half of those with low risk had no vessel lesions [36]. According to the results of the study, a significant association was found between OSAS risk and the presence of coronary artery disease in patients [36]. In this study, there is a relationship between OSAS risk level and CVD risk level. The American Society of Cardiology reports a strong association between OSAS and cardiovascular conditions and recommends OSAS screening, especially for resistant/poorly controlled hypertension, pulmonary hypertension, and recurrent atrial fibrillation following cardioversion or ablation [37].

There are not many primary care studies in the literature investigating the relationship between the risk levels of two diseases. Our results point to a possible relationship between OSAS and CVD and support other studies in the literature in this regard.

This study has important strengths and limitations. The sample of the study is relatively large and includes an unselected group of patients who did not consult a doctor with any complaints about OSAS and did not receive treatment. In addition, although clinical counseling was not the primary objective of the study, high-risk participants were counseled on lifestyle changes and referred to appropriate health services, which was an important aspect of the study. However, with some limitations, the research was applied to patients who came to the family health center that day. Those who wanted to participate in the research voluntarily were included. For these reasons, it may not be generalizable to society.

The limitations of this study are that our study was conducted only in one city center and on a voluntary basis and cannot be generalized to the society. More comprehensive studies with more centers and participants are needed on this subject.

In conclusion, among patients presenting to primary care for any other reason, 25.5% were at high risk for OSAS and 33.4% were in the high and very high-risk group for CVD. The results of this study indicate the necessity of screening for OSAS and CVD. In primary care centers, many health problems are encountered in the early undifferentiated stages. The primary care physician assumes responsibility for the community health and aims to improve the health condition and well-being of patients by approaching them holistically and comprehensively. With all this in mind, we would like to emphasize the necessity of conducting screening programs with appropriate screening tools in primary care for OSAS and CVD, which have high prevalence and serious complications.

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Authors' contributions to the article: A.Y.B. and N.E. constructed the main idea and hypothesis of the study. A.Y.B. and N.E. developed the theory and arranged/edited the material and method section. A.Y.B. has done the evaluation of the data in the results section. The discussion section of the article was written by A.Y.B. and N.E. reviewed, corrected and approved. In addition, all authors discussed the entire study and approved the final version.

Conflict of interest: No conflict of interest was declared by the authors.

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