ORIGINAL RESEARCH

Associations Between Subjective Night Sweats and Sleep Study Findings

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Background: **In 2 previous studies, patients reporting night sweats were found to be more likely to have other sleep-related symptoms. Sleep apnea is often mentioned as a possible cause of night sweats, but there is little evidence to support this assertion.**

Methods: **Retrospective review of data from 2 sleep laboratories in Oklahoma City, Oklahoma. Analyses included bivariate and multivariate tests of associations between reported night sweats and other sleep-related symptoms, scores on specific sleep inventories, and findings from polysomnography.**

Results: **Patients who reported night sweats were more likely to report daytime fatigue ($P = .001$); creepy/crawly feelings in their legs ($P = .003$); kicking during sleep ($P = .004$); snoring ($P = .03$); nighttime breathing trouble ($P < .0001$); awakening in the night with aches and pains ($P < .0001$); and waking in the morning with a headache ($P = .0002$) and still tired ($P = .002$) as compared with those who did not report night sweats. They also had higher mean scores on the Epworth Sleepiness Scale ($P < .0001$). However, there was no statistically significant association between reported night sweats and sleep onset latency, arousal index, apnea hypopnea index, periodic leg movement index, or total sleep time.**

Conclusions: **Subjective night sweats are associated with a variety of other sleep-related symptoms, but we could find no evidence for an association between subjective night sweats and objective evidence of specific sleep disorders. (J Am Board Fam Med 2008;21:96–100.)**

When asked, between 20% and 40% of adults being seen in a primary care office setting report having experienced night sweats within the past month.[1,2] A large majority, including nearly 50% of those reporting sweating severe enough to require a changes of bed clothes, say they have never reported the symptom to their physicians.[1] Although many health conditions (eg, chronic infections, certain malignancies, and menopause) have been listed as causes of night sweats, few if any of these claims of causation have actually been proven. Sleep apnea is often included on lists of probable causes.[3–5]

In a series of cross-sectional studies conducted in primary care settings, we have documented a statistical association between reported night sweats and a variety of sleep-related symptoms including "sleep problems" not otherwise defined, general tiredness, restless or fidgety legs, legs jerking during sleep, increased sleep latency, frequent nighttime awakenings, and waking up with a sour or bitter taste in the mouth.[1,2,6] Interestingly, we have not found associations between night sweats and snoring or between night sweats and high body mass index. The purpose of this study was to determine whether an association exists between subjective night sweats and objective findings on polysomnography (PSG).

Methods

We retrospectively examined the records of 282 patients who had undergone PSG between January 1, 2004 and December 31, 2005. The records were collected from 2 affiliated sleep laboratories in the Oklahoma City metropolitan area. All data from both sleep laboratories were scored by the same clinicians. Most patients had been referred for an

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evaluation of possible sleep apnea. Before their PSG they had completed a 32-item questionnaire that included the item "I sweat excessively during the night." The other items related to symptoms such as breathing trouble at night, snoring, creeping/crawling sensations in the legs, kicking during sleep, awakening with headache, awakening with aches or pains, fatigue during the daytime, and tiredness on awaking. Each item was followed by 6 options; "no," "rarely or never," "sometimes," "often," "frequently," and "always." For each of these items, the first 3 response options were considered negative and the last 3 positive.

The questionnaire also included the Epworth Sleepiness Scale (ESS[7]), a survey asking respondents to estimate the likelihood that they would fall asleep under 8 different circumstances, ranging from 0 (would never fall asleep) to 3 (high chance of falling asleep). Though this item is not strictly a continuous variable, it was treated as such in our analyses. The sleep questionnaire also included an open question about previous and current medical problems. Patient body mass index (BMI) was calculated based on patients' reports of height and weight. The following information was abstracted from the PSGs: sleep onset latency (SOL); apnea-hypopnea index (AHI); arousal index (AI); periodic leg index (movements per hour; PLMI); total sleep time (TST); and time until waking after sleep onset (WASO).

Descriptive statistics were calculated for all variables. All symptom variables were dichotomized using standard cutoff values for normal/abnormal. Sleep parameters were likewise categorized (see Table 1). Student's t test was used to examine associations between presence or absence of reported (subjective) night sweats and each of the continuous variables. In most cases, because the continuous variables were not normally distributed, we tested natural log translations of these variables and then ran Mann Whitney U (nonparametric) tests. The χ^2 test was used to evaluate relationships between night sweats and categorical variables. We also looked specifically for associations between subjective snoring and AHI, AI, WASO, TST, and the ESS. Finally, we examined the relationship between subjective crawling feeling in legs and kicking during the night and PLMI, SOL, TST, WASO, and ESS score.

Logistic regression modeling was used to determine associations between each of the independent variables and history of night sweats. The most parsimonious models were constructed by first entering all variables with bivariate P values $<.1$, and then subtracting one variable at a time based on the highest P value until all remaining variables had P values $<.05$ or until the removal of a variable resulted in a significant change in the variance of the overall model (arbitrarily, a change of >5). Odds ratios and confidence intervals were calculated for variables retained in the final model. Kicking during sleep was not included in the initial regression model because of a large number of missing values, but we did test it in a separate model. All analyses were performed using Statistix Version 8 (Analytical Software, Tallahassee, Florida). The study was approved by the Institutional Review Board of the University of Oklahoma Health Sciences Center.

Table 1. Characteristics of the Study Population (n = 282)

Variable	Mean (SD)
Age	49.13 (13.36)
Height (inches)	69.48 (4.20)
Weight (pounds)	212.69 (46.51)
BMI	31.99 (7.17)
Sex	**N (%)**
Male	180 (63.8)
Female	102 (36.2)
Race/ethnicity [n (%)]	
White, non-Hispanic	238 (86.2)
Black	20 (7.2)
Asian	4 (1.4)
Native American	9 (3.3)
Hispanic	4 (1.4)
Other	1 (0.4)
Marital status [n (%)]	
Married	220 (78.6)
Divorced	17 (6.1)
Separated	4 (1.4)
Widowed	10 (3.6)
Never married	29 (10.4)
Conditions [n (%)]	
Arthritis	12 (4.3)
Asthma	5 (1.8)
COPD	2 (0.7)
Diabetes mellitus	7 (2.5)
Heart disease	2 (0.7)
Hypertension	15 (5.3)

BMI, body mass index; COPD, chronic obstructive pulmonary disorder.

Table 2. Association of Sleep-Related Variables with Night Sweats

Variable	All Variables (n = 282; 100%)	Night Sweats (n = 79; 28%)	No Night Sweats (n = 203; 72%)	P*
Breathing trouble during the night	113 (41.4)	51 (45.1)	62 (54.9)	<.0001
Snoring	208 (75.6)	65 (31.3)	143 (68.7)	.03
Crawling/creeping feeling in legs	31 (11)	17 (54.8)	14 (45.2)	.003
Legs kick during sleep	26 (19.8)	20 (76.9)	14 (23.1)	.004
Wake in AM with headache	80 (28.5)	35 (43.8)	45 (56.2)	.0002
Awakened by aches/pains during the night	95 (33.7)	44 (46.3)	51 (53.7)	<.0001
Daytime fatigue	202 (72.4)	68 (33.7)	134 (66.3)	.001
Wake up tired	220 (78.9)	70 (31.8)	150 (68.2)	.002
ESS [mean (SD)]	12.29 (5.45)	14.53 (5.21)	11.41 (5.29)	<.0001
<10	90 (33)	4 (15.6)	76 (84.4)	
≥10	186 (67)	63 (33.9)	123 (66.1)	.002
AHI [mean #/hour (SD)]	20.82 (24.81)	20.03 (24.82)	21.08 (24.81)	.75
0- 4.99	79 (28)	23 (29.1)	56 (70.9)	
5–14.99	78 (28)	24 (30.8)	54 (69.2)	
15–29.99	63 (22)	17 (27)	46 (73)	
30+	62 (22)	15 (24.2)	47 (75.8)	.82
PLMI [mean #/hour (SD)]	4.70 (23.54)	2.46 (10.13)	5.55 (26.91)	.18
≤5	230 (88)	66 (28.7)	164 (71.3)	
>5	32 (12)	6 (18.8)	26 (81.2)	.24
AI [mean #/hour (SD)]	17.54 (20.44)	17.62 (21.42)	17.50 (20.05)	.96
< 15	167 (59)	50 (29.9)	117 (70.1)	
≥15	114 (41)	28 (24.6)	86 (75.4)	.32
SOL [mean # min (SD)]	24.60 (30.75)	20.97 (18.47)	25.87 (34.22)	.12
< 30	207 (74)	60 (29)	147 (71)	
≥30	74 (26)	18 (24.3)	56 (75.7)	.44
TST [mean # min (SD)]	248.40 (110.89)	250.99 (114.33)	247.42 (109.86)	.82
>6.5	26 (10)	9 (34.6)	17 (65.4)	
≤6.5	236 (90)	63 (87)	173 (91)	.39
WASO [mean # min (SD)]	259 (71.28)	59.78 (49.45)	75.71 (64.29)	.03
<30	72 (28)	21 (29.2)	51 (70.8)	
≥30	187 (72)	51 (27.3)	136 (72.7)	.76

All data shown as n (%) unless otherwise indicated.
*χ^2 test for categorical variables; independent Student's *t* tests for continuous variables.

Results

Patients included in this study ranged in age from 18 to 81. Two-thirds were men and 86% were white, with an average BMI of 32. Other characteristics of the population are shown in Table 1. Of the 282 patients studied, 79 (28%) reported night sweats. There were no significant associations between sociodemographics, body composition, or diagnosis variables and reported night sweats.

The subjective and objective sleep-related variables are shown in Table 2. Those with night sweats were subjectively more tired and sleepier than those without night sweats. Patients who reported night sweats were also more likely to report creepy/crawly feelings in their legs ($P = .003$), kicking during sleep ($P = .004$), snoring ($P = .03$), nighttime breathing trouble ($P < .0001$), waking in the night with aches and pains ($P < .0001$), and waking in the morning with a headache as compared with those without night sweats ($P = .0002$). They had higher mean scores on the ESS ($P < .0001$).

If subjects reporting night sweats are more likely to have obstructive sleep apnea, as postulated in the literature, there should have been positive associations between night sweats and higher AHI and AI scores and lower WASO scores. However, of the objective sleep indices, only WASO was associated with reported night sweats; in the multivariate model it did not contribute to the explainable vari-

Table 3. Independent Associations Between Sleep Variables and Reported Night Sweats*

Variable	Odds Ratio (95% CI)	*P*
ESS	1.09 (1.03–1.15)	.005
Trouble breathing	2.81 (1.54–5.15)	.0008
Awakened by aches/pains	3.21 (1.78–5.82)	.0001

*Kicking at night excluded.
Data determined by multivariate logistic regression. Deviance 217.02 $P = .35$.

ance, and it was not retained. Table 3 shows the results of the final multivariate regression model. When ESS was removed from the model, it was replaced by age (younger patients were more likely to report night sweats). When subjective kicking during sleep was included, and only those patients with values for that variable were considered, it replaced trouble breathing in the model.

When the data were reanalyzed for men only (on the assumption that a predominant cause of night sweats in women might be menopause), the results were virtually identical except that the final regression model included being awakened by aches and pains ($P = .0003$), trouble breathing ($P = .004$), and WASO ($P = .04$). Because the natural log transformations and nonparametric testing of skewed continuous variables yielded virtually the same results, those results are not reported.

Pearson correlations indicated that there were significant positive associations between subjective snoring and higher AHI ($P = .03$) and between subjective snoring and a higher ESS score ($P = .0004$), but there were no significant associations between subjective snoring and higher PLMI, TST, WASO, SOL, or AI. There were also no associations between a crawling sensation in the legs and PLMI, AHI, AI, SOL, TST, or WASO; however, there was a significant positive association between a crawling sensation in the legs and higher ESS scores ($P = .007$). There were no associations between subjective kicking during sleep and PLMI, AHI, AI, SOL, TST, or WASO.

Discussion

Much of what we think we know about the causes of night sweats is based on surprisingly little research. Subjective night sweats are so common and under-reported that, without a control group, one could easily get the impression that the symptom is associated with nearly any disease present in subgroups of patients who have been asked about it. An association between night sweats and obstructive sleep apnea has become virtually axiomatic among sleep specialists, even though there has been only one published study investigating the association in infants.[4] Our findings cast doubt on such an association in adults.

We could find no association between subjective night sweats and AI or AHI. Subjective snoring was associated with night sweats when considered independently, but not after controlling for other variables. There was no association between night sweats and BMI. All these findings are consistent with our previous studies in which subjective night sweats were found to be associated with a large number of other subjective symptoms, including trouble sleeping and musculoskeletal pain but not with sex, age, or BMI.[1,2,6]

It may be that the subjective complaint of night sweats is simply an indicator of a greater inclination to notice and/or complain of virtually any symptom (ie, "the positive review of symptoms"). However, during the PSG studies, those who complained of night sweats awakened sooner (WASO) on average than those who did not. Poor sleep has been associated with a variety of physical symptoms such as cough,[8] pain, arthritis, and high blood pressure.[9] In our previous studies we found strong associations between subjective night sweats and symptoms of depression and anxiety and between night sweats and the use of antidepressants.[1,6] A variety of causal theories could fit these associations.

This study is strengthened by its relatively large sample size and nearly complete data set. Limitations include the highly selected patient population (referral for a sleep study for presumed sleep apnea, predominantly men, predominantly white) and no clear definition of "night sweats" on the patient questionnaire. We were unable to control for concurrent medications that are known to cause diaphoresis or for certain other variables found in other studies to be associated with this symptom (eg, menopause, anxiety, depression, sensory deficits).[1,5]

Further investigations into the causes of night sweats should include full clinical evaluations on a series of patients with and without the symptom, followed by N-of-1 trials of targeted treatment approaches in the symptomatic patients.

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