Epidemiology of Restless Legs Symptoms in Adults

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Background: Restless legs syndrome (RLS) is a disorder characterized by sleep-disrupting unpleasant leg sensations, often accompanied by daytime behavioral problems. Treatment for this condition is available, but it is suspected that most instances of RLS remain undiagnosed. The goal of this investigation was to assess the prevalence and health status correlates of restless legs symptoms (hereinafter referred to as restless legs) in the general population.

Methods: A question reflecting the clinical features of RLS was added to the 1996 Kentucky Behavioral Risk Factor Surveillance Survey. Data on the frequency of experiencing restless legs, self-rated general and mental health status, demographics, and behavioral risk factors were collected by telephone interview from 1803 men and women, 18 years and older.

Results: Experiencing restless legs 5 or more nights per month was reported by 3% of participants aged 18 to 29 years, 10% of those aged 30 to 79 years, and 19% of those 80 years and older. The age-adjusted prevalence for Kentucky adults is 10.0%; prevalence did not vary significantly by sex. The adjusted odds ratios (95% confidence intervals) for restless legs and diminished general health and poor mental health status were 2.4 (1.4-4.0) and 3.1 (2.0-4.6), respectively. Restless legs were significantly associated with increased age and body mass index, lower income, smoking, lack of exercise, low alcohol consumption, and diabetes.

Conclusions: The prevalence of restless legs in the general adult population is high. Restless legs may be associated with decreased well-being, emphasizing the need for further research and greater medical recognition of this condition.

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RESTLESS LEGS syndrome (RLS) is a sleep disorder characterized by unpleasant leg sensations at bedtime that interfere with sleep onset and disrupt sleep. This syndrome was first extensively described in a monograph by Ekbom[1] published over a half century ago. Despite the substantial intervening period, many health care providers remain unaware of RLS. Little is known about the occurrence of RLS in the general population, but it is likely that most cases remain undiagnosed.[2,3] In the only population-based study, Lavigne and Montplaisir[4] surveyed 2019 Canadian adults for RLS symptoms (hereinafter referred to as restless legs). Leg restlessness that delayed sleep onset was reported by 17% of women and 13% of men; waking in the night with unpleasant leg sensations that necessitated movement, by 12% of women and 9% of men. These find-

ings suggest that the prevalence of restless legs may be high. However, the recruitment methods and the response rates for this study were not described, so the validity of the prevalence estimates is unknown. Furthermore, although clinical observations suggest that RLS is associated with emotional distress, psychosocial dysfunction, and depression, studies on adverse health correlates of restless legs in the general population have not been reported.

With the goal of better understanding the importance of having restless legs often in the general population, we included a question based on the clinical features of RLS in the 1996 Kentucky Behavioral Risk Factor Surveillance Survey (BRFSS).[5] We specifically sought to estimate the prevalence of restless legs in a US population and to investigate its association with self-rated general and mental health status.

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METHODS

Kentucky has been participating in the BRFSS since 1985 as part of a nationwide effort to gather information on risk factors, health, and health care usage of US adults (18 years and older). For the 1996 survey, participants were randomly selected using the Waksberg technique, a modified random-digit dialing method, and interviewed by telephone. Calls were made during weekdays, evenings, and on Saturdays; calls with no answer were repeated up to 15 times. The specific method for participant selection is described in detail elsewhere.[5]

We were limited to 1 item for inclusion on the Kentucky BRFSS,[5] so a single question was developed that would best reflect the clinical features of RLS. The diagnosis of RLS is currently based on history provided by the patient; no laboratory test provides a more accurate diagnosis. In 1995, the International Restless Legs Syndrome Study Group[6] published clinical criteria for the diagnosis of RLS. In summary, these criteria are (1) the desire to move the limbs, usually associated with paresthesias; (2) motor restlessness; (3) symptoms worse or present exclusively at rest with at least partial and temporary relief by activity; and (4) symptoms worse in the evening or at night.[6] We developed the following question to reflect these criteria: "Do you have unpleasant feelings in your legs—for example creepy-crawling or tingly feelings—when you lie down at night that make you feel restless and keep you from getting a good night's sleep?" The possible responses were (0) never, (1) rarely (once a month or less), (2) sometimes (2 to 4 times a month), (3) often (5 to 15 times a month), and (4) very often (16 or more times a month).

In addition to this restless legs question, the BRFSS included questions on self-rated general health status (excellent, very good, good, fair, or poor), and the number of days of the past 30 with mental health considered to be "not good." Data were also collected on age, sex, height, weight, alcohol consumption, smoking habits, history of diabetes, exercise, income, education, and marital status.

Variables for restless legs and health status were created from the survey responses. Restless legs syndrome was considered to be present if restless legs were reported to occur often or very often (>5 nights per month). Respondents were coded as having diminished general health status if they reported their health to be poor or fair, and poor mental health if they reported their mental health was not good on all days in the prior 30. Poor mental health was also indicated by the number of days of the previous 30 spent with poor mental health. Other variables from the BRFSS responses were age in years, sex, smoking, income, diabetes status, body mass index (BMI), education, and consumption of less than 1 alcoholic drink per month.

The associations of restless legs occurrence with age, sex, and other covariates were expressed by comparing proportions and mean values. Differences were tested for statistical significance by χ^2 and t tests.

Multiple logistic regression was used to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for assessing the associations of restless legs with the mental and general health variables. Multiple linear regression was used to estimate the association between restless legs and the number of days of poor mental health. In all of these models, the presence or absence of restless legs was used as an independent variable, along with possible confounding factors such as age, sex, and BMI.

To identify independent correlates of restless legs, multiple logistic regression was used with restless legs (present vs not present) as the dependent variable. All of the sociodemographic, lifestyle, and health history variables were investigated.

The statistical significance of logistic and linear regression coefficients was assessed by χ^2 tests and t tests, respectively. A 2-tailed P value of less than .05 was used to indicate statistical significance.

RESULTS

Of the eligible Kentuckians contacted, 84% successfully completed the BRFSS interview, yielding a final sample of 1803 people. The distribution of restless legs frequency is given in the tabulation below:

Frequency Category	No. (%) of Subjects
Never	1453 (80.6)
Rarely (<1 time per month)	43 (2.4)
Sometimes (2-4 times per month)	137 (7.6)
Often (5-15 times per month)	63 (3.5)
Very often (≤16 times per month)	107 (5.9)

Overall, 9.4% of respondents were classified as having restless legs, based on self-reported occurrence of of RLS symptoms often or very often. The presence of restless legs was not significantly associated with sex, but varied by age group (**Figure**). Prevalence was low prior to age 30 years, increased during the middle and older adult years, and was followed by an additional increase for subjects 80 years and older. For the 10-year age groups between 30 and 70 years, the small differences in prevalence were not statistically significant.

The relationships between restless legs and other characteristics are given in **Table 1**. Several characteristics differed significantly by restless legs status. Most notably, a higher proportion of individuals with restless legs, compared with those without, reported diminished general health (65% vs 20%) and poor mental health for every day of the previous 30 days (40% vs 12%).

The relationships between restless legs and self-rated health outcomes, after adjustment for potential confounding factors using logistic regression, are given in **Table 2**. Restless legs was significantly related to diminished general health and poor mental health. People with restless legs were 2.4 times more likely to report diminished general health than were those without restless legs. Similarly, restless legs were associated with poor mental health. The OR for having experienced all days of the previous month in poor mental health was 3.1. On average, those with restless legs experienced 5 additional days in poor mental health.

The health and lifestyle characteristics (**Table 3**) independently related to restless legs were BMI, age, cigarette smoking, history of nongestational diabetes, exercise, and low alcohol consumption. Having diabetes and
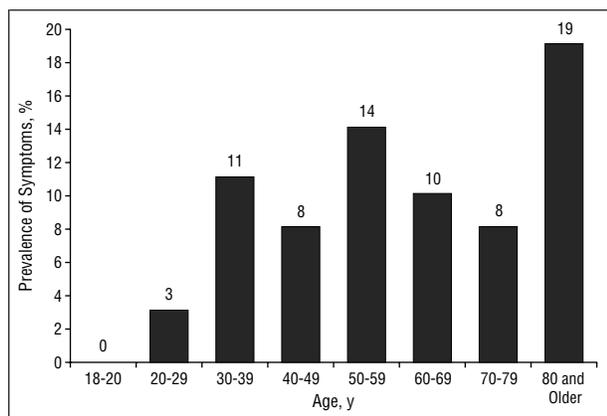
Prevalence of having restless legs symptoms at least 5 nights per month, by age group (N=1803).

Table 1. Selected Characteristics by Restless Legs Symptom Category

Characteristic	Restless Legs Symptom Category	
	Never, Rarely, or Sometimes	Often or Very Often
Men, %	36	32
Diabetes (nongestational), %	5	21*
Regular exercise (at least 30 minutes 3 times a week), %	38	19*
Overall health (fair/poor), %	20	65*
Poor mental health (all days of previous 30), %	12	40*
Current smoker, %	24	35*
Mean ± SD body mass index, kg/m^2	26 ± 5	28 ± 5†
Mean ± SD age, y	48.1 ± 18.5	53.9 ± 17.8†
Income (<$25 000), %	34	67*
Currently married, %	55	46*
Alcohol consumption (<1 drink in the past month), %	32	15*

*The χ^2 test, P<.05.
†The t test, P<.05.

getting almost no exercise (<3 hours per month) were particularly strong predictors of restless legs; adjusted ORs were 4.4 and 3.3, respectively. Marital status and education were not significantly related to restless legs.

COMMENT

This study indicates that a significant proportion of adults experience restless legs, defined as experiencing RLS symptoms at least 5 times per month. In our sample, restless legs occurred in 3% of people younger than 30 years, 10% of those aged 30 to 79 years, and 19% of those older than 79 years. Proportions did not vary significantly by sex. Extrapolating these age-group specific proportions to the Kentucky 1990 census age distribution, we estimate that 10.0% of Kentucky men and women experience restless legs, a prevalence slightly lower than that reported in a Canadian study (17% for women and 13% for men).[4] Most importantly, we found that restless legs were significantly associated with self-reported dimin-

Table 2. Adjusted Associations of Restless Legs With Health Status Outcomes*

Characteristic	Model 1,† Diminished General Health Status‡	Model 2,† Poor Mental Health Status§	Model 3,‖ Mean No. of Days in Poor Mental Health
Restless legs (often or very often vs never or sometimes)	2.4 (1.4-4.0)	3.0 (2.0-4.6)	9.76 vs 4.98

*Adjusted for age, body mass index, sex, smoking, diabetes, exercise, income, and alcohol consumption. Unless otherwise indicated, data are odds ratios (95% confidence intervals).
†Logistic regression model.
‡Self-rated general health status fair or poor vs good, very good, or excellent.
§Had poor mental health all days of the previous 30.
‖Linear regression model.

Table 3. Odds Ratio for Restless Legs Symptoms' Association With Sociodemographic, Lifestyle, and Other Factors, Estimated by Logistical Regression

Variable	Odds Ratio (95% Confidence Interval)
BMI (per increased increment of 5 kg/m^2)*	1.31 (1.11-1.53)*
Age (per increased increment of 10 y)	1.12 (1.01-1.12)
Sex (male vs female)	0.75 (0.50-1.12)
Smoking	
Daily (1 pack vs never)	2.06 (1.27-3.36)
Daily (<1 pack vs never)	1.39 (0.69-2.78)
Some days vs never	1.09 (0.43-2.78)
Past vs never	1.10 (0.67-1.80)
Diabetes (nongestational vs never)	4.42 (2.57-7.59)
Exercise	
<3 h/mo vs ≥3 h/mo	3.32 (1.67-6.30)
Income (≤$25 000 vs >$25 000/y)	2.62 (1.71-4.05)
Alcohol use (<1 drink/mo)	0.56 (0.33-0.94)

*BMI indicates body mass index.

ished general health and poor mental health. Statistically significant correlates of restless legs included age, increasing BMI, diabetes, cigarette smoking, low exercise, and low alcohol consumption.

Confidence in these findings is bolstered by a high response rate and the lack of participation bias linked to restless legs. Prevalence can be overestimated when knowledge of the study's purpose induces a higher response rate among people with the condition of interest. Because the inclusion of a question on restless legs was not known to potential participants in the BRFSS, this bias is not of concern. However, it is likely that the healthy volunteer bias commonly occurring in population survey samples would tend to underestimate the prevalence of restless legs.

Our estimates of prevalence are limited by reliance on self-reported frequency of restless legs. Although our question was based on the newly described diagnostic criteria for RLS,[6] the gold standard diagnostic tool for RLS is a careful, detailed conversation between an experienced clinician and the patient concerning symptoms. It is possible that people with other disorders and con-

ditions are incorrectly included in our prevalence estimate. The restless legs in our question may have been mistakenly endorsed by people with other leg discomforts such as leg cramps or with certain disorders such as diabetic polyneuropathy that can mimic RLS. The lack of clinical examinations to rule out false-positive responses would result in an overestimation of RLS prevalence. The credibility of our prevalence results is greatly strengthened by a recent publication that found remarkably similar results.[7] In a population-based study of 369 Germans aged 65 to 83 years, 2 seasoned RLS-trained clinicians performed face-to-face interviews based on the standard clinical criteria[6] and reported an overall prevalence of RLS of 9.8%. Further, we used a relatively high frequency of symptoms to indicate the presence of restless legs; because the diagnosis of RLS does not depend on frequency of attacks, we may have missed some people with RLS. For these reasons, we restrict our findings to estimating the number of subjects with restless legs rather than with the clinical syndrome.

The generalizability of the prevalence estimates is compromised by the lack of racial heterogeneity in the Kentucky source population. Without knowledge of the extent to which restless legs vary by race, it is not possible to extrapolate our findings with confidence to groups other than whites.

The strong associations between restless legs and lower general and mental health status were striking and suggest that untreated restless legs may significantly diminish perceived well-being. The finding that restless legs are associated with poor mental health is consistent with findings that sleep problems cause psychological distress. A large proportion of patients with RLS complain of great psychological discomfort related to their disorder.[8] In a population-based study of older Germans, Rothdach and colleagues[7] also found a higher incidence of depression and lower self-reported mental health scores in participants with RLS compared with those without.[7] Impaired mood and diminished quality of life are also associated with several other sleep disorders characterized by poor quality of sleep, such as sleep apnea and insomnia.[9] Similarly, the emotional distress and poor sleep quality associated with restless legs may lead to daytime fatigue perceived as poor health or may indirectly contribute to other morbidity. Alternatively, some comorbid conditions may actually cause restless legs.

Misclassification of restless legs occurrence, if random, would tend to underestimate the associations with low general and mental health. However, if misclassification were systematically related to the outcomes, the findings would be biased. One concern is that individuals who have poor mental or physical health may tend to overemphasize somatic problems. It is also possible that other medical problems also associated with perceived poor health may result in leg sensations that are similar to restless legs. Although we are not able to assess the true degree of bias, we were able to control for factors likely to carry some of the bias, such as diabetes, age, BMI, and smoking.

We found several demographic features and behavioral risk factors associated with restless legs. Our findings that the prevalence of restless legs increases with age but does not differ significantly by sex is consistent with a model of RLS as a chronic disease with a variable age of onset, as recently found in 3 studies of patient series.[10-12] It is also consistent with models of possible genetic transmission, which suggest no sex linkage but possible anticipation.[13] The other demographic factor we found associated with RLS, income level, may be related to the generally raised levels of health problems in those with lower incomes. It is possible that misunderstanding of the symptom question varied by income status. However, the lack of association of restless legs and education does not support this explanation.

The association between cigarette smoking and restless legs that we observed is potentially quite important. One study of Canadians did not find a significant association with restless legs as determined by questionnaire and the numbers of periodic limb movements determined in the laboratory.[14] However, in that study smoking was determined by a single, dichotomous question: "Over the past two weeks, have you smoked cigarettes?" (Yes or No). It is possible that their smoking group included a large number of lighter smokers. We found a statistically significant association between cigarette smoking and restless legs for those individuals smoking at least 1 pack per day, but not for lighter smokers.

The relationship between exercise and restless legs is also important to note. Our results do not suggest that exercise has a graded association with restless legs, whereby higher levels of exercise would predict the lowest likelihood of restless legs. If there is a protective association between exercise and RLS, this finding is especially interesting in the public health setting. It means that in terms of prevention, the amount of exercise needed to achieve benefits is attainable by the entire population and not only those who are disciplined enough to stick to a rigorous exercise schedule. This finding is also consistent with anecdotal reports that individuals with restless legs benefit from moderate exercise.[15] On the other hand, it is possible that the association exists because those with restless legs avoid exercise owing to the discomfort of their condition. The association of restless legs with alcohol abstinence is surprising, as alcoholism has been linked to periodic limb movement disorder.[16] Comparison with our finding is limited, however, because the heavy alcohol consumers studied may not be typical of the general population of more moderate drinkers. On the other hand, a protective effect from alcohol use seems unlikely. Interpretation of our finding is difficult because we had no information on alcohol use history, and low consumption may be a consequence of restless legs, other comorbidity, or medication use.

People with diabetes, compared with those without, were 4 times more likely to have restless legs. There have been some reports suggesting that RLS may be more prevalent in people with diabetes.[2] Also, given that glucose intolerance frequently results in both renal failure and neuropathy, other potential causes of RLS, the strong correlation that we found between diabetes and restless legs is not surprising. It is also possible that a certain number of these respondents may have diabetic small-fiber neuropathy, whose features can mimic RLS with predominantly nocturnal dysesthesias. In earlier studies,[16] RLS has been found to be associated with a number of conditions in which there is a clearly elevated preva-

lence or whose resolution leads to alleviation of RLS. These conditions include renal failure, pregnancy, iron deficiency, neuropathy, and radiculopathy.[16] Data on these conditions were not available for this analysis.

In summary, the results of this study suggest that having restless legs at least 5 nights per month is prevalent in the general adult population and is linked to significantly lower perceptions of health and well-being. These are the first findings indicating that the occurrence of restless legs in the general population is associated with some of the same problems that occur in patient groups with RLS. The results emphasize the need for more medical attention at the primary care level to restless legs and provide strong justification for studies designed specifically for investigating outcomes of medically unrecognized RLS in the population. In addition, the potential behavioral risk factors for restless legs identified in this study, including higher BMI, lower exercise, and more cigarette smoking, may have implications for interventional strategies or nonpharmacological treatment of RLS.

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