

# Prevalence of high Epworth Sleepiness Scale scores in a rural population

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**BACKGROUND:** Increased daytime sleepiness is an important symptom of obstructive sleep apnea (OSA). OSA is frequently underdiagnosed, and the Epworth Sleepiness Scale (ESS) can be a useful tool in alerting physicians to a potential problem involving OSA.

**OBJECTIVE:** To measure the prevalence and determinants of daytime sleepiness measured using the ESS in a rural community population.

**METHODS:** A community survey was conducted to examine the risk factors associated with ESS in a rural population in 154 households comprising 283 adults. Questionnaire information was obtained regarding physical factors, social factors, general medical history, family medical history, ESS score, and self-reported height and weight. Multivariable binary logistic regression analysis based on the generalized estimating equations approach to account for clustering within households was used to predict the relationship between a binary ESS score outcome (normal or abnormal) and a set of explanatory variables.

**RESULTS:** The population included 140 men (49.5%) and 143 women (50.5%) with an age range of 18 to 97 years (mean  $\pm$  SD) 52.0 $\pm$ 14.9 years). The data showed that 79.2% of the study participants had an ESS score in the normal range (0 to 10) and 20.8% had an ESS score >10, which is considered to be abnormal or high sleepiness. Multivariable regression analysis revealed that obesity was significantly associated with an abnormal or high sleepiness score on the ESS (OR 3.40 [95% CI 1.31 to 8.80]).

**CONCLUSION:** High levels of sleepiness in this population were common. Obesity was an important risk factor for high ESS score.

**Key Words:** Epworth Sleepiness Scale; Obesity; Rural; Snoring

Obstructive sleep apnea (OSA) syndrome is a common sleep disorder affecting 2% to 4% of middle-age adults (1-2). Newer data suggest that approximately 25% of adults are at risk for OSA (3). OSA is characterized by repetitive upper airway obstructions during sleep. These obstructive episodes are known as apneas and/or hypopneas, which occur for 10 s or longer, often accompanied by oxygen desaturation and/or electroencephalogram-detected arousals from sleep (4). The individual with sleep apnea may not be aware of his or her difficulty with breathing, making a collaborative sleep history from a bed partner beneficial. Classical clinical symptoms of OSA include witnessed snoring and/or apneas. In addition, excessive daytime sleepiness is an important and common symptom of OSA. Sleep disordered breathing is an important health hazard with known cardiac and neurological complications (5,6). Furthermore, OSA plays a major role in many motor vehicle accidents (7-12).

Previous studies have reported an association between daytime sleepiness/sleep apnea and age (13-15), sex (14,16-18), smoking (19-20), hypertension (21) and obesity (21,22). The condition is more common in men than in women (23), although this may be due to under-recognition of OSA in women. More recent data demonstrated sex-specific variation in the clinical features of OSA as well

## La prévalence d'indices élevés de l'échelle de somnolence d'Epworth dans une population rurale

**HISTORIQUE :** La somnolence diurne accrue est un important symptôme d'apnée obstructive du sommeil (AOS). L'AOS est souvent sous-diagnostiquée. L'échelle de somnolence d'Epworth (ÉSS) peut représenter un outil utile pour éveiller les médecins à la possibilité d'un problème d'AOS.

**OBJECTIF :** Mesurer la prévalence et les déterminants de la somnolence diurne au moyen de l'ÉSS dans la population d'une collectivité rurale.

**MÉTHODOLOGIE :** Les chercheurs ont procédé à un sondage communautaire auprès de 154 ménages composés de 283 adultes pour examiner les facteurs de risques associés à l'ÉSS dans une population rurale. Ils ont obtenu de l'information sur les facteurs physiques, les facteurs sociaux, les antécédents médicaux généraux, les antécédents médicaux familiaux, l'indice de l'ÉSS ainsi que la taille et le poids autodéclarés. Ils ont utilisé une analyse de régression logistique binaire multivariable fondée sur un système généralisé d'estimation pour tenir compte des regroupements dans les ménages afin de prédire le lien entre un résultat binaire de l'indice de l'ÉSS (normal ou anormal) et une série de variables explicatives.

**RÉSULTATS :** La population se composait de 140 hommes (49,5 %) et de 143 femmes (50,5 %) de 18 à 97 ans (moyenne  $\pm$ ÉT] de 52,0 $\pm$ 14,9 ans). Les données ont révélé que, chez 79,2 % des participants à l'étude, l'indice de l'ÉSS se situait dans la plage normale (0 à 10) tandis que 20,8 % avaient un indice de l'ÉSS supérieur à dix, ce qui est considéré comme anormal ou comme une somnolence élevée. L'analyse de régression multivariable a révélé que l'obésité s'associait de manière significative à un indice anormal ou de somnolence élevée de l'ÉSS (RRR 3,40 [95 % IC 1,31 à 8,80]).

**CONCLUSION :** Les taux élevés de somnolence étaient courants au sein de cette population. L'obésité était un important facteur de risque d'indice élevé de l'ÉSS.

as differences in polysomnographic findings (24-28). While sleep apnea is common in the general population, approximately 75% to 90% of cases remain undiagnosed (29). The Epworth Sleepiness Scale (ESS) is a simple, self-administered questionnaire (30-32) that has been used by several researchers, clinicians and sleep specialists to measure daytime sleepiness, or as a screening tool to assess sleep apnea or OSA (33-35). The validity and reliability of the English version of the ESS has been tested (33,36-39). The ESS questionnaire has been translated into many languages such as Italian (40), Spanish (41), Thai (42), Korean (43), Portuguese (44), Japanese (45) and Chinese (46). These versions have been tested for their validity and have established the ESS as a standard questionnaire that can be used in epidemiological studies, enabling easy and accurate assessment of daytime sleepiness.

The predictors and prevalence of high ESS scores for rural residents have not been studied extensively. The objective of the present study was to measure the prevalence and identify the determinants of daytime sleepiness as measured by the ESS in a rural community population. Understanding these factors may help in eventually reducing OSA in the population by focusing on reducing daytime sleepiness.

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## METHODS

A pilot study was conducted in rural Saskatchewan in 2009 to examine feasibility and to determine an approach to conducting a larger province-wide cohort study of respiratory health and associated health determinants in a rural population. Participants in the pilot study were recruited from among adults who were residents of a town and adjacent municipality in rural Saskatchewan that were convenient to the researchers for sampling purposes. The municipalities' councillors were approached for their cooperation in accessing the study population. Mailing lists of the resident ratepayers in the municipalities were obtained, and all households were approached to participate in the study. Prospective participants (those named on the list) received a personal letter informing them that they would be receiving a request to participate in the pilot project. After one week, participants living in single-family homes received a personally addressed study package through the mail, while residents in multiple-unit housing received the study packages at their door. The package contained an invitation letter to participate, information about the study, baseline questionnaire and a postage-prepaid, self-addressed return envelope. The procedure for distributing surveys by mail used the Dillman (47) approach (with three reminders) to maximize the questionnaire response rate.

One informed adult member of each household was asked to complete the questionnaire for all adult household members. The questionnaire included physical factors (eg, biological dust, animal confinement environments, pesticides, obesity and household environments), social factors (eg, family income, level of education, ethnicity and marital status), occupational history and health service delivery circumstances. Participants' respiratory health was assessed, which included a general medical history, family medical history, ESS, and self-reported height and weight. The study was approved by the Biomedical Research Ethics Board of the University of Saskatchewan, (Saskatoon, Saskatchewan).

### Definitions

**ESS:** The ESS is a useful tool to identify symptoms of daytime sleepiness. The ESS was introduced by Dr Murray W Johns in 1991 (30-32). The ESS is an eight-item questionnaire that assesses the severity of daytime sleepiness in various situations. The ESS has been validated mainly for OSA (36-39,48,49). Subjects respond to the following question on the scale: "How likely are you to doze off or fall asleep in the situations described below, in contrast to just feeling tired? This refers to your usual way of life in recent times. Even if you haven't done some of these things recently, try to work out how they would have affected you." Each item on the ESS is assessed on a Likert scale of dosing (0 = would never doze; 1 = slight chance of dozing; 2 = moderate chance of dozing; and 3 = high chance of dozing) for the following items: sitting and reading; watching television; sitting inactive in a public place (eg, a theatre or a meeting); as a passenger in a car for 1 h without a break; lying down to rest in the afternoon when circumstances permit; sitting and talking to someone; sitting quietly after lunch without alcohol, or in a car; and while stopped for a few minutes in traffic.

The numbers selected for the eight situations in the ESS are summed to provide a score for each subject ranging from 0 to 24. A score ranging from 0 to 10 is defined as normal, while a score of 11 to 24 is considered to be abnormal and indicative of excessive daytime somnolence (30-32,37).

**Smoking status:** Three types of smoking history were assessed including current smoker (smoking in the past year) or exsmoker (no current smoking or a history of smoking at least 20 packs) or nonsmoker (all others).

**Body mass index:** Body mass index (BMI) was calculated as weight (in kg)/height (in m<sup>2</sup>). BMI was based on self-reported height and weight. Overweight was defined as a BMI of 25 kg/m<sup>2</sup> to 30 kg/m<sup>2</sup>, and obese was defined as a BMI >30 kg/m<sup>2</sup>.

### Statistical methods

Statistical analysis was performed using SAS version 9.02 (SAS Institute, USA). Logistic regression models (50-52) were used to predict the relationship between a binary ESS score outcome (normal or abnormal) and a set of explanatory variables. The SAS procedure PROC GENMOD (52) was used to fit the multivariable model to determine the significant predictors of the ESS score. Robust variance estimation using generalized estimating equation in GENMOD, which accounts only for the within-subject dependencies due to the multiple people from same household, was used in the analysis (53).

## RESULTS

A total of 367 households were sent the questionnaire and, of these, 221 returned the questionnaire, yielding a 60.2% response rate. Of 221 households, 168 (45.8%) completed the questionnaire, and of these, 154 responded to the sleep and ESS questions. Therefore, the study population consisted of 154 households comprising 283 adults 18 to 97 years of age (mean [± SD] age 52.0±14.9 years), which included 140 men (49.5%) and 143 women (50.5%). Most respondents were of Caucasian descent. Thirty-two per cent of participants were obese, 13.1% were current smokers and 37.1% were exsmokers and 68.8% reported snoring. There were 224 (79.2%) participants with an ESS score ≤10 and 59 (20.8%) with an ESS score >10. Overall, the mean ESS score was significantly higher in men (mean [±SE] 7.49±0.38) than in women (6.17±0.33). Among those who had an ESS score >10, the mean ESS score was not significantly different between men and women. However, the prevalence of ESS score >10 for men (25% [35 of 140]) was higher with borderline significance (P=0.089) compared with women (16.8% [24 of 143]).

Univariate binary regression analysis showed that a BMI >30 kg/m<sup>2</sup> (obese), age, snoring and shortness of breath were associated with a risk of having a higher ESS score (Table 1). The other covariables, such as sex, physician-diagnosed high blood pressure and heart disease, and smoking status, were included in the multivariate analysis because they were important (P<0.20).

Multivariate binary logistic regression analysis indicated that the risk of having a higher ESS score increased with each year of age increase (OR 1.03 [95% CI 1.00 to 1.04]) (Table 2). Similarly, with each 10-year age increase, the risk of ESS increased by a 30% (OR 1.30 [95% CI 1.02 to 1.48]). Comparison of the models with and without smoking included indicated that smoking was a potential confounder for relationship with other covariates and an ESS score >10 (Table 2). BMI >30 kg/m<sup>2</sup> was a strong predictor of high ESS score (OR 3.15 [95% CI 1.29 to 7.67]). When smoking was included in the model, the results indicated that age and, with borderline significance, snoring (OR 2.26 [95% CI 0.97 to 5.27]), were predictors of high ESS.

## DISCUSSION

Our study findings revealed that a significant percentage of the rural population experienced symptoms of excessive daytime sleepiness. According to our results, obesity was the most prominent factor associated with an increased risk of daytime sleepiness, although snoring was of borderline significance.

Obesity is a major cause of OSA (21,22). Participants in our study with a BMI >30 kg/m<sup>2</sup> were at increased risk of daytime sleepiness. Fat distribution of the upper part of the body, especially in and around neck area, may be associated with obstruction of the airway (54).

Many studies have reported an association between smoking and OSA (19-20). Kashyap et al (19) reported that after adjusting for BMI, sex, age and number of alcoholic drinks per week, current smokers were 2.7 times more likely to have OSA than former smokers and nonsmokers combined, and 2.8 times more likely to have OSA than never smokers. Results from a Turkish study (20) indicated that snoring and sleep apnea were more prevalent in rural participants compared with urban participants, possibly because of exposure to biomass smoke and smoking in rural areas. Our results show that smoking status was a strong confounder. When smoking was included in the

**TABLE 1**  
Univariate binary logistic regression analysis of patient characteristics\*

Variable	Epworth Sleepiness Scale score, n (%)		Unadjusted OR (95% CI)
	0–10	>10	
Sex			
Male	105 (46.9)	35 (59.3)	1.71 (0.97–3.02)
Female	119 (53.1)	24 (40.7)	1.00 (reference)
Body mass index, kg/m <sup>2</sup>			
<25	73 (35.6)	10 (17.2)	1.00 (reference)
25–30	77 (37.6)	20 (34.5)	2.07 (0.90–4.76)
>30	55 (26.8)	28 (48.3)	<b>3.72 (1.65–8.38)</b>
Age group, years			
≤40	52 (23.2)	8 (13.6)	1.00 (reference)
>40 to ≤50	58 (25.9)	17 (28.8)	1.81 (0.69–4.74)
>50 to ≤60	48 (21.4)	15 (25.4)	2.02 (0.73–5.60)
>60	66 (29.5)	19 (32.2)	1.75 (0.66–4.64)
Age, years, mean ± SD	50.9±14.7	55.7±15.3	<b>1.02 (1.00–1.04)</b>
Smoking status			
Current smoker	32 (14.3)	5 (8.5)	0.43 (0.16–1.21)
Exsmoker	85 (38.0)	20 (33.9)	0.78 (0.41–1.49)
Never smoker	107 (47.7)	34 (57.6)	1.00 (reference)
Has a physician or PCG ever said you have COPD?			
Yes	3 (1.6)	1 (2.1)	1.31 (0.12–14.77)
No	185 (98.4)	46 (97.9)	1.00 (reference)
Have you ever had asthma?			
Yes	18 (8.1)	7 (11.9)	1.54 (0.62–3.81)
No	205 (91.9)	52 (88.1)	1.00 (reference)
Do you usually have a cough?			
Yes	32 (14.4)	7 (11.9)	0.81 (0.34–1.94)
No	191 (85.6)	52 (88.1)	1.00 (reference)
Do you usually bring up phlegm from your chest?			
Yes	33 (14.9)	8 (13.8)	0.91 (0.39–2.12)
No	189 (85.1)	50 (86.2)	1.00 (reference)
Has a physician or PCG ever said you have heart disease?			
Yes	7 (3.3)	5 (8.9)	2.72 (0.75–9.88)
No	205 (96.7)	51 (91.9)	1.00 (reference)
Has a physician or PCG ever said you have high blood pressure?			
Yes	60 (27.3)	22 (37.9)	1.64 (0.88–3.06)
No	160 (72.7)	36 (62.1)	1.00
Has a physician or PCG ever said you have had an attack of bronchitis?			
Yes	70 (36.7)	19 (40.4)	1.15 (0.57–2.34)
No	121 (63.3)	28 (59.6)	1.00 (reference)
Do you snore?			
Yes	136 (65.1)	47 (82.5)	<b>2.59 (1.16–5.76)</b>
No	73 (34.9)	10 (17.5)	1.00 (reference)
Shortness of breath			
Yes	54 (24.1)	25 (42.4)	<b>2.21 (1.19–4.10)</b>
No	170 (75.9)	34 (57.6)	1.00 (reference)

\*Household identification used as the repeated measure. COPD Chronic obstructive pulmonary disease; PCG Primary care giver. Statistically significant results are bolded

model, it strengthened the relationship between other risk factors and outcome, especially the relationship with snoring and the ESS, which supports previously published findings (55,56).

Previous epidemiological studies have shown that there are sex differences in the prevalence of daytime sleepiness and sleep apnea (16,18,21,22,24,28,57-60). A Japanese study (57) reported that female patients experience less daytime sleepiness than do male patients. Other studies have reported a higher prevalence of OSA in men than

**TABLE 2**  
Multivariate binary logistic regression analysis of the prevalence of Epworth Sleepiness Scale score >10

Variable	OR (95% CI)*	OR (95% CI)†
Male sex	1.44 (0.75–2.78)	1.74 (0.86–3.56)
Female sex (reference)	1.00	1.00
Age, years	1.02 (0.99–1.05)	<b>1.03 (1.00–1.05)</b>
Body mass index, kg/m <sup>2</sup>		
<25 (reference)	1.00	1.00
25–30	1.45 (0.62–3.42)	1.47 (0.61–3.52)
>30	<b>2.55 (1.11–5.86)</b>	<b>3.15 (1.29–7.67)</b>
Snoring		
Yes	2.10 (0.89–4.93)	<b>2.26 (0.97–5.27)</b>
No (reference)	1.00	1.00
Smoking status		
Current smoker	–	<b>0.29 (0.10–0.82)</b>
Exsmoker	–	<b>0.42 (0.18–1.00)</b>
Never smoker (reference)		1.00

Adjusted for other covariates and repeated measure household identification. \*Smoking not included in the model; †Smoking included in the model. Statistically significant results are bolded

in women (18,58). Most clinical-based studies (16,17,59) have reported that sleep apnea is more common in men than in women. There is a possibility that this sex-dependent difference in prevalence is due to several factors, including failure of women to attend sleep clinics and underdiagnosis due to circumstances related to family lifestyles and sociocultural factors (24-29). Our study did not show a statistically significant higher prevalence of ESS scores in men compared with women; however, there was a nonsignificant trend toward higher scores in men within the population we studied.

Our study did not show any association between hypertension (physician-diagnosed high blood pressure) and the prevalence of daytime sleepiness. However, other studies have reported an association between OSA and hypertension (21,61).

Snoring is associated with an increased risk of OSA (55,56). Snoring may also be more common in men than in women (13). In our univariate analysis, persons who snored were at 2.6 times higher risk of experiencing daytime sleepiness compared with persons who did not snore. However, in the multivariate regression analysis, this association was of borderline significance when smoking was included in the model. Previous studies have reported that older age is a risk factor for sleep apnea or daytime sleepiness (13-15). Sleep disordered breathing is more common among older adults, with an estimated prevalence of 24% to 26% among those with mean age of 76 years (15). Most risk factors for sleep apnea are prevalent in persons older than 50 years of age (13). In our study, the risk for higher ESS scores increased with age.

Our study was a pilot project, conducted in a population of farm- and small-town dwellers to test both our recruitment strategy in study participants and to pilot test the baseline questionnaire for the main study. One potential weakness of our study is the relatively small sample size. However, these numbers clearly show a prevalence of ESS scores >10 in this that population was higher compared with excessive daytime sleepiness (defined as ESS score >10 [62]) reported in previously published studies in Canada, Britain, Japan and Sweden. We found only one Canadian study (63) that reported prevalence of daytime sleepiness (ie, ESS>10) among Native Americans (6.3%). A British study (64) reported the prevalence of severe daytime sleepiness to be 5.5% (95% CI 4.9% to 6.1%) and moderate daytime sleepiness to be 15.2% (95% CI 14.2% to 16.2%). In a Japanese population, the prevalence rate of excessive daytime sleepiness was reported to be 15% (65). In a study conducted in Sweden (66), excessive daytime sleepiness was found in 17.8% of the population, and was twice as common among males versus females (23.7% versus 12.6%, respectively [P<0.001]).

Several studies have shown a strong association/correlation between daytime sleepiness and OSA (30,34,37,67,68). Based on the report published by the Canadian Public Health Agency in 2009 (69), the prevalence of self-reported OSA was 3% among adults  $\geq 18$  years of age, and 5% in individuals  $\geq 45$  years of age. It was also reported that more than one in four Canadian adults (26%) was at high risk for OSA, and that adult men were twice as likely to report sleep apnea compared with adult women. These findings suggest that there is a need to conduct more studies to investigate the effectiveness of the ESS as a screening tool to measure OSA. Our message to the practicing rural physician is to become familiar with the ESS and to use it as an important diagnostic tool in the practise of rural medicine.

### CONCLUSIONS

High levels of sleepiness in this rural population were common. Obesity was an important risk factor for high ESS score, and snoring was of borderline significance. Clinicians must be aware that high ESS scores in obese males, particularly in the presence of snoring, may be an important indicator for the need to investigate the possible presence of OSA.

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