

INTRODUCTION


Sleep Deprivation definition: Sleeping < 7 hours each night 

In adults:

- Factors known to influence sleep deprivation:
 - Sociodemographic (sex/gender, age, marital status, ethnicity, income)
 - Lifestyle/behavioral (physical activity, smoking, alcohol intake, body mass index, stress)

In adults with CLD:

- Sleep adversely affected in those with Chronic Obstructive Pulmonary Disease/Asthma (collectively: chronic lung disease (CLD)).
- Prevalence as high as 78%¹ vs 33%² in general population.
- Sleep disorders are multifactorial: Known factors that affect sleep include: psychiatric disorders, medication^{3,4}.

Research question: Are the generally known effects of CLD on sleep deprivation in adults influenced by interactions between contextual elements (financial strain, sex/gender) and other factors? 

OBJECTIVES

Among adults:

- Identify correlates of sleep deprivation in the general population.
- Explore association between CLD and sleep deprivation.
- Evaluate scientifically-justified two-way interactions that can influence the likelihood for sleep deprivation.

METHODS

DATA SOURCE: Canadian Community Health Survey (CCHS) 2017-2018 Public Microdata File.

- Overall: 113,290 people aged 12+ years participated.
- Sleep data from: 4 provinces (PEI, QC, AB, BC) and 2 territories (YK, NVT).
- Restricted to adults (>= 18 years)

OUTCOME: Sleep Deprivation dichotomized: <7 hours, >= 7 hours

- Derived from number of hours slept each night

PRIMARY EXPOSURE: CLD (Yes/No)

- Self-report of COPD or Asthma: long term (chronic) condition diagnosed by a health professional lasting/expected to last 6 months or more.

Multiple logistic regression analysis⁵ using STATA 15.

Sampling weights used to ensure final estimates were representative of Canadian population. To estimate standard errors, Taylor linearization was used⁶.

Additive interaction measures evaluated using: Relative Excess Risk due to Interaction (RERI), Synergy Index (S), Attributable Proportion (AP)⁷.

RESULTS

Study participant highlights

- Even split by sex (F: 51%); mostly from Quebec (23%); White ethnicity (72 %).

- About a third over 60 years.

- Majority (80%) with household income > low-income cutoff.

Synopsis of Results (Table 1)

- A number of variables were associated with increased odds for deprived sleep.

- After adjustment, those with CLD had 17% higher odds of being sleep-deprived compared to those who did not.

Notable Interactions (Tables 1 & 2)

Female (sex) – Obese (BMI):

- Significant interaction [AOR (95% CI): 0.77 (0.64-0.92)].

- Probability of sleep deprivation is significantly lower in women (sex) with a higher BMI than the referent (male-normal BMI; Figure 1).

- Showed consistent additive effect, with reduced odds [Table 2 - RERI: -0.32 (95% CI: -0.59,-0.06)].

Occasional alcohol intake – low income households:

- Associated with lower odds (and probability; Figure 2) for deprived sleep [AOR (95% CI): 0.75 (0.60-0.93)].

- Showed similar directionality as above [Table 2 - RERI: -0.36 (95% CI: -0.59, -0.13)].

Table 1. Multiple regression analysis: Adjusted odds ratios [AOR] (95% CI) Sleep Deprivation with associated factors

Variable	Adjusted odds ratio (95% CI)	p-value
Location of residence		
Territories (Yukon, Nunavut)	1	
PEI	1.22 (1.14-1.30)	0.000
AB	1.04 (0.95-1.14)	0.326
QC	0.85 (0.76-0.94)	0.000
BC	1.07 (0.94-1.20)	0.280
Sex		
Male	1	
Female	1.26 (0.67-2.36)	0.458
Age group, in years		
18-29	1	
30-39	1.62 (1.02-2.55)	0.040
40-49	1.68 (1.07-2.65)	0.025
50-59	1.62 (1.02-2.57)	0.042
60+	1.27 (0.81-1.98)	0.296
Body Mass Index (BMI)		
Underweight or normal	1	
Overweight	1.17 (1.06-1.30)	0.003
Obese	1.48 (1.30-1.68)	0.000
Education level		
Post-secondary certificate, diploma or university	1	
Secondary school graduation, no post-secondary education	1.12 (1.09-1.25)	0.060
Less than secondary school graduation	1.24 (1.15-1.34)	0.000
Life Stress		
No	1	
Yes	1.56 (1.47-1.65)	0.000
Household income		
>= \$40,000	1	
< \$40,000	1.14 (0.92-1.42)	0.221
Ethnicity		
White	1	
Indigenous	1.24 (1.07-1.44)	0.005
Visible minority (Non-White)	1.63 (1.44-1.85)	0.000
Marital status		
Married	1	
Common-law	0.95 (0.70-1.28)	0.726
Widowed/Divorced/Separated	1.14 (0.97-1.34)	0.113
Single	0.97 (0.77-1.22)	0.805
Smoking status		
Non-smoker	1	
Daily	1.27 (1.02-1.56)	0.030
Occasional	0.94 (0.68-1.29)	0.697
Alcohol intake		
Did not drink in the last 12 months	1	
Regular drinker	1.06 (0.90-1.23)	0.494
Occasional drinker	1.34 (1.13-1.57)	0.001
Physical activity - CPAG⁸ guidelines		
At or above recommended level	1	
Below recommended level	0.96 (0.88-1.05)	0.397
No physical activity minutes reported	0.95 (0.87-1.03)	0.269
Chronic Lung Disease (Asthma/COPD; CLD)		
Neither	1	
Either	1.17 (1.07-1.27)	0.000
Number of co-existing chronic conditions (multimorbidity)^{9,10}		
No chronic disease	1	
One or more chronic disease	1.18 (1.10-1.27)	0.000
Significant Interactions		
Income <\$40,000 x Occasional alcohol intake	0.75 (0.60-0.93)	0.008
Sex (Female) x BMI (Obese)	0.77 (0.64-0.92)	0.005

Note: BMI - Body Mass Index; COPD - Chronic Obstructive Pulmonary Disease; CPAG - Canadian Physical Activity Guidelines. Significant Odds Ratios at 0.05 level in red.

Table 2. Additive Interaction Measures for select two-way interactions

Measure	Female sex-Obese BMI		Low Income-Occasional alcohol intake	
	Coefficient (95% CI)	p-value	Coefficient (95% CI)	p-value
RERI	-0.36(-0.59,-0.13)	0.002	-0.32(-0.59,-0.06)	0.015
AP	-0.34(-0.55,-0.13)	0.002	-0.27(-0.49,-0.05)	0.074
S-index	0.14(-0.08,0.35)	0.218	0.38(0.06,0.69)	0.02

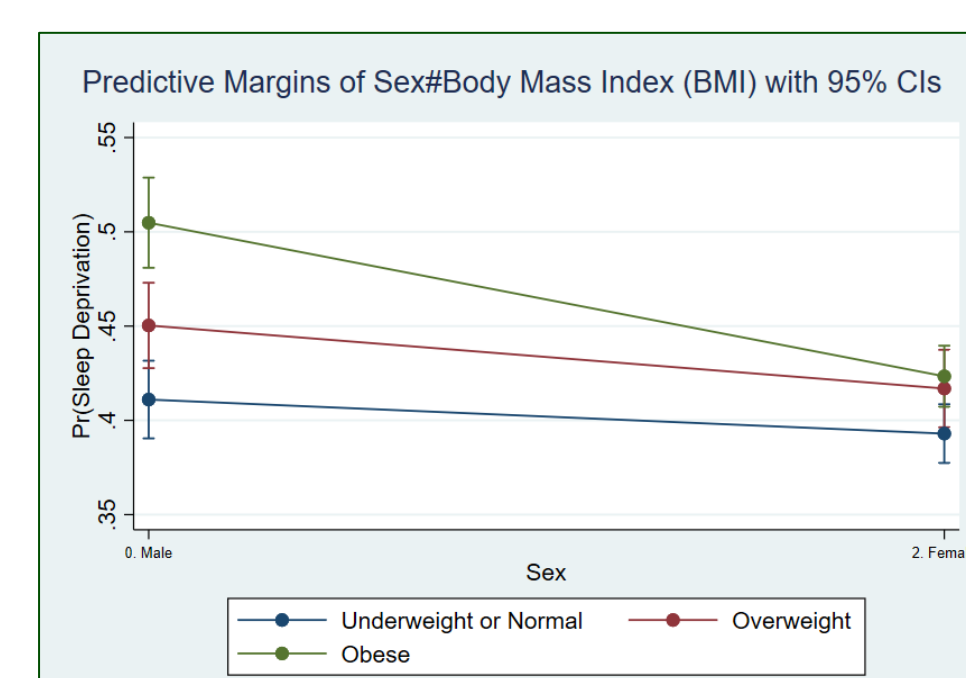


Figure 1. Interaction plot for sex and BMI on the probability scale

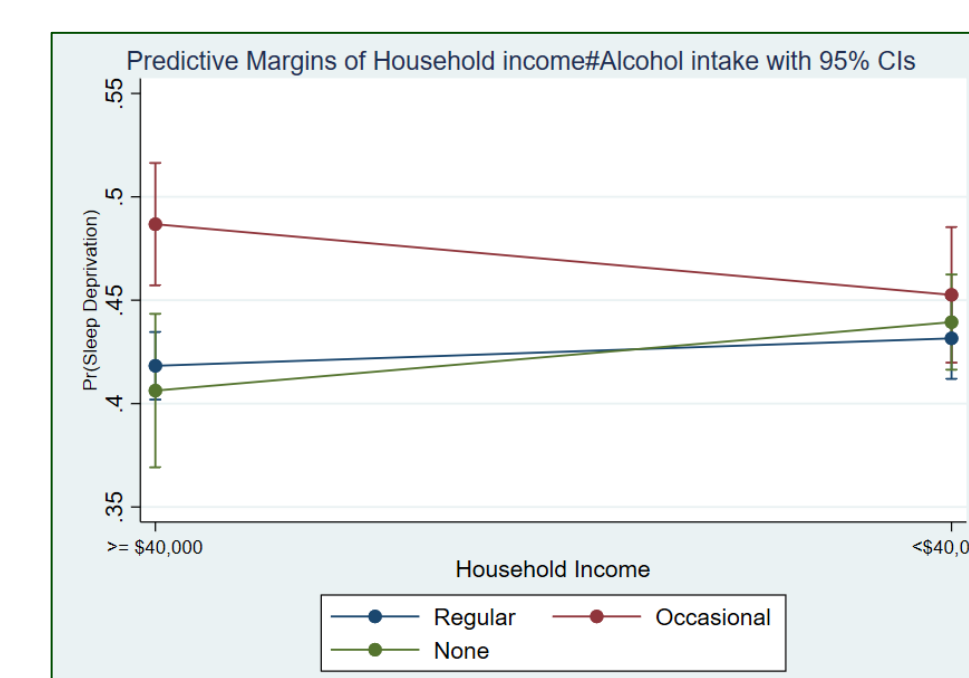


Figure 2. Interaction plot for household income and alcohol intake on the probability scale

DISCUSSION

- Our prevalence estimates (46%) of sleep deprivation (Yes) – CLD (Yes) are consistent with the literature¹.
- As shown in the results, those affected by CLD are more likely to be sleep-deprived (17% higher odds). Respiratory disturbances are common in the CLD afflicted and have been linked to deprived sleep⁴.
- We were surprised obesity impacted women differently from men, perhaps to deteriorate sleep quality but not sleep duration. Obesity is known to affect metabolism and sleep/wake cycles⁸ but was more strongly predictive of sleep deprivation in men than women. Sex/gender is intertwined with sleep in complex ways. Kripke et al (2002) showed that in women, very long or very short sleep duration was associated with high BMI⁹. We acknowledge that a more detailed study is necessary to clarify such effects.
- Moderate alcohol intake is known to be associated with inadequate sleep¹⁰. Alcohol use has been known to aid sleep onset and alleviate insomnia¹¹, which could provide some insight into the observed interaction. However, continued use has been linked to poor sleep quality¹². These observations underscore an intricate relationship between alcohol use and sleep consequences influenced by many factors.

CONCLUSIONS

- Sleep deprivation is a serious public health issue. There are many factors that can affect sleep. These factors need to be studied in more detail to inform prevention and policy efforts.
- Both sex/gender and socioeconomic considerations play an important role in determining patterns of sleep deprivation versus just looking at individual health-related characteristics in isolation.

STRENGTHS AND LIMITATIONS

- A large nationally representative population sample gave us sufficient statistical power to identify a number of correlates and two-way interactions associated with the CLD-sleep deprivation relationship.
- The cross-sectional design limits our ability to make causal/directional inferences. This requires longitudinal data.
- Social desirability/recall issues are likely linked to differential reporting of health/lifestyle behaviours.
- Factors like shift work which can have a close association with sleep and lung health were not considered due to data non-availability.

REFERENCES

- Klink M, Quan SF (1987). Prevalence of reported sleep disturbances in a general adult population and their relationship to obstructive airway diseases. *Chest*. 91:540-46.
- J-P, Chaput, S. L. Wong, and I. Michaud (2017). Duration and quality of sleep among Canadians aged 18 to 79. *Health Rep*. 28(9): 28-33.
- McNicholas WT, Calverley P, Lee A and Edwards J (2004). Long-acting inhaled anticholinergic therapy improves sleeping oxygen saturation in COPD. *Eur Respir J*. 23(6):825-31.
- McNicholas WT, Verbraecken J, and Marin JM (2013). Sleep Disorders in COPD: the forgotten dimension. *Eur Respir Rev*. 22: 565-75.
- Hosmer DW and Lemeshow S (2004). *Applied Logistic Regression*. Wiley.
- Woodruff, R. S. (1971). "A Simple Method for Approximating the Variance of a Complicated Estimate." *J Am Stat Assoc*. 66:411-14.
- Anderson T, Alfredsson L, Kallberg H, Zdravkovic S, and Ahlbom A (2005). Calculating measures of biologic interaction. *Eur. J. Epidemiol*. 20: 575-79.
- Pearson NJ, Johnson LL and Nahin RL (2006). Insomnia, trouble sleeping, and complementary and alternative medicine: Analysis of the 2002 national health interview survey data. *Arch Intern Med*. 166(16): 1775-82.
- Kripke DF, Garfinkel L, Wingard, Klauber DL, Marler MR (2002). Mortality associated with sleep duration and insomnia. *Arch Gen Psychiatry*. 59:131-36.
- Park S-Y, et al. (2015). The Effects of Alcohol on Quality of Sleep. *Korean J Fam Med*. 36(6): 294-99.
- Johnson EO et al. (1998). Epidemiology of alcohol and medication as aids to sleep in early adulthood. *Sleep*. 21:178-86.
- Stein MD and Friedmann PD (2005). Disturbed Sleep and its relationship to alcohol use. *Subst Abuse*. 26(1): 1-13.