

# Association Between Sleep Deprivation and Vision Problems Among Adult Canadians

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## BACKGROUND

- Sleep deprivation is a serious public health problem that can cause several other health problems
- Canadian Health Measures Survey (CHMS) 2014-2015 reported that about 26% of Canadian adults get sleeping hours less than seven, and about half of the adult population has trouble going to sleep<sup>1</sup>
- Recent evidence suggests that fewer sleeping hours/ poor-quality sleep may be linked with the onset of vision problems such as glaucoma, the second leading cause of blindness globally<sup>2,3</sup>
- As per 2017 Canadian Survey on Disability report, 1.5 million Canadians are living with vision loss.<sup>4</sup> Most ocular diseases are preventable if diagnosed at an early stage
- Sleep Deprivation and Vision Problems can impact the quality of life considerably<sup>5,6</sup>
- It is critically important to recognize the relationship between sleep deprivation and vision problems

## OBJECTIVES

- To explore the association between sleep deprivation and vision problems and identify other predictors of vision problems among the Canadian adult population.
- To examine the mediation effect of perceived life stress in a relationship between sleep deprivation and vision problems

## METHODOLOGY

- This cross-sectional study used the secondary data obtained from the Canadian Community Health Survey (CCHS) 2017-2018<sup>7</sup>
- Data related to sleep was collected from four provinces and two territories and subpopulation aged  $\geq 18$  years were selected
- The outcome variable, vision-problems, was dichotomized as presence or absence of vision-problems based on survey question: Do you have difficulty seeing, even wearing glasses?
- The primary predictor, sleep-deprivation, was derived from two variables: the number of sleeping hours per night and trouble sleeping (difficulty falling/ staying asleep) and categorized into four groups: no sleep-issues; fewer sleeping hours ( $<7$  hours) only; trouble sleeping (difficulty falling/ staying asleep) only; and fewer hours trouble sleeping
- A multivariable logistic regression model adjusted for age, sex, smoking, alcohol-intake, multimorbidity, physical activity, and perceived-life-stress was employed to analyze data
- Sampling weights and Taylor-linearization method were used to account for unequal probability of selection and design effects, respectively. Generalized structural equation modeling with bootstrap variance estimation was performed to test for mediation

## RESULTS

### Distribution of Participants' Characteristics

- The largest proportion of participants were in the age group 40–64 years (41.97%), followed by age group  $\leq 39$  years (37.27%)
- Males to females ratio was almost equal
- Over three-quarters of participants were white (76.73%), and 45.63% were married
- Three-quarters of respondents were Canadian-born (75.70%), and about two-thirds of participants attained postsecondary degree/certificate (64.50%)
- The annual household income of more than half participants was \$80,000 or above; however, a small proportion of participants (6.6%) reported average household income below \$20,000
- Approximately 14% of respondents reported vision-problems, 35% of whom reported both fewer hours and trouble sleeping.

### Main effects

- Participants with trouble sleeping and those reporting fewer sleeping hours and trouble sleeping were 1.58 times (95% CI: 1.39-1.79) and 1.86 times (95% CI: 1.65-2.10) more likely to have vision problems, respectively, as compared to those with no sleep issue
- Fewer sleeping hours was not associated with vision problems (ORadj. 1.09, 95% CI: 0.93-1.26)
- The probability of having vision problems increased with age, 1.69 and 1.63 times more likely with age group 40-64 years (95% CI: 1.40-2.05) and 65 years and older (95% CI: 1.33-1.99), respectively; compared to age 39 years and younger.
- Probability of vision problems was 1.13 times more among females than males (95% CI: 1.02-1.24).
- Ever smokers were 1.18 times more likely to develop vision problems than those who never smoked (95% CI: 1.06-1.30)
- The probability of having vision problems decreases with physical activity; those not physically active were 1.17 times more prone to vision problems than those active above the recommended level (95% CI: 1.03-1.31)

### Interaction

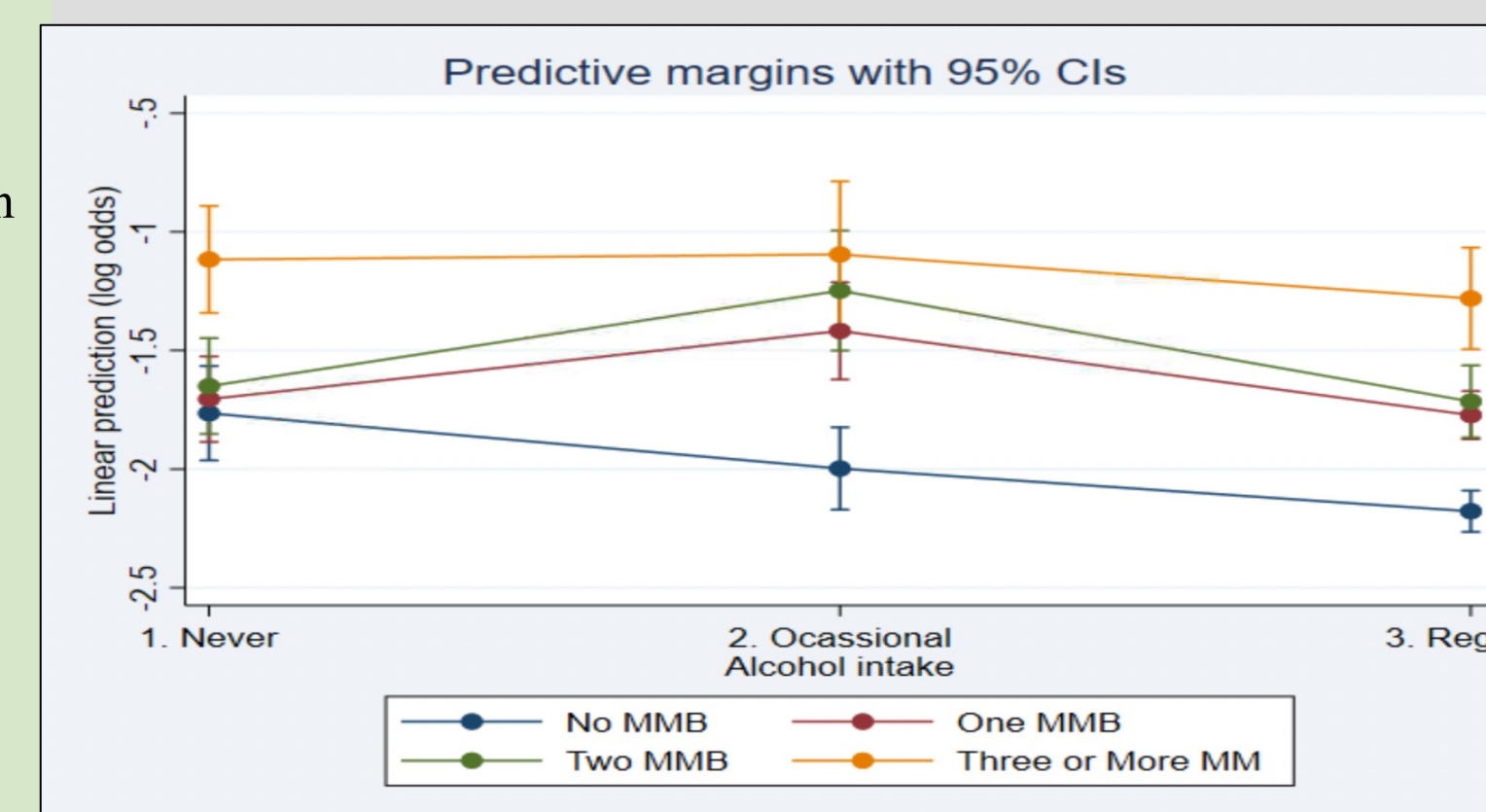
- An association between occasional drinking and vision problems was more pronounced among those with two multimorbidity ( $p=0.002$ ), followed by those with one morbidity ( $p=0.007$ )

### Mediation

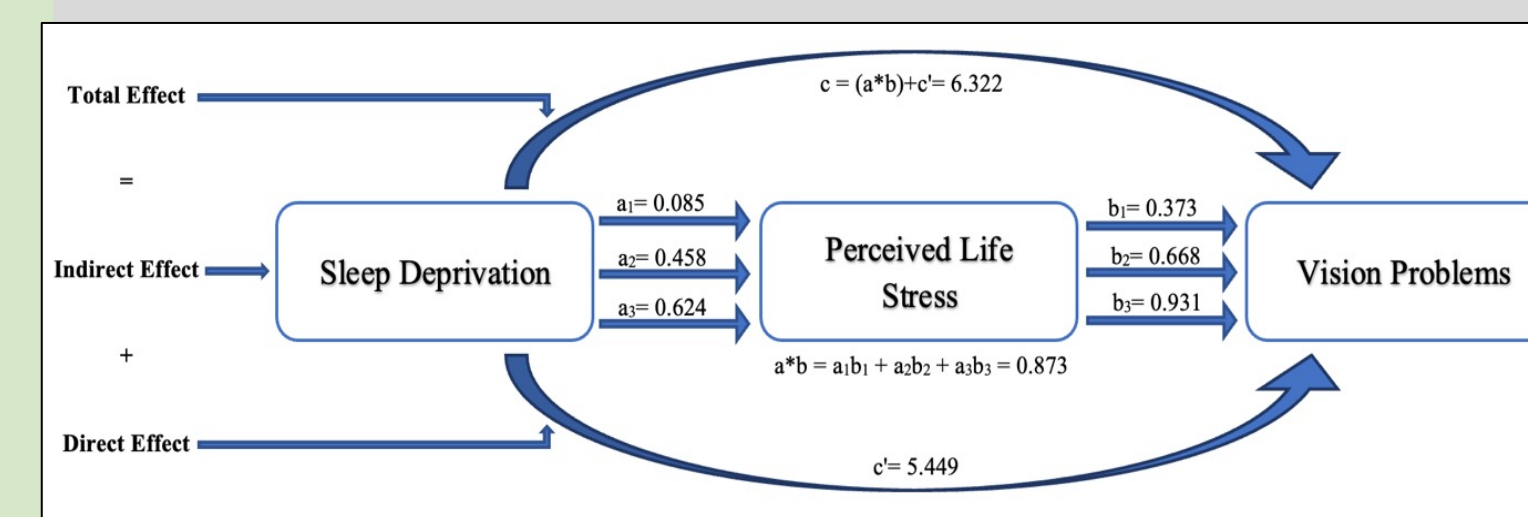
- The ratio of Indirect effect to total effect (RIT) was 12.13%, and the ratio of indirect effect to direct effect (RID) was 16.01%, suggesting a medium-sized mediation effect.
- Results stated that 12.13% of the effect of sleep deprivation on vision problems was mediated by perceived life stress which was about 16 times as large as the direct effect.

**Table 1: Multivariable Logistic Analysis: Adjusted Odds Ratio of Vision Problem Among Adult Canadian Population with Associated Risk Factors**

Variable	Coefficient (Std. Err.)	Odds Ratio (Adj.)	95% Confidence Interval		P value
			Lower	Upper	
<b>Sleep Deprivation</b>					
No Sleep Issue	-	1	-	-	-
Fewer Sleeping hours ( $<7$ )	0.085 (0.077)	1.089	0.937	1.265	0.267
Trouble Sleeping	0.458 (0.065)	1.581	1.393	1.794	$<0.001$
Fewer Hours Trouble Sleeping	0.624 (0.062)	1.866	1.651	2.109	$<0.001$
<b>Age Group (Years)</b>					
$\leq 39$	-	1	-	-	-
40 – 64	0.528 (0.097)	1.695	1.400	2.051	$<0.001$
$\geq 65$	0.487 (0.104)	1.628	1.328	1.996	$<0.001$
<b>Sex</b>					
Male	-	1	-	-	-
Female	0.119 (0.048)	1.127	1.025	1.239	0.013
<b>Smoking Status</b>					
Never Smokers	-	1	-	-	-
Ever Smokers	0.163 (0.053)	1.176	1.061	1.305	0.002
<b>Alcohol intake (past 12 months)</b>					
No Consumption	-	1	-	-	-
Occasional	-0.233 (0.134)	0.792	0.609	1.031	0.083
Regular	-0.413 (0.111)	0.661	0.533	0.822	$<0.001$
<b>Multimorbidity (MMB)</b>					
0 MMB	-	1	-	-	-
1 MMB	0.059 (0.137)	1.061	0.811	1.388	0.664
2 MMB	0.114 (0.143)	1.121	0.847	1.484	0.424
$\geq 3$ MMB	0.648 (0.152)	1.911	1.419	2.575	$<0.001$
<b>Perceived Life Stress</b>					
No	-	1	-	-	-
Yes	0.237 (0.051)	1.268	1.148	1.400	$<0.001$
<b>Physically Active</b>					
Above Recommended	-	1	-	-	-
Below Recommended	0.066 (0.058)	1.068	0.951	1.199	0.265
Not active	0.153 (0.061)	1.165	1.035	1.312	0.012
<b>Alcohol * Multimorbidity</b>					
Occasional * 1 MMB	0.520 (0.192)	1.682	1.155	2.450	0.007
Occasional * 2 MMB	0.635 (0.209)	1.887	1.251	2.846	0.002
Occasional * $\geq 3$ MMB	0.254 (0.231)	1.289	0.819	2.028	0.271
Regular * 1 MMB	0.345 (0.151)	1.413	1.050	1.901	0.022
Regular * 2 MMB	0.348 (0.165)	1.417	1.024	1.959	0.035
Regular * $\geq 3$ MMB	0.249 (0.189)	1.283	0.885	1.859	0.188
Indirect Effect (bootstrap)	0.873 (0.071)	-	0.734	1.011	$<0.001$



**Figure 1: Predictive log odds margins for significant interaction between Alcohol Intake and Multimorbidity**



**Figure 2: Mediation model of the relationship among Sleep Deprivation, Perceived Life Stress and Vision Problems**

## DISCUSSION

- Sleep-deprived individuals with the combined effect of poor sleep quantity and quality were nearly two times more likely, and sleep-deprived individuals with trouble sleeping were 1.5 times more likely to report vision problems than those with no sleep issue after adjusting for other risk factors. However, an association between fewer sleeping hours ( $<7$  hours) and vision problems was insignificant, suggesting fewer sleeping hours did not affect vision
- Highest odds of having vision problems are more marked among occasional drinkers having two multimorbidity followed by occasional drinkers having one multimorbidity than no multimorbidity
- The association between sleep deprivation and vision problems can be explained by direct and indirect pathways. The indirect path was sleep deprivation causes stress and stress causes vision problems.
- The study results suggested that stress can stimulate the onset of vision problems or exacerbate the existing ones; therefore, ophthalmologists should consider the physiological mechanism of stress while managing chronic ocular diseases

## CONCLUSION

- Sleep deprivation is significantly associated with vision problems, particularly when sleep quality (difficulty falling sleep/ staying asleep) is compromised
- Perceived life-stress moderately enhanced the relationship between sleep deprivation and vision problems that may exacerbate vision problems
- This appeals policymakers and healthcare providers' attention; recognizing this relationship will help evidence-based policy development and comprehensive disease management approach

## STRENGTHS AND LIMITATIONS

- This study's main strength was recognizing the mediating role of stress between sleep deprivation and vision problems
- The study could not observe directional relations between sleep deprivation and vision problems due to its cross-sectional nature; therefore, more longitudinal studies are recommended.
- All variables were self-reported; there is a chance of recall and social desirability biases.

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