Sleep Medicine 61 (2019) 26–30

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Original Article

Association between sleep problems and health-related quality of life in Canadian adults with chronic diseases

Haijiang Dai [a, *], Zhen Mei [b], Aijun An [c], Jianhong Wu [a, **]

[a] Centre for Disease Modelling, Department of Mathematics and Statistics, York University, Toronto, M3J 1P3, Canada
[b] Manifold Data Mining, Toronto, M3B 3J5, Canada
[c] Department of Electrical Engineering and Computer Science, York University, Toronto, M3J 1P3, Canada

ARTICLE INFO

Article history:
Received 16 April 2019
Accepted 29 April 2019
Available online 9 May 2019

Keywords:
Sleep duration
Insomnia
Mental illness
Chronic diseases
Adults

ABSTRACT

Objectives: This study aimed to explore the association between sleep problems and health-related quality of life (HRQoL) in Canadian adults with chronic diseases, and whether mental illness can mediate the association.

Methods: Data were drawn from the Canadian Community Health Survey, 2015. A total of 10,900 participants aged ≥18 years and diagnosed with chronic diseases were enrolled in this study.

Results: Of these participants, 23.6% (95% CI 22.1, 25.2) suffered from severe impairment of HRQoL. Extreme sleep durations, including both short (<5, 5 to <6, and 6 to <7 h) and long (9 to <10, and ≥10 h) sleep durations, were significantly associated with severe impairment of HRQoL (compared to 7 to <8 h). Insomnia was also independently associated with severe impairment of HRQoL when compared to those without insomnia. In the mediation analyses, mental illness was shown to partly mediate the associations of extreme sleep durations and insomnia with severe impairment of HRQoL.

Conclusions: In conclusion, both extreme sleep durations and insomnia were independently associated with severe impairment of HRQoL in adults with chronic diseases, and mental illness partly mediated the association.

1. Introduction

The emergence of chronic diseases as the predominant challenge to global health is undisputed [1,2]. In Canada, chronic diseases affect over half of the general population, and its prevalence is still increasing as a result of considerable lifestyle changes, medical technology improvements and population aging [3]. Health-related quality of life (HRQoL) is an important indicator of a person's comprehensive health status [4], and a poorer HRQoL is well documented in adults with chronic diseases [5,6]. As chronic diseases are usually characterized by extended (even lifelong) duration and no clear-cut disposition, identifying and addressing the determinants of HRQoL have been recognized as the key concern in adults with chronic diseases.

Sleep is a fundamental behavior, with unhealthy sleep habits becoming a growing trend in modern society [7,8]. Numerous studies have established robust association between sleep problems and some chronic diseases, such as coronary heart disease, stroke, diabetes, and cancer [9–12]. However, whether intervention should be focused on sleep problems to improve HRQoL in patients already suffering from chronic diseases is still uncertain. In addition, since mental illness can be impacted by sleep problems and it has a causal effect on HRQoL in adults with chronic diseases [13–16], it is critically important to have data-driven inference to determine whether mental illness could be a potential explanation for the association between sleep problems and impaired HRQoL.

In this study, we used a representative Canadian data to: (1) determine whether sleep problems were associated with an increased risk of impaired HRQoL in adults with chronic diseases; and (2) explore whether and to what extent mental illness can explain the association between sleep problems and risk of impaired HRQoL in adults with chronic diseases.

* Corresponding author. Centre for Disease Modelling, Department of Mathematics and Statistics, York University, Toronto, M3J 1P3, Canada. Fax: +1 416-736-5698.
** Corresponding author. Fax: +1 416-736-5698.
E-mail addresses: dhj1217@yorku.ca (H. Dai), wujh@yorku.ca (J. Wu).

https://doi.org/10.1016/j.sleep.2019.04.015
1389-9457/

2. Materials and methods

2.1. Data source and sample

Data were drawn from the Canadian Community Health Survey, 2015. This survey, conducted by Statistics Canada, was a cross-sectional study designed to be representative of 98% of the Canadian population aged 12 or over. Using a multistage stratified cluster design, information on health status, health determinants and health system utilization were collected from the representative respondents through telephone and in-person interviews. Details about the survey have been described elsewhere [17]. All participants were informed about privacy, confidentially and the voluntary nature of the survey, and gave their consent to Statistics Canada. Ethical approval was granted by the relevant policy committees at Statistics Canada.

In this study, participants from three provinces (Ontario, Manitoba, and Saskatchewan) who selected the optional survey module on sleep were included. Exclusion criteria: (1) less than 18 years (because sleep patterns in adolescents and adults are very different); (2) without any common chronic disease, including diabetes, hypertension, hyperlipidemia, heart disease, stroke, cancer, arthritis, scoliosis, fibromyalgia, osteoporosis, back problems, asthma, chronic obstructive pulmonary disease, migraine headaches, chronic fatigue syndrome, multiple chemical sensitivities, and Alzheimer's disease or any other dementia; and (3) had missing data on main study variables, including sleep problems, HRQoL, and mental illness. As a result, 10,900 participants were enrolled in the final analytic sample.

2.2. Variables of interest

Sleep problems referred to extreme sleep duration and insomnia in this study. Sleep duration was collected from the question: “How long do you usually spend sleeping each night?” Participants were instructed not to include time spent resting, and responses were recorded in hourly intervals. To capture possible non-linear relationships, sleep duration was divided into seven categories: <5, 5 to <6, 6 to <7, 7 to <8, 8 to <9, 9 to <10, and ≥10 h, with 7 to <8 h as the reference [18].

Insomnia was estimated using the question, “How often do you have trouble going to sleep or staying asleep?” [19,20]. Responses options included “never”, “rarely”, “sometimes”, “most of the time”, and “all of the time”. Consistent with previous studies, participants who reported “most of the time” or “all of the time” were considered to have insomnia [20].

HRQoL was assessed using the Health Utilities Index mark 3 (HUI3) [21]. The HUI3 is defined by a standardized health status classification system that includes eight attributes: vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain/discomfort. All attribute scores are aggregated into a single measure (global utility score) ranging from −0.36 to 1.0 (−0.36 = worst possible health, 0.0 = dead, and 1.0 = perfect health; negative values are allowed for some health status considered worse than death). Differences of ≥0.03 in HUI3 scores are considered to be clinically important [21]. The HUI3 has been proved valid and reliable in Canadians with chronic diseases [22]. Severe impairment of HRQoL was defined as the HUI3 scores <0.70 [23,24].

Mental illness was defined as the presence of a self-reported mood or anxiety disorder [25,26]. Participants were considered to have a mood disorder if they responded “yes” to the question “Do you have a mood disorder such as depression, bipolar disorder, mania or dysthymia?”, and considered to have an anxiety disorder if they responded “yes” to the question “Do you have an anxiety disorder such as a phobia, obsessive–compulsive disorder or a panic disorder?”. This definition was reliable given its similarity with administrative data [27] and has been widely used [28,29].

2.3. Covariates

Sociodemographic and lifestyle variables included as covariates in the models were as follows: age, sex, visible minority, body mass index, marital status, education, household income, smoking status, physical activity, illicit drug use, number of chronic diseases, and province of residence. Smoking status was grouped into three types: current smoker (includes daily and occasional smoker), former smoker (at least one whole cigarette, non-smoker now), and never. Physical activity was divided into three categories according to the Canadian Physical Activity Guidelines (CPAG) [30]: active (at/above recommended level from CPAG), moderately active (below recommended level from CPAG), and inactive (no physical activity minutes reported). Illicit drug use referred to any kinds of illicit drug use in the past 12 months.

2.4. Statistical analysis

Characteristics of the participants were summarized as percentages for categorical variables and as mean for continuous variables. Comparisons across different sleep categories were assessed using Pearson's $\chi 2$ test for categorical variables and one-way ANOVA for continuous variables. To obtain a deeper understanding of the relationship between sleep problems and HRQoL, we first explored the association between sleep problems and continuous HRQoL scores using generalized linear models. Then, we used logistic regression models to evaluate the association between sleep problems and severe impairment of HRQoL. Each sleep problem was entered in the models separately.

Mediation analyses were conducted following the Baron and Kenny's steps (Fig. 1) [31]: (1) the independent variable is significantly associated with the potential mediator; (2) the mediator is significantly associated with the dependent variable when the independent variable is controlled for; and (3) the association between the independent variable and the dependent variable is significantly attenuated on addition of the mediator to the multivariate regression model. The analyses were tested utilizing the generalized structural equation modelling (gsem) command, which allows for a dichotomous mediator. After generating the model with gsem, the total effect, indirect effect, and proportion of total effect represented by indirect effect can be examined directly with a product-of-coefficients test using the nlcom (nonlinear combination of estimators) command [32].

All analyses were performed in STATA 15.0 (Stata Corp., College Station, TX, USA). Sampling weights were applied to provide population estimates. Bootstrap methods were used to account for the complex survey design. Two-sided P values < 0.05 were considered

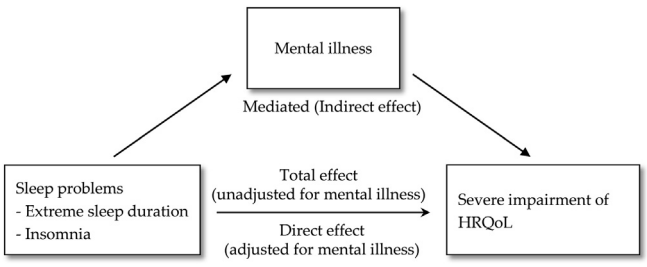

Fig. 1. Hypothesized mediation models predicting severe impairment of HRQoL.

to indicate statistical significance. Multiple comparisons were adjusted using Bonferroni method.

3. Results

3.1. Characteristics of study participants

Participants included in the final sample represented 6,372,800 Canadian adults with chronic diseases. Of these, 23.6% (95% CI 22.1, 25.2) suffered from severe impairment of HRQoL. The percentages of sleeping <5, 5 to <6, 6 to <7, 7 to <8, 8 to <9, 9 to <10, and ≥10 h were 8.3% (95% CI 7.5, 9.2), 13.1% (95% CI 12.0, 14.2), 28.1% (95% CI 26.6, 29.6), 30.1% (95% CI 28.6, 31.7), 16.2% (95% CI 15.0, 17.5), 2.6% (95% CI 2.1, 3.1), and 1.7% (95% CI 1.3, 2.1), respectively. Furthermore, the percentage of insomnia was 19.9% (95% CI 18.6, 21.3). Detailed characteristics of study participants are displayed in Table 1.

Table 1
Characteristics of study participants.

	% (95% CI)
Sample size[a]	10,900
Weighted population[a]	6,372,800
Age, years	
18 to 44	31.0 (29.6, 32.4)
45 to 59	31.5 (30.1, 33.0)
60 to 74	28.0 (26.8, 29.3)
≥ 75	9.5 (8.8, 10.2)
Sex	
Male	45.3 (44.1, 46.5)
Female	54.7 (53.5, 55.9)
Visible minority	
Yes	25.3 (23.6, 27.0)
No	74.7 (73.0, 76.4)
Body mass index, kg/m^2	
<18.5	1.9 (1.5, 2.4)
18.5 to <25.0	36.7 (35.1, 38.4)
25.0 to <30.0	35.7 (34.1, 37.2)
≥ 30.0	25.8 (24.3, 27.3)
Marital status	
Married/common-law	64.7 (63.0, 66.3)
Separated/divorced/widowed	16.4 (15.3, 17.6)
Never married	19.0 (17.6, 20.4)
Education level	
Less than secondary school grad	12.8 (11.7, 14.0)
Secondary school grad	24.1 (22.8, 25.5)
Post-secondary certificate diploma or univ degree	63.1 (61.5, 64.7)
Household income, CAD$	
≤ 29 999	16.2 (15.0, 17.4)
30 000 to 49 999	17.8 (16.6, 19.0)
50 000 to 79 999	24.1 (22.7, 25.5)
≥ 80 000	42.0 (40.3, 43.6)
Smoking status	
Current smoker	20.0 (18.8, 21.3)
Former smoker	40.6 (39.1, 42.2)
Never	39.4 (37.7, 41.0)
Physical activity	
Active	53.9 (52.2, 55.6)
Moderately active	23.4 (22.0, 24.8)
Inactive	22.8 (21.4, 24.1)
Illicit drug use	
Yes	8.2 (7.4, 9.2)
No	91.8 (90.8, 92.6)
Number of chronic diseases	
1	42.0 (40.3, 43.7)
2	24.5 (23.2, 25.9)
≥3	33.5 (32.0, 35.0)
Province of residence	
Ontario	86.0 (85.4, 86.5)
Manitoba	7.6 (7.2, 8.0)
Saskatchewan	6.5 (6.1, 6.8)

CI = confidence intervals.
[a] Numbers are rounded to base 100 for confidentiality purposes according to Statistics Canada data release policies. Percentages are based on weighted numbers.

3.2. Association between sleep duration and HRQoL

As shown in Table 2, we firstly explored the association between sleep duration and continuous HRQoL scores. When compared to 7 to <8 h, the mean HRQoL scores progressively decreased in both short (0.830 for 6 to <7 h; 0.769 for 5 to <6 h; and 0.683 for <5 h) and long (0.836 for 8 to <9 h; 0.780 for 9 to <10 h, and 0.611 for ≥10 h) sleep duration. In the multivariate generalized linear model, the inverse U-shaped association persisted and significant reductions were found in <5, 5 to <6, 9 to <10, and ≥10 h (Table 2).

Next, we assessed the association between sleep duration and the odds of severe impairment of HRQoL. When compared to 7 to <8 h, the prevalence of severe impairment of HRQoL progressively increased in both short and long sleep duration. In the multivariate logistic regression model, the U-shaped association persisted and significant odd ratios (ORs) for severe impairment of HRQoL were found in <5, 5 to <6, 6 to <7, 9 to <10, and ≥10 h (Table 2).

3.3. Association between insomnia and HRQoL

Table 2 also showed the association between insomnia and HRQoL. When compared to those without insomnia, the mean HRQoL scores decreased in those with insomnia. In the multivariate generalized linear model, insomnia was associated with decreased HRQoL scores, and the coefficient was −0.205 (95% CI -0.237, −0.173). The prevalence of severe impairment of HRQoL increased in those with insomnia. In the multivariate logistic regression model, the OR for severe impairment of HRQoL in those with insomnia was 2.74 (95% CI 2.22, 3.37).

3.4. Mediation analyses

In order to explore whether mental illness mediated the association between sleep problems and severe impairment of HRQoL, we conducted mediation analyses. As shown in Table 3, the indirect effect of mental illness on the association between sleep duration and severe impairment of HRQoL was 0.097 (95% CI 0.031, 0.163) for <5 *vs.* 7 to <8 h; 0.040 (95% CI 0.004, 0.075) for 5 to <6 *vs.* 7 to <8 h; 0.109 (95% CI 0.002, 0.216) for 9 to <10 *vs.* 7 to <8 h; and 0.187 (95% CI 0.030, 0.343) for ≥10 *vs.* 7 to <8 h, respectively. The indirect effect of mental illness on the association between insomnia and severe impairment of HRQoL was 0.115 (95% CI 0.072, 0.157). These results indicated that the associations of extreme sleep durations and insomnia with severe impairment of HRQoL can be partly mediated by mental illness.

4. Discussion

Our study showed that 23.6% (95% CI 22.1, 25.2) of Canadian adults with chronic diseases suffered from severe impairment of HRQoL. As more than half of the general Canadian population live with chronic diseases, it is imperative that more public health interventions should be focused on impaired HRQoL. In addition, our study demonstrated that sleep problems, including both extreme sleep durations and insomnia, were independently associated with severe impairment of HRQoL in adults with chronic diseases, and mental illness was shown to partly mediate the association.

The association between sleep duration and HRQoL has been gaining increasing attention. For example, Saku et al. [33], studied a middle-aged and older sample in Finnish, and found that sleeping <6.5 and >10 h were associated with higher probability of having low HRQoL as measured by 15D instrument. Faubel et al. [34], found that extreme sleep duration was a marker of worse HRQoL in older population. However, these studies conducted in general population couldn't provide direct evidence for the management of

Table 2
Association between sleep problems and health-related quality of life.

	HRQoL (Continuous)			HRQoL (Severe)		
	Mean (SE)	Coefficient (95% CI)	*P* value	% (95% CI)	OR (95% CI)	*P* value
Sleep duration, hours						
<5	0.683 (0.016)##	−0.171 (−0.221, −0.121)	<0.001	44.3 (38.7, 50.0)##	2.69 (1.90, 3.79)	<0.001
5 to <6	0.769 (0.012)##	−0.067 (−0.098, −0.036)	<0.001	31.0 (26.6, 35.4)##	1.79 (1.32, 2.44)	<0.001
6 to <7	0.830 (0.008)	−0.021 (−0.047, 0.006)	0.122	21.2 (18.5, 24.0)	1.32 (1.01, 1.73)	0.042
7 to <8	0.850 (0.007)	Ref	–	16.9 (14.4, 19.4)	Ref	–
8 to <9	0.836 (0.009)	−0.006 (−0.033, 0.022)	0.686	20.2 (16.9, 23.5)	1.05 (0.77, 1.42)	0.776
9 to <10	0.780 (0.021)#	−0.049 (−0.095, −0.002)	0.040	31.7 (22.6, 40.8)#	1.70 (1.02, 2.83)	0.040
≥10	0.611 (0.055)##	−0.306 (−0.528, −0.085)	0.007	45.1 (33.5, 56.7)##	2.91 (1.63, 5.21)	<0.001
Insomnia						
No	0.843 (0.005)	Ref	–	18.7 (17.2, 20.4)	Ref	–
Yes	0.685 (0.010)**	−0.205 (−0.237, −0.173)	<0.001	43.3 (39.8, 46.9)**	2.74 (2.22, 3.37)	<0.001

HRQoL = health-related quality of life; SE = standard error; OR = odds ratio; CI = confidence interval; Ref = reference group. Mean and percentages are based on weighted numbers.
$P < 0.001$ and # $P < 0.05$, in comparison with the reference group (7 to <8 h). *P* values were corrected using Bonferroni method due to multiple comparisons.
** $P < 0.001$, in comparison with the reference group (no insomnia).
HRQoL (Severe) refers to severe impairment of HRQoL, which is defined as the Health Utilities Index mark 3 scores < 0.70.
All analyses are adjusted for age, sex, visible minority, body mass index, marital status, education, household income, smoking status, physical activity, illicit drug use, number of chronic diseases, and province of residence.

Table 3
Mental illness as a mediator in the association between sleep problems and severe impairment of health-related quality of life.

	Total effect		Indirect effect		% Mediated
	Coefficient (95% CI)	*P* value	Coefficient (95% CI)	*P* value	
Sleep duration, hours					
<5 *vs.* Ref	1.081 (0.706, 1.457)	<0.001	0.097 (0.031, 0.163)	0.004	9.0%
5 to <6 *vs.* Ref	0.645 (0.348, 0.941)	<0.001	0.040 (0.004, 0.075)	0.029	6.2%
6 to <7 *vs.* Ref[a]	–	–	–	–	–
8 to <9 *vs.* Ref[b]	–	–	–	–	–
9 to <10 *vs.* Ref	0.595 (0.058, 1.132)	0.030	0.109 (0.002, 0.216)	0.046	18.3%
≥10 *vs.* Ref	1.235 (0.614, 1.857)	<0.001	0.187 (0.030, 0.343)	0.019	15.1%
Insomnia					
Yes *vs.* No	1.028 (0.813, 1.244)	<0.001	0.115 (0.072, 0.157)	<0.001	11.2%

CI = confidence interval; Ref = reference group (7 to <8 h).
All analyses are adjusted for age, sex, visible minority, body mass index, marital status, education, household income, smoking status, physical activity, illicit drug use, number of chronic diseases, and province of residence.
[a] Indicates a non-significant relationship between sleep duration and mental illness; therefore, mediation analyses were not conducted.
[b] Indicates a non-significant relationship between sleep duration and severe impairment of health-related quality of life; therefore, mediation analyses were not conducted.

chronic diseases. Recently, several studies have reported the relationship between sleep duration and HRQoL in patients with a specific physical disease, such as predialysis CKD [35], diabetes [36], and chronic liver disease [37]. But due to a limited range of study diseases, small sample sizes, and inconsistent results, we couldn't apply the conclusions to inform policy development of chronic diseases. Therefore, more evidence documented from adults with chronic diseases is really needed. In this study, using a large representative Canadian data with more detailed categories of sleep duration, we demonstrated a reliable and robust association between extreme sleep durations and impaired HRQoL in adults with chronic diseases.

Our study also established a robust association between insomnia and severe impairment of HRQoL in adults with chronic diseases. The finding was a valuable complement to such studies in other population (eg, studies in German adults [38], Chinese adults [39], Wisconsin older population [40], nationally representative sample of American adults [41,42], and etc.) Although the methods regarding insomnia diagnosis and HRQoL measurement were various, the main conclusions derived from these studies were quite similar. What our present study adds was a large representative sample of Canadian adults, and a standpoint of chronic disease management.

The mechanism links the association between sleep problems and severe impairment of HRQoL is unclear. To the best of our knowledge, this is the first study to investigate the mediating role of mental illness on the association between sleep problems and severe impairment of HRQoL. Our finding suggested that intervention on mental illness may mitigate the impact of sleep problems on severe impairment of HRQoL in adults with chronic diseases.

There are some limitations to the present study. First, this cross-sectional study was unable to draw causal conclusions; thus, further prospective cohort studies and intervention trials should be undertaken to conduct causal results. Second, both sleep duration and insomnia were assessed by one single item. Although the method has been widely used, it was still considered to be less valid than more extensive measures. Third, our analyses were based on data that were self-reported rather than measured; however, the ascertainment of chronic diseases and mental illness was considered to be less biased because they are based on a diagnosis by health professionals, and the assessment of HRQoL using self-reported HUI3 has been proved valid and reliable in adults with chronic diseases [22].

5. Conclusions

Our study indicated that severe impairment of HRQoL was prevalent in Canadian adults with chronic diseases. Both extreme sleep durations and insomnia were independently associated with

severe impairment of HRQoL in adults with chronic diseases, and the association can be partly explained by mental illness. Future studies should focus on whether sleep problems or mental illness interventions improve HRQoL in adults with chronic diseases.

Funding

This research was funded by Canada Research Chair Program, grant number 230720; and Natural Sciences and Engineering Research Council of Canada, grant number 105588-2011.

Acknowledgments

The analysis presented in this paper was conducted at the York Research Data Centre, which is part of the Canadian Research Data Centre Network (CRDCN). We sincerely thank the many employees of Statistics Canada who facilitated data access for the research team. This research was supported by funds to the Canadian Research Data Centre Network (CRDCN) from the Social Sciences and Humanities Research Council (SSHRC), the Canadian Institutes of Health Research (CIHR), the Canada Foundation for Innovation (CFI), and Statistics Canada. Although the research and analysis are based on data from Statistics Canada, the opinions expressed do not represent the views of Statistics Canada.

Conflict of interest

The authors declare no conflict of interest.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: https://doi.org/10.1016/j.sleep.2019.04.015.

References

[1] GBD 2015 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 2016;388(10053):1545–602.
[2] Bauer UE, Briss PA, Goodman RA, et al. Prevention of chronic disease in the 21st century: elimination of the leading preventable causes of premature death and disability in the USA. Lancet 2014;384(9937):45–52.
[3] Lix LM, Bruce S, Sarkar J, et al. Risk factors and chronic conditions among Aboriginal and non-Aboriginal populations. Health Rep 2009;20(4):21–9.
[4] Romero M, Vivas-Consuelo D, Alvis-Guzman N. Is Health Related Quality of Life (HRQoL) a valid indicator for health systems evaluation? SpringerPlus 2013;2:664.
[5] Xu RH, Cheung AWL, Wong EL. Examining the health-related quality of life using EQ-5D-5L in patients with four kinds of chronic diseases from specialist outpatient clinics in Hong Kong SAR, China. Patient Prefer Adherence 2017;11:1565–72.
[6] Wei MY, Kawachi I, Okereke OI, et al. Diverse cumulative impact of chronic diseases on physical health-related quality of life: implications for a measure of multimorbidity. Am J Epidemiol 2016;184(5):357–65.
[7] Ford ES, Cunningham TJ, Croft JB. Trends in self-reported sleep duration among US adults from 1985 to 2012. Sleep 2015;38(5):829–32.
[8] Patte KA, Qian W, Leatherdale ST. Sleep duration trends and trajectories among youth in the COMPASS study. Sleep Health 2017;3(5):309–16.
[9] Cappuccio FP, Cooper D, D'Elia L, et al. Sleep duration predicts cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. Eur Heart J 2011;32(12):1484–92.
[10] Lu Y, Tian N, Yin J, et al. Association between sleep duration and cancer risk: a meta-analysis of prospective cohort studies. PLoS One 2013;8(9):e74723.
[11] Shan Z, Ma H, Xie M, et al. Sleep duration and risk of type 2 diabetes: a meta-analysis of prospective studies. Diabetes Care 2015;38(3):529–37.
[12] Jarrin DC, Alvaro PK, Bouchard MA, et al. Insomnia and hypertension: a systematic review. Sleep Med Rev 2018;41:3–38.
[13] Wang S, Wu Y, Ungvari GS, et al. Sleep duration and its association with demographics, lifestyle factors, poor mental health and chronic diseases in older Chinese adults. Psychiatr Res 2017;257:212–8.
[14] Dickens C, Cherrington A, McGowan L. Depression and health-related quality of life in people with coronary heart disease: a systematic review. Eur J Cardiovasc Nurs 2012;11(3):265–75.
[15] Nigatu YT, Reijneveld SA, de Jonge P, et al. The combined effects of obesity, abdominal obesity and major depression/anxiety on health-related quality of life: the LifeLines cohort study. PLoS One 2016;11(2):e0148871.
[16] Blakemore A, Dickens C, Guthrie E, et al. Depression and anxiety predict health-related quality of life in chronic obstructive pulmonary disease: systematic review and meta-analysis. Int J Chronic Obstr Pulm Dis 2014;9:501–12.
[17] Statistics Canada. Canadian Community Health Survey—annual component (CCHS). Detailed information for 2015. Available online: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=238854. accessed on 26 Mar 2019.
[18] Lombardi DA, Folkard S, Willetts JL, et al. Daily sleep, weekly working hours, and risk of work-related injury: US National Health Interview Survey (2004-2008). Chronobiol Int 2010;27(5):1013–30.
[19] Garland SN, Rowe H, Repa LM, et al. A decade's difference: 10-year change in insomnia symptom prevalence in Canada depends on sociodemographics and health status. Sleep Health 2018;4(2):160–5.
[20] Power JD, Perruccio AV, Badley EM. Pain as a mediator of sleep problems in arthritis and other chronic conditions. Arthritis Rheum 2005;53(6):911–9.
[21] Horsman J, Furlong W, Feeny D, et al. The Health Utilities Index (HUI): concepts, measurement properties and applications. Health Qual Life Outcomes 2003;1:54.
[22] Mo F, Choi BC, Li FC, et al. Using Health Utility Index (HUI) for measuring the impact on health-related quality of Life (HRQL) among individuals with chronic diseases. Sci World J 2004;4:746–57.
[23] Pohar SL, Jones CA, Warren S, et al. Health status and health care utilization of multiple sclerosis in Canada. Can J Neurol Sci 2007;34(2):167–74.
[24] Jones CA, Pohar SL, Patten SB. Major depression and health-related quality of life in Parkinson's disease. Gen Hosp Psychiatry 2009;31(4):334–40.
[25] Khan S. Concurrent mental and substance use disorders in Canada. Health Rep 2017;28(8):3–8.
[26] Martin MS, Maddocks E, Chen Y, et al. Food insecurity and mental illness: disproportionate impacts in the context of perceived stress and social isolation. Publ Health 2016;132:86–91.
[27] O'Donnell S, Vanderloo S, McRae L, et al. Comparison of the estimated prevalence of mood and/or anxiety disorders in Canada between self-report and administrative data. Epidemiol Psychiatr Sci 2016;25(4):360–9.
[28] Chen Y, Mo F, Yi Q, et al. Association between mental health and fall injury in Canadian immigrants and non-immigrants. Accid Anal Prev 2013;59:221–6.
[29] Asbridge M, Ralph K, Stewart S. Private space second-hand smoke exposure and the mental health of non-smokers: a cross-sectional analysis of Canadian adults. Addict Behav 2013;38(3):1679–86.
[30] LeBlanc AG, Berry T, Deshpande S, et al. Knowledge and awareness of Canadian physical activity and sedentary behaviour Guidelines: a synthesis of existing evidence. Appl Physiol Nutr Metabol 2015;40(7):716–24.
[31] Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J Personal Soc Psychol 1986;51(6):1173–82.
[32] Kelly SM, Updegraff JA. Substituting activities mediates the effect of cognitive flexibility on physical activity: a daily diary study. J Behav Med 2017;40(4):669–74.
[33] Vaatainen S, Tuomilehto H, Saramies J, et al. The health-related quality-of-life impact of nocturnal awakenings in the middle-aged and older Finnish population. Qual Life Res 2013;22(10):2737–48.
[34] Faubel R, Lopez-Garcia E, Guallar-Castillon P, et al. Sleep duration and health-related quality of life among older adults: a population-based cohort in Spain. Sleep 2009;32(8):1059–68.
[35] Sung SA, Hyun YY, Lee KB, et al. Sleep duration and health-related quality of life in predialysis CKD. Clin J Am Soc Nephrol 2018;13(6):858–65.
[36] Zeng Y, Wu J, Yin J, et al. Association of the combination of sleep duration and sleep quality with quality of life in type 2 diabetes patients. Qual Life Res 2018;27(12):3123–30.
[37] Kim HJ, Chu H, Lee S. Factors influencing on health-related quality of life in South Korean with chronic liver disease. Health Qual Life Outcomes 2018;16(1):142.
[38] Hajak G, Europe SSGSoli. Epidemiology of severe insomnia and its consequences in Germany. Eur Arch Psychiatry Clin Neurosci 2001;251(2):49–56.
[39] Wong WS, Fielding R. Prevalence of insomnia among Chinese adults in Hong Kong: a population-based study. J Sleep Res 2011;20(1 Pt 1):117–26.
[40] Schubert CR, Cruickshanks KJ, Dalton DS, et al. Prevalence of sleep problems and quality of life in an older population. Sleep 2002;25(8):889–93.
[41] Scalo J, Desai P, Rascati K. Insomnia, hypnotic use, and health-related quality of life in a nationally representative sample. Qual Life Res 2015;24(5):1223–33.
[42] Olfson M, Wall M, Liu SM, et al. Insomnia and impaired quality of life in the United States. J Clin Psychiatry 2018;79(5).