



Duration and quality of sleep in 2 rural Cree First Nation communities in Saskatchewan, Canada



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ABSTRACT

Study objectives: Estimates of sleep duration and quality are lacking for Canadian First Nations peoples. This study examines the prevalence of and risk factors for short/normal/long sleep duration and sleep quality.

Methods: Five hundred eighty-eight adults participated in the baseline survey of the First Nations Sleep Health Project conducted in 2018–2019 in Saskatchewan, Canada. Sleep duration and quality were self-reported.

Results: Mean sleep duration was 8.18 hours per night. About 45.5% slept the recommended 7 hours per night. However, short sleep duration and poor sleep quality were relatively common: about one-quarter of the participants slept fewer hours than recommended. Sleep duration was significantly less for men than women. Women were significantly more likely to report poor sleep quality than males. Multiple regression models revealed that age was significantly related with shorter sleep duration; sex and employment status were significantly related with sleep duration; and sex and income indicators were significantly associated with sleep quality. Nearly half of participants reported having had the recommended hours of sleep, but nearly two-thirds reported poor sleep quality.

Conclusions: Information about the proportion of First Nations adults who sleep the recommended duration and the quality of sleep is important in informing health care and health policy.

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Introduction

Sleep problems, including short sleep duration and poor sleep quality, are prevalent around the world.¹ Both short and long sleep duration have been linked to poor health and associated with adverse health outcomes^{1–19} and identified as risk factors for mortality and morbidity.²⁰ According to Bin et al.²⁰ short sleep duration was common in Canada from 1986 to 1998, with no significant change over this time frame. In contrast, the prevalence of long sleep duration has

decreased in Canada over this same period.²⁰ In Cycles 1–3 of the Canadian Health Measures Survey (excluding residents of First Nations Reserves or other Aboriginal settlements, institutions and some remote regions, and the Canadian Forces) about 32% of participants reported having shorter than recommended sleep duration (<7 hours), and 43% of men and 55% of women reported poor sleep quality (trouble going to sleep or staying asleep).²¹

Sleep duration and sleep quality estimates for Canadian adults have been published recently,²¹ but a gap remains in the literature regarding association with short/long sleep duration and sleep quality among First Nations peoples and First Nations sleep patterns in Canada. First Nations are one of 3 groups of Indigenous peoples in Canada who are the descendants of the original inhabitants of Canada

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(the other 2 being Inuit and Métis). There are over 634 recognized First Nations governments or bands in Canada.²² Each First Nation has its own culture, beliefs, traditions, and world views, although there are some similarities among them.^{22–24} All Indigenous peoples in Canada are impacted by colonization that produced inequities in social and structural determinants of health.²⁵ In the past 2 centuries, due to the “Indian Act,” programs of assimilation have been directed towards First Nations cultures, including relocation from traditional or territorial lands, ruinous assimilation programs, banning cultural practices, loss of language and customs. First Nation cultures have survived,²² but colonization is a striking determinant of health impacting First Nations.²⁵ The residential school program has been a particularly negative influence on the health and wellbeing of survivors, as well as their children and grandchildren. Residential schools attempted to expunge First Nations children of their cultural identity, including Indigenous language and cultural customs, traditional foods, family ties linking youth and Elders.^{25–27} Other major impacts from attendance at residential school included physical, sexual and emotional abuse; witnessing abuse; and isolation from family,²⁶ with intergenerational reverberations.

First Nations peoples believe that dreams have significance that is linked to spiritual practices. Sleep practices of First Nations peoples evolved over time, along with changes from a hunting/gathering economy to a modern mainstream economy. Elders have often stated that nighttime is for sleeping and when the sun rises, daytime is for working. With the advent of residential and public schools, bedtimes and waking times changed. Seasonal cycles had largely dictated the rhythm of work and sleep activities, but employment in the modern economy saw First Nations peoples working shorter days and enjoying longer evenings of leisure [K. McMullin, personal communication, March 15, 2021].

To begin to bridge a gap in this current research, this study examined the prevalence of short/normal/long sleep duration and sleep quality and examined the differences in sleep duration and quality associated with sociodemographic factors, including attendance at residential school, among peoples living in 2 Cree First Nation communities in Saskatchewan, Canada using the data from a community-based cross-sectional study.

Methods

Study sample

The data for this study came from baseline assessments in the First Nations Sleep Health Project (FNSHP) collaboration conducted in and with 2 rural Cree First Nation communities (Community A and Community B) in Saskatchewan during 2018 and 2019. The overall purpose of the FNSHP was to examine the relationships between sleep disorders and risk factors and co-morbidities, and to evaluate local diagnosis and treatment. The study was approved by the University of Saskatchewan’s Biomedical Research Ethics Board (Certificate No. Bio #18-110) and adhered to Chapter 9 (Research Involving the First Nations, Inuit, and Metis Peoples of Canada) in the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.²⁸ Written consent was obtained from individual before data collection began.

Data collection

The survey was developed with input from communities to ensure sensitivity to cultural and linguistic factors. In addition, the communities reviewed and edited the surveys before they were submitted to the University of Saskatchewan’s Bio-medical Research Ethics Board for approval. Trained research assistants from each community were hired to conduct the baseline surveys in their respective

community, which ensured that individuals could participate even if they spoke only their First Nations language (not English). Adults 18 years and older were invited to the Community Health/Youth Centre to participate in the interviewer-administered surveys and clinical assessments. A pamphlet describing the study and an invitation to participate was distributed by research assistants during community events such as “Treaty Days,” a celebration of a historical relationship between First Nations peoples and the Government of Canada; as well as during door-to-door canvassing. Simultaneously, there was a social media campaign to invite community members to participate. The survey collected information on demographic variables, individual and contextual determinants of sleep health, self-reported height and weight, and objective clinical measurements. This manuscript is based on the data from the surveys.

Demographic information, including age, sex, educational level, employment status, money left at the end of the month, body mass index (BMI), smoking status (nontraditional use of tobacco), and residential school attendance was collected in the survey. Sleep duration was calculated using questions about the participant’s usual sleep habits during the past month: “When have you usually gone to bed?” “When have you usually gotten up in the morning?” and “How long has it taken to fall asleep each night?” Taking the difference of the first 2 questions, the time in bed at night was calculated, and then time to falling asleep was subtracted to obtain sleep duration. Recommendations for optimal sleep duration were based on those from the National Sleep Foundation²⁹ and 7–9 hours is recommended for adults. Sleep duration was categorized into 3 groups: short sleep duration (<7 hours); normal sleep duration (7–9 hours); and long sleep duration (> 9 hours). The Pittsburgh Sleep Quality Index (PSQI) was used to measure sleep quality. Using 19 items, we measured the 7 individual components (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction over the last month).³⁰ A global PSQI score was calculated by adding the 7 component scores together. A global sum of 5 or greater indicated “poor” sleep; less than 5 was considered a “good” sleep.

Statistical analysis

Statistical analyses were conducted using SPSS version 27 (IBM SPSS Statistics for Windows. Armonk, NY: IBM Corp., 2020). Descriptive statistics were reported using the mean, standard deviation (SD), frequency, and percentage (%). The t-test for 2 sample means and one-way analysis of variance for more than 2 sample means were performed, and *p* values were reported for significant comparisons of sleep hours. Associations between categorical variables were reported using the Chi-square test and corresponding *p* value. Age-adjusted association analyses were conducted using multinomial logistic regression and binary logistic regression models.³¹

Results

Five hundred eighty-eight individuals participated in the baseline survey, 418 from Community A and 170 from Community B. Participant characteristics are summarized in Table 1. The 30–49-year-old age bracket was the largest, with 40.1% of participants compared to other 2 age groups; there were more women (55.8%) than men. More than half (58.1%) reported not having enough money left at the end of the month. In addition, about 46.0% identified as being obese, 72.0% were current smokers (engaged in nontraditional use of tobacco), 37.8% had not completed secondary school, and 34% had attended residential school. In the entire sample, sleep duration was available for 567 individuals who were 18 years and older.

Table 2 depicts the mean duration and percentage distribution of sleep duration by participant characteristics. Overall, participants

Table 1
Characteristics of the study population (n = 588)

Variable	Frequency (%)
Age, in years (Median age = 38.0 years)	
Mean ± SD	40.0 ± 15.3
Age group	
18-29 years	178 (30.3)
30-49 years	236 (40.1)
50 years and over	174 (29.6)
Sex	
Male	260 (44.2)
Female	328 (55.8)
Education level (missing n = 6)	
Less than secondary school graduation	220 (37.8)
Secondary school graduation	175 (30.1)
Some university/completed university/completed technical school	187 (32.1)
Employment status (missing n = 16)	
Employed full or part time or self employed	168 (29.4)
Social assistance or unemployment insurance	133 (23.3)
Unemployed	149 (26.0)
Other (including retired and home makers)	122 (21.3)
Money left at the end of the month (missing n = 8)	
Some money	120 (20.7)
Just enough money	123 (21.2)
Not enough money	337 (58.1)
Body mass index (missing n = 39)	
Obese	254 (46.3)
Overweight	156 (28.4)
Neither overweight nor obese	139 (25.3)
Smoking (nontraditional use of tobacco) status (missing n = 7)	
Current smoker	417 (71.8)
Ex-smoker	70 (12.0)
Never smoker	94 (16.2)
Residential school attendance	
Yes	200 (34.0)
No	388 (66.0)

averaged 8.18 ± 2.28 hours of sleep per night. About 25.4% reported less than 7 hours of sleep per night, and 45.5% reported the recommended 7-9 hours of sleep. Participants aged 18 to 29 years averaged 8.92 hours of sleep per night, and participants aged 50 years and older years averaged 7.88 hours of sleep per night (Table 2). Sleep duration was significantly different between the 18-29 age group and the 30-49-year ($p < .0001$) age group. It was also significantly different between the 18-29-year and 50+ year ($p < .0001$) age groups. There was a linear relationship between age and proportion getting the recommended 7-9 hours (18-29 years: 33.5%; 30-49 years: 48.1%; and 50+ years: 54.3%). About a quarter of the 30-49 age group reported having longer than 7-9 hours of sleep per night, and sleeping more than 9 hours was common (45.3%) in the 18-29 age group. Women's average sleep duration was longer than men's (8.35 vs. 7.96 hours per night, $p = .043$). Those who were employed full time/part time or self-employed and had just enough money at the end of the month were more likely to report sleeping the recommended number of hours per night than those who were retired or homemakers (54.3% vs. 41.0%, $p = .028$) and reported not enough money at the end of the month (50.8% vs. 42.0%, not statistically significant; $p = .095$). Participants who had attended residential schools were significantly more likely to have a short duration of sleep (<7 hours) ($p = .046$) and significantly shorter mean duration of sleep ($p = .002$) than those who had not attended residential school.

Table 3 summarizes the mean quality of sleep and percentage distribution of sleep quality defined by the global PSQI score, stratified by participant characteristics. Overall, 65.0% of participants reported poor sleep quality according to the PSQI. A higher proportion of individuals in the 30-49-year age group rated their sleep as bad or poor, compared to those 50 years and older (68.5% vs. 62.0%, not statistically significant; $p = .183$). In addition, women reported poorer sleep quality than to men (69.3% vs. 59.3%, $p = .016$).

Table 2
Mean duration of sleep and percentage distribution by duration of sleep recommendations of participants aged 18 years and older

	Hours of sleep per night Mean ± SD (95% CI)	p value ¹	Percentage distribution by duration of sleep recommendations [*]			p value ²
			Short (<7 h) n (%)	Normal (7-9 h) n (%)	Long (>9 h) n (%)	
All (n = 567)	8.18 ± 2.28		144 (25.4)	258 (45.5)	165 (29.1)	
Age groups, in years		<.0001				<.0001
18-29 years	8.92 ± 2.55		36 (21.2)	57 (33.5)	77 (45.3)	
30-49 years	7.85 ± 2.25		64 (27.5)	112 (48.1)	57 (24.5)	
50+ years	7.88 ± 1.84		44 (26.8)	89 (54.3)	31 (18.9)	
Sex		.043				.041
Male	7.96 ± 2.39		76 (30.6)	105 (42.3)	67 (27.0)	
Female	8.35 ± 2.17		68 (21.3)	153 (48.0)	98 (30.7)	
Employment status		.004				.027
Employed full or part time or self employed	7.81 ± 2.12		44 (26.8)	89 (54.3)	31 (18.9)	
Social assistance or unemployment insurance	7.99 ± 2.29		35 (27.1)	56 (43.4)	38 (29.5)	
Unemployed	8.71 ± 2.39		29 (20.3)	62 (43.4)	52 (32.7)	
Other (including retired and home makers)	8.27 ± 2.25		31 (26.5)	48 (41.0)	38 (32.5)	
Money left at the end of the month		.793				
Some money	8.44 ± 2.25		27 (23.1)	58 (49.6)	32 (27.4)	.307
Just enough money	8.31 ± 2.01		24 (20.0)	61 (50.8)	35 (29.2)	
Not enough money	8.14 ± 2.24		91 (28.1)	136 (42.0)	97 (29.9)	
Body mass index		.338				.303
Obese	8.11 ± 2.28		66 (26.7)	112 (45.3)	69 (27.9)	
Overweight	8.05 ± 2.08		38 (25.7)	72 (48.6)	38 (25.7)	
Neither overweight nor obese	8.40 ± 2.16		29 (21.6)	56 (41.8)	49 (36.6)	
Residential school attendance		.002				.004
Yes	7.76 ± 2.01		58 (30.5)	93 (48.3)	39 (20.5)	
No	8.39 ± 2.38		86 (22.8)	165 (43.8)	126 (33.4)	

* For age 18-64 years recommended sleep duration is 7-9 hours per night and for age 65 years and over recommended sleep duration is 7-8 hours according to²⁶ In this study, we have used the recommended sleep duration is 7-9 hours per night all ages 18+ years and not define a separate cut off for older age group as we have a small number of participants in that group.

¹ t -test or one-way ANOVA p values.

² Chi-squared test p values.

Table 3
Mean global PSQI score and percentage distribution of sleep quality (poor/good) of participants aged 18 years and older

	Mean global PSQI score Mean ± SD	p value ¹	Percentage distribution of sleep quality		p value ²
			Good (PSQI ≤ 5) n (%)	Poor (PSQI > 5) n (%)	
All	6.26 ± 3.44		193 (35.0)	359 (65.0)	
Age groups, in years		.159			.335
18–29 years	5.83 ± 3.06		60 (37.0)	102 (63.0)	
30–49 years	6.48 ± 3.50		73 (31.5)	159 (68.5)	
50+ years	6.37 ± 3.68		60 (38.0)	98 (62.0)	
Sex		.035			.016
Male	5.90 ± 3.57		97 (40.6)	142 (59.4)	
Female	6.53 ± 3.32		96 (30.7)	217 (69.3)	
Employment status		.725			.940
Employed full or part time or self employed	6.12 ± 3.31		57 (35.2)	105 (64.8)	
Social assistance or unemployment insurance	6.36 ± 3.51		41 (33.1)	83 (66.9)	
Unemployed	6.04 ± 3.44		50 (36.2)	88 (63.8)	
Other (including retired and home makers)	6.47 ± 3.56		42 (36.5)	73 (63.5)	
Money left at the end of the month		.008			.109
Some money	5.82 ± 3.51		47 (40.9)	68 (59.1)	
Just enough money	5.66 ± 2.98		46 (39.0)	72 (61.0)	
Not enough money	6.65 ± 3.53		98 (31.3)	215 (68.7)	
Body mass index		.333			.355
Obese	6.24 ± 3.40		83 (34.7)	156 (65.3)	
Overweight	5.91 ± 3.39		59 (39.9)	89 (60.1)	
Neither overweight nor obese	6.52 ± 3.45		41 (31.8)	88 (68.2)	
Residential school attendance		.130			.384
Yes	6.57 ± 3.94		70 (37.4)	117 (62.6)	
No	6.09 ± 3.14		123 (33.7)	242 (66.3)	

¹ *t*-test or one-way ANOVA *p* values.

² Chi-squared test *p* values.

Age-adjusted regression models were constructed to examine the associations between sleep duration (using multinomial logistic regression) and sleep quality (using binary logistic regression) using the variables sex, body mass index, and social factors such as employment status, financial hardship and residential school attendance (Table 4). Men were significantly more likely than women to report a short sleep duration compared to a normal sleep duration. Also, participants aged 18–29 years were more likely than those in the 50 years and older age group to report a long sleep duration compared to a normal sleep duration. Additionally, participants with full-time/part-time work and those that were self-employed were significantly less likely than those who had retired or those that were homemakers to report long sleep duration compared to a normal sleep duration. In the unadjusted multinomial logistic regression model, participants who had attended a residential school were significantly less likely than those who had not attended a residential school to report a long sleep duration ($p = .008$) compared to a normal sleep duration (Table 4), and this difference was no longer significant after adjusting for confounders. Finally although not statistically significant, participants who reported not having enough money at the end of the month were more likely to report poor sleep quality than those who reported having some money left at the end of the month ($p = .084$). Residential school attendance was not associated with sleep quality (Table 4).

Discussion

This study considered data from adult participants from the 2 Cree First Nation communities in Saskatchewan, Canada. Among this sample, average sleep duration was 8.18 hours per night. Nearly half (45.5%) reported achieving the recommended 7–9 hours of sleep. In previous research,²¹ 65% of Canadians reported getting 7–9 hours of sleep. In our sample, a greater proportion of women than men got 7 or more hours of sleep. Multivariable regression models revealed that age, sex and employment status were significantly related to sleep

duration, while sex and income indicators were significantly associated with sleep quality. Findings from this study were similar to the Canadian findings from the 2005 General Social Survey (respondents aged 15 or older),³² which demonstrated that men slept fewer hours per night than women (7.96 vs. 8.35 hours). Age-adjusted regression association analyses further confirmed the above results.

Studies have found differences in sleep duration among different ethnic groups. A study from the United States reported that the prevalence of short sleep duration (<7 hours) for North American Indians (NAI)/Alaska Natives (AN) populations across the United States was approximately 40.4%, and the prevalence of healthy sleep duration (≥ 7 hours) was lower among NAI/AN individuals than non-Hispanic white people (59.6% vs. 66.8%).³³ Ehlers et al³⁴ reported short sleep duration (<6 hours) was associated with NAI ancestry. Chapman et al³⁵ reported that a significantly higher prevalence of frequent insufficient sleep (34.2% vs. 27.4%) among NAI/AN than non-Hispanic white people. In contrast, in this study, participants from 2 rural Cree First Nations in Saskatchewan, Canada reported a smaller proportion of short sleep duration than United States NAI/AN populations.

The literature reports differences in sleep quality by sex. Black American women reported a greater number of subjective sleep quality complaints and spent less time asleep than white American women.³⁶ With respect to PSG-assessed indices of sleep continuity, Black American women took longer to fall asleep and spent more time awake after sleep onset, which translated into poor overall sleep quality, compared to both white American women and Chinese women in the United States.³⁶ Among individuals who worked full time in Canada, men reported less sleep than women.³² A recent study reported a high prevalence of poor sleep quality among adults (38.2%), especially among women and increasing gradually with age.³⁷ In this study, there was a higher prevalence of poor sleep quality on the PSQI scale rating of poor sleep quality among First Nations women compared with First Nations men (69.3% vs. 59.4%).

Studies have shown that the sleep duration and quality are associated with social factors, such as educational attainment and

Table 4
Age and sex adjusted association analyses for duration of sleep and sleep quality

Multinomial logistic regression analysis for duration of sleep in hours (Ref. Normal sleep duration 7-9 hours)					
	Variables	Unadjusted Odds ratio (95% CI)	p-value	Adjusted Odds ratio (95% CI)	p-value
Short sleep duration (< 7 hours)	Sex (ref. female)				
	Male	1.63 (1.08, 2.46)	.020	1.71 (1.09, 2.70)	.020
	Age group (ref. 50 years and older)				
	18-29 years	1.28 (0.74, 2.22)	.384	1.25 (0.63, 2.48)	.521
	30-49 years	1.16 (0.72, 1.86)	.549	1.18 (0.67, 1.86)	.672
	Income indicator (ref. some money)				
	Not enough money	1.44 (0.85, 2.44)	.178	1.51 (0.85, 2.67)	.162
	Just enough money	0.84 (0.44, 1.63)	.616	0.82 (0.40, 1.66)	.578
	Employment status (ref. other, including retired and home makers)				
	Employed full or part time or self-employed)	0.76 (0.43, 1.36)	.765	0.77 (0.41, 1.44)	.412
	Social assistance or unemployment insurance	0.97 (0.52, 1.79)	.968	0.97 (0.50, 1.89)	.941
	Unemployed	0.72 (0.38, 1.36)	.316	0.62 (0.31, 1.24)	.178
	Body mass index (ref. neither overweight nor obese)				
Obese	1.14 (0.66, 1.96)	.640	1.26 (0.72, 2.22)	.426	
Overweight	1.02 (0.56, 1.85)	.950	0.94 (0.51, 1.76)	.852	
Residential school attendance (ref. no)					
Yes	1.20 (0.79, 1.82)	.401	1.34 (0.81, 2.20)	.250	
Long sleep duration (>9 hours)	Sex (ref. female)				
	Male	0.99 (0.67, 1.48)	.985	0.95 (0.61, 1.50)	.839
	Age group (ref. 50 years and older)				
	18-29 years	3.88 (2.27, 6.61)	<.0001	3.44 (1.82, 6.48)	<.0001
	30-49 years	1.46 (0.87, 2.45)	.152	1.38 (0.79, 2.39)	.256
	Income indicator (ref. some money)				
	Not enough money	1.29 (0.78, 2.14)	.318	1.22 (0.70, 2.14)	.482
	Just enough money	1.04 (0.57, 1.89)	.898	0.98 (0.50, 1.90)	.948
	Employment Status (ref. other, including retired and home makers)				
	Employed full or part time or self-employed)	0.44 (0.24, 0.79)	.006	0.43 (0.23, 0.81)	.009
	Social assistance or unemployment insurance	0.86 (0.47, 1.55)	.610	0.66 (0.34, 1.26)	.205
	Unemployed	1.06 (0.60, 1.86)	.841	0.72 (0.38, 1.37)	.317
	Body mass index (ref. neither overweight nor obese)				
Obese	0.70 (0.43, 1.15)	.158	0.91 (0.54, 1.53)	.715	
Overweight	0.60 (0.35, 1.04)	.071	0.76 (0.42, 1.36)	.353	
Residential school attendance (Ref. no)					
Yes	0.55 (0.35, 0.85)	.008	0.91 (0.53, 1.55)	.725	

Multivariable logistic regression analysis for sleep quality- Global PSQI Score >5

Variable	Unadjusted Odds ratio (95% CI)	p-value	Adjusted Odds ratio (95% CI)	p-value
Sex (ref. female)				
Male	0.65 (0.45, 0.92)	0.016	0.63 (0.43, 0.93)	0.020
Age group (ref. 50 years and older)				
18-29 years	1.04 (0.66, 1.64)	0.862	0.80 (0.46, 1.39)	0.421
30-49 years	1.33 (0.87, 2.04)	0.184	1.39 (0.88, 2.20)	0.156
Income indicator (ref. some money)				
Not enough money	1.52 (0.97, 2.36)	0.065	1.53 (0.94, 2.46)	0.084
Just enough money	1.08 (0.64, 1.83)	0.769	0.99 (0.57, 1.75)	0.989
Employment status (ref. other, including retired and home makers)				
Employed full or part time or self-employed)	1.06 (0.64, 1.74)	0.819	1.26 (0.74, 2.16)	0.392
Social assistance or unemployment insurance	1.16 (0.68, 1.98)	0.575	1.30 (0.73, 2.31)	0.374
Unemployed	1.01 (0.60, 1.69)	0.962	1.13 (0.64, 1.99)	0.679
Body mass index (ref. neither overweight nor obese)				
Obese	0.88 (0.55, 1.38)	0.569	0.85 (0.52, 1.37)	0.508
Overweight	0.70 (0.43, 1.15)	0.163	0.66 (0.39, 1.12)	0.124
Residential school attendance (Ref. no)				
Yes	0.85 (0.59, 1.23)	0.384	0.73 (0.47, 1.14)	0.166

Odds ratios that are significantly different from zero ($p < 0.05$) are shown in bold.

income.³⁸⁻⁴⁰ Stamatakis et al³⁸ reported that age-adjusted odds of short sleep duration was higher among those with low household income and those with less than a high school education. Lower socioeconomic status, including low income and low educational attainment, was also associated with poor sleep quality.^{39,40} Similarly, participants who were employed full-time/part-time or self-employed were less likely to have long sleep duration than those who were retired or home maker (other employment status) and participants with just enough money. This study found no significant

associations between income level and sleep duration or sleep quality, but participants who did not have enough money at the end of the month were more likely to report poor sleep quality than those who had some money left at the end of the month.

In summary, participants from 2 rural Saskatchewan Cree First Nation communities reported a higher proportion of longer than recommended sleep hours than the general population of Canada, sleep quality was poor. Attendance at residential school could be one reason for this association, but this study was not able to confirm the

association in the multivariable analysis. There were disparities between the health of Indigenous peoples and non-Indigenous peoples in Canada, and these disparities are related to social and structural determinants of health.^{28,29} Colonization is the most important structural determinant of Indigenous ill health and has intergenerational impacts.^{28,29} In addition, the intergenerational effects associated with cultural-historical trauma, including the impact of the forced removal of children from their families into residential schools may contribute to health disparities in this population.⁴¹ The significance of these factors in sleep duration and poor sleep quality among participants in this study merits further investigation.

Strengths and limitations

Strengths of this study included the large number of participants and the inclusion of a number of potential factors including lifestyle, socio-demographic, and sleep characteristics. This study was one of the first to examine sleep duration and sleep quality in adults living in the 2 rural Cree First Nation communities in Saskatchewan, Canada. However, some limitations should be noted. The data were self-reported, with possible recall bias. Data did not include how individuals cycle through the stages of sleep, which is an important characteristic of sleep duration and quality. Sleep duration may vary by seasons, and in this analysis seasonal variations were not considered. Although we found associations between several factors and sleep variables, causal relations could not be assessed due to the cross-sectional nature of these data.

Conclusions

First Nations adults in 2 Saskatchewan Cree First Nation communities tended to report sleeping longer than the recommended number of hours. However, overall sleep quality was poor, especially among women. Sleep duration and quality were associated with social factors such as employment and income. Future studies could explore seasonal variations in individual sleep patterns and link these findings to social and structural determinants of health. This information would be helpful for health care professionals when treating chronic conditions and individuals/patients when managing chronic conditions.

Author contributions

Conceptualization, J.A.D., S.A., M.K., P.P., D.C.R., S.K., N.K., M.F., R.S. and the First Nations Sleep Health Project Team; Data curation, B.P.R., K.M.; Formal analysis, C.P.K.; Funding acquisition, J.A.D., S.A., M.K. and P.P.; Investigation, J.A.D., S.A., M.F., M.K. and P.P.; Methodology, J. A. D., P.P., S. A., M. K., C.P.K., M. F.; Project administration, P.P.; Resources, J.S., C.B., R.S., M.F., T.S.; Supervision, J.A.D. and P.P.; Visualization, S.A., J.S., C.B. and V.R.R.; Writing—original draft, C.P.K., J.A.D. P.P.; Writing—review & editing, J.A.D., C.P.K., B.P.R., K.M., S.A., D.C.R., S.K., N.K., J.S., C.B., V.R.R., M.F., M.K., T.S., and P.P.

Declaration of conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this study. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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References

- Irish LA, Kline CE, Gunn HE, Buysse DJ, Hall MH. The role of sleep hygiene in promoting public health: a review of empirical evidence. *Sleep Med Rev.* 2015;22: 23–36.
- Bandyopadhyay A. What is sleep deprivation? *Am J Respir Crit Care Med.* 2019;199: P11–P12. ATS Patient Education Series © 2019 American Thoracic Society.
- Chaput J-P, Leblanc C, Perusse L, Després JP, Bouchard C, Tremblay A. Risk factors for adult overweight and obesity in the Quebec Family Study: have we been barking up the wrong tree? *Obesity (Silver Spring).* 2009;17:1964–1970.
- Chaput J-P, Després J-P, Bouchard C, Tremblay A. The association between sleep duration and weight gain in adults: a 6-year prospective study from the Quebec Family Study. *Sleep.* 2008;31:517–523.
- Chaput J-P, Tremblay A. Insufficient sleep as a contributor to weight gain: an update. *Curr Obes Rep.* 2012;1(4):245–256. <https://doi.org/10.1007/s13679-012-0026-7>.
- McNeil J, Doucet E, Chaput J-P. Inadequate sleep as a contributor to obesity and type 2 diabetes. *Can J Diabetes.* 2013;37:103–108.
- Reutrakul S, Van Cauter E. Interactions between sleep, circadian function, and glucose metabolism: implications for risk and severity of diabetes. *Ann New York Acad Sci.* 2014;1311:151–173. <https://doi.org/10.1111/nyas.12355>.
- Reutrakul S, Van Cauter E. Sleep influences on obesity, insulin resistance, and risk of type 2 diabetes. *Metabolism.* 2018;84:56–66. <https://doi.org/10.1016/j.metabol.2018.02.010>.
- Ayas NT, White DP, Manson JE, et al. A prospective study of sleep duration and coronary heart disease in women. *Arch Intern Med.* 2003;163(2):205–209. <https://doi.org/10.1001/archinte.163.2.205>.
- Mullington JM, Haack M, Toth M, Serrador J, Meier-Ewert H. Cardiovascular, inflammatory and metabolic consequences of sleep deprivation. *Prog Cardiovasc Dis.* 2009;51(4):294–302. <https://doi.org/10.1016/j.pcad.2008.10.003>.
- Nagai M, Hoshida S, Kario K. Sleep duration as a risk factor for cardiovascular disease- a review of the recent literature. *Curr Cardiol Rev.* 2010;6(1):54–61. <https://doi.org/10.2174/157340310790231635>.
- Grandner M, Mullington JM, Hashmi SD, Redeker NS, Watson NF, Morgenthaler TI. Sleep duration and hypertension: analysis of >700,000 adults by age and sex. *J Clin Sleep Med.* 2018;14(6):1031–1039. <https://doi.org/10.5664/jcsm.7176>.
- Ko KD. Link between short sleep duration and hypertension. *Korean J Fam Med.* 2017;38(3):169–170. <https://doi.org/10.4082/kjfm.2017.38.3.169>.
- Faraut B, Touchette E, Gamble H, et al. Short sleep duration and increased risk of hypertension: a primary care medicine investigation. *J Hypertens.* 2012;30(7):1354–1363. <https://doi.org/10.1097/HJH.0b013e32835465e5>.
- Gangwisch JE, Heymsfield SB, Boden-Albala B, et al. Short sleep duration as a risk factor for hypertension—analyses of the First National Health and Nutrition Examination Survey. *Hypertension.* 2006;47:833–839. <https://doi.org/10.1161/01.HYP.0000217362.34748.e0>.
- Kumar A, Goel H, Nadar SK. Short sleep duration and the risk of hypertension: snoozing away high blood pressure? *J Hum Hypertens.* 2019;33:174–176. <https://doi.org/10.1038/s41371-019-0177-z>.
- Hwang H, Lee J, Lee S, et al. The relationship between hypertension and sleep duration: an analysis of the fifth Korea National Health and Nutrition Examination

- Survey (KNHANES V-3). *Clin Hypertens.* 2015;21:8. <https://doi.org/10.1186/s40885-015-0020-y>.
18. Sun Y, Shi L, Bao Y, Sun Y, Shi J, Lu L. The bidirectional relationship between sleep duration and depression in community-dwelling middle-aged and elderly individuals: evidence from a longitudinal study. *Sleep Med.* 2018;52:221–229. <https://doi.org/10.1016/j.sleep.2018.03.011>. Epub 2018 Mar 31.
 19. Li Y, Wu Y, Zhai L, Wang T, Sun Y, Zhang D. Longitudinal association of sleep duration with depressive symptoms among middle-aged and older Chinese. *Sci Rep.* 2017;7:11794. <https://doi.org/10.1038/s41598-017-12182-0>.
 20. Bin YS, Marshall NS, Glozier N. Sleeping at the limits: The changing prevalence of short and long sleep durations in 10 countries. *Am J Epidemiol.* 2013;177(8):826–833.
 21. Chaput J-P, Wong SL, Michaud I. Duration and quality of sleep among Canadians aged 18 to 79. *Health Rep.* 2017;28(9):28–33.
 22. Indigenous Corporate Training Inc. Working effectively with indigenous peoples—7 First Nation facts you should know. Available at: <https://www.ictinc.ca/blog/7-first-nation-facts-you-should-know>. Accessed March 21, 2021.
 23. Katz A, Avery Kinew K, Star L, et al. *The Health Status of and Access to Healthcare by Registered First Nation Peoples in Manitoba*. Winnipeg, MB: Manitoba Centre for Health Policy; 2019.
 24. University of British Columbia. First Nations studies program. Aboriginal Identity & Terminology 2020. Available at: http://indigenousfoundations.arts.ubc.ca/aboriginal_identity_terminology/ Accessed September 18, 2020.
 25. Greenwood M, de Leeuw S, Lindsay NM, Reading C. *Determinants of Indigenous Peoples' Health in Canada: Beyond the Social*. Toronto, ON, Canada: Canadian Scholars' Press; 2015:279 pages.
 26. Loppie Reading C, Wien F. *Health Inequalities and Social Determinates of Aboriginal Peoples' Health*. Prince George, BC: National Collaborating Centre for Aboriginal Health University of Northern British Columbia; 2009. Available at: <https://www.ccsa-nccah.ca/docs/determinants/RPT-HealthInequalities-Reading-Wien-EN.pdf>. Accessed November 2, 2020.
 27. Canada's Residential Schools: The History, Part 2 1939 to 2000. The Final Report of the Truth and Reconciliation Commission of Canada. *The Final Report of the Truth and Reconciliation Commission of Canada*. 1. Montreal & Kingston, ON, Canada: McGill-Queen's University Press; 2015. Available at: http://www.trc.ca/assets/pdf/Volume_1_History_Part_2_English_Web.pdf. Accessed November 11, 2020.
 28. Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, and Social Sciences and Humanities Research Council of Canada, Tri-Council Policy Statement: ethical conduct for research involving humans- TCPS 2 (2018), 2018. Available at: <https://ethics.gc.ca/eng/documents/tcps2-2018-en-interactive-final.pdf> Accessed August 31, 2019.
 29. Hirshkowitz M, Whiton K, Albert SM, et al. National Sleep Foundation's updated sleep duration recommendations: final report. *Sleep Health.* 2015;1:233–243.
 30. Buysse DJ, Reynolds III CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res.* 1989;28:193–213.
 31. Hosmer DW, Lemeshow S, Sturdivant RX. *Applied Logistic Regression*. 3rd ed. Hoboken, NJ: John Wiley & Sons, Inc; 2013.
 32. Hurst M. Who gets any sleep these days? Sleep patterns of Canadians. *Can Soc Trends.* 2008;85(Summer):39–45.
 33. Liu Y, Wheaton AG, Chapman DP, Cunningham TJ, Lu H, Croft JB. Prevalence of healthy sleep duration among adults – United States. *MMWR Morb Mortal Wkly Rep.* 2016;65(6):137–141. <https://doi.org/10.15585/mmwr.mm6506a1>.
 34. Ehlers CL, Wills DN, Lau P, Gilder DA. Sleep quality in an adult American Indian community sample. *J Clin Sleep Med.* 2017;13:385–391. <https://doi.org/10.5664/jcsm.6486>.
 35. Chapman DP, Croft JB, Liu Y, Perry GS, Presley-Cantrell LR, Ford ES. Excess frequent insufficient sleep in American Indians/Alaska natives. *J Environ Public Health.* 2013;2013: 259645. <https://doi.org/10.1155/2013/259645>.
 36. Hall MH, Matthews KA, Kravitz HM, et al. Race and financial strain are independent correlates of sleep in midlife women: the SWAN sleep study. *Sleep.* 2009;32(1):73–82.
 37. Madrid-Valero JJ, Martínez-Selva JM, Ribeiro do Couto B, Sánchez-Romera JF, Ordoñana JR. Age and gender effects on the prevalence of poor sleep quality in the adult population. *Gac Sanit.* 2017;31(1):18–22. <https://doi.org/10.1016/j.gaceta.2016.05.013>.
 38. Stamatakis KA, Kaplan GA, Roberts RE. Short sleep duration across income, education, and race/ethnic groups: population prevalence and growing disparities during 34 years of follow-up. *Ann Epidemiol.* 2007;17(12):948–955. <https://doi.org/10.1016/j.annepidem.2007.07.096>.
 39. Patel NP, Grandner MA, Xie D, Branas CC, Gooneratne N. "Sleep disparity" in the population: poor sleep quality is strongly associated with poverty and ethnicity. *BMC Public Health.* 2010;10:475. <https://doi.org/10.1186/1471-2458-10-475>.
 40. Grandner MA, Patel NP, Gehrman PR, et al. Who gets the best sleep? Ethnic and socioeconomic factors related to sleep complaints. *Sleep Med.* 2010;11(5):470–478. <https://doi.org/10.1016/j.sleep.2009.10.006>.
 41. Chief Moon-Riley K, Copeland JL, Metz GAS, Currie CL. The biological impacts of indigenous residential school attendance on the next generation. *SSM Popul Health.* 2018;7: 100343. <https://doi.org/10.1016/j.ssmph.2018.100343>.