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Who are the individuals with the worst perceived quality of sleep? A population-based survey in southern Brazil

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ABSTRACT

This study aimed to investigate the factors associated with poorer sleep quality. It consisted of a population-based cross-sectional study conducted in Southern Brazil with individuals aged 18 years or older. Participants were selected through a two-stage random sampling strategy and data collection was conducted in 2016. The outcome was self-perceived quality of sleep. Questions regarding the number of hours of sleep and the use of medicines to sleep each week were also asked. Demographic, socioeconomic, behavioral and health conditions were collected through questionnaire. The study sample was composed of 1,300 individuals whose mean age was 46.1 years (SD = 17.3). The prevalence of poor sleep quality was 10.7% (95% CI 9.3% to 12.1%). The poorer the quality of sleep was, the higher the prevalence of the use of medicines to sleep (22.3% versus 10.0% in the overall sample; $p < 0.001$) and the lower the average amount of daily sleep (6.0 h/day versus 7.3 h/day in the overall sample; $p < 0.001$). Groups with the worst quality of sleep, in the adjusted analyses, were female ($p = 0.012$), younger (18 to 39 years versus 60 years or more) ($p = 0.048$), with poorer perceived diet ($p < 0.001$), most stressed ($p < 0.001$), with chronic back pain ($p = 0.002$), with chronic respiratory disease ($p = 0.012$), with worse quality of life ($p = 0.018$) and depression ($p = 0.034$). Concluding, one out of ten individuals reported poor sleep quality. The results suggest that lifestyle changes could improve the quality of sleep.

1. Introduction

Sleep is a basic human need; it is vital for optimal performance during the day and is a predictor of physical and mental health, wellness, and overall quality of life (Ohayon et al., 2017; World Health Organization, 2004). Sleep quality varies considerably from one person to another and is influenced by genetic, behavioral, medical, and environmental factors. To achieve the benefits of sleep, human beings must spend almost a third of their lifetime sleeping (Watson et al., 2015; World Health Organization, 2004). Optimal sleep can improve the immune system's cytokines (helping the body's response to infection), enhance cardiovascular health (through blood pressure as heart and breathing rate changes during non-REM and REM sleep), and boost muscle mass and repair of cells and tissues (due to growth hormone released during deep sleep (stage 3 non-REM sleep).

Current lifestyle and environmental factors are increasingly responsible for difficulties sleeping, with noise being the most important known environmental stimulus for associated disorders (World Health Organization, 2004). There are some indicators used to describe sleep disturbance: sleep latency; number and duration of nocturnal awakenings; total sleep time; REM sleep together with modifications in autonomic functions (heart and respiratory rates, blood pressure, vasoconstriction); repetitive nights of sleep disruption in the period of one week or one month; and self-reported sleep (World Health Organization, 2004). The main consequence associated with poor sleep quality is the increased risk of mortality in these persons (Adams et al., 2016; World Health Organization, 2004). Several negative health outcomes are linked to sleep deprivation, such as mood disturbances and cognitive impairment, physical effects, immune system dysfunction, and social and public health burden (Adams et al., 2016; ; Watson et al., 2015; World Health Organization, 2004).

The literature presents risk factors associated with sleep disorders

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and poorer sleep quality. It is well recognized that aging linearly decreases the total sleep time, efficiency and percentage of shortwave sleep and rapid eye movement stages (Ohayon et al., 2004). Female individuals exhibit a higher probability of having poorer sleep quality (Knutson, 2013). Psychosocial factors, including depression, socioeconomic position, stress, and loneliness, are also risk factors for sleep disorders, constituting important links between the social environment and sleep (Bliwise et al., 2014; Knutson, 2013). Moreover, there is evidence that medication use is also a risk factor (Stein and Friedmann, 2006). Cardiopulmonary conditions (congestive heart failure and chronic obstructive pulmonary disease), as well as back pain, hip impairment, and prostate problems, are also associated with poorer sleep quality (Bliwise et al., 2014).

The annual costs of sleep deprivation have been estimated to be as high as US$16 billion in health care expenses and US$50 billion in lost productivity in the United States of America. In Australia, its costs were estimated to be approximately US$1.8 billion for the health system and US$66.3 billion due to financial loss and decreased well-being (Adams et al., 2016; U.S. Department of Health and Human Services, 2011; Watson et al., 2015; World Health Organization, 2004). Studies on sleep quality could contribute to knowledge of their occurrence and risk factors, drawing the attention of the general public and healthcare stakeholders to the importance of this issue, as well as aiding the population by educating them about their health and well-being (Watson et al., 2015).

Therefore, the primary aim of this study was to measure the prevalence of poor sleep quality and to investigate the factors associated with this outcome among adults and elderly individuals from southern Brazil. The secondary aim was to investigate whether the use of medicines to sleep and short sleep times were associated with poor sleep quality.

2. Methods

This was a population-based cross-sectional study conducted among individuals aged 18 years or more from the municipality of Rio Grande, southern Brazil. Rio Grande has approximately 200,000 inhabitants, 95% of whom reside in the urban area. It is situated near Uruguay and has one of the largest sea ports of the country. The Human Development Index (HDI) was 0.744 in 2010, and the gross domestic product (GDP) per capita was approximately US$10,000 in 2015.

This study is part of a larger project entitled Health of Riograndine Population ("Saúde da População Riograndina"). The data were collected from April to June 2016. A questionnaire was administered by trained interviewers in the selected households. The research project was approved by the Health Research Ethics Committee of Federal University of Rio Grande (FURG) under protocol 20/2016. More details on methodological procedures are fully described elsewhere (Dumith et al., 2018).

A two-stage random sampling strategy was conducted. Primary and secondary sampling units were census tracts and households, respectively. We systematically selected 72 census tracts from 293 in the urban area of the municipality. Then, households were selected within each census tract, with probability proportional to the census tract size. Considering that the average number of individuals aged 18 years or older in each household was two, we expected to select approximately 1,440 individuals. The sample size was sufficient, given outcomes showing a prevalence of approximately 10%, an exposure frequency from 20% to 60%, and a prevalence ratio (PR) of two or more, considering a power of 80%, a sampling design effect of 1.5, and the addition of 15% for adjustment for confounders and 10% for possible losses or refusals.

The outcome of this study was self-perceived quality of sleeping. The English-language equivalent of the description of the Portuguese-language question is as follows: "How do you consider your sleep?", and the response options were "very good", "good", "regular", "poor", and "very poor". This question was extracted from the Brazilian National Population Survey (2013), the larger study about health of the population conducted in Brazil so far (https://www.pns.icict.fiocruz.br/). Those who answered the last two options (poor or very poor) were considered to have poor sleep quality. We also asked about the mean number of hours the subjects slept during the week and whether they used medicine to sleep during the week prior to the interview. Independent covariates encompassed a set of variables: socioeconomic and demographic variables (sex, age group, marital status, if the individual lived alone, schooling and asset index); behavioral variables (smoking, excessive alcohol consumption, physical activity in leisure time, and self-reported quality of diet); morbidities (obesity, chronic back pain, chronic respiratory disease, arthritis or rheumatism, hypertension, diabetes); and mental health (stress, self-rated health, quality of life, depression, feelings of sadness and suicidal thoughts).

The assets index was generated through a principal component analysis with 11 items of home assets or home characteristics; the first component that explained 30% of the variance in all variables (eigenvalue of 3.3) was extracted and divided into tertiles. Excessive alcohol consumption was defined as drinking five or more servings (for men) and four or more servings (for women) of alcoholic beverages in the last month. Physical activity was measured through the leisure section of the International Physical Activity Questionnaire (Craig et al., 2003) and defined as inactive (no activity) or some activity. Stress was measured through the Perceived Stress Scale (Siqueira Reis et al., 2010), and the score was divided into tertiles. Obesity was defined as a body mass index equal to or higher than 30 kg/m^2 through self-reported height and weight. Chronic back pain was defined as back pain in the previous year lasting for at least three consecutive months. Chronic respiratory diseases include asthma, bronchitis, emphysema or chronic obstructive pulmonary disease in the last year. Arthritis or rheumatism, hypertension and diabetes were defined as self-reports of medical diagnoses. Depression was defined as the self-report of a medical or psychological diagnosis. Quality of life was measured by the World Health Organization Quality of Life (WHOQoL-BREF) scale (Fleck et al., 2000), and the score was standardized and divided into tertiles. Feelings of sadness were obtained from a face scale (Andrews and Withey, 1976) and were defined as the selection of the last three faces (sad, very sad, extremely sad). Suicidal thoughts were assessed through the affirmative answer to the last question of the Patient Health Questionnaire (PHQ-9) (Santos et al., 2013).

Data were double-entered into the software EpiData 3.1 and were then transferred to the statistical package STATA 15.1, where the analyses were conducted. First, a univariate analysis was conducted to describe the sample. Second, crude and adjusted analyses were performed using Poisson regression with robust adjustment for variance. We present the PR (prevalence ratio), 95% CI (95% confidence interval) and the p-value of the Wald test for heterogeneity and linear trends. Adjusted analysis was conducted through a four-level hierarchical model of analysis, taking into account the design effect. Variables were selected through a backward stepwise strategy, retaining in our model the variables with a p-value <0.20. The significance level was set as 5% for two-tailed tests. To analyze the administration of medicine to sleep and hours of sleep, we used Fisher's exact test and one-way analyses of variance, respectively.

3. Results

Among the 1,429 eligible individuals, the study sample was composed of 1,300 individuals (response rate = 91.0%). Losses and refusals were higher for males ($p < 0.01$), without differences by age group ($p = 0.8$). The sampling design effect for the outcome (sleep quality) was 0.72, indicating that the variability within census tracts was higher than that between the tracts.

The mean age of the participants was 46.1 years (SD = 17.3), and the median monthly income per capita was US$250 (interquartile interval: US$600 to US$1,760). The proportion of women was slightly higher

than that of men (57%), and a quarter of the sample was aged 60 years or older. Forty-six percent of the sample were single, 10% lived alone, and 27% had 12 years or more of schooling. Regarding behavioral characteristics, we identified that 18% of individuals were current smokers, 12% presented excessive alcohol consumption, 67% did not practice physical activity during their leisure time, and 29% perceived their diet as regular or poor. One in every four respondents was obese, chronic back pain affected approximately one-fifth of the respondents, 16% had chronic respiratory disease, 12% referred to having arthritis or rheumatism, 28% reported medical diagnosis of hypertension, and 7% reported a medical diagnosis of diabetes. A third of the sample perceived their health as regular or poor, 9% had a diagnosis of depression in the last 12 months, 9% had feelings of sadness, and 7% presented suicidal thoughts (Table 1).

The prevalence of poor sleep quality was 10.7% (95% CI 9.3 to 12.1). This prevalence ranged from 4.9% in the individuals with higher quality of life scores to 26.3% in those with a diagnosis of depression (Table 2). In the crude analysis, the following groups had a higher prevalence of poor sleep quality: females, those who perceived their diet as regular or poor, those with higher level of stress, those who had chronic back pain, those with chronic respiratory disease, those with a diagnosis of arthritis or rheumatism, those who perceived their health as regular or poor, those with a worse score for quality of life, those with depression, and those with feelings of sadness and suicidal thoughts (Table 2). In the adjusted analysis, the variables arthritis or rheumatism, health perception, feelings of sadness and suicidal thoughts lost significance. Age presented an inverse association with the outcome, that is, the higher the age, the lower the prevalence of poor sleep quality (Table 2). Excess alcohol consumption presented a significant association with poor sleep quality ($p = 0.06$).

In the secondary analysis, we found that one out of ten individuals used medicine to sleep during the week prior to the interview. Furthermore, the poorer the quality of sleep was, the higher the prevalence of using medicine to sleep ($p < 0.001$). Among individuals who perceived their sleep as very good, good or regular, this prevalence was 8.5%, while among those with poor or very poor sleep quality, it was 22.3%. Finally, the average amount of daily sleep was 7.3 h (SD = 1.6), and among those who perceived their sleep quality to be poor, the average amount of daily sleep was 6.0 h (SD = 1.8).

4. Discussion

We aimed to investigate the factors associated with poor sleep quality among adults and the elderly individuals in southern Brazil and to further analyze the association between the use of medicine to sleep and the number of hours spent sleeping with the quality of sleep. We identified that one in every 10 participants reported having poor sleep quality.

This result was similar to those of a cross-sectional study conducted in a municipality in the United Kingdom that found a prevalence of 8.5% (Gadie et al., 2017). Another investigation comprising eight communities from China identified that 15% of participants had poor sleep quality (Liu et al., 2016). Nevertheless, our prevalence was lower than that in studies that used the Pittsburgh Sleep Quality Index (PSQI) to assess sleep quality (Lysen et al., 2019; Stringhini et al., 2015; The Sleep Council, 2017). The frequency of poor sleep quality in a Brazilian population-based study that also assessed this outcome through a single question was approximately three times higher than that in our research (Barros et al., 2019).

The finding that females have poorer sleep quality is consistent with the literature (Barros et al., 2019; Knutson, 2013; Machado et al., 2018; Madrid-Valero et al., 2017; Mazzotti et al., 2012; Ohayon et al., 2004; Stranges et al., 2012; Stringhini et al., 2015; The Sleep Council, 2017; U. S. Department of Health and Human Services, 2011). Women may be more susceptible to insomnia than men, according to a meta-analysis (Stringhini et al., 2015; Zhang and Wing, 2006). The greater risk of

Table 1
Description of the sample of adults and elderly according to socioeconomic, demographic, behavioral and mental health variables. Rio Grande, Brazil, 2016 (n = 1,300).

Variable	n	%
Sex (N = 1,300)		
Male	564	43.4
Female	736	56.6
Age groups (years) (N = 1,300)		
20–39	508	39.1
40–59	477	36.7
≥ 60	315	24.2
Marital status (N = 1,300)		
Single	602	46.3
Married, widowed, separated, divorced	698	53.7
Living alone (N = 1,299)		
No	1,174	90.4
Yes	125	9.6
Schooling (years) (N = 1,298)		
0 to 8	543	41.8
9 to 11	400	30.8
≥ 12	355	27.4
Assets index (tertiles) (N = 1,299)		
Lower	447	34.4
Intermediate	419	32.3
Higher	433	33.3
Smoking (N = 1,300)		
No smoker	733	56.4
Former smoker	333	25.6
Current smoker	234	18.0
Excessive alcohol consumption (N = 1,297)		
No	1,145	88.3
Yes	152	11.7
Physical activity in leisure time (N = 1,295)		
No	862	66.6
Yes	433	34.4
Perceived quality of diet (N = 1,297)		
Very good or good	927	71.5
Regular or poor	370	28.5
Stress level (tertiles) (N = 1,295)		
Lower	438	33.8
Intermediate	475	36.7
Higher	382	29.5
Obesity (N = 1,242)		
No	948	76.3
Yes	294	23.7
Chronic back pain (N = 1,300)		
No	1,032	79.4
Yes	268	20.6
Chronic respiratory disease (N = 1,279)		
No	1.078	84.3
Yes	201	15.7
Arthritis or rheumatism (N = 1,300)		
No	1.141	87.8
Yes	159	12.2
Hypertension (N = 1,299)		
No	933	71.8
Yes	366	28.2
Diabetes (N = 1,296)		
No	1.206	93.1
Yes	90	6.9
Self-rated health (N = 1,300)		
Excellent or very good	278	21.4
Good	582	44.7
Regular or poor	440	33.9
Quality of life score (tertiles) (N = 1,295)		
Lower	434	33.5
Intermediate	430	33.2
Higher	431	33.3
Depression (N = 1,300)		
No	1,186	91.2
Yes	114	8.8
Sadness (N = 1,296)		
No	1,179	91.0
Yes	117	9.0
Suicidal thought (N = 1,295)		
No	1,210	93.4
Yes	85	6.6

Notes. N = number of valid responses per variable; n = absolute frequency per category; % = prevalence per category.

anxiety and depression are other possible factors that could influence poorer sleep rates among women (Barros et al., 2019; Machado et al., 2018; Stranges et al., 2012).

Our results that sleep quality was better among elderly adults contradict the findings of several studies (Barros et al., 2019; Lima et al., 2012; Machado et al., 2018; Stranges et al., 2012). However, a meta-analysis showed that the overall increase in sleep latency was <10 min in adults between 20 and 80 years of age (Ohayon et al., 2004), not justifying differences along aging. Similarly, a cohort study noted that poor sleep quality and longer sleep latency are more common in younger adults, while inefficient sleep is associated with older adults (Gadie et al., 2017). On the other hand, a cross-sectional study performed with the PSQI found that latency and sleep efficiency are affected by aging but did not find significant differences in the perception of sleep quality according to age (Madrid-Valero et al., 2017).

Epidemiological studies exploring the association between perceived diet quality and sleep quality in the adult population are scarce, and this study is one of the first to present this analysis. Low intake of fish and vegetables and high intake of carbohydrates were not evidenced to be associated with poorer sleep quality in adult and elderly individuals (Del Brutto et al., 2016; Katagiri et al., 2014; Van Egmond et al., 2019). Moreover, a randomized controlled trial conducted with children showed no significant fatty acid effects on subjective sleep measures (Montgomery et al., 2014).

Although two other Brazilian investigations found no association for higher alcohol consumption with poorer sleep quality (Barros et al., 2019; Machado et al., 2018) , positive associations were found by a long-term longitudinal study and by a meta-analysis (Goldman-Mellor et al., 2014; Ohayon et al., 2004). We found a borderline statistically significant association that may have been statistically significant if we had had a larger sample size providing greater statistical power.

Our data presented an association between worse perceived quality of life and poorer sleep quality, a result that was also found in other studies (Chen et al., 2014; Machado et al., 2018; Mazzotti et al., 2012; Reis et al., 2018; Stranges et al., 2012). One possible explanation is the role of poorer general physical health and daily performance (Chen et al., 2014). Our results were according to a Chinese population-based survey that showed perceived stress was strongly associated with poorer sleep quality (Liu et al., 2016). Furthermore, two British surveys also noted that perceived stress was the factor most associated with this outcome (The Sleep Council, 2017). Regarding depression, it is considered a determinant of poor sleep quality (Knutson, 2013).

Regarding back pain, a previous population-based investigation from a Brazilian city also pointed out chronic back pain as an important risk factor for poorer sleep quality (Lima et al., 2012), as we found in our results. The intensity of this painful condition had a relationship with the severity of sleep disorder in a case-control study (Marty et al., 2008). Data from prospective studies suggest that poorer sleep quality during the previous night also predicts higher levels of pain (Gerhart et al., 2017). Furthermore, there is consistent evidence that patients with low back pain have poorer sleep quality and consequently have greater sleep disturbance and poorer daytime functioning (Kelly et al., 2011).

Investigations in Brazil and worldwide showed that the use of sleeping pills is associated with poorer sleep quality, as presented in the results of our secondary analysis (Barros et al., 2019; Castro et al., 2013; Reis et al., 2018; Stringhini et al., 2015). This habit was identified as a predictor of short sleep duration and long sleep latency (Reis et al., 2018; Stringhini et al., 2015). Sleeping pills may cause an increase in periodic leg movement events, resulting in awakening during the night (Castro et al., 2013). Physical dependency, withdrawal, and rebound insomnia after their discontinuation can also be a plausible explanation for this association (Stein and Friedmann, 2006).

We found participants who slept less than the recommended number

Table 2
Crude and adjusted prevalence ratios for association between poor sleep quality and independent variables in a sample of adults and elderly. Multivariate analysis conducted through Poisson regression with robust adjustment for variance according to a four-level hierarchical model, accounting for design effect. Rio Grande, Brazil, 2016 (n = 1,300).

Level	Variable	Poor sleep quality (%)	Crude analysis		Adjusted analysis	
			PR (95% CI)	p-value	PR (95% CI)	p-value
1st	**Sex**			0.014		0.012
	Male	8.3	1.00		1.00	
	Female	12.5	1.50 (1.09; 2.07)		1.53 (1.10; 2.11)	
	Age groups (years)			0.060*		0.048*
	20–39	12.0	1.00		1.00	
	40–59	11.3	0.94 (0.67; 1.33)		0.94 (0.67; 1.32)	
	≥ 60	7.6	0.64 (0.40; 1.01)		0.62 (0.39; 0.99)	
	Marital status			0.941		0.292
	Single	10.6	1.00		1.00	
	Married, widowed, separated, divorced	10.7	1.01 (0.76; 1.35)		1.22 (0.84; 1.78)	
	Living alone			0.207		0.386
	No	11.1	1.54 (0.78; 3.02)		1.35 (0.68; 2.65)	
	Yes	7.2	1.00		1.00	
	Schooling (years)			0.768		0.748
	0 to 8	10.5	0.89 (0.61; 1.28)		0.96 (0.61; 1.52)	
	9 to 11	10.0	0.85 (0.52; 1.38)		0.84 (0.50; 1.41)	
	≥ 12	11.8	1.00		1.00	
	Assets index (tertiles)			0.627		0.668
	Lower	10.5	1.08 (0.71; 1.65)		1.17 (0.76; 1.93)	
	Intermediate	11.9	1.23 (0.80; 1.90)		1.21 (0.78; 1.86)	
	Higher	9.7	1.00		1.00	
2nd	**Smoking**			0.992		0.700
	No smoker	10.8	1.00		1.00	
	Former smoker	10.5	0.98 (0.66; 1.44)		1.12 (0.75; 1.68)	
	Current smoker	10.7	0.99 (0.67; 1.46)		0.90 (0.59; 1.39)	
	Excessive alcohol consumption			0.163		0.061
	No	10.3	1.00		1.00	
	Yes	13.8	1.34 (0.89; 2.03)		1.50 (0.98; 2.30)	
	Physical activity in leisure time			0.054		0.301
	No	12.1	1.58 (0.99; 2.53)		1.27 (0.80; 2.01)	
	Yes	7.6	1.00		1.00	
				<0.001		<0.001

(*continued on next page*)

Table 2 (*continued*)

Level	Variable	Poor sleep quality (%)	Crude analysis		Adjusted analysis	
			PR (95% CI)	p-value	PR (95% CI)	p-value
	Perceived quality of diet					
	Very good or good	7.9	1.00		1.00	
	Regular or poor	17.6	2.23 (1.69; 2.95)		1.76 (1.31; 2.37)	
	Stress level (tertiles)			<0.001*		<0.001*
	Lower	5.3	1.00		1.00	
	Intermediate	8.2	1.56 (0.97; 2.53)		1.40 (0.86; 2.27)	
	Higher	19.9	3.79 (2.48; 5.79)		3.06 (2.00; 4.70)	
3rd	**Obesity**			0.080		0.843
	No	9.6	1.00		1.00	
	Yes	13.3	1.38 (0.96; 1.99)		1.04 (0.70; 1.54)	
	Chronic back pain			<0.001		0.002
	No	8.0	1.00		1.00	
	Yes	20.9	2.60 (1.81; 3.74)		1.89 (1.29; 2.78)	
	Chronic respiratory disease			0.005		0.012
	No	9.3	1.00		1.00	
	Yes	16.4	1.77 (1.20; 2.61)		1.62 (1.12; 2.34)	
	Arthritis or rheumatism			0.022		0.354
	No	9.9	1.00		1.00	
	Yes	16.4	1.65 (1.08; 2.53)		1.23 (0.79; 1.90)	
	Hypertension			0.539		0.870
	No	10.3	1.00		1.00	
	Yes	11.5	1.12 (0.78; 1.59)		0.97 (0.64; 1.47)	
	Diabetes			0.598		0.456
	No	10.8	1.00		1.00	
	Yes	8.9	0.83 (0.40; 1.70)		1.04 (0.33; 1.65)	
4th	**Self-rated health**			<0.001*		0.162*
	Excellent or very good	5.0	1.00		1.00	
	Good	10.7	2.12 (1.17; 3.83)		1.47 (0.78; 2.76)	
	Regular or poor	14.3	2.84 (1.60; 5.06)		1.07 (0.54; 2.14)	
	Quality of life score (tertiles)			<0.001*		0.018*
	Lower	19.4	3.97 (2.55; 6.18)		1.94 (1.08; 3.50)	
	Intermediate	7.7	1.58 (0.95; 2.62)		1.24 (0.70; 2.19)	
	Higher	4.9	1.00		1.00	
	Depression			<0.001		0.034
	No	9.2	1.00		1.00	
	Yes	26.3	2.86 (2.06; 3.98)		1.51 (1.03; 2.22)	
	Sadness			<0.001		0.272
	No	9.4	1.00		1.00	
	Yes	23.1	2.45 (1.76; 3.42)		1.24 (0.84; 1.84)	
	Suicidal thought			0.009		0.207
	No	10.1	1.00		1.00	
	Yes	18.8	1.87 (1.18; 2.97)		0.70 (0.41; 1.22)	

Notes. % = prevalence of poor quality sleep per category; PR = prevalence ratio; 95%CI = 95% confidence interval; * = Wald's test for linear trend's p-value.

of hours were more likely to have poorer sleep quality. Similar results were found in a Canadian study (Chaput et al., 2017). In a 20-year prospective investigation, the authors identified that individuals who had persistent short sleep (≤6 h) or who became short sleepers during the follow-up were more likely to report poorer sleep quality than were those who reported persistent moderate sleep (7–8 h) (Zomers et al., 2017).

Some limitations and strengths should be considered. First, a cross-sectional design does not allow us to establish temporality. Therefore, our results are susceptible to inverse causality bias, especially associations between outcome and behavioral variables. Another limitation is that sleep quality was measured through a single-question self-report. This method may have underestimated the prevalence of poor sleep quality compared with other questionnaires (e.g., the PSQI). Moreover, we did not assess menstrual and menopausal periods among women, which could affect their perception of poorer sleep quality, as well we did not ask if the individual had been diagnosed with sleep disorders, which could act as an additional confounding variable. It is also important to notice that we did not collect information about other factors that may affected sleep quality, such as occupation (shift work), substance-use disorders, bipolar disorders etc.

Notwithstanding, since there are few population-based studies on this subject in Brazil, our results present novel contributions for Brazilian health professionals and researchers. Considering the implications of these results, some recommendations are suggested to help Brazilian adult population remedy the problem of poor sleep quality. Several simple and low-cost activities can be introduced to daily routines, such as regular physical activities, avoiding or reducing intake of caffeine, nicotine and alcohol, reducing bedroom noise, avoiding daytime naps and including before-bedtime warm showers (Auld et al., 2017; Bollens and Reychler, 2018; Haghayegh et al., 2019; Irish et al., 2015). Other possibilities include guided activities such as yoga, mindfulness and psychotherapy (Kumar et al., 2019; Rusch et al., 2019; Trauer et al., 2015).

We concluded that one out of ten participants had poor sleep quality. Females who reported poor perceived quality of diet and who had a diagnosis of low back pain, chronic respiratory disease and depression had a higher probability of reporting poorer sleep quality. Furthermore, the probability of reporting poor sleep quality decreased with increasing participant age and increased with higher participant stress and lower quality-of-life scores. Heavy drinking was marginally associated with the outcome. The use of medicines to sleep, as well as short sleep time, were also associated with poor sleep quality. These characteristics can be used as a proxy to identify poor sleep quality, an outcome that can be underestimated by clinicians despite its harmful impacts on patients'

physical and mental health.

Authors' contributions

SC Dumith conceived the study, performed data analysis and critically reviewed the manuscript; KFD Meneghini wrote the manuscript; LM Demenech critically reviewed the manuscript.

Ethical aspects

This research was approved by the Research Ethics Committee in the Health Area (CEPAS) of the Federal University of Rio Grande (FURG) under process number 20/2016 (CAAE: 52939016.0.0000.5324).

CRediT authorship contribution statement

Samuel Carvalho Dumith: Conceptualization, Methodology, Formal analysis, Project administration, Funding acquisition. **Kevin Francisco Durigon Meneghini:** Investigation, Writing - original draft, Visualization. **Lauro Miranda Demenech:** Supervision.

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References

Adams, R., Appleton, S., Taylor, A., McEvoy, D., Antic, N., 2016. Report to the sleep health foundation 2016 sleep health survey of australian adults. Adelaide Inst. Sleep Health 55.

Andrews, F.M., Withey, S.B., 1976. Social Indicators of Well-Being: Americans' Perceptions of Life Quality, 1st ed. Plenum Press, New York, NY.

Auld, F., Maschauer, E.L., Morrison, I., Skene, D.J., Riha, R.L., 2017. Evidence for the efficacy of melatonin in the treatment of primary adult sleep disorders. Sleep Med. Rev. 34, 10–22. https://doi.org/10.1016/j.smrv.2016.06.005.

Barros, M.B.Z., Lima, M.G., Ceolim, M.F., Zancanella, E., Cardoso, T.A.M.O., 2019. Quality of sleep, health and well-being in a population-based study. Rev. Saude Publica 53, 82. https://doi.org/10.11606/s1518-8787.2019053001067.

Bliwise, D.L., Rosen, R.C., Baum, N., 2014. Impact of nocturia on sleep and quality of life: A brief, selected review for the International Consultation on Incontinence Research Society (ICI-RS) nocturia think tank: Nocturia Impact on Sleep and QOL. Neurourol. Urodynam. 33 (S1), S15–S18. https://doi.org/10.1002/nau.22585.

Bollens, B., Reychler, G., 2018. Efficacy of exercise as a treatment for Obstructive Sleep Apnea Syndrome: A systematic review. Complement. Therap. Med. 41, 208–214. https://doi.org/10.1016/j.ctim.2018.10.002.

Castro, L.S., Castro, J., Hoexter, M.Q., Quarantini, L.C., Kauati, A., Mello, L.E., Santos-Silva, R., Tufik, S., Bittencourt, L., 2013. Depressive symptoms and sleep: A population-based polysomnographic study. Psychiatry Res. 210 (3), 906–912. https://doi.org/10.1016/j.psychres.2013.08.036.

Chaput, J.P., Wong, S.L., Michaud, I., 2017. Duration and quality of sleep among Canadians aged 18 to 79. Health Rep. 28 (9), 28–33.

Craig, C.L., Marshall, A.L., Sjöström, M., Bauman, A.E., Booth, M.L., Ainsworth, B.E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J.F., Oja, P., 2003. International physical activity questionnaire: 12-country reliability and validity. Med. Sci. Sports Exerc. 35 (8), 1381–1395. https://doi.org/10.1249/01.MSS.0000078924.61453.FB.

Chen, X., Gelaye, B., Williams, M.A., 2014. Sleep characteristics and health-related quality of life among a national sample of American young adults: assessment of possible health disparities. Qual. Life Res. 23 (2), 613–625. https://doi.org/10.1007/s11136-013-0475-9.

Del Brutto, O.H., Mera, R.M., Ha, J.-E., Gillman, J., Zambrano, M., Castillo, P.R., 2016. Dietary fish intake and sleep quality: a population-based study. Sleep Med. 17, 126–128. https://doi.org/10.1016/j.sleep.2015.09.021.

Dumith, S.C., Paulitsch, R.G., Carpena, M.X., Muraro, M.F.R., Simões, M.O., Machado, K. P., Dias, M.S., Kretschmer, A.C., Oliz, M.M., Pontes, L.S., Susin, L.R.O., 2018. Planning and execution of a population health survey by means of a multidisciplinary research consortium. Sci. Med. 28 (3) https://doi.org/10.15448/1980-6108.2018.3.30407.

Fleck, M.P.A., Louzada, S., Xavier, M., Chachamovich, E., Vieira, G., Santos, L., Pinzon, V., 2000. Aplicação da versão em português do instrumento abreviado de avaliação da qualidade de vida "WHOQOL-bref". Rev. Saúde Pública 34 (2), 178–183. https://doi.org/10.1590/S0034-89102000000200012.

Gadie, A., Shafto, M., Leng, Y., Kievit, R.A., 2017. How are age-related differences in sleep quality associated with health outcomes? An epidemiological investigation in a UK cohort of 2406 adults. BMJ Open 7 (7), e014920. https://doi.org/10.1136/bmjopen-2016-014920.

Gerhart, J.I., Burns, J.W., Post, K.M., Smith, D.A., Porter, L.S., Burgess, H.J., Schuster, E., Buvanendran, A., Fras, A.M., Keefe, F.J., 2017. Relationships between sleep quality and pain-related factors for people with chronic low back pain: tests of reciprocal and time of day effects. Ann. Behav. Med. 51 (3), 365–375. https://doi.org/10.1007/s12160-016-9860-2.

Goldman-Mellor, S., Gregory, A.M., Caspi, A., Harrington, H., Parsons, M., Poulton, R., Moffitt, T.E., 2014. Mental health antecedents of early midlife insomnia: evidence from a four-decade longitudinal study. Sleep 37 (11), 1767–1775. https://doi.org/10.5665/sleep.4168.

Haghayegh, S., Khoshnevis, S., Smolensky, M.H., Diller, K.R., Castriotta, R.J., 2019. Before-bedtime passive body heating by warm shower or bath to improve sleep: A systematic review and meta-analysis. Sleep Med. Rev. 46, 124–135. https://doi.org/10.1016/j.smrv.2019.04.008.

Irish, L.A., Kline, C.E., Gunn, H.E., Buysse, D.J., Hall, M.H., 2015. The role of sleep hygiene in promoting public health: A review of empirical evidence. Sleep Med. Rev. 22, 23–36. https://doi.org/10.1016/j.smrv.2014.10.001.

Katagiri, R., Asakura, K., Kobayashi, S., Suga, H., Sasaki, S., 2014. Low intake of vegetables, high intake of confectionary, and unhealthy eating habits are associated with poor sleep quality among middle-aged female Japanese workers. J. Occup. Health 56 (5), 359–368. https://doi.org/10.1539/joh.14-0051-OA.

Kelly, G.A., Blake, C., Power, C.K., O'Keeffe, D., Fullen, B.M., 2011. The association between chronic low back pain and sleep: a systematic review. Clin. J. Pain 27 (2), 169–181. https://doi.org/10.1097/AJP.0b013e3181f3bdd5.

Knutson, K.L., 2013. Sociodemographic and cultural determinantes of sleep deficiency: implications for cardiometabolic disease risk. Soc. Sci. Med. 79, 7–15. https://doi.org/10.1016/j.socscimed.2012.05.002.

Kumar, V., Malhotra, V., Kumar, S., 2019. Application of standardised yoga protocols as the basis of physiotherapy recommendation in treatment of sleep apneas: moving beyond pranayamas. Indian J. Otolaryngol. Head Neck Surg. 71 (S1), 558–565. https://doi.org/10.1007/s12070-018-1405-5.

Machado, A.K.F., Wendt, A., Wehrmeister, F.C., 2018. Sleep problems and associated factors in a rural population of a Southern Brazilian city. Rev. Saude Publica 52, 1–11. https://doi.org/10.11606/S1518-8787.2018052000260.

Madrid-Valero, J.J., Martínez-Selva, J.M., Ribeiro do Couto, B., Sánchez-Romera, J.F., Ordoñana, J.R., 2017. Age and gender effects on the prevalence of poor sleep quality in the adult population. Gac. Sanit. 31 (1), 18–22. https://doi.org/10.1016/j.gaceta.2016.05.013.

Marty, M., Rozenberg, S., Duplan, B., Thomas, P., Duquesnoy, B., Allaert, F., 2008. Quality of sleep in patients with chronic low back pain: a case-control study. Eur. Spine J. 17 (6), 839–844. https://doi.org/10.1007/s00586-008-0660-7.

Mazzotti, D.R., Guindalini, C., Sosa, A.L., Ferri, C.P., Tufik, S., 2012. Prevalence and correlates for sleep complaints in older adults in low and middle income countries: A 10/66 Dementia Research Group study. Sleep Med. 13 (6), 697–702. https://doi.org/10.1016/j.sleep.2012.02.009.

Montgomery, P., Burton, J.R., Sewell, R.P., Spreckelsen, T.F., Richardson, A.J., 2014. Fatty acids and sleep in UK children: Subjective and pilot objective sleep results from the DOLAB study - a randomized controlled trial. J. Sleep Res. 23 (4), 364–388. https://doi.org/10.1111/jsr.12135.

Lima, M.G., Bergamo Francisco, P.M.S., de Azevedo Barros, M.B., 2012. Sleep duration pattern and chronic diseases in Brazilian adults (ISACAMP, 2008/09). Sleep Med. 13 (2), 139–144. https://doi.org/10.1016/j.sleep.2011.07.011.

Liu, X., Liu, C., Tian, X., Zou, G., Li, G., Kong, L., Li, P., 2016. Associations of perceived stress, resilience and social support with sleep disturbance among community-dwelling adults: sleep disturbance and psychosocial correlates. Stress Health 32 (5), 578–586. https://doi.org/10.1002/smi.2664.

Lysen, T.S., Darweesh, S.K.L., Kamran Ikram, M., Luik, A.I., Arfan Ikram, M., 2019. Sleep and risk of parkinsonism and Parkinson's disease: A population-based study. Brain 142 (7), 2013–2022. https://doi.org/10.1093/brain/awz113.

Ohayon, M.M., Carskadon, M.A., Guilleminault, C., Vitiello, M.V., 2004. Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: Developing normative sleep values across the human lifespan. Sleep 27 (7), 1255–1273. https://doi.org/10.1093/sleep/27.7.1255.

Ohayon, M., Wickwire, E.M., Hirshkowitz, M., Albert, S.M., Avidan, A., Daly, F.J., Dauvilliers, Y., Ferri, R., Fung, C., Gozal, D., Hazen, N., Krystal, A., Lichstein, K., Mallampalli, M., Plazzi, G., Rawding, R., Scheer, F.A., Somers, V., Vitiello, M.V., 2017. National Sleep Foundation's sleep quality recommendations: first report. Sleep Health 3 (1), 6–19. https://doi.org/10.1016/j.sleh.2016.11.006.

Reis, C., Dias, S., Rodrigues, A.M., Sousa, R.D., Gregório, M.J., Branco, J., Canhão, H., Paiva, T., 2018. Sleep duration, lifestyles and chronic diseases: A cross-sectional population-based study. Sleep Sci. 11 (4), 217–230. https://doi.org/10.5935/1984-0063.20180036.

Siqueira Reis, R., Ferreira Hino, A.A., Romélio Rodriguez Añez, C., 2010. Perceived stress scale: reliability and validity study in Brazil. J Health Psychol 15 (1), 107–114. https://doi.org/10.1177/1359105309346343.

Rusch, H.L., Rosario, M., Levison, L.M., Olivera, A., Livingston, W.S., Wu, T., Gill, J.M., 2019. The effect of mindfulness meditation on sleep quality: a systematic review and meta-analysis of randomized controlled trials. Ann. N. Y. Acad. Sci. 1445 (1), 5–16. https://doi.org/10.1111/nyas.13996.

Santos, I.S., Tavares, B.F., Munhoz, T.N., de Almeida, L.S.P., da Silva, N.T.B., Tams, B.D., Patella, A.M., Matijasevich, A., 2013. Sensibilidade e especificidade do Patient Health Questionnaire-9 (PHQ-9) entre adultos da população geral. Cadernos de Saude Publica 29 (8), 1533–1543. https://doi.org/10.1590/0102-311X00144612.

Stein, M.D., Friedmann, P.D., 2006. Disturbed sleep and its relationship to alcohol use. Substance Abuse 26 (1), 1–13. https://doi.org/10.1300/J465v26n01_01.

Stranges, S., Tigbe, W., Gómez-Olivé, F.X., Thorogood, M., Kandala, N.-B., 2012. Sleep problems: an emerging global epidemic? findings from the INDEPTH WHO-SAGE study among more than 40,000 older adults from 8 countries across Africa and Asia. Sleep 35 (8), 1173–1181. https://doi.org/10.5665/sleep.2012.

Stringhini, S., Haba-Rubio, J., Marques-Vidal, P., Waeber, G., Preisig, M., Guessous, I., Bovet, P., Vollenweider, P., Tafti, M., Heinzer, R., 2015. Association of socioeconomic status with sleep disturbances in the Swiss population-based CoLaus study. Sleep Med. 16 (4), 469–476. https://doi.org/10.1016/j.sleep.2014.12.014.

The Sleep Council. (2017). The Great British Bedtime Report 2017, 5. https://sleepcouncil.org.uk/wp-content/uploads/2018/04/The-Great-British-Bedtime-Report-2017.pdf.

Trauer, J.M., Qian, M.Y., Doyle, J.S., Rajaratnam, S.M.W., Cunnington, D., 2015. Cognitive behavioral therapy for chronic insomnia: a systematic review and meta-analysis. Ann. Intern. Med. 163 (3), 191–204. https://doi.org/10.7326/m14-2841.

Van Egmond, L., Tan, X., Sjögren, P., Cederholm, T., Benedict, C., 2019. Association between healthy dietary patterns and self-reported sleep disturbances in older men: The ULSAM study. Nutrients 11 (5). https://doi.org/10.3390/nu11051029.

Zhang, B., Wing, Y.K., 2006. Sex differences in insomnia: A meta-analysis. Sleep 29 (1), 85–93. https://doi.org/10.1093/sleep/29.1.85.

Zomers, M.L., Hulsegge, G., Van Oostrom, S.H., Proper, K.I., Verschuren, W.M.M., Picavet, H.S.J., 2017. Characterizing adult sleep behavior over 20 years-the population-based doetinchem cohort study. Sleep 40 (7). https://doi.org/10.1093/sleep/zsx085.

Watson, N.F., Badr, M.S., Belenky, G., Bliwise, D.L., Buxton, O.M., Buysse, D., Dinges, D. F., Gangwisch, J., Grandner, M.A., Kushida, C., Malhotra, R.K., Martin, J.L., Patel, S. R., Quan, S.F., Tasali, E., 2015. Recommended amount of sleep for a healthy adult: A joint consensus statement of the american academy of sleep medicine and sleep research society. J. Clin. Sleep Med. 11 (06), 591–592. https://doi.org/10.5664/jcsm.4758.

World Health Organization (2004). WHO technical meeting on sleep and health. Report, World Health Organization Regional Office for Europe, European Centre for Environment and Health, Bonn Office, 185. http://www.euro.who.int/_data/assets/pdf_file/0008/114101/E84683.pdf.