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ASSOCIATION BETWEEN SLEEP DEPRIVATION AND MYOCARDIAL INFARCTION AMONG ADULTS IN THE US

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Association between sleep deprivation and myocardial infarction among adults in the US

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RESUMEN

Contexto:

Existen diversas causas por las cuales las personas no pueden dormir el tiempo suficiente, entre ellas el trabajo, el estrés o enfermedades que evitan un descanso adecuado. La privación de sueño se considera un riesgo para desarrollar diversos problemas de salud, uno de ellos a tener en cuenta es el infarto de miocardio. Esta patología se produce cuando el corazón no recibe una cantidad adecuada de sangre debido a una obstrucción en los vasos coronarios. La importancia de este estudio se centrará en determinar la asociación entre la privación de sueño y el infarto de miocardio.

Objetivo:

Evaluar la asociación entre la privación del sueño y el infarto de miocardio entre los adultos mayores de 18 años en los EE.UU. en 2020.

Metodología:

Se utilizó un diseño de estudio transversal y analítico. Se utilizaron datos nacionales de la encuesta Behavioral Risk Factor Surveillance System del año 2020. La principal variable de resultado fue el infarto de miocardio, y la principal variable de exposición fueron las horas de sueño, laraza/etnia, la edad, el sexo, el índice de masa corporal, el consumo de alcohol y tabaco se añadieron como covariables al análisis.

Palabras clave:

Infarto de miocardio, privación de sueño, adultos, riesgo.

SUMMARY

Context:

People usually don't sleep enough due to diverse factors such as work, stress, or diseases that avoid an appropriate rest. Sleep deprivation is considered as a risk to develop various problems in health, one of them to consider is myocardial infarction.This pathology occurs when the heart doesn't receive a proper blood quantity due to an obstruction in the coronary vessels.
The importance of this study will focus on determining the association between sleep deprivation and myocardial infarction.

Objective:

To evaluate the association between sleep deprivation and myocardial infarction among adults older than 18 years in the US in 2020.
Methods:

We utilized a cross-sectional, analytical study design. We used national data from the 2020 Behavioral Risk Factor Surveillance System survey. The main outcome variable was myocardial infarction, and the main exposure variable was hours of sleep. Race/ethnicity, age, gender, body mass index, alcohol, tobacco use, and alcohol consumption were added as covariates to the analysis.

Keywords:

Myocardial infarction, sleep deprivation, adults, risk.

Introduction

The Centers for Diseases Control and Prevention (CDC) recommends that an adult sleep at least 7 hours per night (1). The Sleep Foundation defines sleep deprivation as the condition in which an adult does not sleep enough hours (at least 7 hours) or does not have a good sleeping quality, this implies that there are interruptions while resting. Underlying conditions such as apnea, or external factors have been contributors for sleep deprivation (2). The American Sleep Association estimates that 50 million - 70 million US adults present some form of sleep disorder including sleep deprivation (3). Having a good sleep quality has been shown to help to restore energy, enhance the immune system, and reduce stress levels. Proper sleep habits have been shown to help to avoid diseases such as diabetes, hypertension, obesity, and neurological disorders (4). On the other hand, sleep deprivation has been associated with increased blood pressure, endothelial dysfunction, obesity, diabetes, and inflammation (5).

Various modifiable risk factors play a crucial role in maintaining a healthy lifestyle and preventing chronic non-communicable diseases, with cardiovascular diseases (CVD) being among the most prevalent worldwide (6). Factors such as physical activity, a healthy diet, and avoiding harmful substances like alcohol and tobacco are well-established targets for improving cardiovascular health (7). However, recent research has also highlighted the significance of sleep in this context. Several studies have explored the connection between the quality and quantity of sleep and cardiovascular complications (8,9,10).

Despite the emerging evidence linking sleep and cardiovascular health, there are still important gaps in our understanding. While some studies have touched upon the relationship between sleep and myocardial infarction, there is a need for more comprehensive research that specifically focuses on the association between sleep deprivation and myocardial infarction among adults in the United States. Existing studies have primarily been conducted in other populations, such as China, and often involve limitations related to sample size and measurement methods (8). Consequently, it remains unclear to what extent sleep deprivation is a modifiable risk factor for myocardial infarction in the US population and how this association can be better understood and applied in medical practice.

To address these knowledge gaps, a new study was done using updated information to rigorously assess the association between sleep deprivation and myocardial infarction, while accounting for relevant confounding factors, in a sample of American adults. Given that myocardial infarction is a leading cause of death in the United States, it is imperative to identify and understand modifiable behaviors associated with this condition (6). Our study aims to shed light on the role of sleep deprivation as a risk factor for myocardial infarction, utilizing a contemporary database. By doing so, we aspired to provide the scientific community with a more comprehensive and accurate understanding of this association, which can, in turn, inform medical practitioners in offering more precise recommendations for preventing cardiovascular disease among patients. This research has the potential to significantly impact public health and enhance our ability to combat the global burden of cardiovascular diseases.

Methods

In our study, we employed a cross-sectional, analytical approach to analyze data extracted from the 2020 Behavioral Risk Factor Surveillance System (BRFSS). This comprehensive dataset was collected via telephone interviews conducted throughout the year 2020, encompassing all 50 states, the District of Columbia, Puerto Rico, and Guam. The questionnaire used in this study was the result of collaborative efforts between the respective state public health departments and the Centers for Disease Control and Prevention (CDC). The survey gathered self-reported information from adults aged 18 years and older, with respondents randomly selected from households. The sampling design varied by state, with some employing county-level, public health district, or other sub-state geographical distinctions. Each state's sampling approach was reviewed and refined in consultation with a state statistician and the CDC. Two distinct samples were utilized: landline telephones for households and cellular telephones for single-adult households. The overarching goal of the BRFSS was to secure a minimum of 4,000 interviews per state annually.

Our study population comprises adults over the age of 18 who participated in the 2020 BRFSS survey. Inclusion criteria encompassed adults who were residents in the United States during 2020 and aged 18 years or older. Exclusion criteria pertained to adults who did not respond to all survey questions, leading to missing information in the relevant variables.

The primary outcome variable of interest was self-reported myocardial infarction (MI). Data on MI diagnoses were derived from the BRFSS survey question that asked respondents whether a

doctor, nurse, or other health professional had ever informed them of a heart attack or myocardial infarction diagnosis, with response options including "Yes," "No," or "Not sure."

As for the main independent variable, it was determined by the number of hours of sleep individuals obtained within a 24-hour period. Participants were queried about their average daily sleep duration, and this variable was subsequently categorized into four groups: ≤ 5 hours, 6 hours, 7 hours, 8 hours, and ≥ 9 hours. In addition to these primary variables, several other potential confounders and factors were included in our study, such as age, gender, race, body mass index (BMI), tobacco usage, and alcohol consumption. Age was divided into seven categories, gender into two, race into six, BMI into four, tobacco usage into four, and alcohol consumption into four categories, each based on specific survey questions and response patterns.

Data were analyzed utilizing SPSS® (v. 28). We initially conducted a descriptive analysis of selected baseline characteristics of the population: sex, age, ethnicity, BMI, smoking and alcohol consumption. We then conducted a bivariate analysis to determine the frequency distribution between the characteristics of the study participants according to exposure (sleep deprivation) and the outcome variable (MI). Thereafter, collinearity diagnostics was performed to revise the correlations of selected variables within the model. Finally, unadjusted and adjusted logistic regression models were used to calculate odds ratios (OR) and 95% confidence intervals.

Results

The study included 387,585 adults (45.2% ≥60 years of age, 45.9% males, and 75.7% whites). Out of the sample, 30.6% slept <7h/day, 29.9% 7h/day and 39.5% >7h/day. The number of MI reported cases was 21,219 (5.5%). Compared to 7 h/day of sleep, both individuals with less and more time of sleep per day had an increase in the odds of MI (70% and 40%, respectively).

It can be seen that seven out of ten respondents who slept <7h/day were white. The age distribution of those sleeping < 7h was broadly distributed. Two thirds of the people who slept < 7h/day were above the normal weight range. More than half of those who reported sleeping <7h/day never smoked (Table 1.).

Table 1. Baseline characteristics of participants above 18 years of age in the 2020 BRFSS according to the number of hours of sleep per day (N=387,585).

Characteristics	Hours of sleep per day						p-value
	<7 h		7 h		>7 h		
	N	%	N	%	N	%	
Race - Ethnicity							<0.0001
White, NH*	83,944	70.8	92,433	79.7	117,080	76.6	
Black, NH	12,019	10.1	6038	5.2	10,826	7.1	
Asian, NH	3327	2.8	3230	2.9	3259	2.1	
AI/A, NH	2387	2.01	1460	1.3	2748	1.8	
Hispanic	11,490	9.7	9539	8.2	14,361	9.4	
Other, NH	5480	4.6	3287	2.8	4677	3.1	
Age (yrs)							<0.0001
18-29	14,219	11.9	13,647	11.8	18,232	11.9	
30-39	17,678	14.9	15,008	12.9	15,660	10.2	
40-49	18,414	15.5	16,358	14.1	16,806	10.9	
50-59	22,909	19.3	20,922	18.0	22,607	14.8	
60-69	23,717	19.9	24,892	21.5	32,950	21.5	
70-79	15,155	12.8	17,919	15.4	30,251	19.8	
80 and older	6555	5.5	7241	6.2	16,445	10.8	
Sex							<0.0001
Male	54,737	46.1	54,921	47.4	68,066	44.5	
Female	63,910	53.9	61,066	52.7	84,885	55.5	
BMI (kg/m2)							<0.0001
UW: <18.5	1886	1.8	1430	1.4	2423	1.7	
NW: 18.5 -25	28,853	26.8	33,855	31.9	44,444	32.2	
OW: 25.1-30	36,689	34.1	39,619	37.4	49,485	35.9	
Obese: >30	40,305	37.4	30,946	29.2	41,620	30.8	
Smoker							<0.0001
CS**-now smokes every day	16,299	14.4	7959	7.2	12,855	8.9	
CS**-now smokes some day	5546	4.9	3302	2.9	5021	3.5	
Former smoker	30,055	26.6	29,519	26.7	41,220	28.4	
Never smoked	60,972	54.1	69,947	63.2	85,820	59.2	
Alcohol							<0.0001
No	56,501	50.8	46,846	42.9	72,826	50.9	
1-3 times a month	35,474	31.9	39,968	36.6	42,394	29.7	
1-6 times a week	13,099	11.8	16,419	15.1	17,868	12.5	
At least once a day	6147	5.5	6061	5.6	9820	6.9	

* NH: Non-Hispanic. **CS: Current smoker

Table 1. It provides the baseline characteristics of the participants and the distribution of the values according to the 3 categories of hours of sleep per day.

The study found that people who sleep <7h/day have a 1.7 times higher risk of suffering from myocardial infarction (MI) compared to people that slept 7h/day; in addition, people who slept >7h/day had an increase of 1.4 in the odds of developing MI when compared to those who slept 7h/day. American Indians have a 1.2 times higher risk compared to the white race. Elderly patients aged 80 years and older have a 4.1 times higher risk of presenting MI compared to those aged 50 to 59 years. Females have a lower risk with a 0.5 decrease in the odds when compared to males. Obese individuals with a BMI greater than 30 have a 1.6 times higher risk compared to those with an adequate weight. People who smoke all or some days have a 2.7 times higher risk compared to those who have never smoked. On the other hand, those who have consumed alcohol have a 0.6 times lower risk compared to those who have not. In conclusion, the factors that most influence the risk of MI are age over 80 years, smoking, and insufficient sleep (Table 2).

Table 2. Unadjusted and adjusted odds ratios (OR) for the associations between hours of sleep per day / population characteristics and myocardial infarction.

Characteristics	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Hours of sleep		
Less than 7 h	1.7 (1.5-1.9)	1.7 (1.5-1.8)
7 h	Reference	Reference
More than 7 h	1.7 (1.5-1.8)	1.4 (1.3-1.5)
Race - Ethnicity		
White, NH	Reference	Reference
Black, NH	0.7 (0.7-0.8)	0.8 (0.7-0.9)
Asian, NH	0.3 (0.2-0.4)	0.7 (0.4-0.9)
AI/A, NH	1.2 (0.9-1.4)	1.2 (0.9-1.5)
Hispanic	0.6 (0.5-0.7)	1.0 (0.8-1.2)
Other, NH	0.8 (0.7-0.9)	1.0 (0.8-1.2)
Age (yrs)		
18-29	0.1 (0.1-0.2)	0.1 (0.1-0.2)
30-39	0.2 (0.2-0.3)	0.2 (0.2-0.3)
40-49	0.5 (0.4-0.6)	0.5 (0.4-0.6)
50-59	Reference	Reference
60-69	1.9 (1.7-2.1)	1.8 (1.6-2.0)
70-79	3.1 (2.8-3.4)	3.1 (2.8-3.5)
80 and older	3.7 (3.3-4.2)	4.1 (3.6-4.7)
Sex		
Male	Reference	Reference
Female	0.6 (0.5-0.6)	0.5 (0.45-0.53)
BMI (kg/m2)		
UW: <18.5	1.4 (1.1-1.9)	1.2 (0.9-1.7)
NW: 18.5 -25	Reference	Reference
OW: 25.1-30	1.5 (1.3-1.6)	1.2 (1.1-1.3)
Obese: >30	1.8 (1.6-1.9)	1.6 (1.4-1.7)
Smoker		
CS**- now smokes every day	2.7 (2.4-2.9)	2.7 (2.4-3.0)
CS**- now smokes some day	2.2 (1.9-2.5)	2.7 (2.3-3.2)
Former smoker	2.9 (2.8-3.6)	1.8 (1.7-1.9)
Never smoked	Reference	Reference
Alcohol		
No	Reference	Reference
1-3 times a month	0.5 (0.4-0.5)	0.6 (0.6-0.7)
1-6 times a week	0.5 (0.4-0.5)	0.5 (0.5-0.6)
At least once a day	0.9 (0.8-1.1)	0.6 (0.5-0.7)

* NH: Non-Hispanic. **CS: Current smoker

Table 2. It shows a comparison between independent variables (hours of sleep per day), the baseline characteristics of the population and the association between the outcome variable which was myocardial infarction adjusting the results to avoid bias.

Discussion

In this study, we investigated the possible association between myocardial infarction and hours of sleep. Our results suggest that there is an increased risk of having a MI among those adult US residents who sleep <7h/day. These findings are consistent with several studies worldwide, such as a retrospective study conducted with a total of 873 patients in Jiangsu Province, China from April 2019 to June 2020 showed a shorter sleep duration (<6 h) was associated with an increased risk of acute myocardial infarction (odds ratio [OR]=3, 95% confidence interval [CI]= (1.95-4.51), P<0.001). In agreement with that study, another longitudinal study including 52,599 participants

from Kailua, China from 2006 to 2010 demonstrated an association between sleep less than 5 hours per night and increased risk of first cardiovascular events (8,9,10). Thus, our results add weight to the scientific literature that addresses this issue and highlights the importance of adequate hours of sleep for better cardiovascular health.

A statistically significant relationship was found between prolonged sleep hours and increased risk of developing acute myocardial infarction in this study. The medical literature that addresses this behavior indicates that there are different pathophysiological pathways by which increased sleep hours affect cardiovascular health compared to sleep deprivation; however, the data from the present study are consistent with previous research (10).

It must be taken into account that this study shows an association, not a causal relationship, between myocardial infarction and hours of sleep; many confounding factors can affect both variables, which were assessed in the statistical analysis. However, the possibility of residual confounding exists which cannot be completely excluded, and further prospective studies with longer follow-up periods should be performed to confirm the results of the current literature.

Although this study has a valid scientific contribution, it is not free of limitations. First, the information on the hours of sleep was obtained through self-reported surveys and not an objective measurement through an instrument such as actigraphy and polysomnography, which lends itself to human error (9). In addition, our study was conducted in a specific population, which limits the generalizability of the results, and future studies that take into account different samples should be performed.

Despite the limitations, the results of this study could have an important clinical importance since they are consistent with the medical literature and emphasize the importance of sleep habits as a modifiable risk factor for the development of cardiovascular disease.

Conclusions

In contrast to individuals who reported obtaining a recommended 7 hours of sleep per night, our analysis revealed that those with either fewer or greater hours of sleep per day experienced an elevated likelihood of myocardial infarction (MI) by 70% and 40%, respectively. These findings align closely with the conclusions drawn from prior research studies in the field. Nevertheless, it is important to acknowledge certain potential limitations of this study.

One notable challenge lies in establishing the temporal sequence of the observed association. In other words, it remains difficult to definitively determine whether the variations in sleep duration precede the occurrence of MI or if MI itself influences sleep patterns. This inherent ambiguity in establishing causality underscores the need for further longitudinal investigations to better elucidate the dynamic relationship between sleep duration and the risk of MI. Additionally, the presence of residual confounding factors, unaccounted for in our analysis, may have exerted an influence on the observed odds ratios. These confounding variables could encompass a wide range of factors, including lifestyle behaviors, comorbidities, and genetic predispositions, which might not have been fully controlled for in our study. Therefore, while our findings provide valuable

insights into the association between sleep duration and MI risk, a comprehensive understanding of this relationship necessitates further research addressing these methodological limitations.

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