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Original Article

Effect of chronic non-communicable diseases (CNCDs) on the sleep of Brazilians during the COVID-19 pandemic



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ABSTRACT

This study aimed to investigate the effect of Chronic Noncommunicable Diseases (CNCDs) on the onset or increase in sleep problems during the COVID-19 pandemic period. The role of the report of sadness or nervousness during the pandemic was also evaluated as a mediator of this association. Data from a behavior survey during COVID-19, conducted in Brazil with 45,161 people (18 years old or older), from April 24 to May 24, 2020, were used. The outcome variable was the onset or increase in sleep problems, and the exposure variable was the presence of CNCDs. The adjusted Odds Ratio of the association between CNCDs and sleep was estimated, and a mediation analysis was performed to test the effect of the report of sadness or nervousness on this association, using the Karlson Holm Breen method. The increase in sleep problems was reported by 44.9% of the population, and 33.9% reported at least one CNCD. The chance of sleep problems was higher among people with diabetes (1.34; 1.05–1.71), hypertension (1.26; 1.06–1.50), and with coronary heart diseases (1.36; 1.13–1.65) or respiratory diseases (1.42; 1.04–1.93). Compared to people without CNCDs, individuals with at least one CNCD had a 36% greater chance of impaired sleep (1.36; 1.19–1.55). The report of sadness or nervousness explained 45.1% of the association between CNCD and sleep. Our findings alert us to care for the emotional state and sleep of chronic patients during the waves of the COVID-19 pandemic, and indicate the need for sleep monitoring in this population.

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1. Introduction

Good quality sleep is essential for the daily restoration of the body, acting significantly in the activities of the immune, metabolic, endocrine systems and anti-inflammatory actions [1,2]. Research has shown the association of chronic non-communicable diseases (CNCDs), such as hypertension, heart disease [3], and diabetes [4],

with a worst quality of sleep. Some of this evidence points to poor sleep as a predictor of diseases, especially cardiometabolic ones [4,5]. Chronic respiratory diseases have also been associated with poor sleep quality [6].

The pandemic of the new coronavirus (COVID-19) requires intensified care for the population with CNCDs, considering that these morbidities present a high risk for complications and mortality due to COVID-19 [7,8]. The topic of sleep also deserves attention regarding care with COVID-19, since bad sleep seems to increase the susceptibility to infection by the new coronavirus and worsen the event [9,10].

Studies have shown that the population's emotional health and sleep conditions deteriorated during the COVID-19 pandemic [11–13], possibly due to fear and uncertainty concerning the

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disease, feelings of mourning, changes in living conditions and health behaviors, and the various consequences of the social distancing sanitary measures [11,14–16]. These feelings and aggravations are added to the concerns of chronic patients, mainly fear of contracting the disease and insecurity regarding medical routines and the continuity of treatment [14]. To our knowledge, no study has assessed the impact of CNCDs on the quality of sleep of the Brazilian population during the COVID-19 pandemic, mainly by analyzing the role of emotional problems in this association.

In this sense, this study aimed to investigate the association between the presence of CNCDs and the onset or increase of sleep problems during the COVID-19 pandemic period; as well as to evaluate the role of the report of sadness or nervousness during the pandemic as a mediator of this association.

2. Methods

We used data from the “Brazilian behavioral research during the COVID-19 pandemic”, conducted by the Oswaldo Cruz Foundation (FIOCRUZ), in partnership with the Federal University of Minas Gerais (UFMG) and University of Campinas (UNICAMP). The analyzed data were collected from April 24 to May 24, 2020, through a virtual questionnaire. Information were collected on demographic and socioeconomic characteristics, changes in lifestyle, routine activities, mood, health status, and access to health services during the COVID-19 pandemic. The questionnaire was developed using the RedCap (Research Electronic Data Capture) application, which facilitates data collection and management. Respondents filled out the instrument using a smartphone or computer after accepting the informed consent form, and the respondent’s anonymity was ensured.

The sampling process was conducted by a “virtual snowball”. In the first wave, each researcher in the study chose 200 other researchers in the various Brazilian states and selected 20 people from their social network. These people (seeds) disseminated the questionnaire, triggering the network of participants. The seeds sent the questionnaire link to at least three people from their social networks in each of the strata of sex, age range, and education level. In the second wave, the people recruited by the seeds invited at least three other people to answer the questionnaire. The data were weighted based on the National Household Sample Survey (PNAD).

2.1. Outcome

The outcome variable of the study was the report of the increase in sleep problems among individuals complaining about these problems or the report of the onset of sleep problems during the pandemic. The question to assess this variable was: “*Did the pandemic affect the quality of your sleep?*”. The answers were: “(1) It didn’t affect anything, I still sleep well; (2) With the pandemic, I started having sleep problems; (3) I already had sleep problems and they continued in the same way; (4) I already had sleep problems and they got worse; (5) I already had sleep problems, but they decreased”. Categories 1, 3 and 5 were joined in (1) individuals who had no increase or onset of problems with sleep; and categories 2 and 4 were joined in (2) individuals who reported onset or increase in sleep problems.

2.2. Exposition

The exposure variables were the presence or absence of diabetes, hypertension, asthma/bronchitis/COPD, heart disease, and cancer. The question that generated these variables was: “*Has any doctor ever diagnosed you with any of these diseases? You can check more than one option*”. In addition to these, we constructed a

variable with information about the presence of at least one among the studied morbidities.

2.3. Mediators

The following questions were used: “*During the pandemic, how often did you feel sad, crestfallen, or depressed?*” for reports of feeling sad or depressed; “*In the period of the pandemic, how often did you feel worried, anxious, or nervous?*”, for reports of feeling anxious or nervous, with the response categories “*never, a few times, often, always*” to both questions. The questions were joined and formed the variable of report of sadness or nervousness during the pandemic (Yes for the answers “*often*” or “*always*”; and No for “*never*” or “*a few times*”).

2.4. Covariates

For the adjustments, the following covariates were used: report of previous depression (yes, no); sex (male, female); age group (18–29, 30 to 39, 40 to 49, 50 to 59, and 60 years or over); and per capita monthly income in minimum wages (MW) (up to half MW, half to one, one to two, two to four, and four or more).

2.5. Statistical analyses

The prevalence of the onset or increase in sleep problems was estimated according to the exposure variables. To guide the analysis model, a directed acyclic graph (DAG) (Fig. 1) was developed based on evidence of the impact of CNCDs on the emotional aspects and well-being of the population [17], the association of these morbidities with sleep [18], and the social and demographic inequalities involved in this relationship [19]. The DAG was also built considering the association between the variables according to the data available for the analyses of this study. Thus, we estimated: (1) crude and adjusted Odds Ratios (OR) by sex, age range, and per capita monthly income and 95% Confidence Intervals (CI), analyzing the association between exposure and outcome variables; (2) the OR and 95% CI of the association between the report of sadness or nervousness with the alteration in sleep and the presence of CNCDs; (3) the OR and 95% CI from the use of multiplicative interaction terms between the variables of sadness or nervousness with CNCDs, and previous depression with CNCDs, to assess the association with sleep. ORs were estimated using simple and multiple logistic regression, and the adjustments were guided by the association of covariables with both, exposure and outcome.

After identifying the non-existence of interaction between the variables, we used the Karlson Holm Breen method [20] to conduct the mediation analysis to test the influence of the report of sadness or nervousness in the association (see Fig. 2). This method was applied using logistic regression models (presenting ORs) and is used to decompose the total effect (the effect of the presence of CNCDs on the incidence or worsening of sleep problems, without considering feelings of sadness or nervousness) in direct effect (the effect of the presence of CNCDs on the incidence or worsening of sleep problems, considering feelings of sadness or nervousness) and indirect effect (the mediating effect). The method also estimates the percentage of explanation of the association by the mediator. For the adjustments, the variables sex, age range, and income were used. The analyses were conducted with STATA 15.0, considering the sample weights.

3. Results

The final sample consisted of 45,161 individuals aged 18 years old or older (mean age of 43.0; CI 95%:42.5–43.5) and women composed the most of sample. Older population had higher income

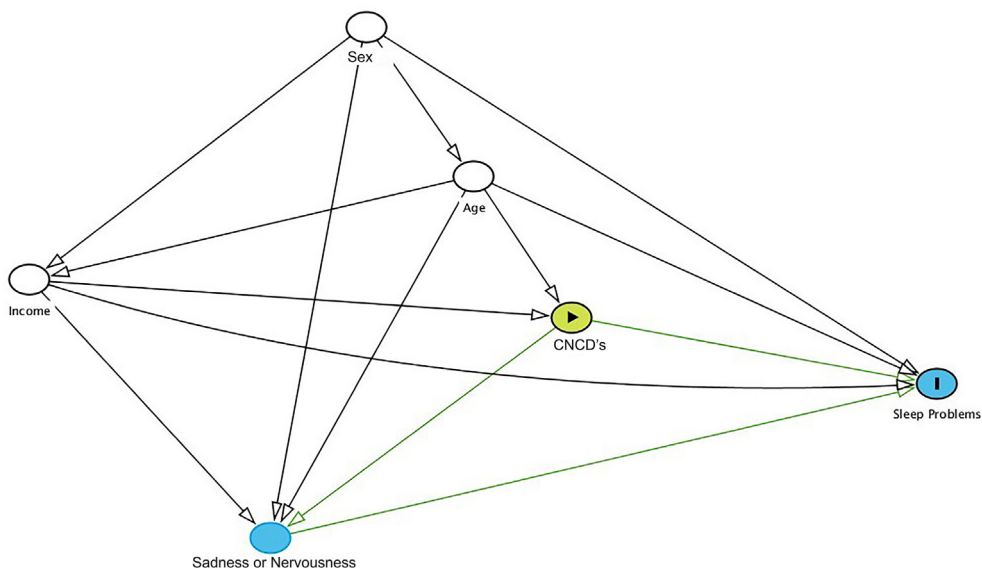


Fig. 1. Directed Acyclic Graph (DAG) used to present the theoretical model and to guide the statistical models.

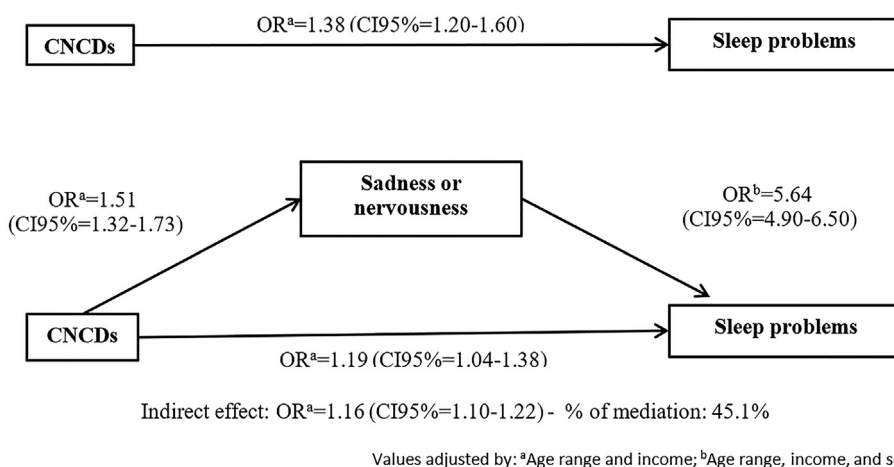


Fig. 2. Role of the reports of sadness or nervousness in the association between CNCDs and sleep disorders during the COVID-19 pandemic.

and greater occurrence of chronic conditions, but emotional and sleep problems during the pandemic was higher in younger individuals. A total of 33.9% (IC 95%:32.5–35.3) people reported having been diagnosed with at least one chronic disease; 45.1% (CI 95%:43.6–46.5) reported the onset or increase in sleep problems in the period; and 57% (CI 95%:55.5–58.4) reported feelings of sadness or nervousness (Table A.1).

Supplementary Table B.1 shows the association of socio-demographic variables with the onset or increase in sleep problems, feelings of sadness or nervousness, and presence of morbidities. These events were, respectively, 34%, 28%, and 32% higher in individuals with lower income. The worsening in sleep and emotional problems during the pandemic was greater in women and younger individuals, and CNCDs were strongly associated with increasing age.

In the crude analysis, the percentage of individuals who reported an incidence of sleep problems was higher in those with respiratory diseases (asthma/bronchitis/emphysema) compared to those who did not have these health events, and lower in those who reported some type of neoplasia. After adjustments, the chance of

onset or increase in sleep problems was greater in individuals with diabetes (OR = 1.34; 95% CI: 1.05–1.71), hypertension (OR = 1.26; 95% CI: 1.06–1.50), respiratory diseases (OR = 1.36; 95% CI: 1.13–1.65), and heart disease (OR = 1.42; 95% CI: 1.04–1.93), compared to those who do not have these diseases. The chance of exacerbating sleep problems was 36% higher in individuals with at least one of these diseases (OR = 1.36; 95% CI: 1.19–1.55), compared to the non-sick population (Table A.2). No significant interactions were observed between the variables of report of sadness or nervousness and CNCDs (OR = 0.88; 95% CI: 0.65–1.19) and previous depression with CNCDs (OR = 0.76; 95% CI: 0.54–1.07) in the association with sleep problems.

Fig. 2 shows the mediation model of the report of sadness or nervousness in the association between CNCDs and altered sleep during the pandemic. The presence of CNCDs was associated with a greater chance of worsening or onset of sleep problems (OR: 1.38; 95%CI: 1.20–1.60). In addition, the presence of at least one CNCD increased the chance of reporting sadness or nervousness by 51% (OR=1.51; 95%CI: 1.32–1.73). The inclusion of the report of sadness or nervousness in the final model partially mediated (45.1%) the

association between the presence of CNCD and worsening or onset of sleep problems.

4. Discussion

This study analyzed data from the Brazilian behavioral research during the COVID-19 pandemic, and sought to identify the effect of CNCDs on sleep problems during the pandemic period. The results showed that the presence of diabetes, hypertension, chronic respiratory disease, and coronary heart disease increased the chance of onset or increase in sleep problems during the COVID-19 pandemic. The chance of worsening sleep was greater in individuals who reported having at least one of these diseases. CNCDs also increased the chance of reports of sadness or nervousness during the pandemic, and these feelings were associated, with great magnitude, with the onset or increase in sleep problems. We also found that the effect of CNCDs on sleep problems was partially mediated by feelings of sadness or nervousness.

The findings of this research regarding sleep problems during the pandemic were lower than those found in Italy, which reached 57% prevalence of poor sleep quality, interviewing 2291 people through an online questionnaire [21].

Reports of emotional problems and sleep disruption or disturbances during the COVID-19 pandemic have been evident in several global regions [12,13,15,22,23]. Mourning feelings, social distance and isolation itself, loss of income, uncertainties concerning work, among other impasses, contribute to the emergence or worsening of emotional problems [11,24]. In addition, the population may be facing difficulties in dealing with healthy lifestyles, increasing levels of alcohol use, physical inactivity, and longer screen time [16,23].

Among individuals with CNCDs, the greater chance of emotional problems and sleep may also be explained by the stress arising from the fear of COVID-19 contagion, since, if it happens, the event may be aggravated in this population [7,8]. In Greece, 1106 people aged 18 and over were assessed by The 4-Dimensional Symptom Questionnaire (4DSQ), which analyzes depression, anxiety, distress, and somatization. The results showed higher levels of distress and somatization in patients with chronic diseases, compared to healthy individuals. Specifically assessing each morbidity, respiratory diseases were highly correlated with these two dimensions assessed with the instrument, while autoimmune diseases were associated with somatization. The authors concluded the need for extra care concerning respiratory diseases, since they have are associated with more than one dimension of emotional health [25].

Another condition that possibly increased the insecurity of chronic patients during the pandemic period was the limitation on the use of health services for the treatment of CNCDs. The limited use of services due to the attempt to reduce the spread of the new coronavirus, and also to the high demand to care for affected patients, seems to have introduced consequences in the worsening of CNCDs in Brazil. As an example, patients with diabetes adhered more to social distancing, stopped going to the doctor, and limited their outings to shop for fear of becoming ill and their case getting worse [26]. A study conducted to assess mortality by specified heart disease and by unspecified cardiac causes showed a decrease in the specified and an increase in the unspecified ones. The authors conclude that this increase may be due to deaths at home, a consequence of the difficulties faced regarding health systems [27]. According to a research conducted during the quarantine, consequent psychic manifestations could be responsible for myocardial instability in cardiac patients, during this period [28].

Our results showed that altered emotional states, particularly sadness, depression, nervousness, and anxiety, explained 45% of the chance of worse sleep quality in chronic patients, compared to

healthy individuals. Sleep is strongly correlated with emotional aspects and well-being [29–31].

A number of studies have analyzed mental health associated with poor sleep in the pandemic context. Studies performed in Italy found significant correlations between Post-Traumatic Stress Disorder (PTSD) related to COVID-19 and sleep disturbance, general distress and anxiety [21,24]. In a French and Greek population, factors related to COVID-19, such as worries and loneliness, were strong risk factors to insomnia [22,32]. In addition, a study performed in Italy found that the confinement at home directly impaired the sleep quality. COVID-19 related aspect and the confinement at home also affected the participants' psychological condition. The finds confirmed a mediator role of psychological distress, PTSD symptoms, and psychological symptoms on self-reported sleep quality. In this study, anxiety it does not appear to play a modulator role in sleep quality, which may due to the weight assumed by other psychological variables such as distress or PTSD symptoms COVID-19 related [33].

According to these evidences, a strong relationship can be observed between the aspects related to COVID-19 pandemic and emotional health, which have impaired sleep quality and increased sleep disturbances.

On the other hand, the total relationship of worsening sleep due to CNCDs may have some explanations. Fear is one of them and perhaps the main one, since it is a factor present in chronic patients in the COVID-19 period, which can be a trigger of stress and, thus, generate losses in sleep quality [23,34]. This research was conducted at the beginning of the social distancing measures in Brazil, when daily domestic tasks were intensified, and there is evidence that high demands and greater physical effort at work can trigger sleep disturbances [34]. It is possible that these tasks require more effort in chronic patients, as a result of the disabilities generated by these morbidities.

Research prior to the pandemic points out the strong relationship between chronic diseases and sleep disorders. The justifications, based on follow-up studies and with biological bases, seem to explain sleep deprivation and disturbances leading to the development of metabolic and vascular diseases [2,4,5,34]. Regarding chronic respiratory diseases, however, evidence has shown that these morbidities seem to have a strong effect on sleep quality, due, among other causes, to nocturnal hypoxemia and to the presence of cough and sputum [6].

The results of our study warn that chronic patients are part of a group that tend to have aggravated sleep problems in adverse situations, particularly in the period of social distancing due to the pandemic of the new coronavirus, compared to the non-sick population. The vulnerability to complications and mortality by COVID-19 in the presence of cardiac, vascular, metabolic, and respiratory diseases is high. In addition, the population affected by these diseases is at a loss in terms of emotional aspects and quality of sleep, which can also increase susceptibility to complications of infection. In this sense, sleep care for chronic patients deserves attention during the epidemic waves of COVID-19. The need for clinical control and scientific studies to monitor sleep problems in this population during and after the pandemic is emphasized. It is also worth paying attention to the monitoring and treatment of the emotional problems of the population affected by CNCDs, which may, in part, minimize the effects of the pandemic on sleep issues.

4.1. Limitations and strengths

It is necessary to consider some limitations of the study. First, this study presented a cross-sectional design, with retrospective data, and causality needs to be treated with caution. For the analysis of sleep disorders, we used a single question, but it is a report of

sleep quality alteration. Self-reported sleep is strongly associated with sleep complaints [35], and other studies have used unique, self-reported questions to analyze sleep quality [35,36]. It is worth noting the difficulty of using standardized instruments in surveys conducted via internet, which can increase the response time and decrease adherence to the survey. Another limitation is that the question of sleep uses a comparison, of individuals about their own sleep, in the period before and after the pandemic, with the possibility of memory bias, although the recall period is short. We also highlight the underrepresentation of people without access to the internet. This limitation, however, was minimized due to the large sample size and the sample calibration. Another issue concerns the fact that the results of the study refer to the beginning of the period of social distancing and may be different in other periods.

On the other hand, our study covers a large sample of 45,161 people interviewed, with calibration and weights based on PNAD, providing information on the Brazilian adult population and knowledge about the effect of CNCDS on sleep and emotional problems. Studies on this topic are scarce in low or middle income countries.

5. Conclusions

The report of the increase in sleep problems during social distancing measures was high, reaching 45.1% of Brazilians. The results of this study showed that diabetes, hypertension, heart and chronic respiratory diseases increased the chance of onset or increase in sleep problems in the Brazilian population in the period studied. We also found that emotional problems, such as sadness and feelings of nervousness and concern, explained part of the association between the presence of CNCDS and increased sleep problems. These findings alert to the care with the emotional state and, above all, with the sleep of chronic patients in adverse situations, particularly as a result of the COVID-19 pandemic, and indicate the need for sleep monitoring in this population.

Ethics statement

This project was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans and was approved by the FIOCRUZ Ethics Committee and by the National Research Ethics Committee (CONEP) under opinion no. 3,980,277, CAAE, 30598320.10000.5241. Informed consent was obtained from all participants.

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Authors' contribution

MGL: study conception and design, data analysis and interpretation, writing of the manuscript; DCM: study conception and design, data interpretation, writing of the manuscript; MBAB, AOW, DBOS, CLS, CSG, GND, WSA: data interpretation, writing and critical review of the intellectual content of the manuscript. All authors

approved the final version to be published and are responsible for the entirety of the study.

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Conflict of interest

The authors declare no conflict of interest.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: <https://doi.org/10.1016/j.sleep.2021.02.052>.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.sleep.2021.02.052>.

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