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Impacts of mental health in the sleep pattern of healthcare professionals during the COVID-19 pandemic in Brazil

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ABSTRACT

Background: After >2 years of the Coronavirus Disease-19 (COVID-19) pandemic, it is well established how sleep symptoms are rising, especially among healthcare workers (HCW). The aim of this study is to evaluate what features are associated with sleep disturbances in the HCW population.

Methods: Cross-sectional and longitudinal analysis of social and clinical variables associated with sleep problems and insomnia incidence in HCW in a large, national-level cohort. The measurement of sleep problems was assessed by self-report using Jenkins Sleep Scale (JSS). A multivariate analysis was used in the cross-sectional design and generalized linear models were used in the longitudinal design.

Results: 10,467 HCW were analyzed in the cross-sectional analysis, 3313 participants were analyzed in the three timepoints of the study. Sex, previously diagnosed mental illness and frontline work with COVID-19 were associated with higher scores in JSS in the univariate analysis. In the multivariate analysis, only previous diagnosis of mental illness was related with sleep difficulties, especially previously diagnosed insomnia. The longitudinal analysis concluded that previous diagnosis of mental illnesses was associated with higher levels of insomnia development (OR = 11.62). The self-reported disorders found to be major risk factors were addiction (OR = 7.69), generalized anxiety disorder (OR = 3.67), social anxiety (OR = 2.21) and bipolar disorder (OR = 2.21).

Limitations: Attrition bias.

Conclusions: Previous diagnosis of mental illness was strongly related to insomnia development in HCW during the COVID-19 pandemic. Strategies that focus on this population are advised.

1. Introduction

Sleep disorders are common psychiatric conditions, associated with considerable health and economic burden. Insomnia, the most common of them, is associated with a significant loss of quality-adjusted life years, more than other diseases such as arthritis, depression, and hypertension (Olfson et al., 2018). It is considered that direct and indirect costs associated with insomnia exceed >1 billion dollars annually in the

Abbreviations: ADHD, attention-deficit hyperactivity disorder; ANOVA, Analysis of Variance; BSI, Brief Symptoms Inventory; CFI, comparative fit index; COVID-19, Coronavirus Disease-19; GAD, generalized anxiety disorder; GSI, Global Severity Index; HCW, healthcare workers; JSS, Jenkins Sleep Scale; MERS-CoV, Middle-East Respiratory Syndrome Coronavirus; OR, odds ratio; PTSD, post-traumatic stress disorder; RMSEA, root mean square error of approximation; SARS-CoV-1, Severe Acute Respiratory Syndrome Coronavirus-1; SD, standard deviation; SRMR, standardized root mean square residual; TLI, Tucker-Lewis index.

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United States (Wickwire et al., 2016), presumably due to its high incidence: approximately 1 among 4 American individuals develop insomnia yearly, as reported by Olfson et al. (2018).

There is a well-established relationship between sleep disturbances and acute stressors, especially those related to work (Hansen et al., 2021; Jiang et al., 2021; Scovelle et al., 2021). Not only do daily stressors influence sleep quality, but the reverse causal relationship is also reported in the literature, with higher sleep quality leading to positive mood effects (Blaxton et al., 2017). This cyclic relationship may play a major role in the pathophysiology of sleep disturbances, as well as other psychological disorders.

Indeed, in a pathological context, sleep diseases seem to be commonly comorbid to other psychiatric conditions. Some researchers have already been trying to explore a possible relationship between insomnia and mental disorders, such as different types of anxiety, post-traumatic stress disorder (PSTD), mood disorders, attention-deficit/hyperactivity disorder (ADHD), and others (Gould et al., 2017; Mantua et al., 2018; Tong et al., 2018).

It is a relative consensus that the Coronavirus-19 disease (COVID-19) pandemic has provoked significant changes in the population’s lifestyle, on a global scale. The completely unexpected stressors related to COVID-19 may be, therefore, a major contributor to both sleep disturbances and psychological distress. 2 years after the formal declaration of COVID-19 as a pandemic, data is becoming available about the short- and long-term effects of the Coronavirus-Disease 19 (COVID-19) in mental health (Chen et al., 2021). The stressors commonly related with the pandemic involve social isolation, fear of death, bereavement, and direct impact of COVID-19 infection in psychiatric symptoms (Jin et al., 2021; Joaquim et al., 2021; Pérez-Mengué et al., 2021; de Sousa Moreira et al., 2021; Rogers et al., 2020).

Due to the intimate relationship between acute stressors and sleep disturbances, it is reasonable to consider that a unique scenario such as the pandemic would affect both symptoms and diagnoses related to sleep. In previous viral outbreaks, such as the Severe Acute Respiratory Syndrome Coronavirus-1 (SARS-CoV-1, 2002) and the Middle-East Respiratory Syndrome Coronavirus (MERS-CoV, 2012), the risks of psychological distress were already described (Maunder et al., 2003; Hawryluck et al., 2004; Mok et al., 2005; Almutairi et al., 2018). Until date, it has been reported that insomnia diagnoses were rising during the COVID-19 pandemic, as observed in Greece and China (Voitsidis et al., 2020; Li et al., 2020).

Previous large meta-analyses have already pointed out that healthcare workers (HCW) were at higher risk of insomnia than the general population (Pappa et al., 2020; Cénat et al., 2021). Two large studies evaluated sleep symptoms in HCW in Turkey during the COVID-19 pandemic, finding a prevalence of over 50% of poor sleep quality among HCW (Şahin et al., 2020; Yılmaz et al., 2021). In these studies, the main risk factors for sleep disturbances in Turkish HCW were sex, education, length of professional experience, working with inpatient care or in frontline against COVID-19, and being a nurse. However, there is a lack of information about how Brazilian HCW are affected and, among them, who is at an even higher risk of insomnia development. Therefore, despite knowing that the sleep of HCW was more affected during the pandemic, the risk features and the strategies that can be made to reduce this burden remains unclear.

The purpose of this study is to analyze the risk factors associated with poor sleep and insomnia development during the COVID-19 pandemic in a large cohort of Brazilian HCW, altogether with clinical and psychiatric covariates that may be related to a higher risk of insomnia development.

2. Participants and methods

This research is part of the project “Influência da COVID-19 na Saúde Mental da população brasileira e de seus profissionais de saúde” (Influence of COVID-19 on the Mental Health of the Brazilian population and its health professionals), which was approved by the National Research Ethics Commission in May 2020 (Registration Number: 30.823.620.6.0000.5149). It follows the principles of the Declaration of Helsinki (1989).

As already described in previous papers, the project has as one of its main goals to evaluate a) physical health status; b) COVID-19 diagnosis and contact history; c) perceptions and concerns related to COVID-19.
fulfill the digital research. Ministry of Health of Brazil received an invitation to participate and contact if the patient worked or not as a frontline professional against COVID-19 incidence and sociodemographic data. The contact was made using the e-mail address registered in the Ministry of Health of Brazil. The patients were advised that the participation was voluntary, and that no incentive would be provided to the participants. They were also informed that the survey would take about 25 min to be completed and that it was composed of 13 pages.

The patients who did not consent to participate in the research, those under 18 years old and those who self-reported neurological diseases (epilepsy, seizures, brain tumors, hydrocephalus, agenesis of the corpus callosum, etc.) with a declared impact on cognitive capacity were excluded from the study. Only patients who consented to participate in the research and those 18 years old or over were allowed to proceed with the questionnaire.

Those with incomplete questionnaires (defined as >20 % of missing data) were not included in the statistical analysis. For the purposes of this study, patients with recent hospitalization and thyroid diseases were also excluded due to possible impacts on sleep.

2.2. Methods

The questionnaire of this study was made using the SurveyMonkey platform (Survey-Monkey, Palo Alto, California, www.surveymonkey.com), which implements data security protocols in compliance with the rules established by the Health Insurance Portability and Accountability Act for the business plan, which was used in this study. The data was pre-processed to remove any information that allows the identification of the participants and stored in a private cloud folder created in OneDrive, which was available only to the registered members of the project.

The questionnaire had been tested by the researchers to evaluate its usability and technical functionality. In the first pages of the questionnaire, they answered an informed consent that stated the approximate length of time of the survey, who were the investigators responsible for the study and which data would be stored. The survey was not open and only the target population was given access to it. In any question, the patient could leave a blank answer and he/she could use a “back” button to revise a specific question before submitting the questionnaire. Each patient could answer the survey only once. Cookies were used to identify possible duplicate answers from the same patient. If any duplicate was found, the less complete one was deleted from the dataset.

To avoid attrition bias in the cross-sectional and longitudinal analyses of this study, only the patients that answered both the first and the second survey were included in the cross-sectional analysis (which, however, was performed using only the answers of the first survey).

2.3. Instruments

The questionnaire was composed by anonymous questions that asked about the covariates included in the study, including sex, gender, age, type of work, psychiatric background, educational degree, marital status and 2 specific instruments, the Jenkins Sleep Scale (JSS) (Jenkins et al., 1988) and the Brief Symptoms Inventory (BSI) (Derogatis, 1982).

In the cross-sectional analysis, the primary outcome was to evaluate whether the covariates included in the questionnaire influenced the sleep pattern of the patients. It was measured by the JSS, which varies from 0 to 6. JSS consists of 4 questions, each approaching how often the respondent felt different sleep symptoms, resulting in larger scores for increased sleep distress. It was validated for the Portuguese language in 2014 (Reis et al., 2014).

The BSI was used both in the cross-sectional and longitudinal analyses. It is a 53-item self-report inventory designed to assess psychological distress and psychopathological symptoms across nine dimensions (Somatization, Obsessive-Compulsion, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, Psychoticism) and a Global Severity Index (GSI), which represents the sum of all the other items. Each dimension is quantified via a Likert scale from 0 to 4, ranging from ‘not at all’ to ‘extremely’. It is designed for a
minimum age of 13 years, comprehending the target audience of this study, and its internal structure was verified for the Brazilian population during the COVID-19 pandemic (Serpa et al., 2021).

2.4. Statistical analysis

All quantitative data was tested for normality with the Shapiro-Francia test. In the descriptive analysis, normally distributed data were presented as mean (standard deviation) and non-normally distributed data were presented as median (25th percentile–75th percentile).

In the cross-sectional arm of the study, the covariates with only two answers were analyzed using one-tailed Student’s t-test. The covariates with three or more answers were analyzed with Analysis of Variance (ANOVA). The analysis of correlation between quantitative covariates was made using linear regression. α-Value was fixed as 0.05 for the univariate analysis and 0.025 for the multivariate analysis. Pearson’s R² value was used to determine correlation in linear regression, with a threshold of 0.5.

The longitudinal analysis was performed using a mixed effects logistic regression. The predicted variable was the presence or absence of insomnia according to the JSS classification at the second data collection timepoint. Sex, whether has previous mental disorder condition, being a COVID-19 frontline health professional, occupation, and the interval between the two data collections for each individual were the predictors. Random effects were tested for occupation and the data collection interval. A second model was tested, where the previous mental disorder condition variable was changed by each kind of mental disorder. All the mental disorders were tested in the same model because some participants reported several conditions.

In the end, a cross-lagged panel model was designed to investigate the longitudinal effect between insomnia and global psychological distress across the timepoints. The model fit will be evaluated considering the recommendations of Kline (Kline, 2015), considering an acceptable model fit when comparative fit index (CFI) > 0.930, Tucker-Lewis index (TLI) > 0.900, root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR) < 0.08. If the model reached an acceptable fit, the standardized regression estimates were interpreted in terms of effect sizes. Standardized β equal or >0.10, 0.20 and 0.30 were considered small, typical and large, according to Gignac and Szodorai (2016). All the analyses were performed on R software (R: A Language and Environment for Statistical Computing, Vienna, Australia. Available in https://www.r-project.org/), using lmerTest (Kuznetsova et al., 2017), lme4 (Bates et al., 2015), emmeans (Lenth, 2022), lavaan (Rosseel, 2012), semPlot (Epskamp, 2022) and jtools (Long, 2020).

2.5. Timing of data collection

The data collection for the longitudinal analysis was performed in three different periods: the first one was from 05/09/20 to 06/07/20,
sectional studies39, and the CHERRIE checklist for online questionnaires (von Elm et al., 2008; Eysenbach, 2004).

STROBE checklist for cohort studies, the STROBE checklist for cross-inhabitants, a graph adapted from Our World in Data (Ritchie et al., 2020).

points) accompanied by the daily number of deaths per million Brazilian inhabitants, a graph adapted from Our World in Data (Ritchie et al., 2020).

the second from 11/23/20 to 01/29/21 and the third one from 05/11/21 to 08/12/21. Fig. 1 illustrates the periods of data collection (timepoints). Age was excluded in the multivariate analysis due to its low Pearson’s R² value of 0.01 (p < 0.001). The results of correlation between BSI and JSS scores are summarized in Table 2.

3.2. Longitudinal analysis

The covariates included in the longitudinal analysis were sex, previously diagnosed mental illness, direct association with healthcare and frontline work against COVID-19. As Fig. 1 implicitly shows, the intervals among data collection varied per each individual; therefore, these intervals also became a new covariate (ΔT), due to its possible influence on insomnia development.

The first model of the multivariate analysis compared the first and second periods of data collection. The results of the generalized linear model are shown in Table 3 and the Odds Ratios for all the covariates analyzed are illustrated in Fig. 3. ΔT was found to have no influence on insomnia development, so it was excluded in further analyses. In addition, the random effects for both occupation and ΔT were not statistically significant.

As only previously mental illnesses were associated with insomnia development (OR = 11.62 [8.83–15.29]), a second model was performed, stratifying the previous diagnoses collected in the first survey: Generalized Anxiety Disorder (GAD, n = 1869), depression (n = 1835), social anxiety (n = 310), eating disorder (n = 199), PTSD (n = 169), ADHD (n = 165), bipolar disorder (n = 161), postpartum depression (n = 135), premenstrual dysphoric disorder (n = 109), addiction (n = 31), learning specific disorder (n = 15), conduct disorder (n = 10), autism (n = 9), and schizophrenia (n = 9).

The results of the second generalized linear model are described in Table 3 and illustrated in Fig. 4. The mental illnesses associated with insomnia development were addiction (OR = 7.74 [1.68–35.62]), GAD (OR = 3.67 [2.79–4.81]), depression (OR = 3.37 [2.56–4.44]), premenstrual MDD (OR = 1.35 [0.61–2.99]), Postpartum depression (OR = 0.44 [0.16–1.19]), Learning specific disorder (OR = 8.32 [0.84–82.49]), Autism (OR = 278,605.62 [0.00, 7,37E+281]), Schizophrenia (OR = 0.09 [0.00, 4.22]), PTSD (OR = 1.62 [0.81, 3.22]), and BIC (OR = 2051.59 [6178.3–6.1E+29]).

Table 3
Summary of mixed effects logistic regression for models 1 and 2.

| Covariates                                | Model 1 OR (95% CI) | p-Value | Model 2 OR (95% CI) | p-Value |
|-------------------------------------------|---------------------|---------|---------------------|---------|
| T                                         | 1.00 (0.99, 1.01)   | 0.98    | 1.00 (0.99, 1.01)   | 0.86    |
| Male                                      | 0.80 (0.53, 1.19)   | 0.27    | 0.75 (0.49, 1.13)   | 0.17    |
| Non-health occupation                     | 1.05 (0.72, 1.54)   | 0.79    | 1.07 (0.72, 1.58)   | 0.75    |
| Health occupation                         | 1.07 (0.77, 1.49)   | 0.69    | 1.08 (0.77, 1.53)   | 0.66    |
| Covid19 frontline health professional     | 1.18 (0.91, 1.53)   | 0.21    | 1.20 (0.92, 1.57)   | 0.18    |
| Mental disorder                           | 11.61*** (8.83, 15.28) | <0.001  |                     |         |

ADHD: attention-deficit/hyperactivity disorder; MDD: major depressive disorder; PTSD: post-traumatic stress disorder; AIC; BIC.

*** p < 0.001.
** p < 0.01.
* p < 0.05.

the second from 11/23/20 to 01/29/21 and the third one from 05/11/21 to 08/12/21. Fig. 1 illustrates the periods of data collection (timepoints) accompanied by the daily number of deaths per million Brazilian inhabitants, a graph adapted from Our World in Data (Ritchie et al., 2020).

2.6. Standardisation of report

The report of the results in this study was developed following the STROBE checklist for cohort studies, the STROBE checklist for cross-sectional studies39, and the CHERRIE checklist for online questionnaires (von Elm et al., 2008; Eysenbach, 2004).

3. Results

3.1. Cross-sectional analysis

The first survey reached a total of 223,867 participants. Those who did not consent to participate in the research (n = 18,276) and those under 18 years old (n = 18,276) were excluded at the first moment. As only previously mental illnesses were associated with insomnia development (OR = 11.62 [8.83–15.29]), a second model was performed, stratifying the previous diagnoses collected in the first survey: Generalized Anxiety Disorder (GAD, n = 1869), depression (n = 1835), social anxiety (n = 310), eating disorder (n = 199), PTSD (n = 169), ADHD (n = 165), bipolar disorder (n = 161), postpartum depression (n = 135), premenstrual dysphoric disorder (n = 109), addiction (n = 31), learning specific disorder (n = 15), conduct disorder (n = 10), autism (n = 9), and schizophrenia (n = 9).

The results of the second generalized linear model are described in Table 3 and illustrated in Fig. 4. The mental illnesses associated with insomnia development were addiction (OR = 7.74 [1.68–35.62]), GAD (OR = 3.67 [2.79–4.82]), depression (OR = 3.37 [2.56–4.44]), ADHD (OR = 2.35 [1.14–4.86]), social anxiety (OR = 2.21 [1.34–3.64]), and bipolar disorder (OR = 2.21 [1.15–4.27]). Between the first and second timepoints of data collection, 878 patients (9.07 % of the initial non-

ADHD: attention-deficit/hyperactivity disorder; MDD: major depressive disorder; PTSD: post-traumatic stress disorder; AIC; BIC.

*** p < 0.001.
** p < 0.01.
* p < 0.05.
insomniac sample) reported a new diagnosis of insomnia. 698 (79.5 %) of them had reported a previous diagnosis of mental illness in the first survey.

3313 eligible patients answered the third survey, which showed 73 new cases of insomnia (2.20 %). No association was found between previous diagnosis of mental illnesses and development of insomnia in the analysis of the sample that reached the third timepoint. Fig. 5 illustrates the JSS Score mean of four different groups of analysis, which found no statistical difference neither among inter-group scores in the same timepoint nor longitudinally for any group. Unreliable answers (e.g., individuals who reported previous diagnosis of insomnia in timepoint 1 but no previous diagnosis of insomnia in timepoint 2) were excluded from this analysis (n = 633, 19.1 %).

The model used to test the cross-influence between the GSI index of BSI and insomnia development reached a good fit (CFI = 0.982, TLI = 0.931, RMSEA = 0.073 95 % CI [0.058–0.089], SRMR = 0.053) and all the regressions coefficients were significant (Fig. 6). Nevertheless, 3 out 4 effects were close to the boundary of no to small effects. The effect of insomnia diagnosis in timepoint 2 on BSI score in timepoint 3 was the only exception, considered of small size. Most of the effects on a variable from the subsequent timepoint are due to its own state at the current timepoint. The general correlations between GSI scores and insomnia diagnosis are small, varying from 0.21 (timepoints 1 and 3) to 0.32 (timepoint 2) (Fig. 6).
4. Discussion

In this study, the sleep pattern of Brazilian HCW was measured and associated with many covariates in a large cohort. It is noteworthy that sleep disturbances in HCW have already been observed in previous pandemics, such as the ones related to SARS-CoV-1 and MERS-CoV (Almutairi et al., 2018; Voitsidis et al., 2020). Even now, meta-analyses have observed the increase in sleep disorders (Pappa et al., 2020; Cénat et al., 2021). Previous studies have already found risk factors for poor sleep symptoms in Turkish HCW, especially related to sex, education, professional experience, working with inpatient care or in frontline against COVID-19, and being a nurse.

This study adds to previous data because it focuses on a large cohort of high risk Brazilian professionals for sleep disorders during a stressful period of two years in the COVID-19 pandemic, which were proven to be at even higher risk of sleep disturbances.

As expected, previous diagnosis of insomnia was the largest predictor of poor sleep patterns, while other clinical covariates (such as education and marital status) were found to have no correlation with them. Although covariates such as sex and professional characteristics were correlated with differences in JSS scores in the cross-sectional analysis, only previous mental illness was associated with a higher risk of insomnia development during the pandemic. This offers a contrast with previous data, especially in Turkey, which found these covariates to be strongly related to poor quality of sleep. This difference may be explained by differences in population and evaluation of psychiatric comorbidities, which, in the longitudinal arm of this study, had a higher impact in sleep quality. It is noteworthy that the results of the cross-sectional arm of this study are very similar to previous data on risk factors for sleep disturbances in HCW.

For a satisfactory critical analysis of the results of this study, it is important to differentiate the continuous sleep pattern measure (the JSS score) from the categorical covariate (insomnia development). First, there was a high percentage of unreliable answers (almost 20%), which
could be explained by transient insomnia in this sample of HCW. About the JSS scores, they did not significantly vary across time in all groups of recently diagnosed insomnia. It was able to infer specific time periods of insomnia diagnosis in the longitudinal analysis by observing the shift in the answers for the question “have you already been diagnosed with insomnia?” among timepoints. Despite the lack of correlation between JSS score means and recent insomnia diagnosis, the cross-sectional analysis showed a precise correspondence of previous insomnia diagnosis and sleep problems. This may lead to the conclusion that, in the long-term, patients with a formal diagnosis of insomnia are more prone to sustain high levels of sleep problems as expected. Further evaluation is needed to conclude if JSS scores tend to rise in the long-term follow-up of HCW with the diagnosis of insomnia.

In the longitudinal analysis, the only risk factor found for insomnia development in HCW was the previous diagnosis of a mental illness — especially addiction, ADHD and anxiety and mood disorders. Age, gender, education, and marital status were not important risk factors in this cohort. These results are correspondent to previous studies that have related sleep disturbances with other psychiatric illnesses (Mantua et al., 2018; Tong et al., 2018). After discrimination of different previous mental illness diagnosis, it was found that individuals with addiction were at a larger risk of insomnia development, followed by those with...
GAD, social anxiety, bipolar disorder, ADHD, and depression. Considering the stressful characteristics of the moment and the disruption in the health and specifically psychiatric care, it is reasonable to assume a possibility of symptoms worsening of the previously diagnosed psychiatric disorder. The predominance of anxiety and mood disorders in the list of comorbidities may indicate an overlap of pathogenesis between them and insomnia, although a causal relationship remains largely unclear. Despite previous diagnosis of addiction being the most important risk factor for insomnia development, this study prospects but did not detail the substance of addiction.

Years before, it was known that HCW were more prone to these disturbances, but there was scarce data about the specific risk factors that could lead to a formal diagnosis of insomnia. In this study, while age, gender, marital status, and education do not seem to be related with insomnia, there was a clear distinction between the HCW with previous diagnosis of mental illnesses and the ones without it. Understanding these results can help us to guide our efforts toward populations with higher risk of insomnia development, and to prepare ourselves for possible future outbreaks.

4.1. Limitations

This study has limitations, including a high level of attrition bias. The subjects were included via professional entries of the Ministry of Health of Brazil invitees, which limits its generalizability in other countries and in non-HCW patients. However, it also has strong qualities, such as conformity with CHERRIES checklist for online questionnaires, a high number of respondents, strict statistical analysis, and a national level of divulgation by official institutions.

Among the strengths, the results of this study help to elucidate the most important risk factors in HCW during the COVID-19 pandemic for insomnia development, which was the strongest predictor of poor sleep in its cross-sectional analysis. They help to understand how this population, which is known to be at a higher risk of insomnia, can have a risk stratification that directs efforts toward the prevention and early treatment of sleep disturbances. Further investigation of the probable delay in medical seek among HCW is advised, as well as a deeper study on the effects of substance addiction on sleep among HCW.

5. Conclusion

The COVID-19 pandemic is known to be related with a higher incidence of sleep disturbances, especially in HCW. In this study, it was found that previous insomnia diagnosis is the covariate most closely associated with sleep problems, and previous mental health illnesses were the major risk factors for insomnia development in HCW during the COVID-19 pandemics. Further investigation of mental health symptoms and long-term effects of insomnia in this population is advised.

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CRediT authorship contribution statement

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Conflict of interest

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