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THE SLEEP QUALITY COST OF WORK-RELATED SOCIAL RESTRICTION POLICY AMIDST COVID-19 PANDEMIC

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ABSTRACT

Background: The COVID-19 pandemic-related social restriction policy has a spillover effect on sleep quality. Sleep quality worsened after the social restriction policy was implemented, followed by an improved sleep quality longitudinal trajectory. Previous studies have focused on the pre-pandemic and post-implementation impacts of social restrictions on sleep quality, but not after social restrictions were lifted. **Objective:** Evaluate the sleep quality after the ease of the COVID-19 pandemic-related social restriction policy. **Methods*:*** We recruited voluntary academic staff who lived in Indonesia, had no leave during the work from home (WFH) period, and were non-shift workers to participate in the study. We administered the Pittsburgh Sleep Quality Index (PSQI), Sleep Hygiene Index, Connor-Davidson Resilience Scale, Reduced Morning-Eveningness, and micro-Munich Chronotype Questionnaires. We additionally attempted to get the subject to recall their sleep quality one year after the pandemic. The repeated measure of sleep quality was analyzed using a linear mixed-effect model, and the determinant factors of sleep quality in the WFO period were analyzed using a linear model. **Results:** A total of 52 academic staff participated in this study. We found non-significant overall PSQI score increments between the two periods ($\beta = 0.20$, p-value > 0.05). In addition, we found heterogeneity in sleep quality trajectories among subjects. On the other hand, sleep hygiene, individual resilience, and marital status significantly impact sleep quality among academic staff in the WFO period. **Conclusion:** There was no difference in sleep quality between the two time periods. The study highlighted the significant influence of sleep hygiene, resilience, and marital status on sleep quality among academic staff during the WFO period.

INTRODUCTION

Indonesia detected the first coronavirus disease 2019 (COVID-19) case in early March 2020.[1] Six weeks later, COVID-19 cases have been identified in all provinces in Indonesia.[2] The Indonesian government imposed social restriction measures to curb the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Indonesia, especially after the World Health Organization (WHO) declared the COVID-19 pandemic.[3,4] These restrictive measures disrupt and coerce people into doing activities from home, such as studying, working, and performing worship.[5] The pandora's box of the COVID-19 pandemic has been opened.

Implementing work-from-home (WFH) policies during the COVID-19 pandemic had many adverse spillover effects on physical health, mental health, and daily functioning. A systematic review study indicated that WFH during the COVID-19 pandemic resulted in decreased physical activity, increased fast food consumption, increased body weight, musculoskeletal pain, headaches, and fatigue.[6] The same study also suggested that WFH during the COVID-19 pandemic resulted in increased anxiety,

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stress, and depression.[6] Other studies also indicated that WFH during the pandemic increased work-family conflict, work over flexibility, and decreased job satisfaction.[7] The findings of the previous studies may be heterogenous from one study to another, with most review studies attempting to explore all possible externalities.[8] Despite the heterogeneity, monitoring and evaluating adverse spillover effects of social restriction policy on workers, i.e., WFH, is necessary to formulate sustainable policies.[9]

Sleep quality is a comprehensive proxy for monitoring and evaluating the impact of WFH policy during the COVID-19 pandemic. Sleep quality can be a proxy for physical health, mental health, and daily functioning.[10] The relationship between sleep quality and physical and mental health, and daily functioning can also be reciprocal.[11] Sleep quality also contains comprehensive sleep parameters, including sleep duration.[12,13] Sleep quality can be used as an outcome variable for monitoring the externalities of WFH policy during the COVID-19 pandemic.

Several previous studies have evaluated the impact of social restriction measures on sleep quality at various times. A previous study indicated worsened sleep quality in the early period after implementing the social restriction policy.[14] Another study with a longer time frame demonstrated that sleep quality decreased at the beginning of the pandemic and improved over time.[15] Other studies show no difference in sleep quality over time.[16] Some previous studies were conducted to monitor and evaluate the impact of social restriction policies on sleep quality at a specific time with pre-pandemic data as a baseline and in the early pandemic period. A study that monitors and evaluates the impact of social restriction policies mainly focusing on sleep quality after lifting social restriction policies, is still limited. This study aims to analyze the difference in sleep quality between the WFH and WFO periods and the determinants of sleep quality during WFO.

METHODS

Research Subjects

The subjects of this study were administrative staff (Tendik) at the Faculty of Medicine, Diponegoro University (FK UNDIP), Semarang.

Survey Design and Procedure

The recruitment process of this research subject was carried out voluntarily, where the link to fill out the questionnaire form was distributed through the Tendik telecommunications media at FK UNDIP. Tendik could voluntarily open the link to get more information related to the study and provide consent to participate.

The inclusion criteria for this study were Tendik, who have worked at FK UNDIP during the period of implementation of social restriction measures related to the COVID-19 pandemic for formal workers in Indonesia, namely Large-Scale Social Restrictions (PSBB) to the Implementation of Restrictions on Community Activities (PPKM) which were implemented in the practice of Work from Home (WFH). The exclusion criteria for this study included Tendik, who stayed abroad during the WFH period, took leave during the WFH period, and worked shifts. These exclusion criteria have been implemented into specific questions on the first page of the research questionnaire form. The answers or responses of Tendik to the exclusion criteria questions will be processed through the skip pattern implemented in the questionnaire. Tendik, who did not meet the inclusion criteria, will be directed to the submission page. The subject selection mechanism based on the survey design and procedures is shown in Figure 1.

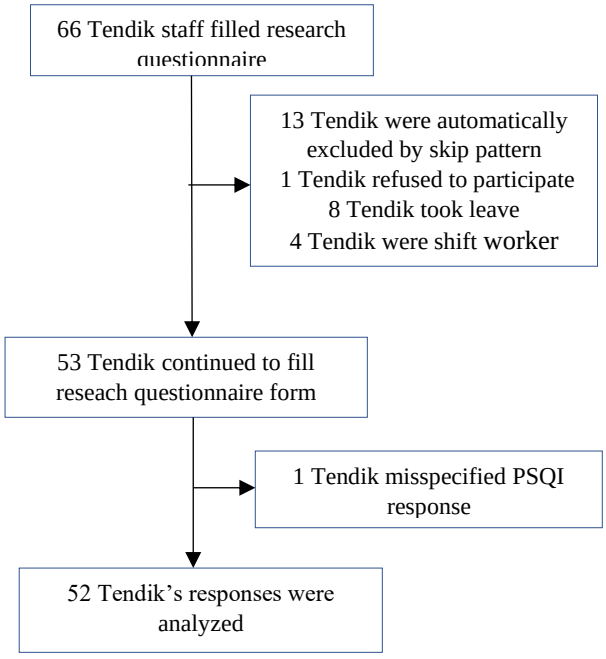

Figure 1. Subject selection mechanism

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Data Measurement and Collection

Data measurement and collection included independent variables, dependent variables, and covariates. The independent variable of this study was the implementation period of work-related social restriction measures, namely WFH and WFO. The dependent variable was sleep quality.

Implementation Period of Work-related Social Restriction Policy

The implementation period of the work-related social restriction policy includes the WFH and WFO periods. The WFH period was when Tendik worked from their respective homes. The researcher specifies data collection related to WFH in February 2021, where there was a peak surge in Indonesia's first wave of COVID-19 cases. The WFO period was when Tendik returned to work at FK UNDIP. Researchers specified the WFH period in February 2023.

Sleep Quality

Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI) questionnaire. PSQI was a composite questionnaire that assesses sleep quality with several domains, subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleeping medications, and daytime dysfunction.[12] Each of these domains had a score range of 0 - 3. The score of each domain was summed to get the global PSQI score. The global PSQI score ranged between 0 and 21, where the threshold for individuals to be classified as poor sleepers is > 5.[12]

The PSQI score in the study was measured by recall through two measurements. The research subject measured the first PSQI by recalling sleep quality during WFH in February 2021. The researcher has also adjusted the phrase on each PSQI question item to "During WFH in February 2021, what time have you usually gone to bed at night?". The second PSQI score measurement was conducted by recalling sleep quality during the WFO in February 2023. The PSQI measurement for the WFO period was separated or paused by other questions to prevent the automatic response from a memory of the WFH period PSQI recall.[17] The Cronbach α values for the WFH and WFO period PSQI measurements were 0.49 and 0.59, respectively.

Determinant Factors of Sleep Quality

The determinants of sleep quality in this study were sociodemographics (age, gender, education level, ethnicity), marital status, household structure, household income, division/section of employment, job flexibility, commuting duration, circadian preference, social jet lag, sleep hygiene, and individual resilience after the COVID-19 pandemic. The determinant factors of sleep quality data were only collected for the WFO period (February 2023) to minimize the number of questions, duration of questionnaire completion, and the possibility of subjects dropping out before completing the questionnaire. Instructions for completing particular questionnaires were also specified for the WFO period.

Sociodemographic. The age of the subjects was calculated from the day of birth to the end of February 2023. The computation of rounding the subject's age was done automatically. Education level was the highest level of education completed by the subject. Ethnicity was the subject's self-identification as part of a particular ethnic group.

Marital status. Marital status was the marriage status registered and recognized by the law in Indonesia. Subjects who were unmarried or divorced were classified as unmarried.

Household structure. The household structure was the biological and marital family members who lived in the same house. The classification of family structure in the study referred to Sharma's reclassification of household structure and dynamics.[18] Proton, electron, and nuclear families were classified into simple family structures. Atomic and molecular families were classified as complex family structures.

Household income. Household income was the total income of working family members. Questions related to working household members used a skip pattern.

Job flexibility. Job flexibility was the subjective perception of flexibility related to the daily work that was carried out. Job flexibility was assessed using a Likert scale from inflexible to very flexible, scored between 0 to 4.

Commuting duration. *Commuting duration* is the duration taken by the subject from home to FK UNDIP and vice versa. The duration of commuting comes from the question of the average time the subject departed from home ("What time do you usually leave from home to the Faculty of Medicine, Diponegoro University?"), arrived at FK UNDIP ("What time do you usually arrive at the Faculty of

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Medicine, Diponegoro University?"), returned home ("What time do you usually return from the Faculty of Medicine, Diponegoro University to home?) and arrived home ("What time do you usually arrive at home?"). The duration of departure is obtained from the difference between the time of departure and arrival at FK UNDIP, and the duration of return is obtained from the difference between the time of return and arrival at home. The commuting duration was the sum of leaving and returning from work.

Circadian preference. Circadian preference was an individual preference to do activities or alertness and rest according to the phase of the circadian rhythm without social constraints or entrainment. Circadian preference was examined based on the reduced Morningness-Eveningness Questionnaire (rMEQ). The rMEQ contained five questions from the full version of the MEQ.[19] The scoring for each of the five questions was different. The total scoring range was 4 - 25 points. The circadian preference was classified as evening type (4 - 11), neither type (12 - 17), and morning type (18 - 25).[19] The Cronbach α value of rMEQ in this study was 0.47.

Social jet lag. Social jet lag (SJL) was a jet lag due to the difference between the biological clock (circadian clock/rhythm) and the social clock, such as work activities. SJL was estimated using the Micro-Munich Chronotype Questionnaire (μMCTQ), which contained four questions about the average sleeping and waking time habits during working and work-free days. The calculation of SJL was obtained from the difference between midtime sleep on working and work-free days. Further computation of SJL could be found in reference No.20.[20]

Sleep hygiene. Sleep hygiene was the practice of ideal behaviors and environmental preconditions for initiating sleep or maintaining sleep continuity.[21] Sleep hygiene in this study was assessed using the Sleep Hygiene Index (SHI) questionnaire. The SHI contained 13 questions about practicing certain habits before bedtime and the conditions of a particular sleep environment. Each statement was rated on a Likert scale of never to always, ranging between 0 and 4. The total SHI score range was 0 to 52 points. A higher SHI score indicated maladaptive sleep behavior. The Cronbach α value of the SHI questionnaire in this study was 0.71.

The resilience of individuals after the COVID-19 pandemic. Resilience was the capacity to adapt to unfavorable events, such as the COVID-19 pandemic. Resilience was also seen as an outcome of successful adaptive coping. Individual resilience was measured using the Connor-Davidson Resilience Scale 10 (CD-RISC-10), which contained ten statements about adaptability, self-efficacy, emotion regulation, optimism, and attention under stress.[22] Each of these statements was rated on a Likert scale related to their agreement with the statement (disagree (0) - strongly agree (4)). A higher CD-RISC score indicated a more resilient individual. The Cronbach α value of the SHI questionnaire in this study was 0.90.

Statistical Analysis

The data collected in this study will be analyzed descriptively or inferentially. Numerical data will be presented as mean ± standard deviation. Categorical data will be presented in frequency and percentage. Inferential analysis of the impact of work-related COVID-19 pandemic measures on sleep quality would be analyzed using linear mixed model regression, where individual subjects were random effects; therefore, researchers could model the impact for every individual. In addition, the inferential analysis of the determinant factors of sleep quality during the WFO period was analyzed using linear regression. Statistical model building in analyzing determinant factors of sleep quality rFSA (feasible solution algorithm) package to determine the final model that will be compared with the full model. The fixed variables in rFSA were statistically significant variables in the full model. The final model for statistical inference was the simplest model with the largest F statistic.

RESULTS

Demographics of Research Subjects

A total of 54 Tendik participated as research subjects voluntarily and were analyzed in this study. The demographic characteristics of the study subjects are shown in Table 1.

Table 1. Subject Demographic Characteristics

Characteristic	Frequency (%)	Mean ± SD
Age (Years)		37.98 ± 8.31
Sex		
Male	16 (30.77)	
Female	36 (69.23)	
Education Level		
Secondary	5 (9.62)	
Higher	47 (90.38)	

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Ethinicity		
Javanese	50 (96.15)	
Non-Javanese	2 (3.85)	
Marital Status		
Married	42 (80.77)	
Unmarried	10 (19.23)	
Household Structure		
Simple	38 (73.08)	
Complex	14 (26.92)	
Housegold Income		8.16 ± 4.34
Division		
Academic	9 (17.30)	
Finance	5 (9.62)	
Information	2(3.85)	
Technology	14 (26.90)	
Laboratory	2(3.85)	
Librarian	16 (30.80)	
Administation -	4 (7.69)	
Miscellaneous		
Not specified		
Job Flexibility		
Very flexible	9 (17.31)	
A little flexible	38 (73.08)	
Rather inflexible	4 (7.69)	
Very inflexible	1 (1.92)	
Commuting Duration		1.00 ± 0.45
Preferensi Sirkadian		
Morning type	47 (90.38)	
Neither type	5 (9.61)	
Sleep Hygiene		15.48 ± 5.41
Resilience		28.54 ± 5.05
Sleep Quality - WFH		4.65 ± 2.04
Sleep Quality – WFO		4.85 ± 2.15

Sleep Quality

This study showed an increased trend in global PSQI scores between the WFH and WFO periods, but it was not statistically significant (β = 0.19, p = 0.45). This study also showed no statistically significant difference in mean PSQI scores between WFH and WFO in Tendik (4.65 vs. 4.85, p = 0.45). This study also demonstrated a heterogenous sleep quality trajectory among Tendik between WFH and WFO periods (Figure 2).

Determinants of Sleep Quality during the WFO Period

Model building in the determinant factor analysis of sleep quality in the WFO period used the full model and the most optimal model provided by FSA. Comparison between models indicated no significant difference in F statistics between the full and optimal models (Model 1). Model 1 showed that sleep hygiene (β = 0.20, p < 0.001), resilience to the COVID-19 pandemic (β = -0.11, p = 0.02), and marital status (β = 1.31, p = 0.03) were significant determinant factors of sleep quality among Tendik in WFO period. Regression coefficients between models are shown in Table 2.

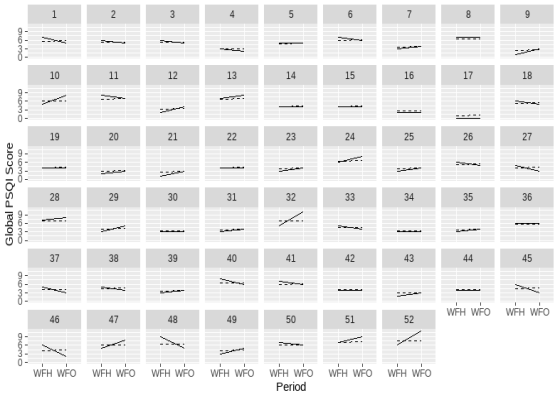

Figure 2. Individual Sleep Quality Trajectory
Solid line: observed trajectory, Dashed line: predicted trajectory

Table 2. Model Building and Comparison

Variabel	Full Model (β)	Model 1 (β)
Age	-0.04	-
Sex		
Female	Referensi	-
Male	0.76	
Education Levels		
Higher	Referensi	-
Secondary	-0.64	
Ethnicity		
Javanese	Referensi	-
Non-Javanese	1.70	
Marital Status		
Married	Referensi	
Unmarried	1.30	1.31*
Household Structure		
Complex	Referensi	-
Simple	0.45	
Household Income	0.024	
Job Flexibility		
Very flexible	0.66	-
A little flexible	Referensi	
Rather inflexible	-0.19	
Very inflexible	3.48	
Commuting Duration	0.78	-
Circadian Preference		-
Morning type	Referensi	
Neither type	0.93	
Social Jet Lag	-0.27	-
Sleep Hygiene	0.20***	0.20***
Resilience	-0.14*	-0.11*
F Statistics	3.85	14.73
ΔF Statitics	-10.88	
p	0.4123	

Significance levels: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

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DISCUSSION

This study demonstrated a trend of worsened sleep quality between the WFH and WFO periods, although it was not statistically significant. This result is different from some previous studies. A previous longitudinal study demonstrated a trend of deteriorated sleep quality between the pre-lockdown and lockdown periods.[23] The same study showed a significant trend of improvement in sleep quality post-lockdown, but still above the threshold of good sleep quality.[23] This condition shows the persistence of worsening sleep quality. A previous longitudinal study showed that with a longer time frame, sleep quality improved between the start of the COVID-19 pandemic and two years afterward.[15] The study implies that the sleep quality trajectory will improve over time, but not yet to the conclusion of a return to the sleep quality trajectory before the COVID-19 pandemic. Therefore, collecting many time points is essential for repeated measurements to analyze trends and draw conclusions.[24] For example, a previous study showed that the sleep quality of individuals affected by the COVID-19 pandemic could return to the pre-COVID-19 trajectory within three months of lockdown implementation in Italy.[25] The study could infer that the sleep quality trajectory due to the first wave of lockdowns could return to the pre-COVID-19 sleep quality trajectory, despite the narrow time frame used and the possibility of follow-up impacts for the next wave of lockdowns.

This study also demonstrated heterogeneous sleep quality trajectories between WFH and WFO. A longitudinal study of the impact of social restriction measures on sleep quality in the early phases of the COVID-19 pandemic also showed heterogeneous impacts, where there was no one-size fits all impact for individual subjects.[26] The same study also demonstrated sleep quality before the COVID-19 pandemic to strongly predict sleep quality in the early phases of social distancing policy implementation.[26] Theoretically, this could be due to the autocorrelation of sleep quality time series.[27] Furthermore, this result implied that the restriction policy exacerbated poor sleep quality.

An increase in SHI score indicated a positive impact on an increase in PSQI score. Increased SHI and PSQI scores indicated maladaptive sleep behavior and poor sleep quality. This implied that maladaptive sleep behavior resulted in poor sleep quality. Previous studies have shown that sleep hygiene practices were associated with sleep quality. Previous studies also indicated differences in sleep hygiene awareness and practices between good and poor sleepers.[28] Previous studies demonstrated that sleep hygiene practices are associated with sleep quality during the COVID-19 pandemic.[29]

Sleep hygiene practices might eliminate factors that interfere with sleep initiation and continuity.[30] Sleep initiation disturbances prolonged sleep latency, indicating poor sleep quality.[30,31] Sleep interruptions due to environmental exposures, such as being too cold or hot, also affected sleep efficiency, corresponding to poor sleep quality.[31] Additionally, using the bedroom for activities other than sleep and sex, such as eating, studying, and watching television, could cause conditioned (pre-sleep) arousal.[32] This preconditioning would also lead to the prolongation of sleep latency.[32]

CD-RISC scores showed a negative impact on PSQI scores. An increase in CDRS score resulted in a decrease in PSQI score, where an increase in CDRS score implied better resilience in the individual, and a decrease in PSQI score implied better sleep quality. This further implied that resilient subjects were likely to have better sleep quality. The results of this study are in line with previous studies. A longitudinal study showed that resilience to the COVID-19 pandemic was crucial in improving sleep quality during the second wave of COVID-19 cases.[33] A cross-sectional study also suggested that resilience played a significant role in improving sleep quality.[34]

The changes and uncertainties at the beginning of the COVID-19 pandemic caused psychological distress, indirectly leading to decreased sleep quality.[35] On the other hand, these unfavorable conditions could be a prerequisite to trigger positive adaptation, where the outcome of successful positive coping is resilience. Individual resilience to all forms of adversity could improve sleep quality.[36] Previous research has also shown that resilience and sleep quality have a reciprocal relationship.[37]

This study indicated that the group of subjects who were not married had higher PSQI scores compared to the group of subjects who had a spouse. The results of this study are in line with several previous studies. Previous studies have shown that married individuals sleep better than other marriage groups.[38] Other studies have also shown that marital

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status is associated with sleep quality.[39] The role of marital status on sleep quality could be explained by the relationships and social interactions that occur in marriage. Married individuals had both support and social pressure from their spouse, where a more portion of support could be contributed and mediated by gender; therefore that the impact of support or pressure could differ between gender.[40] Marital status also provides social support to ease the burden of depression and anxiety in the family.[41] Conversely, marital status could also be a source of social strain.[40]

Limitations of the Study

This study did not have sleep quality data before the COVID-19 pandemic that could be used as a benchmark for the period when social restriction policies were removed. The following questions will arise, is the sleep quality of Tendik during the WFO the same as the quality of sleep before the COVID-19 pandemic? If yes, then the impact of the COVID-19 pandemic worsened sleep quality, followed by sleep improvement. This condition of improving sleep quality during the WFO period was also found in previous studies. If otherwise, the sleep quality of Tendik might worsen or improve relative to the pre-pandemic sleep quality trajectory. This conclusion was a counterfactual condition if this study had data on the pre-pandemic sleep quality of Tendik.

The results of measuring sleep quality during WFH must be considered carefully, given the recall bias that the subject may experience. Unfortunately, this bias could not be controlled statistically and methodologically. At least, researchers could estimate sleep quality and its determinant factor during WFO.

This study was concerned with the non-probability sampling method use, which may encourage selection bias and representativeness bias. Selection bias occurred, where only certain prospective subjects could participate in the study. The consequence of this bias was representativeness bias in which the subjects in this study did not represent the population, for example, the number of Javanese and non-Javanese populations, educational demographics, and other variables.[42] A further implication of this was a lower external validity of this study.[43]

This condition could be overcome using non-probability sampling to form a homogeneous sample. This approach would improve the external validity of a study where the results only be generalized to a homogeneous sample with similar characteristics.[44] Sample homogeneity could be achieved regarding gender, age group, ethnicity, educational strata, and other characteristics.

CONCLUSION

This study showed no statistical difference in sleep quality. On the other hand, this study accentuated the positive impact of sleep hygiene practices, resilience, and marital status on the sleep quality of Tendik during the WFO period.

ETHICAL APPROVAL

The studies that involved human subjects adhered to the principles of the Declaration of Helsinki. This study has been reviewed and obtained ethical clearance and approval from the Health Research Ethics Committee of FK UNDIP No. 89/EC/KEPK/FK-UNDIP/III/2023. This study has received permission from the Dean of FK UNDIP No. 273/UN7.F4.1/PP/V/2023 to conduct research in the FK UNDIP

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHOR CONTRIBUTIONS

Conceptualization, Irhamni; methodology, Irhamni, Tanjung, Muflihatul, Neni; data analysis, Irhamni; data collection, Irhamni; source of funds, Irhamni; wrote the original draft, Irhamni; review and edit, Irhamni, Tanjung, Muflihatul, Neni; supervision, Tanjung, Muflihatul, Neni.

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