Global Medical and Health Communication

Online submission: https://ejournal.unisba.ac.id/index.php/gmhc
DOI: https://doi.org/10.29313/gmhc.v9i3.8530

GMHC. 2021;9(3):185–192
pISSN 2301-9123 | eISSN 2460-5441

RESEARCH ARTICLE

Relationship between Tension-Type Headache and Quality of Sleep, Excessive Daytime Sleepiness, and Fatigue Syndrome among Healthcare Workers during COVID-19

Pepi Budianto, Stefanus Erdana Putra, Muhammad Hafizhan, Fauzi Novia Isnaening Tyas, Astrida Fesky Febrianty, Hanindia Riani Prabaningtyas, Diah Kurnia Mirawati, Rivan Danuaji, Subandi Subandi

Department of Neurology, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia

Abstract

Coronavirus disease 2019 (COVID-19) is an infectious disease that was later declared a pandemic. During a pandemic, excessive workloads cause an increase in physical symptoms, such as tension-type headaches, in medical personnel. Tension-type headache (TTH) is associated with decreased sleep quality which will lead to excessive daytime sleepiness (EDS) and fatigue syndrome. This study aims to determine the relationship between TTH and sleep quality, EDS, and fatigue syndrome in medical personnel during the pandemic. This study is a cross-sectional study conducted on health workers at Sebelas Maret University Hospital, Surakarta, Indonesia in March–August 2020. The relationship between TTH and three other variables was analyzed using the Spearman correlation test. Multiple logistic regression analysis was used to calculate the odds ratio (OR) of headache associated with the covariate. The Kruskal-Wallis test was used to compare sleep quality, EDS, and fatigue syndrome in the TTH, non-TTH headache, and control groups. There were 120 respondents (mean age 30.93±12.48) in this study. The Spearman correlation test found a weak positive correlation between TTH and the three dependent variables. OR sleep quality, EDS, and fatigue syndrome with the incidence of TTH respectively 2.33 (95% CI=1.18–5.11, p<0.001); 2.52 (CI 95%=1.17–4.79, p=0.001), and 4.46 (95% CI=2.71–7.69, p<0.001). The Kruskal-Wallis test showed that the TTH group had poorer sleep quality and more frequent EDS and fatigue syndrome. There is a significant relationship between TTH and sleep quality, EDS, and fatigue syndrome in medical personnel during the pandemic.

Keywords: Coronavirus disease 2019, fatigue syndrome, quality of sleep, sleepiness, tension-type headache

Hubungan Nyeri Kepala Tipe Tegang dengan Kualitas Tidur, Rasa Kantuk Berlebihan di Siang Hari, dan Sindrom Kelelahan pada Tenaga Medis selama COVID-19

Abstrak

Coronavirus disease 2019 (COVID-19) merupakan penyakit menular yang kemudian dinyatakan sebagai pandemi. Selama pandemi, beban kerja yang berlebihan menyebabkan peningkatan gejala fisik, seperti nyeri kepala tipe tegang (*tension-type headache*) pada tenaga medis. *Tension-type headache* (TTH) dikaitkan dengan penurunan kualitas tidur yang akan menyebabkan rasa kantuk berlebihan di siang hari (*excessive daytime sleepiness*, EDS) dan sindrom kelelahan. Penelitian ini bertujuan mengetahui hubungan TTH dengan kualitas tidur, EDS, dan sindrom kelelahan pada tenaga medis selama pandemi. Penelitian ini merupakan studi potong lintang yang dilakukan pada petugas kesehatan di RS Universitas Sebelas Maret, Surakarta, Indonesia pada Maret–Agustus 2020. Hubungan antara TTH dan tiga variabel lainnya dianalisis menggunakan uji korelasi Spearman. Analisis regresi logistik ganda digunakan untuk menghitung *odds ratio* (OR) nyeri kepala yang terkait dengan kovariat. Uji Kruskal-Wallis digunakan untuk membandingkan kualitas tidur, EDS, dan sindrom kelelahan pada kelompok TTH, nyeri kepala non-TTH, dan kontrol. Terdapat 120 responden (rerata usia 30,93±12,48). Uji korelasi Spearman menemukan korelasi positif lemah antara TTH dan tiga variabel terikat. OR kualitas tidur, EDS, dan sindrom kelelahan dengan kejadian TTH secara berurutan 2,33 (IK 95%=1,18–5,11; p<0,001); 2,52 (IK 95%=1,17–4,79; p=0,001); dan 4,46 (IK 95%=2,71–7,69; p<0,001). Uji Kruskal-Wallis menunjukkan bahwa kelompok TTH memiliki kualitas tidur yang lebih buruk dan lebih sering mengalami EDS, serta sindrom kelelahan. Terdapat hubungan yang signifikan TTH dengan kualitas tidur, EDS, dan sindrom kelelahan pada tenaga medis selama pandemi.

Kata kunci: *Coronavirus disease 2019*, kualitas tidur, nyeri kepala tipe tegang, rasa kantuk, sindrom kelelahan

Received: 24 September 2021; Revised: 22 December 2021; Accepted: 30 December 2021; Published: 31 December 2021

Correspondence: dr. Pepi Budianto, Sp.N(K)., FINR., FINA. Department of Neurology, Faculty of Medicine, Universitas Sebelas Maret. Jln. Ir. Sutami No. 36A, Surakarta 57126, Central Java, Indonesia. E-mail: pepibudianto@staff.uns.ac.id

Introduction

In late December 2019, severe acute respiratory illness reports emerged from Wuhan in Hubei province, China. By January 2020, the condition now known as coronavirus disease 2019 (COVID-19) had rapidly spread from Wuhan to other regions.[1] The rapid global spread of the disease led to the declaration of COVID-19 as a pandemic on March 11th, 2020.[2] On March 2nd, 2020, Indonesia reported its first two cases. Until January 12th, 2021, there were 846,765 confirmed cases and 24,645 total deaths cases in Indonesia.[3]

Infectious disease outbreaks are known to have a psychological impact on healthcare workers and the general population. A notable example would be the psychological sequelae observed during the severe acute respiratory syndrome (SARS) outbreak in 2003.[4] In addition to the specific physical manifestations of various diseases, some symptoms may arise due to the psychological sequelae of these infection outbreaks. Commonly reported symptoms to range from more particular symptoms like headache and back pain to less-specific ones like fatigue, weakness, and lethargy.[5]

During the escalation of the COVID-19 outbreak in Indonesia, frontline healthcare workers in all major hospitals were mandated to wear personal protective equipment (PPE) while taking care of suspected or confirmed COVID-19 patients. It consists of close-fitting N95 face masks, protective eyewear (mainly goggles), gowns, surgical gloves, and the use of powered air-purifying respirators (PAPR). In practice, donning of the PPE is often felt cumbersome and uncomfortable by the frontline healthcare workers, especially if a long period of exposure to such equipment is necessary during the outbreaks of emerging infectious diseases.[6] Previous reports highlighted that pain or discomfort (headache, facial pain, and ear lobe discomfort) arising from tight-fitting face masks and elastic head straps resulted in limited tolerability when the N95 face mask was used for a prolonged period.[7] Besides, the additional workload to the already constrained healthcare systems, increased prevalence of depression, anxiety, and stress, especially in the context of the COVID-19 pandemic, increased the risk factors causing headaches, like sleep disorder, delayed rehydrated condition, and unscheduled meal time.[8]

Around 86% of tension-type headache (TTH) cases among healthcare workers during pandemic were strongly related to PPE use.[9] Previous studies showed that TTH was significantly associated with sleep apnea, insomnia, poor sleep quality, fever, restless sleep leg syndrome, and excessive daytime sleepiness (EDS). It also correlates with poor health quality, poor resting time, irregular meals, and insufficient sleep,[10] which is increased during the COVID-19 pandemic.

The current COVID-19 outbreak in Indonesia provided a unique opportunity to study the association of TTH and quality of sleep, EDS, and fatigue syndrome. We hypothesized that those factors contributed to the development of TTH in healthcare workers or led to the worsening of pre-existing primary headache diagnosis that could influence healthcare workers' work performance during the COVID-19 pandemic. Therefore, this study aimed to determine the relationship between TTH and sleep quality, EDS, and fatigue syndrome among healthcare workers during the pandemic.

Methods

It was an observational analytic study with a cross-sectional design to determine the relationship between TTH and sleep quality, EDS, and fatigue syndrome. This research was conducted at Universitas Sebelas Maret (UNS) Hospital, Indonesia, with a consecutive sampling technique from March to August 2020. The inclusion criteria in this study were older than 21 years old, cooperative, compos mentis, able to read and write, and working as healthcare workers based primarily in high-risk hospital areas in our institution such as the isolation wards, emergency rooms, and the medical intensive care unit. In addition, this study's exclusion criteria included secondary headaches, pregnancy, and severe obstructive sleep apnea (OSA) diagnosed by Berlin score >2. Written informed consent was signed, and the study design was approved by the local institutional review board, UNS Health Research Ethics Committee, through ethical clearance number 120/UN27.06/KEPK/2019.

The participants in this study were grouped into a control group, TTH group, and non-TTH group based on the International Classification of Headache Disorders (ICHD)-3 criteria. All participants completed self-administered questionnaires written in Indonesian, which confirmed validities and reliabilities. They consisted of Pittsburgh Sleep Quality Index

(PSQI) as sleep quality parameter, Epworth Sleepiness Scale (ESS) as EDS parameter, and Fatigue Severity Scale (FSS) as fatigue syndrome parameter. Participants with PSQI score >five were categorized as having poor sleep quality, ESS score >10 were classified as having excessive daytime sleepiness, and FSS score >27 were categorized as experiencing fatigue syndrome.

The data obtained were then analyzed by the Kolmogorov-Smirnov test to determine the normality of data distribution. Data analysis was then continued with the Spearman correlation test to determine the relationship between TTH and PSQI, ESS, and FSS scores representing sleep quality, EDS, and fatigue syndrome. Next, the statistical analysis continued with a logistic regression test using backward elimination procedures to determine the odds ratio (OR) of headaches to sleep quality, EDS, and fatigue syndrome adjusted for covariates. The covariates assessed in this study were OSA, smoking habits, body mass index (BMI), and gender. Finally, the Kruskal-Wallis test was used to compare PSQI, ESS, and FSS scores in the control group, non-TTH group, and TTH group. All statistical analyses were carried out using SPSS 25.0 for Windows.

Results

A total of 131 frontline workers participated in the study, with 120 healthcare workers meeting the inclusion and exclusion criteria, consisting of 30 (25%) male and 90 (75%) female participants. There was no missing data in this study. Participants included 34 nurses (28.3%), 26 general practitioners (21.7%), 18 medical residents (15%), 36 medical clerkships (30%), and 6 paramedical staffs (5%). Participants were 21 to 55 years old with a mean age of 30.93±12.48 years old. The average BMI of participants was 23.44±4.46 kg/cm2. We had 13 (10.8%) smokers and 107 (89.2%) non-smokers. There were 42 participants in the control group, 36 subjects in the TTH group, and 42 subjects in the non-TTH group. The poor sleep quality was found in 84 participants, EDS was found in 41 participants, and fatigue syndrome was found in 98 participants.

Kolmogorov-Smirnov analysis showed that all data were normally distributed ($p>0.05$). The correlation of headaches with PSQI, ESS, and FSS scores was assessed using the Spearman correlation test to determine the correlation coefficient (r). The result showed a weak positive correlation between headache and sleep quality ($r=0.173$, $p=0.039$), between headache and daytime sleepiness ($r=0.157$, $p=0.037$), also between headache and fatigue syndrome ($r=0.293$, $p=0.001$). There were various factors affecting sleep quality, EDS, and fatigue syndrome other than headache.

Then, the data obtained were analyzed using multiple logistic regression tests. The results showed the OR for headache on sleep quality, daytime sleepiness, and fatigue syndrome were 2.33 (95% CI=1.18–5.11, $p<0.001$); 2.52 (95% CI=1.17–4.79, $p=0.01$); and 4.46 (95% CI=2.70–7.69, $p<0.001$) respectively. Meanwhile, the coefficient of determination (R2) were 0.084 ($p<0.001$), 0.284 ($p=0.001$); and 0.354 ($p<0.001$), respectively. It meant that headache had an effect of 8.4% on sleep quality; 28.4% on EDS; and 35.4% on the incidence of fatigue syndrome, with the remaining percentage influenced by other factors such as poor health quality, lack of rest time, irregular meal, lack of physical activity, and gender.[10]

In the backward elimination procedure, ORs for TTH were calculated for the three variables through six steps, i.e., without covariate adjustment, adjusted for OSA risk, adjusted for smoking habits, adjusted for BMI, adjusted for sex, and adjusted ORs for age covariates. A p-value of <0.05 was considered statistically significant during analysis, as shown in Figure 1–Figure 3.

Finally, the comparison of PSQI scores representing sleep quality, ESS representing daytime sleepiness, and FSS describing fatigue syndrome in the control, non-TTH, and TTH groups was made by Kruskal-Wallis test, presented in Table. It is suggested that poor sleep quality, EDS, and fatigue syndrome were most common in the TTH group, followed by the non-TTH group, and were least prevalent in the control group. All of the results were statistically significant.

Discussion

This study evaluated the relationship between TTH and poor sleep quality, EDS, and fatigue syndrome in health workers during the COVID-19 pandemic. In our study, 80.8% of patients experiencing headaches were female, 35.9% had

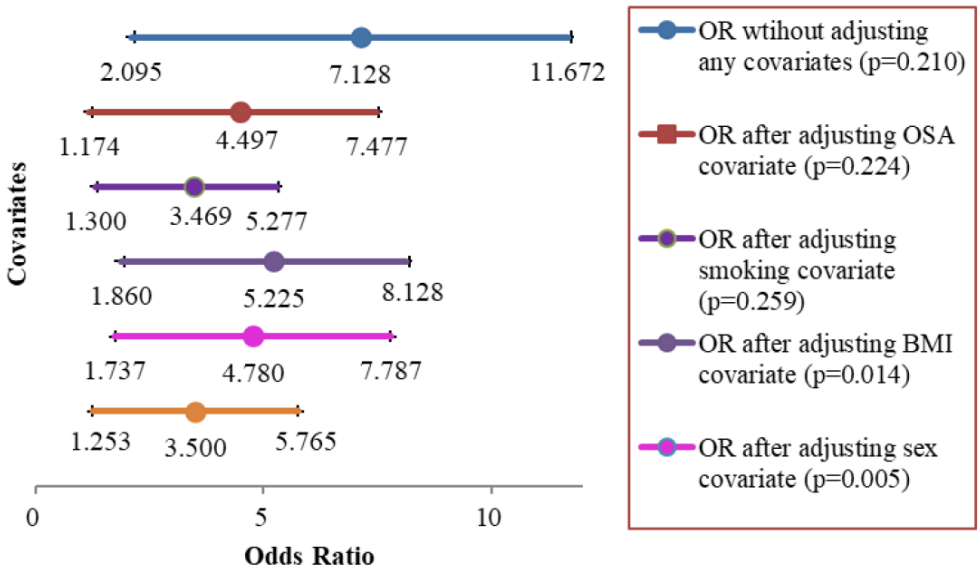

Figure 1 ORs between TTH and Quality of Sleep, adjusted with Covariates

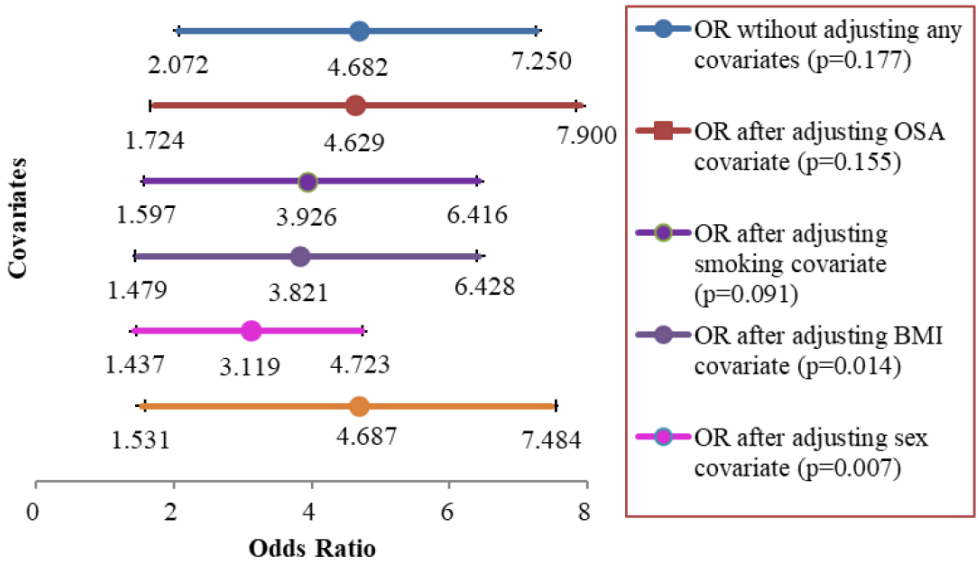

Figure 2 ORs between TTH and Excessive Daytime Sleepiness, adjusted with Covariates

TTH.

Pressure or tractional forces from the PPE (mask and goggles together with the accompanying straps) may lead to local tissue damage and exert an irritative effect on the underlying superficial sensory nerves. It affected particularly trigeminal or occipital nerve branches innervating the face, head, and cervical region. The cervical neck strain from donning the equipment could have led to cervicogenic headache or TTH.[11] The peripheral sensitization may activate the trigeminocervical complex through nociceptive information transmitted via different trigeminal nerve branches. It runs through the trigeminal ganglia and brainstem to the higher cortical areas, triggering headache attacks.[12] The increased duration of PPE exposure among frontline healthcare workers during COVID-19 is mandated by infectious diseases protocols, which is a clear departure from prior

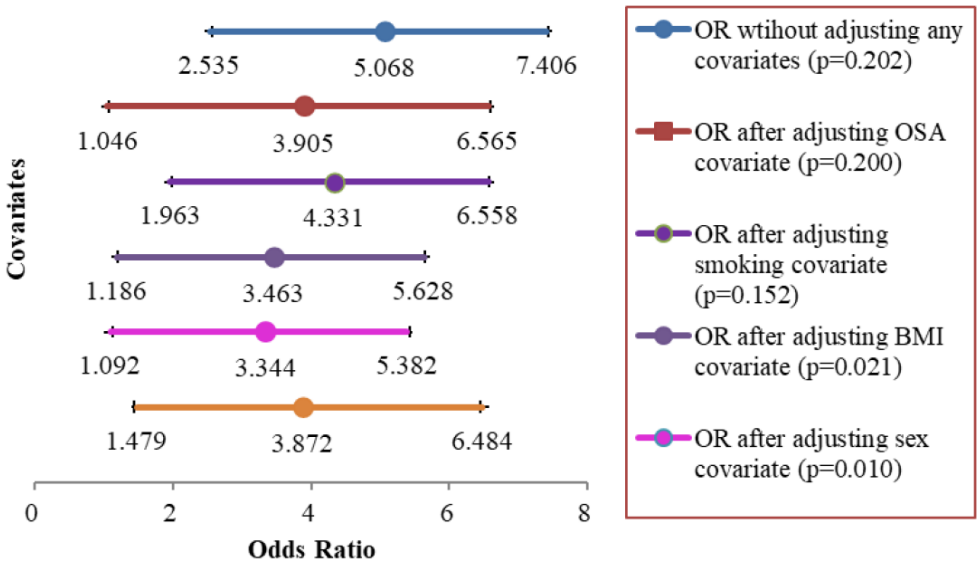

Figure 3 ORs between TTH and Fatigue Syndrome, adjusted with Covariates

usage patterns before the start of the pandemic. These etiological reasons could perhaps explain why a large proportion of those with pre-existing primary headache disorders and concomitant de novo PPE-associated headaches reported an increase in the average number of headache days, with the perception that this change was probably attributable to the PPE.

In terms of gender, our finding was in line with previous studies stating that the highest prevalence occurred in productive age women. Hormonal cycles in productive age women, such as during menstruation, pregnancy, response to stress exposure, and pain, are the causes of high headache pain prevalence in this group.[13] In addition, previous research stated that women health workers, especially those who were married, experienced higher levels of stress as a result of the multiple and complex roles that these women had to play as wives, mothers, employees (health workers), and housekeepers.[14]

Since the COVID-19 pandemic in Indonesia, most respondents have experienced increased headache frequency. Other factors such as sleep deprivation, physical and emotional stress, irregular meal times, and inadequate hydration contributed to this phenomenon. Our findings were in line with multiple studies demonstrating the triggers in migraine or TTH were often related to a change in internal and external homeostasis like circadian rhythm, underscoring the importance of addressing these factors in optimizing headache control.[15]

TTH is caused by persistent activation of peripheral nociceptors and increased pain sensitivity in muscles and fascia. One of the activators of nociceptors is nitric oxide (NO), stimulating the N-methyl-D-aspartate receptor.[16] Sensitization to the presence of these nociceptors also decreases the pain threshold. This phenomenon will reduce sleep quality and increase wake-up time at night, disrupting sleep quality.[10] Decreased sleep quality will lead to fatigue syndrome and daytime sleepiness.[17] Abnormalities in the central nervous system, especially the hypothalamus via orexinergic

Table Mean Rank Results from Kruskal-Wallis Analysis

	PSQI Analysis	ESS Analysis	FSS Analysis
Control group	52.79%	52.86%	51.50%
Non-TTH group	64.21%	63.33%	62.93%
TTH group	65.17%	65.71%	68.17%
Statistical significance	p=0.040	p=0.043	p=0.039

neurons, also affect the pathogenesis of TTH and changes in the sleep-wake cycle. Melatonin, a hormone affecting circadian rhythms, can also affect sleep-wake processes resulting as headaches.[18]

Headache often causes a decreasing quality of life, especially in chronic headaches caused by recurrent headaches, even though no abnormalities were found on physical examination. Both episodic and chronic TTH could affect the quality of work and physical and social functioning. Anxiety, depression, and sleep quality were also worse in headache patients. The decrease of sleep quality in TTH patients could lead to fatigue and EDS.[19] This situation was hazardous to the health system integrity amid the COVID-19 pandemic. Reduced productivity could result in medical errors during working time. It could be a vicious circle caused by the increasing number of working hours and the psychological burden on healthy people medical personnel.[20]

When adjusted for covariates, it was found that the covariates of sex, age, and BMI had a significant effect on sleep quality, EDS, and fatigue syndrome. Meanwhile, other covariates, i.e., OSA and smoking, did not significantly influence these three dependent variables. The significant effect of gender on sleep quality, EDS, and fatigue was supported by Faro et al.,[21] showing that psychological factors like stress levels in women were higher than in men, increasing the incidence of fatigue syndrome. Women were more likely to have more severe depressive symptoms, sleeping difficulty at night, greater EDS, and a higher level of difficulty concentrating due to drowsiness or fatigue.[22]

We also found that age affected sleep quality disturbances, EDS, and fatigue syndrome. This finding was in line with previous studies stating these three-variable were increased in young adults as they get older and shows the accelerated aging process of the brain, which still had a normal cognitive function.[23] Both EDS and fatigue syndrome were caused by insufficient sleeping time, changes in daily work routines, and hormonal sleep homeostasis changes. It involves stress-induced corticotrophin-releasing hormone, which causes sleep disturbances to appear more frequently in older subjects.[24]

The significant effect of BMI on the three independent variables was also in line with previous studies. Vargas et al.[25] stated that one-third of the respondents had BMI≥25, and 51% had poor sleep quality. Poor sleep quality was associated with hormonal changes, particularly with decreased levels of leptin (a hormone suppressing appetite) and increased levels of ghrelin (a hormone increasing appetite), which might mediate the relationship between sleep quality and BMI. In addition, a study by Markwald et al.[26] demonstrated that five days of consistent sleep deprivation increased energy requirements and energy intake and decreased responses to satiety and satiety hormones. From a physiological point of view, higher energy requirements during sleep deprivation might lead to decreased leptin and increased ghrelin levels leading to excessive weight gain. Bariatric surgery in obese patients had also been clinically shown to reduce EDS, fatigue, and snoring during sleep.[27]

We found no significant effect of OSA on sleep quality, EDS, and fatigue syndrome. However, it was inconsistent with other studies showing that OSA affected sleep quality, apnea, and snoring, leading to fatigue and increased EDS.[28] The difference of this study from previous studies might happen because all participants had a low risk of OSA with a Berlin score<2.

When adjusted for smoking covariates, there was no significant effect on all three variables. However, in contrast to previous studies, worse sleep quality in smokers was reflected by reduced sleep continuity, increased sleep onset latency, and decreased total sleeping time, resulting in fatigue and daytime sleepiness.[29] The difference with previous studies might happen because most (75%) of the subjects in this study were women. In Asian countries, including Indonesia, men have a higher dependence on smoking than women.[30] This reason caused the low number of smoking participants in this study.

Poor sleep quality, daytime sleepiness, and fatigue were more common in the TTH group than in the non-TTH group and the control group. It is in line with a study done by Uhlig et al. They observed a 1.8 times higher prevalence of sleep quality disturbances in subjects with TTH than those without headaches.[31] Other studies also showed that poor sleep quality was more common in individuals in the TTH group than in the migraine group. Poor sleep quality was a risk factor for progression from episodic to chronic TTH.[17] Half of TTH patients experiencing insomnia and decreased sleep quality was associated with increased frequency and intensity of headaches resulting in fatigue and EDS.[32]

We also realized some limitations of our

study. First, the sample size may be considered small. However, the restrictions imposed by infection control protocols during the COVID-19 outbreak and barriers in approaching healthcare personnel working in the high-risk areas made it difficult to recruit more participants. The cross-sectional nature of the study also does not allow interpretation for causality. To establish the cause-effect relations, it is necessary to conduct longitudinal studies. Second, since the study was performed among frontline healthcare providers based in high-risk hospital areas, we could have missed more predisposed personnel who had avoided or been excused from working in such areas. Third, other predisposing factors such as ambient room temperature and humidity were not assessed and may have influenced PPE use. For example, healthcare workers based at the outdoor emergency room or fever facility in a tropical country like Indonesia are often subject to hot and humid conditions. These unaccustomed environmental changes may trigger new-onset headaches or exacerbate pre-existing headaches. Fourth, we used a self-administered questionnaire, which could have been affected by the recall bias. Fifth, our study did not assess the efficacy of the analgesics used to treat headaches. Lastly, we did not record socioeconomic status and education level, which could have influenced our results.

Conclusions

This study showed a relationship between TTH and sleep quality, EDS, and fatigue syndrome among frontline health workers, along with the frequency of headaches in the era of the COVID-19 pandemic.

Conflict of Interest

All authors state there was no conflict of interest in this article.

Acknowledgments

The authors would like to thank the Director of Universitas Sebelas Maret Hospital Sukoharjo for data collection permission.

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