



Sleep Quality as the Mediator between Sleep Hygiene and Insomnia, Anxiety, and Depression

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ABSTRACT *This study evaluated the role of sleep quality as mediator between sleep hygiene and insomnia, anxiety, or depressive symptoms. There were 225 participants with an average age of 30.22 (SD 8.92), the majority were female (75.11%) and residing in metropolitan areas. Measures included the Sleep Hygiene Index, the Pittsburgh Sleep Quality Index, the Insomnia Severity Index, and the Hopkins Symptoms Checklist-25. Causal mediation analysis using PROCESS Macro Model 4 with 5,000 bootstrapping iterations was employed to analyze the data. The results revealed significant relationships and partial mediating effects after controlling for covariates such as age, gender, and weight. Sleep hygiene significantly predicted sleep quality, with sleep quality mediating the relationship between sleep hygiene and symptoms of insomnia, anxiety, or depression. Direct effects were also found between sleep hygiene and symptoms of insomnia, anxiety, and depression. Therefore, better sleep hygiene led to better sleep quality, and better sleep quality led to less insomnia, anxiety, or depression.*

INTRODUCTION

Quality sleep is important for overall well-being, characterized by waking up with a sense of vitality (Yilmaz, Tanrikulu, & Dikmen, 2017). Achieving optimal sleep involves ensuring an adequate sleep duration, with recommendations of 7-9 hours for adults aged 18-60 (Chaput et al., 2020; Watson et al., 2015). However, research shows a significant portion (70-75%) of the working and college student population in Indonesia sleeps below the recommended duration (Arifnia & Asih, 2020; Wijaya & Asih, 2018; Ridzky & Asih, 2017).

Poor sleep quality is a risk factor for negative psychological outcomes, as insufficient sleep increases negative affect

and decreases positive affect (Triantafillou et al., 2019; Watson & Clark, 1984). Prolonged wakefulness, such as up to 56 hours, is associated with heightened somatic complaints, depression, anxiety symptoms, and paranoid ideation (Babson et al., 2010). Shorter sleep duration leads to physiological consequences like increased agitation and restlessness (Li et al., 2016b; Gujar et al., 2011), contributing to heightened anxiety. Sleep deprivation also amplifies depressive ideation and reduces interest in pleasurable activities, linking to an elevated susceptibility to depression (Li et al., 2016a). Consequently, sleep insufficiency is intricately connected to an increased risk of depression and anxiety problems. (Li et al., 2016a).

Strategies commonly known to enhance an individual's sleep quality include the implementation of sleep hygiene practices (Sleep Foundation, 2023a; Wijaya & Asih, 2018). Sleep hygiene refers to a set of practices promoting healthy and restful sleep. It encompasses behaviors, habits, and conditions that contribute to quality sleep and lessen the likelihood of sleep disturbances (Wijaya & Asih, 2018; Voinescu & Szentagotai-Tatar, 2015). Good sleep hygiene involves specific sleep routines and efforts to create an environment conducive to optimizing both the quantity and quality of sleep (Wijaya & Asih, 2018; Irish, et al., 2015; Voinescu & Szentagotai-Tatar, 2015). In the study conducted by Irish et al. (2015), some ways to apply sleep hygiene include avoiding caffeine and alcohol close to bedtime, refraining from nicotine use, engaging in regular exercise, managing stress, minimizing noise in the bedroom, maintaining a consistent sleep schedule, and avoiding daytime napping.

Insomnia is a widespread public health concern (Bollu & Kaur, 2019). It encompasses challenges with initiating sleep, difficulties in sustaining sleep, and early morning awakenings (Bollu & Kaur, 2019; APA, 2013). Recent studies suggest 10-15% prevalence worldwide and 10-11% in Indonesia for insomnia (Bollu & Kaur, 2019; Peltzer & Pengpid, 2019). Causes of insomnia include stress, poor sleep habits, mental and physical illnesses, medications, and genetic factors (Sleep Foundation, 2023b; Cleveland Clinic, 2023). Stress, both acute and chronic, can disrupt sleep (Kalmbach et al., 2018). Circadian rhythm disturbances from factors like jet lag and shift work can also contribute to insomnia (Walker et al., 2020). Understanding the link between sleep quality and insomnia, as well as the relationship between poor sleep quality and anxiety or depressive symptoms, is crucial.

Anxiety is an emotional state marked by heightened apprehension, fear, and physiological responses like an accelerated heart rate (Emily et al., 2020; Staner, 2003).

It's a natural response to stress or perceived threat, activating the body's "fight or flight" mechanism (Staner, 2003). Bandelow et al. (2008) note temporal fluctuations in anxiety within the normal spectrum of human emotional experiences. Anxiety symptoms vary in manifestation, intensity, and duration. They manifest in the form of restlessness and cognitive distortions related to perceived concerns. The contributing factors of anxiety encompass genetic predispositions, personality traits, and environmental stressors (Hettema et al., 2001). Comprehending and addressing these experiences is crucial for enhancing overall mental well-being (Padesky & Mooney, 2012; Hofmann, 2008).

The state of depression is characterized by pervasive feelings of low mood and continuous sadness, often transient in nature and experienced as a response to stressors or life challenges (APA, 2013). Depressive symptoms can manifest as feelings of hopelessness, loss of interest in previously pleasurable activities, and disruptions in sleep and appetite patterns (APA, 2013). The occurrence of depressive symptoms is influenced by various factors, including genetic predispositions, personality traits, and environmental stressors (Kendler, et al., 2006).

Studies by Taylor et al. (2016) and Wang et al. (2018) consistently show that inadequate or disturbed sleep significantly impacts psychological well-being, positively correlating with anxiety. Grandner et al. (2019) explain a dynamic interaction where poor sleep quality contributes to increased anxiety, and pre-existing anxiety worsens sleep quality. Smith et al. (2019) and Foster et al. (2020) assert that insufficient or disrupted sleep plays a crucial role in exacerbating depressive symptoms. Anderson and Platten (2018) investigate neurobiological factors related to changes in neurotransmitter levels, emphasizing the stronger effect of poor sleep quality on depression than the reverse. Mitchell et al.'s (2022) research highlights the substantial risk faced by individuals with persistent

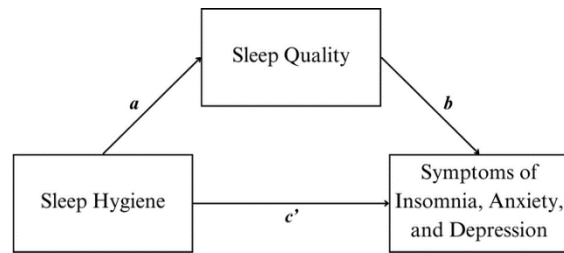
sleep disorders in developing and sustaining depression symptoms.

Poor sleep quality has a broad psychosocial impact on productivity, relationships, and overall well-being in the general population. Roehrs et al. (2021) stress the importance of proactive recognition and addressing of sleep health, advocating for preventive measures to mitigate the adverse effects on anxiety and depression. This highlights the crucial role of prioritizing sleep health to enhance mental resilience and well-being across diverse contexts. Additionally, the reciprocal relationship between poor sleep quality and symptoms of anxiety and depression underscores the necessity for comprehensive well-being interventions that include addressing sleep hygiene (Patel et al., 2018).

The literature consistently links poor sleep quality to increased symptoms of insomnia, anxiety, and depression (Grandner et al., 2019; Wang et al., 2018). Mitchell et al. (2022) highlight the bidirectional relationship between sleep hygiene and sleep quality, emphasizing their combined impact on mental health. Promoting optimal sleep quality through effective sleep hygiene practices can help mitigate the risk and severity of insomnia, anxiety, and depression, contributing to overall well-being (Patel et al., 2018; Roehrs et al., 2021). The research hypothesis posits that sleep quality mediates the relationship between sleep hygiene and psychological conditions consisting of insomnia, anxiety, and depression.

Research on how sleep quality mediates the relationship between sleep hygiene and psychological outcomes is important for targeted interventions and public health initiatives. While there are substantial studies linking sleep hygiene to sleep quality and sleep quality to psychological variables, comprehensive studies incorporating all variables remain limited. More research is needed to gain a more comprehensive understanding on the role of sleep quality in

Figure 1.
Research Model



mediating the relationship between sleep hygiene and psychological factors.

RESEARCH METHOD

This study was conducted online from July 5th to November 10th, 2023 as part of the effectiveness study for sleep quality. Data were collected through non-random sampling by disseminating a Google Form link. The research adopts a quantitative approach with a correlational design, incorporating mediation analysis. The independent variable is sleep hygiene, the mediating variable is sleep quality, and there are three dependent variables: insomnia, anxiety, and depression.

This research has been approved by the Ethics Committee of the Faculty of Psychology, Universitas Indonesia, with ethical clearance certificate number 253/FPsi.KomiteEtik/PDP04.00/2023.

Participants

The participants in this study were individuals aged 18 and above residing in metropolitan areas. The research consisted of 225 participants (age $M=30.22$, $SD=8.92$). Table 1 presents the sociodemographic characteristics.

Measures

This study employed four self-reported measures, namely Sleep Hygiene Index (SHI), Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), and the Hopkins Symptom Checklist 25 Items (HSCL-25), all of which have been adapted into Bahasa Indonesia.

Table 1.
Sociodemographic of participants

Characteristics	Sample Size
<i>Gender</i>	
Male	66
Female	159
<i>Level of Education</i>	
High School	44
Diploma	14
Undergraduate	118
Postgraduate	49
<i>Profession</i>	
College Student / Intern	50
Freelancer	22
Entrepreneur	20
Lecturer	17
Healthcare Professional	2
Mental Healthcare Professional	3
Private Sector Employee	92
Public Sector Employee	19

Sleep Hygiene

The Sleep Hygiene Index (SHI), developed by Mastin, Bryson, and Corwyn in 2006, evaluates sleep hygiene through 13 self-report items aligned with International Classification of Sleep Disorders criteria. Each Likert scale item ranges from 1 ("Never") to 5 ("Always"), with higher scores indicating poorer sleep hygiene. SHI exhibits superior internal consistency ($r=0.86$, $p<0.01$) and reliable test-retest reliability ($r=0.71$, $p<0.01$). External

correlations with PSQI ($r=0.62$, $p<0.01$) and ISI ($r=0.61$, $p<0.01$) validate its use. In this study, reliability testing with 225 participants yields α of 0.765, surpassing the recommended threshold ($\alpha>0.70$), confirming SHI's strong reliability.

Sleep Quality

The Pittsburgh Sleep Quality Index (PSQI), measures sleep quality with nine items grouped into seven components: (1) sleep duration, (2) sleep disturbance, (3) sleep latency, (4) daytime dysfunction due to sleepiness, (5) sleep efficiency, (6) overall sleep quality, and (7) sleep medication use. Scores range from 0-21, with higher scores indicating poorer sleep quality. The tool shows good internal homogeneity ($\alpha=0.83$). Alim (2015) validated the Indonesian version of PSQI, yielding a content validity score of 0.89 and internal consistency (Chronbach's Alpha) of 0.79. Reliability testing on 227 individuals resulted in a coefficient α of 0.797, indicating good internal consistency ($\alpha>0.70$), as recommended by Kaplan and Saccuzzo (2007).

Insomnia

The Insomnia Severity Index (ISI), developed by Morin in 1993, assesses insomnia symptoms using a 7-item Likert scale with responses ranging from 0 to 4. It measures the severity and impact of insomnia over the past month, covering aspects like difficulty initiating and maintaining sleep. Reliability, tested through internal consistency, yielded a Chronbach's alpha coefficient of 0.74 (Bastien, Vallières, & Morin, 2001). Subsequent studies by Morin et al. in 2011 and Swanenghyun (2015) reported alpha coefficients of 0.90, 0.91, and 0.92, respectively, indicating the ISI's reliability in measuring insomnia symptoms.

Anxiety and Depression

Anxiety and depression symptoms are assessed using the Hopkins Symptom Checklist 25 items (HSCL-25). It consists of

Table 2.
Participant Scores Overview

Variable	Min	Max	Mean	SD
Sleep Hygiene	6.0	41.0	20.28	6.64
Sleep Quality	1.0	20.0	8.04	2.79
Insomnia	1.0	28.0	12.84	5.54
Anxiety	.60	4.0	2.07	.76
Depression	.40	4.0	2.19	.76

25 items, with two subscales: anxiety (10 items) and depression (15 items). Each item has a Likert scale from 1 ("Not at all") to 4 ("Very much). Reliability testing, examining anxiety, depression, and overall internal consistency, yielded alpha coefficients of 0.910, 0.760, and 0.850, respectively. According to Kaplan and Saccuzzo (2009), HSCL-25 demonstrates good reliability.

Table 3.
Descriptive statistics and bivariate correlations between the research variables

Variables	Mean	SD	1	2	3	4	5	6	7
1. Age	30.22	8.924	-	-.047	.235**	.063	-.123	-.147*	-.106
2. Gender	-	-		-	-.430**	.124	.109	.191**	.147
3. Weight	65.04	13.97			-	.010	-.007	-.133*	-.066
4. Sleep Quality	8.036	2.785				-	.655**	.404**	.484**
5. Symptoms of Insomnia	12.844	5.548					-	.465**	.529**
6. Symptoms of Anxiety	2.065	.765						-	.774**
7. Symptoms of Depression	2.195	.756							-

Notes: * $p < 0.05$, ** $p < 0.01$.

Data Analysis

The statistical analysis method employed in this study is causal mediation analysis using PROCESS Macro Model 4 (Model 4, Hayes, 2018) with 5,000 bootstrapping iterations. The data processing was conducted using SPSS v.26. Three separate regression models for mediation analysis were tested for insomnia, anxiety, and depression. The analysis also included covariates. The selection of covariates was determined from the bivariate correlation results.

RESULT

Table 2 presents a general overview of the scores obtained by the participants. Subsequently, a bivariate correlation analysis was conducted prior to model testing to identify variables that function as covariates. Results shown in Tabel 3. Based on the significant results, age, gender, and weight were utilized as the covariates.

In the regression analysis employing a mediation model, three models were tested, based on dependent variables consisting of insomnia (Y1), anxiety (Y2), and depression (Y3). The independent variable in this study is sleep hygiene (X), with sleep quality (M) as the mediating variable.

In the three existing models, it was observed that sleep hygiene significantly predicted sleep quality ($\beta = .233$, $SE = .024$, $t(224) = 9.561$, $p < 0.001$). Figure 2 illustrates the mediating role of sleep quality in predicting insomnia symptoms (Y1). From the model, it can be inferred that sleep quality significantly predicts insomnia symptoms ($\beta = .947$, $SE = .110$, $t(224) = 8.614$, $p < 0.001$). Furthermore, sleep quality serves as a mediator in the relationship between sleep hygiene and insomnia symptoms ($\beta = .264$, $BootSE = .041$, $BootCI\ 95\% [.187, .347]$). Notably, there are significant direct associations from sleep hygiene to the prediction of insomnia symptoms ($\beta = .292$, $SE = .047$, $t(224)$, $p < 0.001$).

The second model depicted in Figure 3 reveals a significant relationship, indicating that sleep quality significantly predicts anxiety symptoms ($\beta = .087$, $SE = .020$, $t(224) = 4.416$, $p < 0.001$). Similar to Model 1, Model 2 also suggests that sleep quality serves as a mediator in the relationship between sleep hygiene and anxiety symptoms ($\beta = .175$, $BootSE = .042$, $BootCI\ 95\% [.096, .263]$). Furthermore, there is a direct association wherein sleep hygiene significantly predicts anxiety symptoms ($\beta = .019$, $SE = .008$, $t(224) = 2.208$, $p < 0.05$).

Figure 2.
Analysis of Mediation Model 1
($X \rightarrow M \rightarrow Y1$)

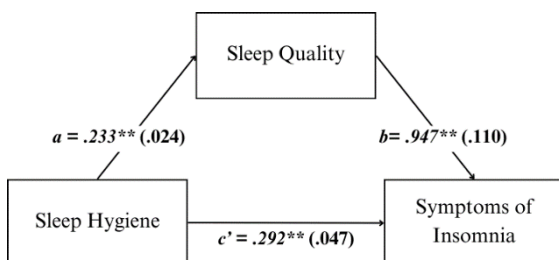
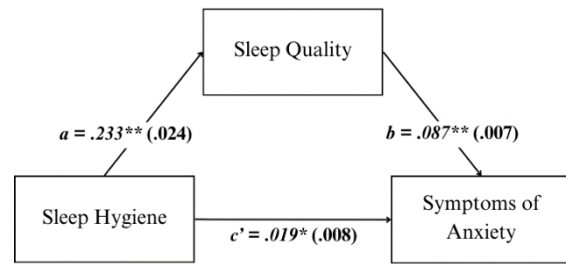


Figure 3.
Analysis of Mediation Model 2
($X \rightarrow M \rightarrow Y2$)



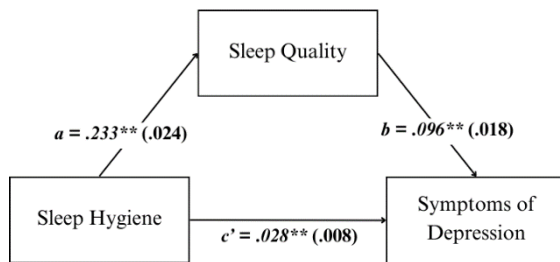
In the last model, the results of the analysis indicate that sleep quality significantly predicts depression symptoms ($\beta = .096$, $SE = .018$, $t(224) = 5.179$, $p < 0.001$). Significant mediation by sleep quality is found in the relationship between sleep hygiene and depression symptoms ($\beta = .196$, $BootSE = .042$, $BootCI\ 95\% [.096, .263]$). Additionally, direct relationships are also evident from sleep hygiene in predicting depression ($\beta = .028$, $SE = .008$, $t(224) = 3.546$, $p < 0.001$).

All mediation effects in Models 1, 2, and 3 are positive as the analysis results show positive coefficients. From these findings, it can be concluded that sleep quality partially mediates the relationship between sleep hygiene in predicting symptoms of insomnia, anxiety, and depression. Better sleep hygiene was associated with better sleep quality. Better sleep quality was associated with less insomnia, anxiety, and depression.

DISCUSSION

Sleep quality serves as a robust predictor of individual's physical and psychological wellbeing. Sleep hygiene represents practices typically recommended by experts to enhance sleep quality. Conditions strongly associated with poor sleep quality include symptoms of insomnia, anxiety, and depression. Therefore, this study evaluated the role of sleep quality as the mediator between sleep hygiene and psychosocial outcomes.

Figure 4.
Analysis of Mediation Model 3
(X→M→Y3)



The findings of this study reveal a significant and positive relationship between sleep quality, sleep hygiene, and symptoms of insomnia, anxiety, and depression. Sleep quality partially mediates the relationship between sleep hygiene and these symptoms. This implies that better sleep hygiene predicts better sleep quality, a notion supported by prior research indicating that adopting sleep hygiene practices is linked to improved sleep quality (Lukowski & Tsukerman, 2021; Touitou, Reinberg, & Touitou, 2017; Walker, 2017).

Several behaviors constitute sleep hygiene practices. Research consistently demonstrates a positive correlation between adherence to good sleep hygiene practices and enhanced sleep quality. Maintaining a consistent sleep schedule with regular bedtimes and wake-up times has been associated with improved sleep quality (Banks & Dinges, 2007). Limiting the intake of stimulants such as caffeine and nicotine close to bedtime is another factor linked to enhanced sleep quality (Drake et al., 2013). Creating a comfortable sleep environment, including a cool and dark bedroom, has also been positively correlated with sleep quality (Touitou et al., 2017). Additionally, minimizing screen time before bedtime, which can interfere with melatonin production, is associated with improved sleep quality (Chang et al., 2015).

These findings underscore the significance of adopting good sleep hygiene practices for overall well-being and optimal sleep quality (Walker, 2017). However, as a predictor, the highest average score for sleep

hygiene is the item, "I use my bed for things other than sleeping or sex (for example: watch television, read, eat, or study)." This indicates that the participants have a habit of engaging in activities other than sleeping and intimate relations in bed, which may contribute to their compromised sleep quality.

Fundamentally, the aim is to establish mental associations connecting sleep behaviors with the bed (stimulus control). Such associations create conditioned effects, making it easier to sleep when on the bed due to the signal that it is time to sleep (Jansson-Fröjmark, 2023; Patel, 2021). Similar associations exist for other places like the kitchen or office. Mental associations with the kitchen signal it's time to eat, and associations with the office signal it's time to work. Engaging in activities other than sleep and sex in bed can diminish and even disrupt the association between the bed and sleep (Patel, 2021).

Using electronic devices for work, entertainment, or social media in the bedroom or on the bed can stimulate the brain during times that should be dedicated to rest and sleep (Gradisar et al., 2013). Research also indicates that the blue light emitted by these devices interferes with melatonin production, a hormone crucial for regulating the sleep-wake cycle (Shechter et al., 2020). This is supported by Ishizawa et al. (2021), showing that exposure to blue light before sleep significantly impacts the reduction of deep sleep compared to exposure to incandescent light. Moreover, using devices before sleep is positively associated with insomnia and negatively associated with morningness (Fossum et al., 2014), as well as positively correlated with low alertness the next day (Patel, 2021).

Sleep quality can also predict the condition of individuals with symptoms of insomnia, anxiety, and depression. Good sleep quality predicts better symptom conditions. Multiple studies have shown that compromised sleep quality is not only a consequence but also a predictor of mental health issues. Longitudinal studies, such as

the study by Baglioni et al. (2011), emphasize the bidirectional link between poor sleep quality and the development of insomnia symptoms. Individuals with persistent insomnia consistently exhibit poorer sleep quality, emphasizing the enduring impact of sleep quality on insomnia symptoms (Morin et al., 2009).

In the context of anxiety, Alvaro et al. (2013) found that chronic sleep disturbances contribute to the development or worsening of anxiety. The bidirectional nature of this relationship suggests that addressing sleep quality may be crucial in managing symptoms related to anxiety. Moreover, Capron et al. (2018) highlighted a connection between poorer sleep quality and heightened anxiety sensitivity, offering insights into cognitive vulnerabilities associated with anxiety. In the context of depression, Gehrman et al. (2015) demonstrated a significant association between poor sleep quality and increased severity of depressive symptoms, emphasizing the role of sleep quality in predicting depression severity.

CONCLUSION

Our findings indicate that sleep hygiene, sleep quality, symptoms of insomnia, anxiety, and depression are interrelated. Furthermore, sleep quality significantly mediates the relationship between sleep hygiene and the prediction of insomnia, anxiety, and depression symptoms partially, controlling for covariate variables such as age, gender, and weight. The positive associations underscore that improved sleep hygiene corresponds to enhanced sleep quality, subsequently influencing the amelioration of symptoms related to insomnia, anxiety, and depression. Each variable exhibits mutual relationships with the others. Additionally, activities other than sleeping and engaging in sexual activities in bed emerge as the habits most adversely affecting individuals' conditions.

SUGGESTION

In this research, the mediating role of sleep quality in the relationship between sleep hygiene and the prediction of insomnia, anxiety, and depression symptoms has been discussed. Furthermore, it has been identified that the items most influential in this study are those related to activities conducted on the bed. Therefore, future research could entail a series of experimental studies examining the effectiveness of various sleep hygiene practices in predicting sleep quality, as well as specific psychological conditions in participants. Furthermore, further research to explore sleep hygiene and sleep quality in specific populations, considering cultural, socio-economic, and regional variations, can be undertaken to examine psychosocial factors influencing sleep behavior. This can help tailor interventions to diverse needs.

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