



Association between sleep quality with overweight/obesity and other factors among adults in Indonesia post-COVID-19 pandemic

Hubungan antara kualitas tidur dan kelebihan berat badan/obesitas dan faktor lainnya pada usia dewasa di Indonesia pasca pandemi COVID-19

Athiya Fadlina¹ & Khoirul Anwar^{2*}

¹ Department of Nutrition, Faculty of Food Technology and Health, Sahid University, Jakarta, Indonesia.

Email: athiyafadlina12@gmail.com

² Department of Nutrition, Faculty of Food Technology and Health, Sahid University, Jakarta, Indonesia.

Email: khoirul_anwar@usahid.ac.id

*Correspondence Author:

Department of Nutrition, Faculty of Food Technology and Health, Sahid University, Jakarta, Indonesia.

Email: khoirul_anwar@usahid.ac.id

Article History:

Received: March 28, 2023; Revised: July 23, 2023; Accepted: August 29, 2023; Published: March 12, 2024.

Publisher:



Politeknik Kesehatan Aceh
Kementerian Kesehatan RI

© The Author(s). 2024 **Open Access**

This article has been distributed under the terms of the *License Internasional Creative Commons Attribution 4.0*



Abstract

The prevalence of adult overnutrition in Indonesia increased from 26,3% to 35,4% from 2013 to 2018. Poor sleep quality is one of the factors of overnutrition. Poor sleep quality increases appetite and decreases energy expenditure, which leads to weight gain. Sleep quality has also worsened during the COVID-19 pandemic. This study aimed to examine the relationship between sleep quality and the incidence of overweight/obesity in adults post-COVID-19. The design of this study was cross-sectional, and an online survey was used. The questionnaire included the current weight, height, and sleep quality using the Pittsburgh Sleep Quality Index (PSQI) questionnaire. Data were collected from June to August 2022 in Indonesia, using convenience sampling. A Total of 148 participants completed the questionnaire. The association was analyzed using the Chi-square software. This study found 58,8% of the subjects had poor sleep and 23,6% were overweight/obese. Age, sex, education level, occupation, and marital status were associated with sleep quality. A higher proportion of poor sleep quality was found among overweight/overnutrition participants, but no association was found. In conclusion, no association was found between sleep quality and overweight or obesity. Most subjects had poor sleep quality; thus, further intervention is needed to improve sleep quality.

Keywords: COVID-19, quality of sleep, overnutrition

Abstrak

Prevalensi kejadian kelebihan gizi pada populasi dewasa di Indonesia meningkat dari 26,3% ke 35,4% di tahun 2013 - 2018. Salah satu faktor penyebab kelebihan berat badan adalah kualitas tidur. Kualitas tidur yang buruk meningkatkan nafsu makan dan menurunkan pengeluaran energi sehingga menyebabkan penambahan berat badan. Kualitas tidur juga memburuk selama pandemi COVID-19. Tujuan penelitian ini adalah untuk mengetahui hubungan antara kualitas tidur dengan kejadian kegemukan pada orang dewasa pasca masa pandemi COVID-19. Desain penelitian ini adalah *cross-sectional* menggunakan survei *online*. Kuesioner terdiri dari berat dan tinggi badan saat ini dan kualitas tidur menggunakan kuesioner Pittsburgh Sleep Quality Index (PSQI). Pengumpulan data dilakukan pada bulan Juni hingga Agustus 2022 di Indonesia dengan teknik pengambilan sampel *convenience sampling*. Sebanyak 148 subjek mengisi kuesioner secara lengkap. Analisis hubungan dilakukan dengan menggunakan Chisquare. Studi ini menemukan 58,8% subjek memiliki kualitas tidur yang buruk dan 23,6% *overweight/obesitas*. Umur, jenis kelamin, pendidikan, pekerjaan, dan status perkawinan berhubungan dengan kualitas tidur. Proporsi yang lebih tinggi dari kualitas tidur yang buruk ditemukan di antara subjek yang *overweight/obesitas*, Namun, tidak ditemukan hubungan. Kesimpulannya, tidak ada hubungan antara kualitas tidur dengan kelebihan berat badan. Sebagian besar subjek

memiliki kualitas tidur yang buruk sehingga diperlukan intervensi lebih lanjut untuk memperbaikinya.

Kata Kunci: COVID-19, kualitas tidur, kelebihan gizi

Introduction

The prevalence of adult obesity and being overweight in Indonesia and worldwide has increased in recent years. The prevalence of obesity worldwide has reached a pandemic dimension and has nearly tripled from 1975 to 2016. Global obesity prevalence is increasing by approximately 2 percentage points per decade (Boutari & Mantzoros, 2022). Based on Indonesia's basic health research, the prevalence of obesity and overweight has increased from 26,3% in 2013 to 35,4% in 2018. This condition can be a serious problem if it is not controlled for individuals and can burden the healthcare system (Kementerian Kesehatan RI, 2018).

Obesity and being overweight increase the risk of non-communicable diseases, including some cancers, hypertension, stroke, coronary heart disease, diabetes, and sleep apnea, which can lead to premature death (Ansari et al., 2020). From a previous study in 2016, six out of ten leading causes of disability-adjusted life-years in Indonesia were caused by non-communicable diseases, with dietary risk as its leading contributor (Mboi et al., 2018; Al Rahmad, 2021).

In addition, obesity can affect an individual's social life, leading to lower self-esteem and discrimination. Lower work opportunities and productivity that lead to economic constraints are also impacts of obesity (Okunogbe et al., 2021). Intervention is needed to control the risk factors of obesity such as excessive calorie intake, physical inactivity, and other factors such as sleep quality.

Previous studies have suggested that poor sleep quality is a risk factor for obesity and being overweight (Abdallah et al., 2021; Muhammad et al., 2020). One of the ways that short sleep duration can lead to obesity is that it is associated with higher energy intake caused by the increased consumption of high-saturated fat food. Consumption of energy-dense foods that contain high sugar and fat during nighttime eating and snacking is associated with low sleep quality and overweight (Papatriantafyllou et al., 2022). Another mechanism that explains the relationship between sleep quality and obesity is the shorter sleep duration. Sleep deprivation

increases appetite and food intake by affecting leptin regulation (Mosavat et al. 2021). Low sleep quality can also cause weakness, which reduces energy for physical activity (Al-Rasheed & Ibrahim, 2020).

The COVID-19 pandemic is likely to have a negative impact on sleep quality and positively increase the rate of obesity (Anyanwu et al., 2022; Meo et al., 2022). Social restrictions during the COVID-19 pandemic have changed individual habits, including dietary and physical activities towards physical inactivity, sedentary lifestyle, and poor eating patterns (Nour & Altıntaş, 2023). A study in Indonesia that assessed lifestyle alterations during the COVID-19 pandemic found that 30% of its subjects changed from normal to overweight/obese nutritional status. Moreover, there have been increases in BMI, physical inactivity, and sweet drink consumption during the COVID-19 pandemic (Azhar et al. 2022). Sleep problems are also common during the COVID-19 pandemic due to higher psychological distress and changes in sleeping habits, especially during the lockdown (Alimoradi et al., 2021). A study in Indonesia during the COVID-19 pandemic indicated that most subjects had poor sleep quality (Argo et al., 2021).

Several studies in Indonesia investigated the relationship between obesity and overweight during COVID-19 pandemic in adolescents and young adults (Isti et al., 2021; Pijaryani, 2022; Suja'I et al., 2022). To our knowledge, there is limited evidence of the relationship between obesity/overweight and sleep quality post-COVID-19 among the adult population in Indonesia. This study aimed to assess the association between sleep quality and overweight/obesity in Indonesian adults post-COVID-19 pandemic.

Methods

The study design was cross-sectional, and an online survey was conducted in Indonesia. The inclusion criteria were adults aged 19 – 49 years, living in Indonesia, and willing to participate in the study. The study was conducted from June

to August 2022, until the minimum number of samples was reached.

Convenience sampling was performed. Sample size calculation was obtained from hypothesis testing of the difference between the two proportions from Lwanga et al. (1991) with P1 66% and P2 34%. The power of the test for sample calculation was 90%, with a level of significance of 5%. The minimum sample size needed for this study was 100, with an additional 10% for the non-response possibility to 110.

$$n = \frac{\left\{ z_{1-\alpha/2} \sqrt{2\bar{P}(1-\bar{P})} + z_{1-\beta} \sqrt{P_1(1-P_1) + P_2(1-P_2)} \right\}^2}{(P_1 - P_2)^2}$$

- n : sample size
- P₁ : Proportion of obese adults with adequate sleep time
- P₂ : Proportion of obese adults with adequate sleep time
- α : level of significance
- 1 - β : Power of the test

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) questionnaire. There are seven components of the PSQI questionnaire, and each component score was added to produce the global PSQI score. Good sleep quality was defined as a PSQI score less than or equal to 5. The validity of the PSQI questionnaire in assessing sleep quality has been discussed in some studies (Sukmawati & Putra, 2019). The respondents' current weight, height, and weight were self-reported in the questionnaire. Body mass index was calculated and classified based on Indonesia's Balance Nutrition Guidelines (Kementerian Kesehatan RI, 2014).

Before the study began, pretesting was conducted to measure the validity and reliability of the questionnaire. The result of the test is that the PSQI questionnaire has good reliability with Cronbach's alpha for seven items, 0,74; hence, it can be used for data collection. After pre-testing and finalizing, the questionnaire was entered into the online survey platform, Lime survey, and distributed through social media.

The completed answers were checked, coded, entered, and analyzed using SPSS version 25.0. The descriptive analysis used proportions

for categorical data and median/mean for numerical data. Chi-square or Fisher's exact tests were used to assess the association between variables.

Ethical clearance was approved by the ethics committee of Mataram Health Polytechnic number LB.01.03/6/3876/2022. This study was funded by the LPPM USAHID.

Result and Discussion

A total of 148 subjects were collected with characteristics mostly female (85,5%), university graduate (64,1%), married (78,4%), aged 19 - 24 (57,4%), and working (39,2%). Table 1 shows the participants' sleep quality and nutritional status.

Table 1. Subject's sleep quality and Nutritional Status Characteristics (n=148)

Characteristics	Median (Min-Max)	Mean (±SD)	n (%)
Sleep Quality	6 (1-17)	6,8 (± 3,0)	
Good Quality			61 (41,2)
Poor Quality			87 (58,8)
Body Mass Index	21,9 (12,1 - 37,0)	22,8 (±4,3)	
Nutritional Status			
Underweight (<18,5)			21 (14,2)
Normal (18,5 - 25,0)			92 (62,2)
Overweight (>25 - 27,0)			8 (5,4)
Obese (>27,0)			27 (18,2)

Most of the subjects had poor sleep quality (58,8%) with median (min - max) and mean (±SD) PSQI scores of 6 (1 - 17) and 6,8 (± 3,0). A similar proportion was obtained in another study in Indonesia during the COVID-19 pandemic with 59,5% having poor sleep quality (Argo et al., 2021). This number is lower than that in the previous national representative survey which 21,7% had poor sleep quality. Several factors, such as physical activity, chronic illness, body mass index, mental health, and sociodemographic factors, may affect sleep quality among the population (Amelia et al., 2022).

Overall, the subjects had normal nutritional status (62,2%) with a median (min-max) of 21,9

(12,1 – 37,0) and a mean (\pm SD) of 22,8 (\pm 4,3). Of all subjects, 23,6% were overweight/obese. The prevalence of obesity is lower than that in Indonesia based on the 2018 Basic Health survey (35,4%) (Kementerian Kesehatan RI, 2018).

Table 2 shows the subjects' characteristics based on sleep quality. An association was found between sleep quality and sex, most recent education, occupation, marital status, and age. In this study, the 19 – 24 age group had higher odds of poor sleep quality (OR=2,24, 95% CI=1,14-4,38). Another study in Indonesia also finds a similar result that young adults have lower sleep quality (Argo et al., 2021). Young adults are prone to poor sleep quality due to stress caused by the high burden of academic or employment pressure and difficulties. Stress can lead to sleep disturbances such as insomnia (Yin et al., 2022).

Moreover, this study found that female has higher odds to have poor sleep quality (OR=2,67, 95% CI=1,03-6,92). This finding aligns with that of another study on a Chinese adult population (Madrid-Valero et al., 2017). A possible explanation for this is hormonal factors, such as premenstrual syndrome and menstrual pain (Bogale et al., 2022). Another study stated that a possible explanation is higher psychological and

behavioral in females, such as greater insomnia and depression with lower sleep quality (Guadagni et al., 2020).

Participants with secondary education as it last education had higher odds of lower sleep quality. Most of the participants in this study had secondary education, as the last education was a student. Students also had higher odds of poor sleep quality than their counterparts (OR=3,12, 95% CI=1,35 – 7,19). This finding is in line with other studies showing that the majority of university students had poor sleep quality (Herawati & Gayatri, 2019; Meo et al., 2022). University students have many activities and obligations, including academics and non-academics, that can increase their stress levels and affect their sleep quality.

Unmarried subjects also had higher odds of having poor sleep quality (OR=3,63, 95% CI=1,59 – 8,27). This finding is in line with that of another study on Taiwanese people (Shih et al., 2020). Marriage may affect people's physical and psychological wellbeing. The availability of a partner's emotional and material resources can increase mental and physical health, and enhance sleep quality (Liu et al., 2021).

Table 2. Subjects characteristics based on sleep quality (n=148)

Variables	Sleep Quality		Total (%)	p-value	Crude OR (CI 95%)
	Poor (%)	Good (%)			
Age					
19 – 24	57 (67,1)	28 (32,9)	85 (57,4)	0,018	2,24 (1,14 – 4,38)
25 – 38	30 (47,6)	33 (52,4)	63 (42,6)		
Sex					
Female	79 (62,2)	48 (37,8)	127 (85,8)	0,038	2,67 (1,03 – 6,92)
Male	8 (38,1)	13 (61,9)	21 (14,2)		
Last Education					
Secondary education	37 (69,8)	16 (30,2)	53 (35,8)	0,042	2,08 (1,02 – 4,23)
University	50 (52,6)	45 (47,4)	95 (64,1)		
Occupation					
Student	35 (74,5)	12 (25,5)	47 (31,8)	0,023	3,12 (1,38 – 7,19)
Not working	24 (55,8)	19 (44,2)	43 (29,1)		
Working	28 (48,3)	30 (51,7)	58 (39,2)		
Marital Status					
Not married	76 (65,5)	40 (34,5)	116 (78,4)	0,002	3,63 (1,59 – 8,27)
Married	11 (34,3)	21 (65,6)	32 (21,6)		

Table 3 shows the association between sleep quality and its components in overweight and obesity. In this study, although the obese/overweight group had a slightly higher proportion of poor sleep quality, there was no significant association between sleep quality and obese or overweight.

This finding is in line with that of another study conducted among university students (Kawi et al., 2019; Srimati et al., 2020). Another study of elementary school students in Indonesia found no significant relationship between sleep quality and obesity (Fikri & Husna, 2018). A study in Turkey also found a similar result, namely that

there was no association between sleep quality and anthropometric measurements, such as

weight, waist circumference, and BMI (Yilmaz et al., 2022).

Table 3. The association between sleep quality with overweight/obesity (n=148)

	Obese/overweight group (%)	Non Obese/overweight group (%)	Total	p-value
Sleep Quality				
Poor quality	21 (24,1)	66 (75,9)	87	0,867
Good Quality	14 (23)	47 (77,0)	61	
Sleep Quality Component				
Subjective sleep quality				
Bad/Very Bad	9 (18,8)	39 (81,3)	48	0,331
Good/Very Good	26 (26)	74 (74)	100	
Sleep Latency				
>15 minutes	23 (24,7)	70 (75,3)	93	0,687
<15 minutes	12 (21,8)	43 (78,2)	55	
Sleep duration				
≥7 hours	23 (25,3)	68 (74,7)	91	0,558
<7 hours	12 (21,1)	45 (78,9)	57	
Habitual Sleep Efficiency				
>85%	10 (25)	30 (73)	40	0,814
<85%	25 (23,1)	83 (76,9)	108	
Sleep disturbance				
>10 scores	8 (34,8)	15 (65,2)	23	0,172
<10 scores	27 (21,6)	98 (78,4)	125	
Sleeping medication				
Yes	2 (13,3)	13(86,7)	15	0,522
No	33 (24,8)	100 (75,2)	133	
Daytime dysfunction				
Yes	24 (22,9)	81 (22,9)	105	0,723
No	11 (25,6)	32 (74,4)	43	

A possible explanation for this study found no association between sleep quality and obesity/overweight; other factors influence nutritional status, such as the type of food consumed, physical activity, stress, and other factors that were not assessed and controlled in this study (Kawi et al., 2019). The cause of obesity is multifactorial because of the intricate interactions between genetics, epigenetics, and the environment (Tirthani et al., 2023). Obesity is caused by a long-term energy imbalance between calories consumed and burned (Lin & Li, 2021). Although these factors are important, the amount of energy consumed and used was not assessed in this study.

Differences in how data collected, research instrument, population and sample may result in different study outcome (Novziransyah & Daulay, 2018). Some studies collected weight and height data directly (Abdallah et al., 2021; Gupta et al., 2022; Sagala et al., 2017). Self reported that body weight and

height may not be as accurate as direct measurements.

Contrary to our results, a study of an adult population in a university setting found an association between poor sleep quality and overweight/obesity in young adults (Gupta et al., 2022). Our findings are also not in line with a study in Indonesia with adolescent subjects that found an association between sleep quality and obesity (Sagala et al., 2017).

This explains how poor sleep quality can cause an increase in appetite and energy intake due to metabolic and endocrine alterations (Broussard & Klein, 2022). Sleep is crucial for glucose metabolism and neuroendocrine function. Sleep loss can cause alterations in metabolic and endocrine systems such as lower insulin sensitivity, glucose tolerance, leptin levels, and increased cortisol and ghrelin levels, leading to increased hunger and appetite (Beccuti & Pannain, 2011). Insufficient sleep quality and duration often decreases physical activity (Krističević et al., 2018). Tiredness after

waking may occur because of poor sleep quality. When the body is exhausted, people tend to engage in sedentary activities such as watching television or using mobile phones (Cahyati et al., 2023). Other findings also found that poor sleeping patterns can increase food intake, such as snacking, which is high in fat and carbohydrates and can lead to weight gain (Papatriantafyllou et al., 2022).

Sleep quality components, such as subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, sleep duration, and sleep medication were also found to be unrelated to obesity/overweight. In contrast, a study in an Egyptian adult population also found an association between sleep duration and sleep disturbance in obesity/overweight. A study in Poland also found that obesity risk was greater in people with long and short sleep duration (Suliga et al., 2017; Dieny et al., 2021).

However, in line with this study, no association was found between subjective sleep quality, sleep latency, sleep efficiency, sleep medication, and daytime dysfunction (Abdallah et al., 2021; Elizabeth et al., 2022).

A study of Indonesian adolescents found no significant association between sleep duration and nutritional status. This can be explained by the fact that sleep duration and other sleep quality components are indirect factors of nutritional status, unlike infection and dietary intake (Suja'I et al., 2022). The mixed results on the relationship between sleep duration and overweight/obesity could be explained by the fact that short sleep duration might also increase energy expenditure due to longer wakefulness (Bacaro et al., 2020).

This study had some limitations. Data on sleep quality, weight, and height were also self-reported. This can lead to biases such as social desirability and recall bias. The investigator tried to minimize this bias by using current data on weight and height, and having clear instructions to fill in the data. Another limitation was that the nature of the online survey was more accessible to subjects who were literate, had higher education, and had Internet connections. To minimize the homogeneity of the respondents' characteristics, this survey was broadly shared through social media.

Conclusion

The conclusion of this study was that even though there was a slightly higher proportion of poor sleep quality in obese adults, there was no association between sleep quality and obesity. However, the majority of the adults in this study had poor sleep quality. Factors such as age, sex, education, occupation, and marital status were found to be related to sleep quality.

This finding highlights the need for further intervention to improve sleep quality, especially for the 19 – 24 years age group, females, secondary education, students, and unmarried subjects. The intervention aimed to raise awareness of the importance of good sleep quality and control factors that can interfere with sleep quality.

Acknowledgments

The author would like to express gratitude to the LPPM Universitas Sahid Jakarta for funding this study. We also thank all parties who helped distribute the research questionnaire.

References

- Abdallah, A. A., Mahfouz, E. M., Mohammed, E. S., Emam, S. A., & Rahman, T. A. A.-E. (2021). Sleep quality and its association with body weight among adults: an epidemiological study. *Malaysian Journal of Public Health Medicine*, 21(1), 15. <https://doi.org/10.37268/mjphm/vol.20/no.3/art.912>
- Alimoradi, Z., Broström, A., Tsang, H. W. H., Griffiths, M. D., Haghayegh, S., Ohayon, M. M., Lin, C.-Y., & Pakpour, A. H. (2021). Sleep problems during COVID-19 pandemic and its' association to psychological distress: A systematic review and meta-analysis. *EclinicalMedicine*, 36, 100916. <https://doi.org/10.1016/j.eclinm.2021.100916>
- Al Rahmad, A. H. (2021). Several risk factors of obesity among female school teachers and relevance to non-communicable diseases during the Covid-19 pandemic. *Amerta Nutrition*, 5(1), 31–40. <https://doi.org/http://dx.doi.org/10.2047>

- 3/amnt.v5i1.2021.31-40
- Al-Rasheed, A. S., & Ibrahim, A. I. (2020). Does the poor sleep quality affect the physical activity level, postural stability, and isometric muscle strength in Saudi adolescents? *Saudi Medical Journal*, 41(1), 94–97.
<https://doi.org/10.15537/smj.2020.1.24761>
- Amelia, V. L., Jen, H.-J., Lee, T.-Y., Chang, L.-F., & Chung, M.-H. (2022). Comparison of the associations between self-reported sleep quality and sleep duration concerning the risk of depression: A nationwide population-based study in Indonesia. *International Journal of Environmental Research and Public Health*, 19(21), Article 21.
<https://doi.org/10.3390/ijerph192114273>
- Ansari, S., Haboubi, H., & Haboubi, N. (2020). Adult obesity complications: Challenges and clinical impact. *Therapeutic Advances in Endocrinology and Metabolism*, 11, 2042018820934955.
<https://doi.org/10.1177/2042018820934955>
- Anyanwu, O. A., Naumova, E. N., Chomitz, V. R., Zhang, F. F., Chui, K., Kartasurya, M. I., & Folta, S. C. (2022). The Effects of the covid-19 pandemic on nutrition, health and environment in Indonesia: A qualitative investigation of perspectives from multi-disciplinary experts. *International Journal of Environmental Research and Public Health*, 19(18), 11575.
- Argo, T. M., Kurniawan, A., Liem, J. A., Sugianto, J. O., Michael, R. J., Agatha, L., Tanuwijaya, N. V. S., Wonsono, B., & Rivami, D. S. (2021). Association between depression, anxiety, and stress with sleep quality in Indonesian people during the COVID-19 pandemic. *Public Health of Indonesia*, 7(2), Article 2.
<https://doi.org/10.36685/phi.v7i2.409>
- Azhar, N. J. B., Zahra, Z. D., Irawan, D. A., & Rahmanna, S. (2022). Lifestyle alterations during the COVID-19 pandemic and its impact on obesity amongst Indonesian university students. *Sriwijaya Journal of Medicine*, 5(1), 51–60.
- Bacaro, V., Ballesio, A., Cerolini, S., Vacca, M., Poggiogalle, E., Donini, L. M., Lucidi, F., & Lombardo, C. (2020). Sleep duration and obesity in adulthood: An updated systematic review and meta-analysis. *Obesity Research & Clinical Practice*, 14(4), 301–309.
<https://doi.org/10.1016/j.orcp.2020.03.004>
- Beccuti, G., & Pannain, S. (2011). Sleep and obesity. *Current Opinion in Clinical Nutrition and Metabolic Care*, 14(4), 402–412.
<https://doi.org/10.1097/MCO.0b013e3283479109>
- Bogale, B., Wolde, A., Mohammed, N., Midaksa, G., & Bekele, B. B. (2022). Poor sleep quality and factors among reproductive-age women in Southwest Ethiopia. *Frontiers in Psychiatry*, 13.
- Boutari, C., & Mantzoros, C. S. (2022). A 2022 update on the epidemiology of obesity and a call to action: As its twin COVID-19 pandemic appears to be receding, the obesity and dysmetabolism pandemic continues to rage on. *Metabolism*, 133, 155217.
<https://doi.org/10.1016/j.metabol.2022.155217>
- Broussard, J. L., & Klein, S. (2022). Insufficient sleep and obesity: Cause or consequence. *Obesity*, 30(10), 1914–1916.
<https://doi.org/10.1002/oby.23539>
- Cahyati, W. H., Putriningtyas, N. D., Rengga, W. D. P., & Suharyo, S. (2023). Nutrition intake, physical activity, and sleep quality in the month of fast during Covid-19 pandemic. *Jurnal Kesehatan Masyarakat*, 18(4), Article 4.
<https://doi.org/10.15294/kemas.v18i4.40547>
- Dieny, F. F., Jauharany, F. F., Tsani, A. F. A., & Nissa, C. (2021). Perilaku makan sebelum dan selama pandemi covid-19 pada kelompok remaja dan dewasa di Indonesia. *Action: Aceh Nutrition Journal*, 6(2), 128–138.
<https://doi.org/10.30867/action.v6i2.418>
- Elizabeth, B., Wanda, D., & Apriyanti, E. (2022). The correlation between sleep quality and the prevalence of obesity in school-age children. *Journal of Public Health Research*, 10(1 Suppl), jphr.2021.2331.
<https://doi.org/10.4081/jphr.2021.2331>
- Fikri, H. K., & Husna, C. A. (2018). Hubungan kualitas tidur dengan obesitas pada anak

- sekolah dasar (SD) negeri di Desa Kampung Jawa Lama dan Lancang Garam Kota Lhokseumawe. *AVERROUS: Jurnal Kedokteran Dan Kesehatan Malikussaleh*, 4(1), 41–49.
- Guadagni, V., Umilta', A., & Iaria, G. (2020). Sleep quality, empathy, and mood during the isolation period of the COVID-19 pandemic in the Canadian population: Females and women suffered the most. *Frontiers in Global Women's Health*, 1.
- Gupta, P., Srivastava, N., Gupta, V., Tiwari, S., & Banerjee, M. (2022). Association of sleep duration and sleep quality with body mass index among young adults. *Journal of Family Medicine and Primary Care*, 11(6), 3251–3256. https://doi.org/10.4103/jfmpc.jfmpc_21_21
- Herawati, K., & Gayatri, D. (2019). The correlation between sleep quality and levels of stress among students in Universitas Indonesia. *Enfermería Clínica*, 29, 357–361. <https://doi.org/10.1016/j.enfcli.2019.04.044>
- Isti, A. N., Safitri, D. E., & Arumsari, I. (2021). Kualitas tidur dan stres berhubungan dengan status gizi orang dewasa pada masa pandemi Covid-19. *NUTRIRE DIAITA*, 13(02). <https://doi.org/10.47007/nut.v13i2.4053>
- Kawi, Y. A., Wihandani, D. M., & Surudarma, I. W. (2019). Pengaruh obesitas pada kualitas tidur mahasiswa Fakultas Kedokteran Universitas Udayana periode 2018. *Intisari Sains Medis*, 10(3). <https://doi.org/10.15562/ism.v10i3.442>
- Kementerian Kesehatan RI. (2014). *Peraturan Menteri Kesehatan Republik Indonesia Nomor 41 Tahun 2014 Tentang Pedoman Gizi Seimbang*.
- Kementerian Kesehatan RI. (2018). Hasil utama RISKESDAS 2018. *Jakarta Badan Penelit Dan Pengemb Kesehatan, Kementrian Kesehat Republik Indones*.
- Krističević, T., Štefan, L., & Sporiš, G. (2018). The Associations between Sleep Duration and Sleep Quality with Body-Mass Index in a Large Sample of Young Adults. *International Journal of Environmental Research and Public Health*, 15(4), 758. <https://doi.org/10.3390/ijerph15040758>
- Lin, X., & Li, H. (2021). Obesity: Epidemiology, Pathophysiology, and therapeutics. *Frontiers in Endocrinology*, 12, 706978. <https://doi.org/10.3389/fendo.2021.706978>
- Liu, Q., Zhu, Y., & Pei, Y. (2021). Bachelor status and the sleep quality among chinese men: A moderated mediation model. *American Journal of Men's Health*, 15(3), 15579883211018424.
- Lwanga S. K., Lemeshow S., & World Health Organization. (1991). Sample size determination in health studies: A practical manual / S. K. Lwanga and S. Lemeshow. *Determination de la taille d' un échantillon dans les études sanométriques: manuel pratique*. WHO IRIS. <https://apps.who.int/iris/handle/10665/40062>
- Madrid-Valero, J. J., Martínez-Selva, J. M., Ribeiro do Couto, B., Sánchez-Romera, J. F., & Ordoñana, J. R. (2017). Age and gender effects on the prevalence of poor sleep quality in the adult population. *Gaceta Sanitaria*, 31(1), 18–22. <https://doi.org/10.1016/j.gaceta.2016.05.013>
- Mboi, N., Murty Surbakti, I., Trihandini, I., Elyazar, I., Houston Smith, K., Bahjuri Ali, P., Kosen, S., Flemons, K., Ray, S. E., Cao, J., Glenn, S. D., Miller-Petrie, M. K., Mooney, M. D., Ried, J. L., Nur Anggraini Ningrum, D., Idris, F., Siregar, K. N., Harimurti, P., Bernstein, R. S., ... Hay, S. I. (2018). On the road to universal health care in Indonesia, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. *The Lancet*, 392(10147), 581–591. [https://doi.org/10.1016/S0140-6736\(18\)30595-6](https://doi.org/10.1016/S0140-6736(18)30595-6)
- Meo, S. A., Alkhalifah, J. M., Alshammari, N. F., Alnufaie, W. S., & Algoblan, A. F. (2022). Impact of COVID-19 pandemic on sleep quality among medical and general science students: King Saud University Experience. *Pakistan Journal of Medical Sciences*, 38(3Part-I), 639–644. <https://doi.org/10.12669/pjms.38.3.5171>
- Mosavat, M., Mirsanjari, M., Arabiat, D., Smyth, A., & Whitehead, L. (2021). The role of sleep curtailment on leptin levels in obesity and diabetes mellitus. *Obesity Facts*, 14(2), 214–221.

- <https://doi.org/10.1159/000514095>
- Muhammad, H. F. L., Pratama, S. A., Sulistyoningrum, D. C., Hartono, M. N., Huriyati, E., Lee, Y. Y., & Muda, W. A. M. W. (2020). The impact of sleep quality and duration on leptin, appetite, and obesity indices in adults. *Medical Journal of Indonesia*, 29(4), 417–421.
- Nour, T. Y., & ALTINTAŞ, K. H. (2023). Effect of the COVID-19 pandemic on obesity and its risk factors: A systematic review. *BMC Public Health*, 23(1), 1018. <https://doi.org/10.1186/s12889-023-15833-2>
- Novziransyah, N., & Daulay, M. S. (2018). Hubungan waktu tidur dengan kelebihan berat badan pada mahasiswa dan staf pengajar FK UISU. *Jurnal Kedokteran Komunitas Dan Tropik*, 6(1).
- Okunogbe, A., Nugent, R., Spencer, G., Ralston, J., & Wilding, J. (2021). Economic impacts of overweight and obesity: Current and future estimates for eight countries. *BMJ Global Health*, 6(10), e006351. <https://doi.org/10.1136/bmjgh-2021-006351>
- Papatriantafyllou, E., Efthymiou, D., Zoumbaneas, E., Popescu, C. A., & Vassilopoulou, E. (2022). Sleep deprivation: Effects on weight loss and weight loss maintenance. *Nutrients*, 14(8), Article 8. <https://doi.org/10.3390/nu14081549>
- Pijaryani, I. (2022). Kebiasaan makan (eating habits) dan sedentary lifestyle dengan gizi lebih pada remaja pada saat pandemi Covid-19. *Jurnal Ilmiah Kesehatan*, 21(1), 33–37.
- Sagala, N. J., Sofyani, S., & Supriatmo, S. (2017). Association between sleep quality and obesity in adolescents. *Paediatrica Indonesiana*, 57(1), 41–46.
- Salahuddin, M., Maru, T. T., Kumalo, A., Pandi-Perumal, S. R., Bahammam, A. S., & Manzar, M. D. (2017). Validation of the pittsburgh sleep quality index in community dwelling Ethiopian adults. *Health and Quality of Life Outcomes*, 15(1), 58. <https://doi.org/10.1186/s12955-017-0637-5>
- Shih, A.-C., Chen, L.-H., Tsai, C.-C., & Chen, J.-Y. (2020). Correlation between Sleep Quality and Frailty Status among Middle-Aged and Older Taiwanese People: A Community-Based, Cross-Sectional Study. *International Journal of Environmental Research and Public Health*, 17(24), Article 24. <https://doi.org/10.3390/ijerph17249457>
- Srimiati, M., Fayasari, A., Rizqiawan, A., & Agestika, L. (2020). Food supplement consumption does not related to self-reported symptoms of covid-19 among students in Binawan University. *Action: Aceh Nutrition Journal*, 5(2), 203–209. <https://doi.org/10.30867/action.v5i2.348>
- Suja'I, M. N. M., Noviasy, R., Kurniawati, E. R., & Wisnuwardani, R. W. (2022). The association between sleep duration, breakfast routine and nutritional status in indonesian adolescents during COVID-19 pandemic. *Jurnal Gizi Indonesia (The Indonesian Journal of Nutrition)*, 10(2), 168–180. <https://doi.org/10.14710/jgi.10.2.168-180>
- Sukmawati, N. M. H., & Putra, I. G. S. W. (2019). Reliabilitas kusioner pittsburgh sleep quality index (Psqi) versi bahasa Indonesia dalam mengukur kualitas tidur lansia. *WICAKSANA: Jurnal Lingkungan Dan Pembangunan*, 3(2), 30–38.
- Suliga, E., Koziel, D., Cieśła, E., Rębak, D., & Głuszek, S. (2017). Sleep duration and the risk of obesity—a cross-sectional study. *Medical Studies/Studia Medyczne*, 33(3), 176–183.
- Tirthani, E., Said, M. S., & Rehman, A. (2023). Genetics and Obesity. In *StatPearls*. StatPearls Publishing. <http://www.ncbi.nlm.nih.gov/books/NBK573068/>
- Yilmaz, B., Çiçek, B., & Kaner, G. (2022). The Effect of Body Weight on Sleep Quality and Sleep Duration in Adolescents. *Journal of Contemporary Medicine*, 12(2), 238–243. <https://doi.org/10.16899/jcm.1015273>
- Yin, F., Chen, C., Song, S., Chen, Z., Jiao, Z., Yan, Z., Yin, G., & Feng, Z. (2022). Factors affecting University Students' sleep quality during the normalisation of COVID-19 epidemic prevention and control in China: A cross-sectional study. *Sustainability*, 14(17), 10646.