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THE INFLUENCE OF SMOKING BEHAVIOR ON SOCIAL JETLAG, CHANGES IN BODY MASS INDEX, AND MENTAL HEALTH IN STUDENTS DURING AND AFTER THE COVID-19 PANDEMIC

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Abstract: Introduction: Smoking is a major public health problem globally and nationally in Indonesia. Smoking is a risk factor for various non-communicable diseases such as cancer, cardiovascular and other degenerative diseases. Social jetlag is a circadian rhythm phenomenon that has surfaced in the recent electricity era where social jetlag is a measure of accumulated daily sleep deficits. The impact of jetlag has a bad influence on health and is associated with bad health behavior. Obesity has recently become a global phenomenon, apart from being a risk for various non-communicable diseases, during the COVID-19 pandemic obesity was a determinant of the poor clinical condition of a person who was attacked by the COVID-19 virus. Mental health is also starting to emerge and become a phenomenon that is often found in late adolescents. The transition period of the learning system from online to offline is a phase that demands adaptability for students. Does smoking behavior in this group who experience changes from online to offline learning systems affect social jetlag, changes in body mass index, and mental health. Purpose: evaluate the effect of smoking on social jetlag, changes in body mass index and mental health in adolescents in the transition era of online to offline learning. Methods: a cross-sectional design study evaluating differences in average social jetlag, changes in body mass index, and levels of depression, anxiety and stress (Indonesian version of the DASS-21) between smoking and non- smoker students. Data from respondents were obtained by filling in a Google form which was distributed through social media networks with WhatsApp, Instagram, Facebook and Line platforms. Results: as many as 389 students voluntarily participated in this study. Student smokers have significantly higher body mass index during the pandemic, and lower BMI when offline. Social jetlag, levels of depression, anxiety and stress are increasing. Conclusion: Smoking increases the risk of social jetlag, significant changes in body mass index, and mental health disorders during the online-to-offline transition.

Keywords: smoking behavior, social jetlag, body mass index, mental health, the COVID-19 pandemic

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Introduction

Smoking behavior is a major public health problem globally and nationally in Indonesia. Globally, the prevalence of smoking in adults respectively is 32.6% and 6.5% for men and women in 2020. (Dai et al., 2022) The prevalence of smoking in China study found a decrease from 30.30% in 2010 to 28.69% in 2018. In terms of intensity, cigarette consumption obtained relatively stable figures from 16.96 cigarettes to 15.12 cigarettes per day from 2010 to 2018. (G. Zhang et al., 2022) In England the prevalence of adults with overweight / obesity has reached 64%, and active smokers are currently at 14%. (McLaughlin et al., 2022) The prevalence of smokers in Indonesia was also relatively stable, in 2007 active smokers every day were 23.7%; sometimes 5.5% and in 2018 active daily smokers 24.3% and sometimes 4.6%. (Badan Penelitian dan Pengembangan Kesehatan, Kementerian Kesehatan RI, 2007)(Kemenkes RI, 2019) Even though there have been many health promotion campaigns to stop smoking, the reduction in smoking prevalence was not as expected, especially recently, electronic nicotine delivery systems have begun to appear. (Kaiping Zhang et al., 2022)

Smoking is a primary risk factor for various cancers, such as respiratory tract cancer, ovarian cancer, and preventable early death. (Zhou et al., 2022)(Sarich et al., 2022)(Huang et al., 2022)(Wu et al., 2022) In another study, smoking habits influence various parameters that indicate poor sleep quality. (Ermis & Imamoglu, 2022)

Obesity is another major public health problem both globally and nationally in Indonesia. Obesity is a major health problem, related to its impact on various degenerative diseases, such as metabolic syndrome, hypertension, type 2 diabetes, and morbidity and mortality related to heart disease. (Lee et al., 2022)(Khanna et al., 2022) Body mass index is one of the most frequently used measures of obesity in the population. (Khanna et al., 2022) There was a change in the prevalence of overweight and obesity before and during the pandemic in Bangladesh, where there was an increase during the pandemic. (Hossain et al., 2022)

In human life, circadian rhythms are the coordination of molecular clocks in the brain and peripheral areas, which are synchronized by signals (zeitgeber) of light and other signals such as clocks of social norms. This harmonious interaction between the internal clock and external signals is important in maintaining physiological homeostases, such as cell cycle progression, cytokine release, sleep-wake rhythm, immune activity and various other important functions. (Fang et al., 2022) Social jetlag is a state of mismatch between internal biological clocks and social norms. Social jetlag is associated with prolonged sleep duration on weekends/holidays and irregular wake/sleep times on weekdays. (Nishimura et al., 2022) Sleep duration itself is an important physiological function, as one of the endogenous drives that has both short and long term health impacts. (Pilcher et al., 2022)(Liu et al., 2023) Night chronotype, namely people who sleep later and wake up later, tend to increase their body mass index through sedentary behavior. (Sempere- Rubio et al., 2022)

College students are a group that is vulnerable to experiencing due to several things, namely pressure related to a change or new responsibilities on the one hand, on the other hand immature psychological development and weak resistance to pressure. (Hou, 2022)(Hernandez-ruiz, 2022) Entering university is marked by drastic changes in life management, academic responsibility, increasing social responsibility, and finding new freedoms. At the same time, it was also found that the prevalence of

poor sleep quality was more common. (Schminckler et al., 2023) The COVID-19 pandemic has had a strong influence on various aspects of human life, in addition to victims related to morbidity and mortality as a result, mandatory preventive measures such as social isolation changes the way social activities are carried out, during an active pandemic. When it ended, many major adjustments had to be made. This situation more or less has a

significant influence on human behavior and its impact on physical, mental health and quality of life. (Garcia-Garro et al., 2022) Groups of students who have a habit of sleeping late – waking up late (night chronotype) have a vulnerability to experiencing circadian rhythm mismatches called social jetlag as previously mentioned. Furthermore, this social jetlag is a risk factor for increased visceral fat, as the results of a study conducted in Germany. (Krueger et al., 2023) Until now there is still limited research evaluating comparisons of social jetlag, body mass index, and mental health in college students, during the pandemic and afterward in Indonesia. This study aims to evaluate these differences.

Materials and Methods

Subject and Study Design

The research subjects were university students who were actively studying in the territory of Indonesia. Participants were recruited through broadcasting on the author's social media network. The social media platforms used include Whatsapp, Instagram and Line. Participants gave their consent to participate in the study before filling out a questionnaire which was distributed further online. Participants fill in data regarding age, gender, height, weight during the COVID-19 pandemic, current weight (after the COVID-19 pandemic), hours of sleep and wake up on holidays and working days both during the pandemic and afterward, the depression anxiety stress scale-21 (DASS-21) questionnaire and smoking habits. This research was conducted in the period October – December 2022.

Body Mass Index Calculation

Body mass index is a body mass index calculated using the formula $\frac{weight\ (kg)}{height\ (m)^2}$

Weight data is asked both during an active pandemic/lockdown, and current weight. Body mass index is not further classified.

Social Jet Lag Calculation

Generally, the calculation of social jetlag is obtained from calculating the midpoint of sleep on holidays minus the midpoint of sleep on weekdays. In this study, social jetlag was calculated when the COVID-19 pandemic took place and now after the pandemic has ended. The calculation steps are as follows:

$$\text{midsleep point freeday (a)} = \textit{sleep hour free day (a)} + \frac{(\textit{wake up hour free day (a)} - \textit{sleep hour free day (a)})}{2}$$

$$\text{midsleep point workday (a)} = \textit{sleep hour workday (a)} + \frac{(\textit{wake up hour workday (a)} - \textit{sleep hour workday (a)})}{2}$$

$$\text{Social Jet lag (a)} = \textit{midsleep point free day (a)} - \textit{midsleep point workday (a)}$$

Social jetlag after the Covid-19 pandemic (b)

$$\text{midsleep point freeday } (b) = \textit{sleep hour free day } (b) + \frac{(\textit{wake up hour free day } (b) - \textit{sleep hour free day } (b))}{2}$$

$$\text{midsleep point workday (b)} = \textit{sleep hour workday } (b) + \frac{(\textit{wake up hour workday } (b) - \textit{sleep hour workday } (b))}{2}$$

$$\text{Social Jet lag (b)} = \textit{midsleep point free day } (b) - \textit{midsleep point workday } (b)$$

Result

Table 1. Characteristics of Research Respondents (n=389)

Variable	Attribute / mean [SD]	□ / min	% / max
Age (years)	20 (2)	15	26
Gender	Women	282	72
	Men	107	28
Smoking behavior	Not smoking	356	92
	Smoking	33	8
Body mass index during the pandemic	21.59 (3.89)	14.53	40.98
Body mass index after the pandemic	21.52 (3.80)	13.96	38.14
Body mass index after – during the pandemic	-0.05 (1.58)	-5.14	5.65
Social jet lag during the pandemic	0.67 (1.20)	-3.00	5.50
Social jet lag after the pandemic	0.67 (1.29)	-3.00	5.50
Level of depression	8.29 [6.18]	0.00	24.00
Level of anxiety	8.24 [4.84]	0.00	21.00
Level of stress	8.64 [5.17]	0.00	21.00

Table 2. Bivariate analysis of differences in body mass index and social jetlag during and after the pandemic and levels of depression, anxiety, and stress after the pandemic between smokers vs non-smokers.

		N (389)	Mean	SD	P
Body mass index during the pandemic					
	Non-smoker	356	22.08	11.86	0.014
	Smoker	33	22.60	3.22	
Body mass index in the post-pandemic					

	Non-smoker	356	22.08	12.11	0.129
	Smoker	33	21.98	2.80	
Body mass index post – during the pandemic					
	Non-smoker	356	0.00	1.57	0.044
	Smoker	33	-0.61	1.64	
Social jetlag during the pandemic					
Smoking habits	Non-smoker	356	0.60	1.11	0.0003
	Smoker	33	1.42	1.74	
		Social jetlag in the post pandemic			
	Non-smoker	356	0.59	1.25	0.00004
	Smoker	33	1.56	1.33	
		Level of depression			
	Non-smoker	356	7.94	6.02	0.0007
	Smoker	33	12.06	6.64	
		Level of anxiety			
	Non-smoker	356	8.07	4.71	0.040
	Smoker	33	10.12	5.88	
Level of stress					
Non-smoker		356	8.44	5.08	0.030
Smoker		33	10.79	5.73	

Discussion

Traditionally it has been stated that the risk factor for obesity with the anthropometric measurements used is the body mass index including lack of physical activity, unbalanced diet, and imbalance between calorie intake and calories expended, as well as other factors related to poor sleep quality. (Chaput et al., 2022) This study provides an additional risk factor, namely smoking behavior. When studied further smoking also contributes to the risk of poor sleep quality, through the nicotine mechanism is a stimulant. (Chaput et al., 2022) Simultaneously that smoking makes sleeping more late, less physical activity, further increases body fat mass. In general, college students are a group that tends to decrease physical activity after college, increase the use of computers and gadgets, sit longer, and lower fiber consumption. (Mule et al., 2022) Research on 1042 students in China found that the prevalence of mild to moderate depression was 18 and 6.9%. The prevalence of depression is associated with social jetlag ≥ 2 hours and night chronotype and sleep duration of less than 8 hours. (Qu et al., 2023)

Attention to smoking has a very significant effect on social jetlag needs serious attention. This is because this social jetlag in the student group is furthermore a risk factor for various kinds of health risks and risks of bad health behavior, both in physical and mental health. (Qu et al., 2023)(Nowakowska-Domagala et al., 2023)(Putilov et al., 2023) Apart from physical and mental health aspects, social jetlag in adolescents has a strong correlation with poor academic achievement as well as high absenteeism and lack of concentration. (Futenma et al., 2023)(D'Angiulli et al., 2023) Naturally according to the milestone stages of their development, adolescents aged 17-20 years have a

tendency to sleep later, this condition is a risk factor for social jetlag. So social jetlag is relatively common in this age group. (Pvalinac Dodig et al., 2023) Long periods of social activity restriction, as in this study, affect the sleep-wake cycle pattern of the college students (late teens). When most of them migrate from their place of residence, social jetlag becomes more severe, especially in the smoker group. Social jetlag and smoking behavior are a link in a vicious circle that reinforces one another. Furthermore, these two conditions also have bad implications for the mental health of adolescents. (Uccella et al., 2023) Nevertheless, some researchers conclude that smoking is more of a consequence than a cause of social jetlag. (Ghotbi et al., 2023) Research that is closer to this study in terms of the effect of smoking behavior on social jetlag is a study on 2364 young high school students in Poland aged 14-19 years. The conclusive thing in this study is that smoking is a strong risk factor in influencing sleep disorders such as staying up late in addition to other risk factors such as lack of physical activity. (Tatar et al., 2023) Research in a similar group, namely in 1031 adolescents (13-18 years) in British Columbia found that social jetlag of more than 1 hour increased the risk of consuming higher sugary foods/drinks. (Kexin Zhang et al., 2023) When associated with long travel as a risk factor for non- communicable diseases such as cardiovascular disease, an increase in body mass index is a mediating factor between social jetlag and an increase in low-grade systemic inflammation and poor metabolic biomarkers. Indicators of low-grade systemic inflammation include C-reactive protein and interleukin-6, while metabolic biomarkers include adiponectin and leptin. (Alqaderi et al., 2023) Furthermore, social jetlag, which is higher in the late adolescent group, worsens their quality of life. (Yuksel & Ozakgul, 2023)

In this study, the average social jetlag in the non-smoker group (SD) was 0.60 (1.11) hours during the pandemic/online learning, and 0.59 (1.25) hours offline. The smoker group during the pandemic and after

the pandemic were 1.42 (1.74) hours and 1.56 (1.33) hours respectively. The average social jetlag in all groups before and after the pandemic was 0.67 (1.20) and 0.67 (1.29) hours, respectively. When compared with research on 1,200 Japanese male college students, getting an average social jetlag of 1.1 ± 1.0 h. (Nishimura et al., 2022)

The changes were found in the body mass index of the smoking group during the pandemic and after the COVID-19 pandemic, as shown by the difference between the two times, which was - 0.61. Meanwhile, from the DASS-21 questionnaire that we used to see how high the level of student mental health was, it was found that student smokers had higher levels of depression, anxiety, and stress than students who are not smokers.

Conclusion

Smoking increases the risk of social jetlag, significant changes in body mass index, and mental health disorders during the online-to-offline transition.

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Declaration of Interest Statement

The author declares to have no conflict of interest in this research.

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