

SHORT COMMUNICATION

Relationship between Physical Activity and Chronotype with Nutritional Status in Female Students during Covid-19 Pandemic

Puji Lestari^{1*}, Eti Poncorini Pamungkasari², Tri Rejeki Andayani³

1. Postgraduate Program of Human Nutrition, Faculty of Sekolah Pascasarjana, Universitas Sebelas Maret, Surakarta, Indonesia

2. Department of Public Health, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia

3. Department of Psychology, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia

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*Corresponding author:

Puji Lestari, MSc;
Postgraduate Program of Human Nutrition, Faculty of Sekolah Pascasarjana, Universitas Sebelas Maret, Surakarta, Indonesia.
Tel: +62 813 27654685
Email: ppujilestari910@gmail.com
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ABSTRACT

Background: There has been a decrease in physical activity among female students during the COVID-19 pandemic. This can be a risk factor for obesity in female students. This study was undertaken to analyze the relationship between physical activity, chronotype, and nutritional status in female students during COVID-19 pandemic.

Methods: In a cross-sectional study, 171 female students were enrolled as respondents in Jebres, Surakarta using multistage random sampling and simple random sampling methods. Data were analyzed using the Physical Activity Questionnaire for Adolescents (PAQ-A) and Morningness-Eveningness Questionnaire (MEQ).

Results: Female students had mostly normal nutritional status, but 26.9% were overweight. There was a relationship between physical activity ($p=0.032$) and chronotype ($p=0.004$) with nutritional status among female students during the COVID-19 pandemic.

Conclusion: Physical activity and chronotype showed significant relationship with nutritional status among female students during the COVID-19 pandemic.

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Introduction

COVID-19 was reported as an outbreak global pandemic in March 2020 by World Health Organization (WHO) (1) changing adolescents' lives due to social restrictions, closures of schools, public facilities and sports facilities (2). A prior study showed sedentary behavior to be correlated with well-being in adolescents during pandemic (2). During pandemic, there have been increased poor eating habits, sedentary habits and screen time caused obesity in adolescence (2). According

to World Health Organization (WHO) report, about 340 million people aged 5-19 years old have been obese and adolescents obesity has reached epidemic levels and about 17% were found obese in United States (3). In Indonesia, the incidence of obesity is 26.6% that has increased up to 30%, while the prevalence of obesity has been higher in girl than boys (4) and 11.8% of girls aged 16-18 years were found overweight and 4.5% were obese (5). The prevalence of obesity was demonstrated to differ based on age, ethnicity, gender and socioeconomic

status (6). Based on a cohort study, Body Mass Index (BMI) increases during pandemics among school aged children and youths (6).

As COVID-19 can interfere with routine physical activity, obesity can happen in adolescence (1). During the COVID-19 pandemic, increase in sedentary habits and decrease in physical activity have occurred in school children as they were closed and online classes have started leading to obesity (1). Circadian rhythms play important role in human biological processes regulating the sleep-wake cycle or chronotype. Changes in a person's circadian rhythm can lead to sleep disturbances and chronic diseases such as obesity (7). Social distancing during the COVID-19 pandemic has caused people to be exposed to more screens such as TVs, laptops and cell phones leading to poor sleep quality and obesity (7). So this study has determined the relationship between physical activity and chronotype with nutritional status in female students during Covid-19 pandemic in Jebres, Surakarta, Indonesia.

Materials and Methods

In a cross-sectional study from February to March 2022, four high schools with a total of 171 female students in Jebres, Surakarta, Indonesia were enrolled using multistage random sampling and simple random sampling methods utilizing OpenEpi (Open Source Epidemiological Statistics for Public Health). The inclusion criteria were being registered as active students at SMA N 8 Surakarta, SMA Warga Surakarta, SMK N 8 Surakarta and SMK Kristen 1 Surakarta, aged 16-18 years and willing to be respondents. Female students who suffered from chronic diseases were excluded. Nutritional status was obtained by measuring weight (weight scale) and height (microtoice) and were categorized according to the Z-score, nutritional status

Normal-2 SD to 1 SD, underweight <-3 SD to <-2 SD and overweight 1 SD to >2 SD. Physical activity was measured by the self-administered Physical Activity Questionnaire for Adolescents (PAQ-A), during the last 7 days and developed for high school students in grades 9-12 or around 14-19 years old. Chronotypes were measured with Morningness-Eveningness Questionnaire (MEQ) and classified into morning type >58, moderate 42-58 and evening <42. The data were analyzed using Chi Square. This research has been confirmed by Ethics Committee of the Faculty of Medicine, Universitas Sebelas Maret No: 03/UN.27.06.6.1/KEP/EC/2022.

Results

As Table 1 shows, most of the respondents were 16 years old (56.7%), 41.5% were 17 years old and 1.8% were 18 years old. The majority of female students had mild (56.5%) and moderate activities (43.3%). Table 1 demonstrates that female students mostly had morning (46.2%), intermediate (46.2%) and evening 7.6% chronotypes. Based on nutritional status, most of the respondents had normal nutritional status (64.3%) and 26.9% overweight female students. A person's nutritional status was influenced by various interrelated factors and consumption of adequate food in quality and quantity had a significant impact on nutritional status. Table 2 reveals the relationship between physical activity and chronotype with nutritional status in female students during COVID-19 pandemic. Result on Table 2 showed that physical activity and nutritional status had a significant correlation ($p=0.032$).

Physical activity was shown to contribute weight and maintenance of weight loss. During the pandemic, obese individuals gained an average of 1.5 kg weight.

Table 1: Characteristics of respondents enrolled in the study.

Variable	n	Percentage (%)
Age (Years)		
16	97	56.7
17	71	41.5
18	3	1.8
Physical activity		
Mild	97	56.5
Moderate	74	43.3
Chronotype		
Morning	79	46.2
Intermediate	79	46.2
Evening	13	7.6
Nutritional Status		
Normal	110	64.3
Underweight	15	8.8
Overweight	46	26.9

Table 2: Relationship noticed between physical activity and chronotype with nutritional status in female students during COVID-19 pandemic.

Variable	Nutritional status						P value
	Normal		Underweight		Overweight		
	n	%	n	%	n	%	
Physical activity							0.032
Mild	63	65	4	4.12	30	31	
Moderate	47	63	11	15	16	22	
Chronotype							0.004
Morning Type	57	72	6	8	16	20	
Intermediate	50	63.3	5	6.3	24	30.4	
Evening Type	3	23	4	31	6	46	

The respondents mostly had mild physical activity even though physical activity could be beneficial in health and mental wellbeing in adolescence during the pandemic. Consumption of high-energy foods and sedentary habits, obesity were influenced by circadian rhythms and chronotype was correlated with nutritional status female students ($p=0.004$). The evening chronotype was associated with higher BMI and unhealthy eating behavior in adolescents.

Discussion

In our study, chronotype changes occurred significantly in adolescence with an increase in age. This can be due to biological and individual factors such as age and gender as well as environmental factors (changes in light and dark and latitude). During the COVID-19 pandemic, adolescents often experienced a delay of sleep-waking time and there was a shift to the evening type. In addition, symptoms of severe insomnia, poor sleep quality, and an increase in disturbed sleep habits including waking time and nap time were also reported during the COVID-19 pandemic (8). Moreover, social factors such as school schedules and lifestyle can affect a person's chronotype (8).

Nutritional status can also be an effort to increase resistance to viruses during the COVID-19 pandemic. Optimal nutrition and adequate intake will have an impact on increasing the immune system. Consuming foods rich in iron intake, vitamins A, E, B6, B12, C and zinc was demonstrated to be very beneficial for maintaining immune function (8). Our findings showed that physical activity and nutritional status had both a significant correlation with COVID-19 pandemic ($p=0.032$). These results are in line with another research reporting a significant relationship between physical activity and nutritional status during the COVID-19 pandemic. Social distancing and lock downs during the pandemic caused limited space for carrying out daily activities (8). In addition, school closures and changes into the online learning system have resulted spending more time sitting

and doing less physical activity by female students. A study conducted before during the COVID-19 pandemic revealed that 90.5% of young women did activities at home and 54% spent their time sitting or lying down (9). A review during the pandemic illustrated a decrease in physical activity from 10.8 minutes to 91 minutes per day based on factors such as age, gender, social economy, and environmental factors (10).

Physical activity also contributes to weight and maintenance of weight loss. During the COVID-19 pandemic, obese individuals gained weight due to low exercise frequency, loneliness, anxiety, increased eating, excessive snack consumption, consumption of unhealthy foods and frequent intake of sweets (10, 11). It was shown that Moderate to Vigorous Physical Activity (MVPA) per day can reduce BMI to 0.006 kg/m² and waist circumference to 0.015 cm. In addition, female gender showed lower MVPA and had a higher prevalence of obesity (11). Environmental, lifestyle and socio-cultural factors were mentioned to contribute to the increasing prevalence of obesity. Overweight and obesity are generally associated with excessive intake of calories and fat. However, it turns out that sugar intake from soft drinks, large meal portions, and decreased physical activity play a role in reducing the prevalence of obesity. In addition, poor academic performances and low quality of life are also experienced by obese adolescents (12).

Consumption of high-energy foods and sedentary habits, obesity were found to be influenced by circadian rhythms. Our findings revealed chronotype to be correlated with nutritional status among female students ($p=0.004$). This finding is similar to a previous report that evening chronotype is associated with obesity in adolescent girls, while there was a change in the evening chronotype of female students due to excessive screen time during the Covid-19 pandemic. In addition, adolescents with screen time ≥ 2 h/day had higher risk incidence of obesity (12). A study in elementary school children

(n=7419) explained that the duration and time of screen time were positively related to BMI. In addition, respondents who had short screen time had more physical activity and better academic performance when compared to respondents who had excessive screen time (13). A cohort study with 11,361 respondents (13-15 years old) found that excessive screen time was associated with short sleep duration, sleep disturbances, poor sleep quality and frequent waking at night. The strongest impact appeared with the use of screen time for internet and social media usage (14).

We showed the evening chronotype to be associated with higher BMI and unhealthy eating behavior in adolescents. A study conducted on adolescents in Hong Kong described the evening chronotype to have watching television habits during meals, and to be 14 times more likely to skip breakfast, and 7 times more orientation to fast food consumption (15). A cross-sectional study on adolescents aged 10-18 years (n=233) displayed that the evening chronotype was four times more likely to skip breakfast when compared to the morning type (16). Another study with 721 undergraduate students as respondents exhibited that the evening chronotype was associated with skipping breakfast and consuming foods high in calories, carbohydrates and fat in their breakfast. This behavior is often associated with the incidence of being overweight (17). Moreover, one study in adolescents aged 14-17 years revealed a positive relationship between social jet lag and BMI scores and waist to height ratio (18). Another study showed that the evening chronotype initiated a person to skip breakfast and contribute to increased glycemic levels. In other words, evening chronotype was associated with an increased risk factor for type 2 diabetes (19).

It was shown that people with the evening type consumes more carbohydrates and excess fat at night. They consume foods rich in energy, sucrose, fat and saturated fat after 8 pm (20). A previous study denoted to consumption of macronutrients (carbohydrates, fat, proteins) after 8 pm with an average sleep duration of 4 hours among those with a higher BMI (21). Evening chronotype has been positively associated with an increase in BMI among adolescents consuming unhealthy foods, frequently consume caffeine at night and to have inadequate intake of fruits and vegetables (22). Identical to our results, Mota *et al.* (2016) found a positive relationship between chronotype and sleep duration, showing that respondents with the morning type had longer sleep times. Sleep disturbances can be caused by the use of electronic devices in bed, caffeine intake at night and irregular dinner hours. Also,

sleep duration and sleep quality can affect eating preference for foods rich in energy, carbohydrates, fat, sodium and BMI (23).

We demonstrated that individuals' behaviors such as sleep, sedentary habits and physical activity can affect adolescent's health. A previous research showed that short sleep duration, poor sleep quality, and lack of physical activity could simultaneously contribute to an increase in BMI (23). Merikanto *et al.* have also found that individuals with evening chronotype had sedentary habits and decreased physical inactivity (24). Furthermore, an abnormal sleep-wake cycle can interfere the circulation of several nutrients such as glucose, fatty acids, and triglycerides, the insulin, glucocorticoids and adipokines and to impact on obesity (25).

Conclusion

Physical activity and chronotype were shown to be significantly correlated with nutritional status among female students during the COVID-19 pandemic. To prevent obesity during the COVID-19 pandemic, female students are needed to be more active, to have routine physical activities, to decrease screen exposure and to early go to bed.

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Conflict of Interest

None declared.

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