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Impact of COVID-19 Pandemic on Dietary Patterns and Physical Activity in Overweight and Obese Adolescents Based on Body Fat Percentages

Dampak Pandemi COVID-19 Terhadap Pola Makan dan Aktivitas Fisik Pada Remaja Obese dan Overweight Berdasarkan Persen Lemak Tubuh

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ABSTRACT

Background: *Obese and overweight adolescents have a high risk of COVID-19 susceptibility and severity compared to normal nutritional status. Although a healthy dietary pattern and physical activity do not entirely prevent infection, they play a substantial role in the host's response to infectious agents. The purpose of this study is to analyze the changes in dietary patterns and physical activity during the COVID-19 pandemic in overweight and obese adolescents based on body fat percentages (BFP).* ***Method:*** *A cross-sectional study using purposive sampling was conducted on 159 adolescents from selected high schools in West Lampung, Indonesia. Data collection was assessed using a body composition scale and Food Frequency Questionnaire (FFQ). Data analysis was performed using SPSS. The Wilcoxon signed-rank test was used to analyze the differences between the two adolescent groups.* ***Result:*** *The overweight and obese adolescents group increased the consumption of unhealthy foods and beverages compared to the normal group ($p<0.05$). Both groups significantly increased the fruit rich in vitamin C consumption ($p<0.05$), but no significant difference in vegetable consumption ($p>0.05$). Both groups were found to have no significant difference in physical activity, both before and during the COVID-19 pandemic ($p>0.05$).* ***Conclusion:*** *Adolescents with normal body fat percentages (BFP) tend to have better dietary patterns, in contrast to overweight and obese adolescents with a high BFP who tend to have a decrease in the quality of their dietary patterns. Then, both groups were found to have a significant decrease in the frequency of physical activity during the COVID-19 pandemic.*

ABSTRAK

Latar belakang: Remaja dengan obesitas dan overweight lebih rentan mengalami keparahan COVID-19 dibandingkan remaja dengan status gizi normal. Meskipun pola makan dan aktivitas fisik tidak mencegah infeksi secara langsung, tetapi mereka memainkan peran penting terkait respon host terhadap agen infeksi. Penelitian ini menganalisis perubahan pola makan dan aktivitas fisik selama pandemi COVID-19 pada remaja dengan overweight ataupun obesitas berdasarkan persentase lemak tubuh (PLT). **Metode:** Menggunakan desain *cross - sectional* dan purposive sampling yang dilakukan pada 159 remaja dari SMA terpilih di Lampung Barat, Indonesia. Pengumpulan data dilakukan menggunakan *Food Frequency Questionnaire* (FFQ) dan alat *body composition scale*. Analisis data dilakukan menggunakan *Wilcoxon signed-rank test* untuk menganalisis perbedaan pada kedua kelompok. **Hasil:** Kelompok overweight dan obesitas mengalami peningkatan konsumsi jajanan *snack* dan minuman dibandingkan dengan kelompok normal ($p<0,05$). Kedua kelompok mengalami peningkatan asupan buah – buahan yang kaya vitamin C ($p<0,05$), tetapi tidak terdapat perbedaan pada asupan sayuran ($p>0,05$). Kedua kelompok tidak memiliki perbedaan aktivitas fisik baik sebelum maupun selama pandemi COVID-19 ($p>0,05$). **Kesimpulan:** Remaja dengan persentase lemak tubuh (PLT) yang normal cenderung memiliki pola makan yang lebih baik, dibandingkan dengan remaja overweight dan obesitas dengan PLT tinggi, yang cenderung memiliki penurunan pada kualitas pola makan. Kemudian, kedua kelompok mengalami penurunan frekuensi aktivitas fisik selama pandemi COVID-19.

Keywords : COVID-19, dietary patterns, physical activity, adolescents, body fat percentages

Kata Kunci : COVID-19, pola makan, aktivitas fisik, remaja, persen lemak tubuh

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INTRODUCTION

COVID-19 is an acute respiratory syndrome caused by the SARS-CoV-2 virus. Anyone can get ill with COVID-19 at any age. This disease has infected and killed thousands worldwide.[1] The first COVID-19 case in Indonesia was announced in early March 2020.[2] Governments worldwide have adopted policies to respond to and eliminate the spread of COVID-19. Indonesia enforces a physical distancing policy in the form of "Large Scale Social Restriction". People are suggested to stay home during quarantine, restrict daily activities, and preserve separation from anyone.[3] COVID-19 has also impacted academic learning methods around the world. Many schools implement online classes as an alternative to learning. Even though online courses prevent students and teachers from the COVID-19 risk, they are certainly less effective than conventional learning. In developing countries, some students have challenging access to the internet due to technical or financial problems.[4] Inefficient online course experiences and sometimes unstable signal networks cause many students to feel smartphone/ internet addiction, contributing to stress and psychological distress in adolescents.[5] In addition, the abundance of negative information causes most people to be afraid they are infected, as well as shame and guilt when they are infected.[6] All these stress conditions can finally lead to changing many lifestyles, especially dietary patterns and physical activity.[7]

It has been reported that dietary patterns during the COVID-19 pandemic had a more increase in energy intake. On average, people consume 539 kcal more than the recommended but have lower nutritional quality than before the COVID-19 pandemic.[8] The COVID-19 pandemic has also promoted unhealthy dietary patterns through more significant consumption of alcohol, beer, and fast food. However, there is also an increase in the consumption of healthier food such as legumes, meat, fish, rice, pasta, fruit, and vegetables.[9] Not only the change in dietary patterns but the confinement during COVID-19 has also decreased physical activity and increased sedentary lifestyles in many adolescents, students, and very active populations.[10] Physical activity was found to drop suddenly at the start of the confinement, followed by a slight increase after that.[11] Adequate physical activity can improve the immune system and reduce inflammation.[12] In contrast, a sedentary lifestyle is a risk factor for death in hospitalized COVID-19 patients. This fact suggests the usefulness of physical activity in preventing severe COVID-19.[13] Evidence suggests that overweight and obese are at risk of being more vulnerable to the severity of COVID-19.[14] Overweight and obese are high-risk populations because they are more at risk of being admitted to the internal care unit (ICU) due to COVID-19.[15] Overweight and obese people have been incredibly disruptive in their dietary patterns and physical activity compared to other group. This group population has unhealthy eating behaviors, such as eating without hunger and overeating.[16] It also found that during confinement, people with excessive body weight, especially those with a higher BFP, had less physical activity than people with a normal body fat percentage.[11] On the other hand, adolescents are a group often neglected to be taken as a research subject investigated. It is due to the incidence of COVID-19 in adolescents being lower than in adults and older people.[17] Therefore, although a healthy dietary pattern and physical activity do not entirely prevent infection, they play a substantial role in the host's response to infectious agents.[18] Current research about dietary patterns and physical activity changes among obese and overweight adolescents, especially those based on body fat percentages, is limited. This research aims to analyze the changes in dietary patterns and physical activity among obese and overweight adolescents based on body fat percentages during the COVID-19 pandemic.

METHOD

Study Design and Participants

This research is a cross-sectional study using purposive sampling conducted on two selected Senior High Schools in West Lampung District, Lampung Province, Indonesia. Eligibility

criteria were: healthy adolescents aged 10 to 19 who agreed to participate in the study. This study has been approved by the Research and Community Engagement Ethical Committee of the Faculty of Public Health University of Indonesia No: Ket-607/UN2.F10.D11/PPM.00.02/2020.

Data Collection

One hundred fifty-nine adolescents (77 men, 82 women) from 1 selected high school participated in the study. Subjects were divided into 2 groups, the overweight and obese group who had a high BFP, and the normal group who had a normal BFP. Data collection was divided into "before the pandemic" and "during the pandemic." We defined the "before pandemic" period as before March 2020 and the "during pandemic" period after March 2020, as the first COVID-19 onset in Indonesia commenced in March 2020. Before data collection, the researcher explained the background, aim, and information about research ethics. Informed consent was obtained from all the participants before starting the study. The data collection before the pandemic was conducted directly at the school. All recruited participants had interviewed about their basic socio-demographic information and lifestyles and then had an anthropometric measurement in the school. The data collected during the pandemic was conducted by an online questionnaire using Google Forms®. The description of the study and the link to access the questionnaire were shared with adolescents in selected senior high schools. Participants accessed the questionnaire through a gadget that had access to the internet. The survey was sent to the final database and downloaded as a Microsoft Excel archive.

Dietary Patterns Before and During the COVID-19 Pandemic

Dietary patterns in the study referred to the frequency of food and beverage consumption. A total of 6 primary food and beverage groups consumed by adolescents were investigated before and during the COVID-19 pandemic, including snacks, fast foods, oily foods, fruits, vegetables, and beverages. Participants were asked to answer the consumption frequency of each item before and during the COVID-19 pandemic using the Food Frequency Questionnaire (FFQ). Consumption Frequencies were divided into five categories ('daily,''4–6d/week', '1–3 d/week', '1-3 d/month', and 'none'), and all participants chose the answer according to their consumption habit.

Physical Activity Before and During the COVID-19 Pandemic

We are using a questionnaire to assess the frequency and duration of physical activity before and during COVID-19 among adolescents. We asked the participant to answer "how many days per week they conducted moderate to vigorous physical activity" and "how long the duration of their physical activity per session." The frequency of physical activity is categorized as poor (<3x / month) and good (≥ 3x / month), while the duration of physical activity is classified as poor (<30 minutes) and good (≥30 minutes).

Statistical Analysis

Data were analyzed using SPSS version 26.0. Descriptive statistics were used to analyze the participants' socio-demographic information, lifestyles, and anthropometric measurement. Data are represented as numbers and percentages (%) for categorical variables and represented as mean and standard deviation (SD) for continuous variables. The Wilcoxon signed-rank tests compare the differences in dietary patterns and physical activities before and during the COVID-19 Pandemic in adolescents specifically divided into two categories: obese and overweight group (11,4%) and normal group (88,6%). Statistical significance was set at $\alpha = 5\%$, with significant results for p-values <0.05.

RESULT

Table 1 shows the information related to the socio-demographic characteristics of the subject. While Table 2 presents the difference in dietary patterns before and during the COVID-19 pandemic among the obese and overweight group

and the normal group. Results showed that the obese and overweight group only decreased the consumption of the packaged snack ($p<0.05$), while the normal group decreased more snacks like toast, boiled-steamed dishes, starch-based dishes, and noodle dishes ($p<0.05$). Moreover, the obese and overweight group increased the consumption of frozen food ($p<0.05$), while the normal group decreased more fast food like french fries, fried chicken, burgers/hotdogs, instant noodles, and fatty foods ($p<0.05$). Also, the obese and overweight group increased more oily foods like fried tofu, fried tempeh, fried tempura, fried bread, and chips ($p<0.05$), while the normal group decreased the consumption of croquette ($p<0.05$). Regarding beverage consumption, the obese and overweight group reported no significant difference, while the normal group decreased the consumption of soft drinks and sugary drinks ($p<0.05$). Both groups showed an increase in consumption of fruit rich in vitamin C ($p<0.05$), but no difference in consumption of vegetables ($p>0.05$). Table 3 shows that participants reported no difference in physical activity before and during COVID-19 both in the normal group and high BFP groups ($p > 0.05$).

Table 1. Socio-Demographic Characteristics of the Participants

Variables	Normal		Obese and Overweight	
	n	%	n	%
Gender				
Female	77	57.1	8	42.1
Male	22	48.3	11	57.9
Age	15.54 (0,801)		15.47 (0.841)	

Table 2. Changes in Dietary Patterns in Obese and Overweight Adolescents

Intake Frequency	Normal			Obese and Overweight		
	Before	**After**	***P-value***	**Before**	**After**	***P-value***
Snack						
Packaged snacks	2.64 ± 0.856	2.43 ± 1.002	0.547	2.79 ± 1.084	2.21 ± 0.032	0.013*
Toast	2.69 ± 0.861	2.46 ± 0.858	0.000*	2.68 ± 0.885	2.42 ± 0.838	0.405
Boiled-steamed dishes	3.04 ± 0.922	2.75 ± 1.013	0.000*	2.89 ± 0.809	2.79 ± 0.631	0.480
Starch-based dishes	2.69 ± 0.877	2.44 ± 0.918	0.000*	2.63 ± 0.761	2.63 ± 0.955	1.000
Noodle dishes	2.68 ± 0.86	2.43 ± 0.917	0.000*	2.84 ± 1.117	2.84 ± 1.068	0.157
Fast foods	1.87 ± 1.082	1.67 ± 0.721	0.000*	1.89 ± 0.994	2.05 ± 0.970	0.257
French fries	2.14 ± 0.838	2.01 ± 0.842	0.001*	2.42 ± 0.961	2.32 ± 0.820	1.000
Fried chicken	1.48 ± 0.632	1.41 ± 0.604	0.008*	1.47 ± 0.772	1.42 ± 0.692	0.564
Burger/Hotdog	1.73 ± 0.827	1.68 ± 0.789	0.276	1.26 ± 0.452	1.47 ± 0.772	1.102
Pasta	3.00 ± 0.846	2.86 ± 0.908	0.014*	3.00 ± 0.745	3.21 ± 0.713	0.206
Instant Noodles	2.22 ± 0.829	2.17 ± 0.883	0.328	1.95 ± 0.780	2.21 ± 0.855	0.059
Canned foods	3.05 ± 0.932	3.00 ± 0.944	0.470	2.68 ± 0.946	3.05 ± 1.079	0.035*
Frozen food	2.36 ± 0.798	2.17 ± 0.844	0.005*	1.89 ± 0.737	2.16 ± 0.688	0.059
Oily foods						
Fried Tofu	2.60 ± 0.986	2.45 ± 1.003	0.006	2.63 ± 0.895	3.05 ± 0.848	0.005*
Fried Tempeh	2.97 ± 0.933	2.91 ± 0.954	0.178	2.95 ± 0.911	3.42 ± 0.769	0.007*
Fried yams	2.83 ± 0.883	2.74 ± 0.888	0.117	3.11 ± 0.937	3.53 ± 0.905	0.054
Fried tempura	2.84 ± 0.831	2.88 ± 0.813	0.462	3.00 ± 1.054	3.26 ± 1.046	0.025*
Croquette	2.22 ± 0.907	2.05 ± 0.880	0.001*	2.58 ± 1.017	2.63 ± 1.065	0.739
Fried bread	2.13 ± 0.884	2.03 ± 0.825	0.020	2.26 ± 0.991	2.53 ± 1.020	0.025*
Chips	3.00 ± 0.878	2.97 ± 0.896	0.595	3.11 ± 0.937	3.68 ± 1.057	0.013*
Beverages						
Coffee	2.37 ± 1.254	2.38 ± 1.923	0.469	2.32 ± 1.293	2.32 ± 1.376	1.000
Soft drinks	2.21 ± 0.738	2.03 ± 0.783	0.001*	2.16 ± 0.765	2.16 ± 0.765	1.000

Sugary drinks	2.63 ± 0.873	2.39 ± 0.928	0.000*	2.53 ± 0.772	2.53 ± 0.964	1.000
Fruits						
Rich in water	3.13 ± 0.849	3.20 ± 0.923	0.112	3.37 ± 1.165	3.21 ± 1.228	0.180
Rich in Vitamin-C	3.21 ± 0.808	3.48 ± 0.859	0.000*	3.26 ± 0.933	3.42 ± 0.902	0.008*
Rich in Fiber	3.10 ± 0.844	3.09 ± 0903	0.875	3.53 ± 0.841	3.26 ± 1.098	0.340
Vegetables						
Green vegetables	3.74 ± 0.896	3.72 ± 0.894	0.838	3.84 ± 1.015	3.95 ± 1.079	0.157
Colored vegetables	3.64 ± 0.872	3.60 ± 0.837	0.674	3.47 ± 1.020	3.42 ± 1.170	0.705
Cabbage vegetables	3.30 ± 0.891	3.36 ± 0.856	0.186	3.47 ± 0.612	3.26 ± 0.806	0.102
Legume vegetables	3.26 ± 0.849	3.21 ± 0.835	0.253	3.32 ± 0.885	3.42 ± 1.071	0.739

* = p-value <0.05

Table 3. Changes on Physical Activity in Adolescents

Physical Activity	Normal			Obese and Overweight		
	Before	After	*P-value*	Before	After	*P-value*
Frequency	6.09 ± 6.051	5.70 ± 5.819	0.040*	5.26 ± 4.479	4.16 ± 3.848	0.046*

* = p-value <0.05

Table 2 shows that in the normal BFP group, there was a significant decrease in several unhealthy food and beverage groups such as snacks, fast food, oily foods, and beverages between before and during the pandemic (*p-value*<0.05). Meanwhile, the obese and overweight group that had a high BFP had a significant increase in several unhealthy food and beverages groups (*p-value*<0.05). Both groups were known to have a significant increase in consumption of fruit rich in vitamin C (*p-value*<0.05), but no significant difference was found in their consumption of vegetables (*p-value*>0.05).

Table 3 shows that the two groups of adolescents experienced a significant decrease in the frequency of physical activity before and during the COVID-19 pandemic (*p-value*<0.05).

DISCUSSION

Dietary Patterns

We consider this to be the first study of dietary patterns and physical activity in obese and overweight adolescents based on body fat percentages during the social restriction enforced by the COVID-19 pandemic. This study examined selected high schools in Lampung, Indonesia. Body fat percentage values were defined by the cutoff points of ≥25% for males and ≥30% for females, recommended by Williams et al.[19] From an epidemiological perspective, it is essential to determine how dietary patterns are affected by time of restrictions and the consequences of these health changes, especially among obese and overweight adolescents.

Our results indicate that during the COVID-19 pandemic, adolescents with a normal body fat percentage showed the healthiest dietary patterns with a significant decrease in various unhealthy foods and beverages such as toast, boiled-steamed dishes, starch-based dishes, noodle dishes, french fries, fried chicken, burgers/hotdogs, instant noodles, fatty foods, and croquettes. They also decrease the consumption of soft drinks and sugary drinks. This improvement in dietary patterns may be due to social restriction, resulting in lower adolescents' exposure to unhealthy food from eating out. The change in dietary patterns also resulted from fears of contracting the virus and the

closure of many food service establishments.[20] Several previous studies have revealed a positive increase in the tendency to eat better. In line with this study, a previous study in Chile, Italy, Spain, Brazil, and Colombia, also found that confinement increased the trend of cooking at home and consuming the recommended weekly portion of healthy food before the pandemic.[21] The improvement of healthy dietary patterns may also reflect the concern of the parents of teenagers about the food consumed by adolescents, realizing the importance of strengthening the immune system during the pandemic.[22]

Otherwise, obese and overweight adolescents based on body fat percentage showed the unhealthiest dietary patterns compared to normal body fat percentages during the COVID-19 pandemic. There was an increase in unhealthy foods such as fatty foods, fried tofu, fried tempeh, fried bread, and chips. Meanwhile, the decrease in unhealthy food was only found in packaged snacks. It means that the overweight and obese group with a high BFP shows a change in dietary patterns in an unhealthy direction. A previous study has reported that Individuals who are overweight or obese have more unhealthy eating behaviors, such as frequent overeating, eating without feeling hungry, and increased thoughts about food compared to those who are thin or of average weight.[16] Changes in dietary patterns also can result from everyday experiences such as boredom.[23] Studies have also found that obese children and adolescents have lower self-esteem and mood disorders than normal-weight children and adolescents.[24] Lower self-esteem and mood disorder may affect hedonic aspects and homeostasis in the regulation of food intake.[25] Peoples with low self-esteem tend to respond to boredom by avoiding self-consciousness through eating; that is why many of them have unhealthy eating behaviors.[26] Escaping from the awareness of healthy eating is their attempt to improve mood.[27] [28] Correspondingly, there is a link between bad emotions such as boredom and stress that arise during confinement and unhealthy dietary patterns to distract attention.[29] Besides, many studies report a strong positive association between high body fat percentage with leptin resistance. Leptin is one of the significant appetite suppressants and regulates food intake.[30] Leptin resistance is characterized by increased hunger and decreased energy expenditure, leading to increased food intake and total body mass.[31]

This study found that both groups in this study have nutritional awareness for consuming fruits rich in vitamin C during the pandemic, but there was no difference in vegetable consumption. Another study also revealed that fruit rich in vitamin C is one of the most consumed natural foods during quarantine because it is known for its immune-boosting effect.[32] This aspect is noteworthy because increased fruit consumption can increase antiviral immune defense.[33] Although there have been many studies that reveal the role of Vitamin C in the immune response, large-scale clinical trials around the world should be encouraged to analyze the efficacy of Vitamin C during the COVID-19 pandemic.[34]

Physical activity

Moreover, this research shows that social restriction during COVID-19 decreases the frequency of physical activity both in the normal group and the high BFP group. In line with research conducted in Spain which also showed that highly active youth, students and men in particular reduced their daily physical activity during the COVID-19 pandemic.[35] This may be due to limited space for physical activities both indoors and outdoors.[36] Each country has its own rules regarding outdoor physical activity depending on the development of COVID-19 conditions. For this reason, maintaining active physical activity should also be encouraged through exercise at home or daily activities. WHO recommends moderate-intensity physical activity for 150 minutes or vigorous-intensity physical activity for 75 minutes each week. This recommendation can still be achieved even without special equipment at home. People should be encouraged to be active outdoors, especially in green areas, as it can benefit physical and mental health. Some exercises suggested

during lockdown include walking, jumping, sit-ups, push-ups, and squats.[37] However, excessive exercise (high-volume, high-intensity training) is not recommended because it can lead to an immunodepression state and increase susceptibility to infection.[38]

Nevertheless, the study is not without some limitations. Online data collection may involve memory or information bias due to self-reported data, especially in the collection of *food frequency questionnaire* data. However, the adequate education level of the respondents supports high data reliability.

CONCLUSION

This study shows that during the COVID-19 pandemic, obese and overweight adolescents based on body fat percentage tend to change their dietary patterns in an unhealthy direction, in contrast to the normal body fat percentage who tend to change their dietary patterns in a healthier direction. Moreover, both groups experienced an increase in consumption of fruits rich in vitamin-C, and also a decrease in the frequency of physical activity due to social restrictions. Considering that a healthy dietary patterns and adequate physical activity play a key role in protecting individuals from the severity of COVID-19, and also that overweight and obese adolescents have increased vulnerability to infections and their severity, health authorities should strengthen nutrition support strategies in dietary patterns and physical activity targeting these groups, especially during the social restriction of COVID-19 pandemic.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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