

5-31-2023

Dietary Changes Among Normal and High Blood Pressure Adolescents During the COVID-19 Pandemic

Bernadette Victoria

Department of Public Health Nutrition, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia,
bernadettevictoria95@gmail.com

Ratu Ayu Dewi Sartika

Department of Public Health Nutrition, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia,
ratuayu.fkm.ui@gmail.com

Rizti Millva Putri

Department of Public Health Nutrition, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia,
rizti.millvaputri@gmail.com

Follow this and additional works at: <https://scholarhub.ui.ac.id/kesmas>



Part of the [Epidemiology Commons](#), and the [Nutrition Commons](#)

Recommended Citation

Victoria B , Sartika RD , Putri RM , et al. Dietary Changes Among Normal and High Blood Pressure Adolescents During the COVID-19 Pandemic. *Kesmas*. 2023; 18(2): 97-103

DOI: 10.21109/kesmas.v18i2.6804

Available at: <https://scholarhub.ui.ac.id/kesmas/vol18/iss2/3>

This Original Article is brought to you for free and open access by the Faculty of Public Health at UI Scholars Hub. It has been accepted for inclusion in Kesmas by an authorized editor of UI Scholars Hub.

Dietary Changes Among Normal and High Blood Pressure Adolescents During the COVID-19 Pandemic

Bernadette Victoria*, Ratu Ayu D Sartika, Rizti Millva Putri

Department of Public Health Nutrition, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia

Abstract

The COVID-19 pandemic has significantly impacted adolescents' unhealthy eating habits and sedentary lifestyles, leading to an increase in blood pressure and obesity rate. High blood pressure among adolescents is an early indicator of adult hypertension, but this condition has received less attention recently. Therefore, this study aimed to determine the differences in dietary changes among high school students with normal and high blood pressure before and during the COVID-19 pandemic in West Lampung District, Indonesia. A cross-sectional design was used, and the sample population consisted of 167 students aged 14-19 years. The results showed that 43 participants had elevated blood pressure and stage 1 hypertension, accounting for 25.7% of the total population. Among these participants, 14 (32.6%) were found to be overweight and obese. Based on the results, students with high blood pressure were less likely to improve their dietary choices during the COVID-19 pandemic than those with normal blood pressure.

Keywords: adolescent, blood pressure, COVID-19, dietary changes

Introduction

High blood pressure (BP) among adolescents is a significant health problem that has received less attention, specifically in developing countries.¹ Furthermore, high BP during childhood and adolescence can be an early indicator of hypertension and cardiovascular diseases later in life.² Several risk factors, such as obesity, high sodium intake, low vegetable and fruit consumption, and sedentary lifestyles, have been reported to contribute to the rising incidence rate of this condition.³ The global prevalence of hypertension in children and adolescents stands at 4%, with 9.7% exhibiting prehypertension (elevated BP).⁴ In Indonesia, the prevalence among adolescents aged 15-17 years was 5.3%, based on the 2013 Indonesian Basic Health Research.⁵

The COVID-19 pandemic has significantly impacted the younger population, leading to lifestyle changes that increase the risk of cardiometabolic disease.⁶ Social restrictions, such as school closure and social distancing, have caused an increase in sedentary activities associated with screen time,⁷ decreased physical activity,⁸ and dietary changes, thereby increasing the risk of obesity and metabolic syndrome.⁹ Furthermore, obesity has been rec-

ognized as a risk factor for hypertension,¹⁰ and its prevalence has continued to increase during the COVID-19 pandemic.¹¹

Maintaining a normal nutritional status is essential, specifically during the COVID-19 pandemic. Several studies have been carried out in international and Indonesian settings to identify changes in the dietary patterns of adolescents due to the viral outbreak.¹²⁻²¹ However, no study has specifically identified these changes among adolescents with different BP categories. Eating habits have been reported to be one of the potentially modifiable risk factors for non-communicable diseases, specifically hypertension and obesity.²²

According to the 2018 Indonesian Basic Health Research, there has been an increase in the prevalence of hypertension among individuals aged 18 years in Lampung Province from 2013 to 2018.²³ In West Lampung, the prevalence was recorded at 29.1%, thereby ranking as one of the top 5 in the province, according to the Lampung Province Health Profile.²⁴ Therefore, this study aimed to determine the differences in dietary changes among adolescents with normal and high BP before and during the COVID-19 pandemic among selected

Correspondence*: Bernadette Victoria, Department of Public Health Nutrition, Faculty of Public Health Universitas Indonesia, F Building 2nd Floor, Kampus Baru UI Depok, Depok City, West Java, Indonesia 16424,
E-mail: bernadettevictoria95@gmail.com, Phone: +62 857-7938-8365

Received : March 30, 2023
Accepted : May 16, 2023
Published : May 30, 2023

high school students in the West Lampung District, Indonesia. The results had the potential to contribute valuable insights into the dietary habits of high school students with and without hypertension. They could also highlight the importance of promoting healthy eating habits among adolescents as a preventive measure against hypertension and other non-communicable diseases later in life.

Method

This study used a cross-sectional design, which involved the collection of primary data from students grades 10-12 attending selected high schools in the West Lampung District, Indonesia. Furthermore, the sample population comprised all the students at Senior High School A during the 2020 academic year. This particular school was selected based on its exceptional performance in the national exam in Liwa (the capital city of West Lampung District), as high-achieving academic institutions often exerted more pressure and stress. Emotional eating habits among students were known to be associated with academic stress, which could impact their blood pressure. A total of two senior high schools were initially selected for the process—Schools A and B. However, due to the increased COVID-19 cases, learning activities were relocated online, and blood pressure measurements could not be completed in School B. The minimum sample size of 46 was calculated using an alpha level of 0.05 (95% CI) and a power of 90%.²⁵ Purposive sampling was utilized to select the total sample size of 167 students who met the inclusion criteria of being healthy and willing to participate.

Data were collected directly in July 2020 for age, sex, BP, weight, height, and pre-pandemic food consumption habits. Subsequently, data on food consumption frequency were collected online in October 2020 during the pandemic due to the increasing number of COVID-19 cases. Age, sex, and food consumption frequency were obtained through interviews, while body mass index (BMI) was calculated by dividing weight (in kilograms) by the square of height (in meters). Body weight was measured using a GEA Medical Type EB9250 digital weight scale (with an accuracy of 0.1 kg), and height was assessed using a GEA Medical microtoise (with an accuracy of 0.1 cm). Blood pressure measurements were obtained using a mercury sphygmomanometer. Data were collected by trained health workers with nursing academy educational backgrounds and trained enumerators with health-related educational backgrounds. Nutritional status was categorized as thinness, normal, overweight, and obese based on the body mass index for age (BMI/A) z-score, as indicated by the Indonesian Ministry of Health regulation for child anthropometry standards.²⁶

The students' eating habits before and during the

COVID-19 pandemic were collected through Food Frequency Questionnaires (FFQ) consisting of five food and one beverage group. The food groups included 1) snacks, such as packaged snacks (chips/snacks/wafers), baked goods (biscuits/bread/donuts/pastries), traditional products (*siomai/pempek/dimsum/batagor/telur gulung/sausage/fishcake*), tapioca-based products (*cilok/cimol/cireng*), noodle dishes (ramen/udon/Indonesian noodle topped with chicken/dumpling/meatball); 2) fast food, such as french fries, fried chicken/nuggets/crispy chicken, burgers/hot dogs/pizza, pasta (spaghetti/lasagna/macaroni), instant noodles, canned foods (corned beef/sardines/canned vegetables and fruits), coconut milk-based foods, fatty foods (beef *rendang*/innards); 3) fritters, such as fried tofu (stuffed tofu/spicy tofu and others), fried tempeh/*mendoan*, fried sweet potatoes/breadfruit/banana/jackfruit/cassava, tempura (vegetables fritters/potato croquette/sweetcorn fritter/shrimp fritter), fried bread, and crackers/potato chips/cassava chips/yam chips/jackfruit chips; 4) vegetables, including green leafy vegetables (spinach/morning glory/cassava leaves/papaya leaves), colorful vegetables (carrots/tomatoes/eggplants/beets and others), and legumes (long beans/green beans/red beans/mung beans); and 5) fruits, such as high water/mineral fruits (bananas/watermelon/cantaloupe/water rose apples), vitamin C-rich fruits (oranges/guavas/mangoes), and fiber-rich fruits (papayas/apples/pears/avocados/pineapples). While, the beverage group in the FFQ included carbonated/soda drinks and packaged sweet beverages.

The variable of food consumption frequency was obtained from FFQ results, assigned by authors with five answer options and scores of 1 = never, 2 = rarely (1-3 times/month), 3 = sometimes (1-3 times/week), 4 = frequently (4-6 times/week), and 5 = daily. The BP data were taken directly based on preexisting health protocols. The results of blood pressure measurements were categorized based on the Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents, published by the American Academy of Pediatrics in 2017.²⁷ Children aged ≥ 13 years were defined as having elevated BP when a value of 120/<80 or 129/<80 mmHg was obtained, and stage 1 hypertension was diagnosed when a value of 130/80 or 139/89 mmHg was recorded.

The data were then analyzed using IBM SPSS Statistics for Windows (IBM Corp., Armonk, New York) Version 26. The descriptive analysis was conducted to obtain an overview of the frequency distribution of the study variables. Furthermore, Wilcoxon-signed tests were carried out to examine the differences in food consumption frequencies in each group before and during the COVID-19 pandemic. Changes in frequencies among adolescents with normal BP or elevated BP and stage 1

hypertension were considered significant at a p-value of <0.05.

Result

Based on the data obtained, 52.1% of the participants were aged 15 (52.1%), and 50.9% were males. Furthermore, 6% and 19.7% of the participants had elevated BP and stage 1 hypertension, respectively. The results showed that most students had a normal BMI (73.7%), and almost one-fifth were overweight and obese, as shown in Table 1. Table 2 shows that 78.2%, 10.5%, 5.6%, and 5.6% of students with normal BP had normal, overweight, obese, and thinness nutritional statuses, respectively. While, 60.5%, 16.3%, 16.3%, and 7% of those with elevated BP and stage 1 hypertension had normal, overweight, obese, and thinness nutritional statuses, respectively.

The results showed significant changes in the consumption of snacks among the food and beverage groups (Table 3). Furthermore, a decrease occurred in the frequency of all types of snack consumption (packaged snacks, baked goods, traditional products, tapioca-based products, and noodle dishes). Among students with normal BP, the frequency of fast food intake generally decreased, including french fries (p-value = 0.004), fried

chicken/nugget (p-value = 0.011), burger/hot dog/pizza (p-value = 0.012), pasta (spaghetti/lasagna/macaroni) (p-value = 0.012), and fatty foods (*rendang/innards*) (p-value = 0.012). In the group with elevated BP and stage 1 hypertension, there was no significant change in the frequency of fast food, as shown in Table 4. The frequency of soft drink consumption showed a significant decrease among students with normal BP (p-value = 0.019)

Table 1. General Characteristics of the Participants

Variable	Category	n	%
Sex	Male	85	50.9
	Female	82	49.1
Age (years)	14	6	3.6
	15	87	52.1
	16	56	33.5
	17	15	9.0
	18	2	1.2
	19	1	0.6
Nutritional status based on BMI/A z-score	Thinness	10	6.0
	Normal	123	73.7
	Overweight	20	12.0
	Obese	14	8.4
Blood pressure category	Normal	124	74.3
	Elevated BP	10	6.0
	Stage 1 hypertension	55	19.7

Notes: BMI/A = BMI-for-age, BP = Blood Pressure

Table 2. The Distribution of Participants' Data Based on Blood Pressure

Variable	Category	Normal BP (n = 124)		Elevated BP & Stage 1 Hypertension (n = 43)	
		n	%	n	%
Sex	Male	55	55.6	30	30.2
	Female	69	44.4	13	69.8
Age (years)	14	5	4	1	2.3
	15	63	50.8	24	55.8
	16	42	33.9	14	32.6
	17	12	9.7	3	7.0
	18	1	0.8	1	2.3
	19	1	0.8	0	0
Nutritional status based on BMI/A z-score	Thinness	7	5.6	3	7
	Normal	97	78.2	26	60.5
	Overweight	13	10.5	7	16.3
	Obese	7	5.6	7	16.3

Notes: BP = Blood Pressure, BMI/A = BMI-for-age, BP = Blood Pressure

Table 3. Changes in the Frequency of Snacks Consumption before and during the COVID-19 Pandemic

Variation of Snack	Normal BP (Mean±SD)			Elevated BP & Stage 1 Hypertension (Mean±SD)		
	Before	During	p-value	Before	During	p-value
Packaged snack	2.67±0.917	2.47±1.008	0.002*	2.63±0.787	2.23±0.096	0.001*
Baked goods	2.71±0.872	2.51±0.879	0.005*	2.60±0.821	2.20±0.775	0.022*
Traditional snack	3.06±0.931	2.81±0.991	0.001*	2.91±0.840	2.58±0.932	0.032*
Tapioca starch-based snack	2.71±0.909	2.48±0.950	0.001*	2.58±0.698	2.37±0.817	0.048*
Noodle dishes	2.74±0.864	2.49±0.935	0.001*	2.65±1.021	2.40±0.955	0.008*

Notes: BP = Blood Pressure, SD = Standard Deviation, *p-value<0.05

Table 4. Changes in the Frequency of Fast Food and Beverage Consumption before and during the COVID-19 Pandemic

Varian of Fast Food and Beverage		Normal BP (Mean±SD)			Elevated BP & Stage 1 Hypertension (Mean±SD)		
		Before	During	p-value	Before	During	p-value
Fast food	French fries	1.86±1.145	1.68±0.771	0.004*	1.88±0.851	1.81±0.732	0.257
	Fried chicken/nugget	2.10±0.811	1.98±0.836	0.011*	2.40±0.955	2.21±0.861	0.085
	Burger/hot dog/pizza	1.51±0.681	1.45±0.640	0.012*	1.40±0.541	1.35±0.529	0.317
	Pasta	1.71±0.844	1.65±0.807	0.012*	1.56±0.666	1.65±0.720	0.351
	Instant noodle	2.98±0.865	2.89±0.921	0.131	3.05±0.754	2.95±0.815	0.384
	Canned food	2.24±0.810	2.19±0.852	0.306	2.05±0.872	2.14±0.966	0.329
	Foods with coconut milk	3.00±0.946	2.98±0.988	0.775	3.00±0.926	3.05±0.872	0.665
Beverage	Fatty food	2.33±0.795	2.15±0.857	0.012*	2.21±0.833	2.21±0.804	1.000
	Soft drink	2.17±0.740	2.04±0.800	0.019*	2.28±0.734	2.05±0.815	0.018*
	Packaged sweet drink	2.43±0.861	2.29±0.951	0.002*	2.72±0.826	2.35±0.785	0.002*

Notes: BP = Blood Pressure, SD = Standard Deviation, *p-value<0.05

Table 5. Changes in the Frequency of Fritters Consumption before and during the COVID-19 Pandemic

Varian of Fritter		Normal BP (Mean±SD)			Elevated BP & Stage 1 Hypertension (Mean±SD)		
		Before	During	p-value	Before	During	p-value
	Fried tofu	2.57±0.964	2.44±0.982	0.029*	2.65±0.997	2.70±1.036	0.627
	Fried tempeh	3.02±0.975	2.94±0.998	0.115	2.77±0.751	3.00±0.787	0.012*
	Fried sweet potato/others	2.86±0.922	2.81±0.945	0.307	2.84±0.814	2.88±0.879	0.704
	Tempura	2.85±0.852	2.88±0.852	0.672	2.84±0.871	3.02±0.851	0.101
	Croquette	2.26±0.927	2.10±0.932	0.007*	2.23±0.895	2.12±0.851	0.251
	Fried bread	2.14±0.839	2.08±0.822	0.211	2.16±0.924	2.12±0.981	0.595
	Chips	2.97±0.874	2.94±0.931	0.752	3.14±0.915	3.33±0.919	0.124

Notes: BP = Blood Pressure, SD = Standard Deviation, *p-value<0.05

Table 6. Changes in Frequency of Vegetable and Fruits Consumption before and during The COVID-19 Pandemic

Varian of Vegetable and Fruit		Normal BP (Mean±SD)			Elevated BP & Stage 1 Hypertension (Mean±SD)		
		Before	During	p-value	Before	During	p-value
Vegetable	Green vegetables	3.82±0.875	3.78±0.889	0.585	3.86±0.804	3.65±0.897	0.020*
	Colorful vegetables	3.71±0.863	3.65±0.867	0.355	3.35±0.923	3.40±0.903	0.658
	Cabbage	3.40±0.855	3.40±0.834	0.981	3.07±0.856	3.21±0.888	0.156
	Beans	3.32±0.851	3.27±0.877	0.248	3.09±0.840	3.12±0.823	0.782
Fruits	Rich in water	3.10±0.840	3.20±0.892	0.061	3.30±1.015	3.16±1.111	0.361
	Rich in vitamin C	3.19±0.810	3.48±0.841	0.001*	3.30±0.860	3.44±0.934	0.206
	Rich in fiber	3.15±0.827	3.15±0.917	0.786	3.12±0.931	3.00±0.951	0.485

Notes: BP = Blood Pressure, SD = Standard Deviation, *p-value<0.05

and elevated BP, and stage 1 hypertension (p-value = 0.018). The results also showed a significant decrease in the intake of packaged sweet drinks in the normal BP group (p-value = 0.002) and the elevated BP and stage 1 hypertension group (p-value = 0.002), as shown in Table 4.

The consumption of various fritters generally decreased in the normal BP group (Table 5). A significant reduction was also found in the frequency of fried tofu (p-value = 0.029) and croquette (p-value = 0.007) intake. While, there was a significant increase in the frequency of fried tempeh consumption in the elevated BP and stage

1 hypertension group (p-value = 0.012).

Based on the results, there was an insignificant decrease in the intake of vegetables among students with normal BP except for those who consumed cabbage (Table 6). In the elevated BP and stage 1 hypertension group, there was a significant decrease in the frequency of green vegetable consumption (p-value = 0.020). The frequency of vitamin C-rich fruit consumption significantly increased among students with normal BP (0.001). While, participants with elevated BP and stage 1 hypertension did not show significant changes in the frequency of intake of all fruits.

Discussion

This study was the first to report that dietary changes differed between adolescents with normal and higher BP (elevated BP and stage 1 hypertension) before and during the COVID-19 pandemic. Furthermore, the results highlighted that adolescents with higher blood pressure were less likely to change their food consumption toward a healthier eating pattern compared to those with normal BP during the COVID-19 pandemic. A significant decrease in consumption of snacks, fast food, sweet packaged drinks, and soft drinks was due to limited access to such foods, social distancing, and increased parental control.²⁸⁻³⁰

During the pandemic, people tried harder to maintain a healthy diet and lifestyle to support their immunity and avoid infection.³¹ Several studies showed contradictory results, in which the viral outbreak caused increased snack consumption due to loneliness, anxiety, and depression during social restrictions. The COVID-19 pandemic has changed adolescents' lifestyles and emotions, which could affect the intake of comfort foods, including snacks.¹²⁻¹⁴ However, most of these studies used completely online self-reported data, indicating the possibility of some recall bias or inaccurate data.

The eating habits of students with elevated BP and stage 1 hypertension showed a lack of positive changes before and during the COVID-19 pandemic compared to others with normal BP. For example, there was a significant decrease in the consumption of almost all types of fritters, particularly fried tofu, and croquettes. However, an opposite trend was observed in the group with elevated BP and stage 1 hypertension. It was indicated by increased intake of most foods in the fritters category, but only fried tempeh significantly increased. The consumption of vitamin C-rich fruits experienced a significant increase only in the normal BP group. These findings indicated that unhealthy eating patterns developed over a long period were difficult to change, and these habits contributed to the occurrence of high BP.³² However, further studies were still needed to investigate long-term dietary patterns and their correlation with adolescents' blood pressure.

The descriptive analysis revealed that among the elevated BP and stage 1 hypertension group, 14 students (32.6%) were identified as overweight and obese. A previous study in Italy also showed that overweight and obese children and adolescents had poorer eating habits and physical activity during the COVID-19 lockdown.¹⁵ Higher BMI was one of the risk factors that played a role in the emergence of hypertension in adolescents. The results followed the existing theory that nutritional status was related to blood pressure, which could be mediated by leptin. The effect of this hormone on systolic blood

pressure occurred through the modulation of the sympathetic nervous system and subsequent increase in heart rate.³³ People with food-induced obesity often experience disrupted hormonal regulation of body weight and hunger due to the coexistence of leptin resistance and hyperleptinemia. The occurrence of leptin resistance made the hypothalamus increasingly unresponsive to this hormone. This condition caused the hunger level to remain high, and food intake did not decrease even though energy in the form of adipose was abundant.³⁴

A previous study had shown that adolescents with an obese nutritional status had more problematic eating patterns compared to others without obesity.³⁵ This study showed that the proportion of adolescents consuming an adequate amount of fruits was higher in the non-obese group; while, the intake of fast food was higher in the obese group.³⁵ Obese people tended to be more sensitive to food cues compared to others with normal-weight people. The occurrence of obesity was reported to affect changes in brain and peripheral responses to food cues and disrupt the hormonal and energy balance mechanism. Changes caused by obesity under homeostatic conditions could increase brain responses triggered by food cues and make people more motivated to increase their intake level, making it difficult to lose weight or maintain weight loss.³⁶ Changing eating patterns was also challenging for overweight and obese individuals due to various factors, including intrapersonal, interpersonal, and environmental factors, as shown in the study of 31 women in a low-income neighborhood of Santiago, Chile.³⁷ Factors beyond an individual's control, such as family and economic circumstances, could also influence the dietary patterns of adolescents, specifically those with an overweight or obese nutritional status and high blood pressure problems.

Several studies have previously examined the correlation between eating habits and BP.^{32,38} However, this study focused on presenting the differences in dietary changes among normal and high BP groups of adolescents during the COVID-19 pandemic. This could be used for implementing nutrition education and non-communicable disease prevention among adolescents. The limitation of this study was that the samples did not represent adolescent diets in other regions. Future studies in diverse locations are advised to investigate dietary patterns in high BP adolescents and the external factors associated with their difficulty developing healthier eating habits.

Conclusion

Based on the results, there are differences in food consumption changes among adolescents with normal and high BP at a selected high school in West Lampung District, Indonesia. Furthermore, students in the elevated

BP and stage 1 hypertension group are less likely to adopt healthier eating habits, such as increased consumption of fried foods and decreased intake of vegetables. To reduce the risk of developing non-communicable diseases in the future, it is important to provide nutrition education for all adolescents, particularly those with high blood pressure.

Abbreviations

BP: Blood Pressure; COVID-19: coronavirus disease 2019; BMI: Body Mass Index; SD: Standard Deviation; BMI/A: BMI-for-age, BP: Blood Pressure.

Ethics Approval and Consent to Participate

This study was approved by the Research and Community Engagement Ethical Committee of the Faculty of Public Health, Universitas Indonesia, with number: Ket- 607/UN2.F10.D11/PPM.00.02/2020. Written informed consent was obtained from all of the participants.

Competing Interest

The authors declared that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

This study's data can be provided upon reasonable request.

Authors' Contribution

BV was involved in data analysis and interpretation, and prepared the manuscript draft; RADS reviewed the manuscript, advised on the data analysis and interpretation, and owned the primary data; RMP was involved in data collection and compilation.

Acknowledgment

This study was funded by the International for the final project UI Students (PUTI) Saintekes 2020 with reference number NKB-4847/UN2.RST/HPK.05.00/2020. The authors are grateful to the study participants and the supporting staff in this study for their time and cooperation.

References

1. Soua S, Ghammam R, Maatoug J, Zammit N, Fredj SB, Martinez F, et al. The prevalence of high blood pressure and its determinants among Tunisian adolescents. *J Hum Hypertens*. 2022. DOI: 10.1058/s41371-022-00677-x
2. Azegami T, Uchida K, Tokumura M, Mori M. Blood Pressure Tracking from Childhood to Adulthood. *Front Pediatr*. 2021; 9: 785356. DOI: 10.3389/fped.2021.785356
3. Robinson CH, Chanchlani R. High Blood Pressure in Children and Adolescents: Current Perspectives and Strategies to Improve Future Kidney and Cardiovascular Health. *Kidney Int Rep*. 2022; 7 (5): 954-970. DOI: 10.1016/j.ekir.2022.02.018
4. Song P, Zhang Y, Yu J, Zha Mingming, Zhu Y, Rahimi K, et al. Global Prevalence of Hypertension in Children. *JAMA Pediatr*. 2019; 173 (12): 1154-1163. DOI: 10.1001/jamapediatrics.2019.3310
5. Badan Penelitian dan Pengembangan Kesehatan. Hasil Utama Riset Kesehatan Dasar 2013. Jakarta: Kementerian Kesehatan Republik Indonesia; 2013.
6. Jané BA, Manent JIR, Gil PT, Lliteras PM, Villalonga JLC, González ÁAL. Impact of COVID-19 Lockdown on Cardiometabolic Risk Scales in Adults: A Before and After Pandemic Lockdown Longitudinal Study. *Acad J Health Sci*. 2022; 38 (2): 78-84.
7. Musa S, Elyamani R, Dergaa I. COVID-19 and screen-based sedentary behaviour: Systematic review of digital screen time and metabolic syndrome in adolescents. *PloS One*. 2022; 17 (3): e0265560. DOI: 10.1371/journal.pone.0265560
8. Dunton GF, Do B, Wang SD. Early effects of the COVID-19 pandemic on physical activity and sedentary behavior in children living in the U.S. *BMC Public Health*. 2020; 20: 1351. DOI: 10.1186/s12889-020-09429-3
9. Karatzi K, Poulia K-A, Papakonstantinou E, Zampelas A. The Impact of Nutritional and Lifestyle Changes on Body Weight, Body Composition and Cardiometabolic Risk Factors in Children and Adolescents during the Pandemic of COVID-19: A Systematic Review. *Children*. 2021; 8 (12): 1130. DOI: 10.3390/children8121130
10. Song K, Jung SY, Yang J, Lee HS, Kim HS, Chae HW. Change in Prevalence of Hypertension among Korean Children and Adolescents during the coronavirus disease 2019 (COVID-19) Outbreak: A Population-Based Study. *Children*. 2023; 10 (1): 159. DOI: 10.3390/children10010159
11. Stavridou A, Kapsali E, Panagouli E, Thirios A, Polychronis K, Bacopoulou F, et al. Obesity in Children and Adolescents during COVID-19 Pandemic. *Children*. 2021; 8 (2): 135. DOI: 10.3390/children8020135
12. Pujia R, Ferro Y, Maurotti S, Khoory J, Gazzaruso C, Pujia A, et al. The Effects of COVID-19 on the Eating Habits of Children and Adolescents in Italy: A Pilot Survey Study. *Nutrients*. 2021; 13 (8): 2641. DOI: 10.3390/nu13082641
13. Aguilar-Martínez A, Bosque-Prous M, González-Casals H, Colillas-Malet E, Puigcorbè S, Esquius L, et al. Social Inequalities in Changes in Diet in Adolescents during Confinement due to COVID-19 in Spain: The Deskcohort Project. *Nutrients*. 2021; 13 (5): 1577. DOI: 10.3390/nu13051577
14. Androutsos O, Perperidi M, Georgiou C, Chouliaras G. Lifestyle Changes and Determinants of Children's and Adolescents' Body Weight Increase during the First COVID-19 Lockdown in Greece: The COV-EAT Study. *Nutrients*. 2021; 13 (3): 930. DOI: 10.3390/nu13030930
15. Cipolla C, Curatola A, Ferretti S, Giugno G, Condemi C, Delogo AB, et al. Eating habits and lifestyle in children with obesity during the COVID19 lockdown: A survey in an Italian center. *Acta Biomed*. 2021; 92 (2): e2021196. DOI: 10.23750/abm.v92i2.10912
16. Giannini DT, Tavares CM, Takey M, Aloise MLR, da Costa AJ, de Carvalho DS, et al. Adolescents Emotional State and Behavioral and Dietary Habit Changes during Isolation due to the COVID-19 Pandemic. *J Am Nutr Assoc*. 2022; 41 (4): 415-423. DOI: 10.1080/07315724.2021.1897899
17. Kim SY, Yoo DM, Min C, Choi HG. Changes in Dietary Habits and

- Exercise Pattern of Korean Adolescents from Prior to during the COVID-19 Pandemic. *Nutrients*. 2021; 13 (10): 3314. DOI: 10.3390/nu13103314
18. Munasinghe S, Sperandei S, Freebairn L, Conroy E, Jani H, Marjanovic S, et al. The Impact of Physical Distancing Policies during the COVID-19 Pandemic on Health and Well-being among Australian Adolescents. *J Adolesc Health*. 2020; 67 (5): 653–661. DOI: 10.1016/j.jadohealth.2020.08.008
 19. Maulina YR, Margawati A, Purwanti R, Tsani AFA. Differences in eating habits and physical activity before and during distance learning. *Jurnal Gizi Indonesia (The Indonesian Journal of Nutrition)*. 2022; 10 (2): 122-134. DOI: 10.14710/jgi.10.2.122-134
 20. Ruiz-Roso MB, de Carvalho Padilha P, Mantilla-Escalante DC, Ullola N, Brun P, Acevedo-Correa D, et al. COVID-19 Confinement and Changes of Adolescent's Dietary Trends in Italy, Spain, Chile, Colombia and Brazil. *Nutrients*. 2020; 12 (6): 1807. DOI: 10.3390/nu12061807
 21. Dieny FF, Jauharany FF, Tsani AFA, Nissa C. Perilaku Makan Sebelum dan Selama Pandemi COVID-19 pada Kelompok Remaja dan Dewasa di Indonesia. *Action: Aceh Nutrition Journal*. 2021; 6 (2): 128-138. DOI : 10.30867/action.v6i2.418
 22. Neves SC, Rodrigues LM, Bento PASS, Minayo MCS. Risk Factors Involved in Adolescent Obesity: An Integrative Review. *Ciencia Saude Coletiva*. 2021; 26 (Suppl 3): 487-4884. DOI: 10.1590/1413-812320212611.3.30852019
 23. Badan Penelitian dan Pengembangan Kesehatan. Hasil Utama Risetdas 2018. Jakarta: Kementerian Kesehatan Republik Indonesia; 2018.
 24. Dinas Kesehatan Provinsi Lampung. Profil Kesehatan Provinsi Lampung 2021. Bandar Lampung: Pemerintah Provinsi Lampung; 2018.
 25. Kadir S. Pola makan dan kejadian hipertensi. *Jambura Health and Sport Nutrition*. 2019; 1 (2): 56-60. DOI: 10.37311/jhsj.v1i2.2469
 26. Menteri Kesehatan Republik Indonesia. Peraturan Menteri Kesehatan Republik Indonesia Nomor 2 tentang Standar Antropometri Anak. Jakarta: Kementerian Kesehatan Republik Indonesia; 2020.
 27. Flynn JT, Kaelber DC, Baker-Smith CM, Blowey D, Carroll AE, Daniels SR, et al. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. *Pediatrics*. 2017; 140 (3): e20171904. DOI: 10.1542/peds.2017-1904
 28. Magalhães P, Pereira B, Garcia F, Vilas C, Moreira T, Rosário P. Changes in Student's Breakfast and Snack Consumption during the Second COVID-19 Lockdown in Portugal: A Five Wave Study. *Int J Environ Res Public Health*. 2023; 20 (4): 3034. DOI: 10.3390/ijerph20043034
 29. Adams EL, Caccavale LJ, Smith D, Bean MK. Food insecurity, the home food environment, and parent feeding practices in the era of COVID-19. *Obesity*. 2020; 28 (11): 2056-2063. DOI: 10.1002/oby.22996
 30. Chenarides L, Grebitus C, Lusk JL, Printezis I. Food consumption behavior during the COVID-19 pandemic. *Agribusiness*. 2021; 37 (1): 44-81. DOI: 10.1002/agr.21679
 31. Motiwala ZY, Khan IR, Ahmad S, Abedi AJ. Dietary Changes among the Indian Population during the COVID-19 Pandemic: A Cross-Sectional Study. *Indian J Community Med*. 2023; 48 (1): 137-141. DOI: 10.4103/ijcm.ijcm_521_22
 32. Syah MNH, Wahyuningsih U, Ardiansyah S, Asrullah M. Hypertension and Related Factors Among Female Students at Vocational High School Bekasi, Indonesia. *Media Gizi Indonesia*. 2020; 15 (3): 219-224. DOI: 10.20473/mgi.v15i3.219-224
 33. Kelly RK, Magnussen CG, Sabin MA, Cheung M, Juonala M. Development of Hypertension in Overweight Adolescents: A Review. *Adolesc Health Med Ther*. 2015; 6: 171-187. DOI: 10.2147/AHMT.S55837
 34. Mendoza-Herrera K, Florio AA, Moore M, Marrero A, Tamez M, Bhupathiraju SN, et al. The Leptin System and Diet: A Mini Review of The Current Evidence. *Front Endocrinol*. 2021; 12: 749050. DOI: 10.3389/fendo.2021.749050
 35. Grace GA, Edward S, Gopalakrishnan S. Dietary Habits and Obesity among Adolescent School Children: A Case Control Study in an Urban Area of Kancheepuram District. *Indian J Community Med*. 2021; 46 (4): 637-640. DOI: 10.4103/ijcm.IJCM_1013_20
 36. Belfort-DeAguiar R, Seo D. Food Cues and Obesity: Overpowering Hormones and Energy Balance Regulation. *Curr Obes Rep*. 2018; 7 (2): 122-129. DOI: 10.1007/s13679-018-0303-1
 37. Vizcarra M, Palomino AM, Iglesias L, Valencia A, Espinoza PG, Schwingel A. Weight Matters—Factors Influencing Eating Behaviors of Vulnerable Women. *Nutrients*. 2019; 11 (8): 1809. DOI: 10.3390/nu11081809
 38. Margerison C, Riddell LJ, McNaughton SA, Nowson CA. Associations between Dietary Patterns and Blood Pressure in A Sample of Australian Adults. *Nutrition Journal*, 2020; 19 (5). DOI: 10.1186/s12937-019-0519-2