

Artículo Original

Online intervention of elementary school children with overweight and obese during pandemic in Jakarta: a pilot cluster randomized control trial

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ABSTRACT

Background and Objectives: To determine the effect of online interventions with parental assistance on the nutritional status of school children with overweight or obesity in Jakarta.

Methods and Study Design: We used a cluster-randomized controlled trial design, with one elementary school as the intervention group and another as the control. The study was conducted for 8 weeks, from the beginning of October to the end of November 2020. In the intervention group, children were given nutrition education by the teacher every week and exercise instruction 2 times a week, and parents were given assistance online. Children in the control group were given nutrition education by the teacher every week and exercise instruction in accordance with the curriculum. The sample consisted of 45 children. Anthropometric data were collected through home visits in compliance with pandemic health protocols. Data on participant demographics, 24-h food intake, and exercise practice were collected through WhatsApp interviews and Google Forms questionnaires.

Results: After 2 months, the height of the participants in the intervention group had increased from the baseline significantly (p=0.001), and improvements in nutritional status were indicated by a decrease in Body Mass Index z-score for age (p=0.001). The duration of physical activity increased significantly from baseline in intervention group (p=0.044)

Correspondencia: Iskari NGADIARTI Iskari.ngadiarti@poltekkesjkt2.ac.id and in control group (p=0.007). After adjusting for several variables, the analysis demonstrated that parental assistance was not significantly associated with the change in Body Mass Index z-score.

Conclusion: Online interventions improve the nutritional status of school children. The implementation of online assistance to parents requires further exploration.

Keywords: weight overload, malnutrition, nutritional education, excess weight, anthropometry.

INTRODUCTION

Investment in the health and nutritional status of school children is essential for their future, especially during the Coronavirus Disease 2019 (COVID-19) pandemic. At the beginning of 2020, the World Health Organization (WHO) declared COVID-19 to be a pandemic, and in March 2020, the Indonesian government stated that Indonesia was exposed to the infection¹. To minimize the risk of transmission, the WHO advised that schools should be closed temporarily as a public health measure². The Indonesian government subsequently introduced regulations for all schools stating that they should provide distance learning and advised students from kindergarten to university to study from home³.

In 2018, Jakarta, the capital city of Indonesia, had the second highest prevalence of overweight and obesity in children aged 5 to 12 years (29.2%) in the country after Papua province (30.6%)⁴. In 2019, the results of a screening survey conducted by the Health Department of South Jakarta revealed that the prevalence of overweight and obesity among school children had increased from 29.2% (in 2018) to 33%. (M. Damayanti, personal communication). The prevalence of obesity in children must be reduced to prevent an increase in non-communicable diseases—such as hypertension, diabetes, and heart disease—in adulthood⁵. During the pandemic, in addition to school closures, the WHO advised populations to practice social distancing and self-isolation and to limit their movement to prevent the transmission of COVID-19. These special circumstances and changes to everyday life may have reduced people's physical activity (PA) and changed eating behaviors, which could have contributed to an increase in the risk of obesity. Researches revealed that during the pandemic, children, adolescents, and young adults in the United States, China, and Palestine had eaten more and gained weight^{6,7}.

Obesity occurs because of an imbalance between energy intake and energy expenditure. However, numerous factors contribute to this complex condition, including an unhealthy diet and sedentary lifestyle⁸. A survey in Indonesia conducted from 2013 to 2018 revealed that the proportion of individuals aged older than 10 years with exercise less than 150 minutes per week had increased from 26.1% to 33.5%. Jakarta was the province with the highest prevalence of individuals exercise less than 150 minutes per week (47.8%). The proportion of people older than 5 years who ate vegetables and fruit less than five portion a day also increased from 93.5% (2013) to 95.5% (2018)⁹. Another national survey reported that children have increased their consumption of packaged drinks, both powdered and liquid¹⁰.

Researchers conducting a study in Palestine during the pandemic reported that 41.7% of adolescents had gained weight because of increased consumption of fried foods, sweet foods, sugary drinks, and dairy products in lockdown situations¹¹. Researcher revealed that parents of children aged 9–13 years reported decreased PA and increased sedentary behavior in their children during the early COVID-19 pandemic period¹².

Several studies have demonstrated that school interventions improve the health and lifestyle behaviors of school children. Qian et al. examined a comprehensive nutrition program implemented in grade 4 elementary school children in Shandong and Qinghai provinces, China, and used other schools as a control¹³. They reported that the interventions increased the frequency of healthy-eating behaviors in both provinces and were more effective in the more affluent province, Shandong. Landau et al. examined the long-term effects of after-school program interventions on children with overweight or obesity. The improved weight control achieved through the intervention, especially in children with mild obesity, was attributed to increased PA¹⁴.

In Indonesia, a few intervention studies on children with obesity have been conducted. Mihardja et al. conducted a 3-month trial in which the intervention group ran twice a week at school and received education on healthy foods whereas the control group received regular nutrition information through leaflets and posters and performed PA once a week. They reported that the BMI of the intervention group was significantly lower than that of the control group after the intervention¹⁵. However, research by Kipping et al. demonstrated that school-based interventions were not effective at increasing PA, reducing sedentary behavior, or increasing fruit and vegetable consumption in elementary school children with obesity. Personal behavior lifestyle change requires a more intensive intervention involving families, communities, and schools working together¹⁶.

The COVID-19 pandemic has had an impact on health behaviors associated with increased risk of obesity. School closure policies have had implications for distance-learning facilities, with elementary school children using either online classes or distance learning. School-based interventions for children with obesity using online resources require further exploration. Therefore, this study aimed to determine the effect of an online school-based nutrition intervention on the bodyweight of elementary-school-age children with overweight or obesity in Jakarta.

MATERIALS AND METHODS

Study Design

We used a cluster-randomized controlled trial design. We randomized two public elementary schools: Sekolah Dasar Negeri (SDN) Kramat Pela 09 was assigned to the intervention group and SDN Kramat Pela 01 to the control group.

Population and Sampling

The two schools are located in Kebayoran Baru, South Jakarta, which is a business area with many malls, schools, and hospitals. The school's facilities include classrooms, a library, a laboratory, sanitary facilities, and access to the Internet. Kramat Pela 01 elementary school has an area of 4,070 m2, with 6 teachers and 193 school children (100 boys and 93 girls)¹⁷. By comparison, Kramat Pela 09 elementary school has an area of 4,875 m2, with 21 teachers and 423 school children (219 boys and 204 girls)¹⁸.

The target population for this study was elementary school children with overweight or obesity in South Jakarta. We identified two elementary schools that had relatively high prevalence of overweight and obesity in 2019 (33% in SDN Kramat Pela 01 and 35% in SDN Kramat Pela 09) (M Damayanti, personal communication). We included children from classes 4, 5, and 6 whose parents gave consent for their children to participate. We excluded a child if they or a member of their family had COVID-19 infection. A power analysis estimated a required sample size of 26 children per group, with a 5% significance level, 80% power, and medium effect size. However, because of several obstacles related to parental consent and the COVID-19 pandemic, we enrolled 25 children in the intervention group and 20 in the control group (Figure 1).



Figure 1. Schematic flow of study

Intervention

The study consisted of multicomponent interventions, which included nutrition education, PA instruction, and parental assistance. In the intervention group, the class teacher provided nutrition education to the children online every Friday morning, the PA teacher led a session of PA twice a week online, and we provided online assistance to parents. In the control group, the classroom teacher provided nutrition education and the PA teacher led a session of PA online once a week. Booklets on implementation of the nutrition guidelines and PA were given to the parents of the children in both groups. Parents were asked to record the food consumption and PA of their children and any progress in this booklet.

Nutrition education videos based on Indonesian nutrition guidelines were created and provided to all students, includ-

ing the participants, online¹⁹. The eight videos were titled *Nutrition and health, Consuming food in a balanced diet, Getting used to a clean and healthy lifestyle, Have a Good Personal Hygiene Practice, Let's do some physical activity, Monitoring bodyweight regularly, Let's have a healthy breakfast, Learning to consume vegetables and fruit, and Choosing a suitable healthy snack.* The PA teachers used their own PA videos as well as three PA videos created for this study: *Simple and fun workouts at home, Stretching at home,* and *Workout at home with kids.*

Data Collection

The primary outcome was weight gain. The bodyweight of the participating school children was measured using a weighing scale from CAMRY (CAMRY Electronic Ltd, Guangdong, China) with 0.01-kg precision. The height of the participants was measured using a microtoise with a precision of 0.1 cm. The children's nutritional status was calculated using the WHO Anthropometry plus software. The criteria for nutritional status were based on the WHO Growth Reference for children aged 5–19 years, overweight if BMI for age z score > + 1 SD and obesity if z score > + 2 SD (https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators/bmi-for-age). The middle upper arm circumference was measured for the left arm at the midpoint between the tip of the shoulder and tip of the elbow by using microtoise tape.

Bodyweight was collected three times: at baseline, after 1 month, and after 2 months of the intervention. Height was measured at baseline and after 2 months of the intervention. Anthropometric data measurements were performed at the house of each child in compliance with the COVID-19 infection prevention protocol. Everyone involved in performing the measurements including the enumerators, children, and parents—used a mask and face shield. The enumerators washed their hands with hand sanitizer, checked the body temperature of the children and parents using a thermogun, and cleaned the equipment before and after use with disinfectant. To reduce physical contact, the anthropometric measurements were performed by a parent or guardian who had been given instructions by the enumerators. Demographic data were collected using Google Forms. PA was assessed through an interview over WhatsApp at baseline and after 1 and 2 months of the intervention. PA included sports activities, play, and household activities.

Data Analysis

We used the Chi-square test to compare the demographic data of the children in the intervention and control groups. The mean differences in variables among the baseline and after 1 and 2 months of the intervention were calculated to assess within-group differences using a paired t test, between-group differences using an independent t test, and trends using ANOVA and repeated measures. We assessed the effective-ness of the intervention by using multilinear regression.

RESULTS

In the present study, the majority of the child participants were boys, and the proportion of school children with obesity and central obesity was higher than that of school children with overweight²⁰. The highest education level of the majority of parents was high school. The median age of the participants was 11 years. The demographic distributions of the participants between the two groups were not significantly different (p>0.05; **Table 1**).

Characteristic	Intervent	ion Group	Contro		
	n (25)	%	n (20)	%	p-value
Age (years)					0.876
9	3	12	1	5	
10	6	24	7	35	
11	9	36	8	40	
12	6	24	4	20	
13	1	4	0	0	
Sex					
Boys	16	64.0	13	65.0	
Girls	9	36.0	7	35.0	
Grades					0.474
Grade 4	6	24.0	5	25.0	
Grade 5	9	36.0	8	40.0	
Grade 6	10	40.0	7	35.0	

Table 1. Participant demographics

Table 1 continuation. Participant demographics
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Characteristic	Intervent	ion Group	Contro	n value		
Characteristic	n (25)	%	n (20)	%	p-value	
Father education						
Elementary	1	4.0	1	5.0		
Middle school	2	8.0	4	20.0		
High school	17	68.0	9	45.0		
College	5	20.0	6	30.0		
Mother education					0.965	
Elementary	3	12.0	2	10.0		
Middle school	4	16.0	3	15.0		
High school	14	56.0	10	50.0		
College	4	16.0	5	25.0		
Father Occupation						
Private sectors	14	56.0	11	55.0	0.638	
Enterpreneur	7	28.0	4	20.0		
Laborer	1	4.0	3	15.0		
No employment	3	12.0	2	10.0		
Mother Occupation						
Private sectors	1	4.0	5	25.0		
Enterpreneur	3	12.0	1	5.0		
Housewife	21	84.0	14	70.0		
Nutritional Status at Baseline						
Overweight	4	16.0	7	35.0		
Obese	21	84.0	13	65.0		

The results revealed a significant increase (p=0.001) in the mean height of the participants and significant decrease (p=0.001) in their BMI z-score for age in the second month of the intervention in the intervention group. They also revealed that the duration of the school children's PA increased significantly in both groups (p<0.05; **Table 2**).

The implementation of assistance to parents online through WhatsApp is summarized in **Table 3**. The results revealed that the BMI z-score was significantly different (p<0.05) in relation to no parent involvement, involvement 3 or 4 times,

and involvement 5–8 times in the first and second month of the intervention.

In addition to energy expenditure, the energy, fat, protein, and dietary fiber intakes of the school children had decreased significantly (p<0.05) after the first month of the intervention. However, the protein and dietary fiber intakes then increased significantly (p<0.05) during the second month of the intervention. The study results relating to nutrition knowledge and nutrient intake among the school children will be published in a separate paper.

Variables	Intervensi g	roup (n=25)	Control group (n=20)				
Variables	Mean ± SD	p-value	Mean ± SD	p-value			
Bodyweight (Kg)							
Baseline	55.43±18.34	Ref	53.61±11.34	Ref			
1 month	55.61±19.73	0.800	53.69±11.16	0.786			
2 months	55.58±19.98	0.927	54.01±10.95	0.338			
p-trend		0.827		0.418			
Waist circumference ((cm)	•		•			
Baseline	82.54±11.36	Ref	82.01±8.22	Ref			
1 month	80.59±10.64	0.129	82.43±8.85	0.465			
2 months	80.72±13.79	0.928	81.84±9.41	0.598			
p-trend		0.264		0.892			
Height (cm)							
Baseline	144.04±10.03	146.87±8.95					
2 months	145.98± 9.79	0.001	0.508147.23±8.35				
Z-Score (BMI for age))			·			
Baseline	2.73±0.76	Ref	2.44±0.80	Ref			
1 month	2.65±0.91	0.540	2.30±0.88	0.208			
2 months	2.32±1.03	0.001	2.20±0.81	0.195			
p-trend		0.006		0.042			
Physical Activity (hours)							
Baseline	1.43±0.58	Ref	1.61±0.75	Ref			
1 Month	1.63±0.56	0.095	1.59±0.63	0.772			
2 Month	2.17±0.95	0.044	2.27±1.06	0.007			
p-trend		0.003		0.007			

Table 2. Bodyweight, height, waist circumference, BMI z-score for age, and PA of participants before and after the intervention

Table 4 presents the results of the multiple linear regression between changes in BMI z-score and the independent variables. Dietary fiber intake had a significant relationship (p=0.012) with change in the participants' BMI z-score, indicating that an increase in dietary fiber in food improved the nutritional status of the children.

DISCUSSION

The results revealed that the online intervention program implemented during the COVID-19 pandemic decreased the BMI z-score of children with overweight or obesity in both participating schools. This result is consistent with that of the study by Guo et.al, who demonstrated that interventions significantly decreased the BMI z-score of children and adolescents with obesity in Shantou²¹, and also with that of Xu et al., who conducted school-based interventions for children in China²². Jacob et al. obtained the same limited result in their meta-analysis conducted before the pandemic. From 33 studies, they identified 14 on school-based interventions that included BMI z- score as an outcome of the intervention and discovered a small but significant reduction in the BMI z- score of school children after the interventions. The major-

Frequency of	n	%	Parant responses	BMI z-score (mean \pm SD) of the children		
assistance (times)			Farent responses	Baseline	1 month	2 months
0	6	24	No response	2.47 ± 0.61	2.05 ± 0.82	1.79 ± 0.87
3-4		28	Children eat breakfast regularly, try to eat vegetables & fruit, cycle, play soccer, do gymnastics, jog, and try to control or decrease their food intake	3.14 ±1.06	3.25 ± 1.08	3.10 ± 1.149
			Children still eat fast food, chips, and chocolateand do not eat vegetables			
			Children have breakfast regularly, try to eat vegetables & fruit, try new foods, have lower food intake, have appropriate portions, eat less street food, follow exercise videos, walk, help			
5–8	12	48	Children could not decrease their food intake, including instant noodles, were not interested in exercise, skipped breakfast, still had a large appetite, had unchanged food and exercise, and exercised depending on their mood	2.63 ± 0.57	2.60 ± 0.63	2.11 ± 0.83
	25	100		<i>p</i> =0.242	<i>p</i> =0.049	<i>p</i> =0.042

Table 3. Role of parental assistance in the intervention for school children with ove	erweight or obesity
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ity of studies in that meta-analysis (56%) conducted research for more than 6 months in a high-income setting, whereas the present study was conducted for 2 months in Indonesia²³.

Although the differences between the two groups were not significant, we discovered that the frequency of parental assistance affected the bodyweight of school children. However, some parents were busy working or had changed their phone number and were therefore unable to participate. During a pandemic, supporting children who are studying at home using an online system is a challenge for parents. The low-to-middle socioeconomic status of the participants in this study may also have been a factor; the low level of parental participation in schools aiming to promote their students' health was also Health Promoting Schools was noted by the WHO²⁴.

In the studies conducted by Nyberg and Norman, the involvement of parents in the prevention and treatment of overweight and obesity in children was more intensive^{25,26}. Nyberg et al. discovered that their intervention had no significant effect on the BMI of all children after 4 months; however, it significantly lowered the BMI of the children with obesity (p=0.03)²⁵. Furthermore, Norman's study suggested that increasing family engagement and integrating school-based prevention into routine school activities had strong long-term effects on the nutritional status of school children²⁶. These studies were conducted before the pandemic; therefore, the implementation of parental assistance in an online setting still requires exploration.

The key role of PA interventions in reducing the BMI z-score has been revealed in several studies, including the present study. Landau et al. demonstrated that PA was a contributing factor in weight control, especially in children with mild obesity¹⁴. Jacob et al. identified 12 (36%) studies from a total of 33 that included exercise or PA classes as the school-based intervention and 4 studies demonstrating that exercise or PA classes were significantly related to the BMI of children and adolescents²³. In the study by Nyberg et al, the intervention had no effect on any of the PA measurements of children, except that the time the children spent on sedentary activities was significantly less during the week (p=0.03) and at the weekend (p=0.04) compared with before the intervention²⁵. The results of the present study are different to those of Mihardja et al. The differences in intervention design, anthropometric indicators, and PA intervention setting may have influenced the results¹⁵.

The present study was conducted during the pandemic, when schools were closed and distance learning was provided to all students. Therefore, all the interventions in the present study were conducted through online systems, including PA instruction. The role of online systems in interventions was also demonstrated in 16 of the 33 studies included by Jacob et al. in their meta- analysis; the online systems used were **Table 4.** Relationship of the school interventions, energy and nutrient intake, and physical activity with change in BMI z-score among children with overweight or obesity*

Variabel	Coefficient (95% CI)	p value				
Groups						
- Control School	Ref					
- Intervention School	0.87 (-0.030;0.204)	0.139				
Physical activity (hours) at 2 months	0.029 (-0.039;0.096)	0.396				
Energy intake (Calorie) at 2 months	0.000 (0.000;0.000)	0.225				
Dietary fiber (g) at 2 months	-0.031 (-0.055;-0.007)	0.012				
Age (year)	-0.013 (-0.075;0.048)	0.663				
Sex: -						
Boys -	Ref -	0 659				
Girls	0.029 (-0.161;0.103)	0.055				
BMI for age (z-score) at baseline	0.028 (-0.053;0.110)	0.489				
Mother education	0.000 (-0.67;0.066)	0.991				
Mother occupation	0.000 (-0.055;0.054)	0.996				

* R^2 adjusted = 0.040; adjusted for age, sex, BMI z-score baseline, and mother's education and occupation; p=0.325 with linear regression.

digital media including websites and apps²³. In these studies, the online systems complemented the offline system. Smith et al. revealed that the use of smartphones in school-based interventions affected children's muscular fitness, movement skills, and key weight- related behaviors. The amount of PA might explain why it had no significant effect on BMI²⁷. In the present study, multicomponent interventions delivered by teachers resulted in a significantly increased duration of PA and decreased BMI z-score.

The strength of this study is that only a few studies are likely to have been conducted during the pandemic. Although achieving this was a challenge, it provided an opportunity to explore the implementation of interventions using online systems. This study also benefited from applying multicomponent interventions in a lockdown situation in which students had limited resources and information. This study also has several limitations. First, the number of schools (two) and participants (45 children) may have been insufficient for the trial's design to adequately assess differences. Second, we had limited time to collaborate with school stakeholders and train and motivate the teachers to deliver the nutrition education and PA instruction. Third, the nutrition education and PA instruction were delivered by teachers to all students, not only the participants in the online classes. Although this approach may be useful, individual and structured counseling may be required for children with overweight or obesity. This study followed Helsinki declaration and received ethical approval from University Research Ethics Commission (number: LB.02.01/I/KE/ 31418/2020). Informed consent was obtained from each of participant in this study.

The study suggests several implications for future development. These include enhancing online based interventions with interactive technologies, exploring the role of parental involvement in supporting intervention programs, and conducting long term studies to assess the sustained impact on children's health. It also highlights the need to implement these programs across diverse social and economic contexts. Furthermore, fostering multidisciplinary collaboration among nutritionists, educators, technologists, and policymakers is essential to create comprehensive, accessible, and effective interventions for addressing childhood obesity holistically.

CONCLUSION

Online intervention programs improved the nutritional status of school children by increasing their duration of PA. However, the role of parental assistance, nutrition knowledge and nutrient intake requires further exploration.

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