ORIGINAL

Effects of the COVID-19 Pandemic on the Lifestyle and Physical Activity of School-aged Children : Survey of Students at Japanese Language Supplementary School in the United States

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Abstract : Coronavirus disease 2019 (COVID-19) and associated lockdowns affected many people regardless of location, age, or gender. This study aimed to focus on school-aged children studying at a Japanese Language Supplementary School (JLSS) in the southwestern region of the United States and assessed the impact of COVID-19 on their lifestyle and physical activity (PA). An online-based cross-sectional survey was administered to students (age range : 6-18) enrolled in a JLSS as of June 11, 2021. Data were collected from 151 students. The questionnaire consisted of lifestyle and PA questions. A paired and Student t-test was used to test the differences in changes before COVID-19 and during COVID-19 among children. Chi-square tests were used for comparisons with descriptive analyses of frequencies. Level of statistical significance was set at $p < .05$. Screen time was significantly longer on weekdays ($t = 8.71$, $p < .001$) and weekends ($t = 5.94$, $p < .001$) than before COVID-19. The number of children who went to bed after 10 pm was significantly higher ($\chi^2 = 4.06$, $p < 0.05$) than before the new coronavirus infection. The frequency of PA per week was significantly higher ($\chi^2 = 4.01$, $p < 0.05$) in the group using digital devices. Findings suggested that the use of digital devices for PA can enhance PA frequency in JLSS students. J. Med. Invest. 72 : 117-123, February, 2025

Keywords **:** *Physical Activity, COVID-19, Lifestyle, Japanese Language Supplementary School, Screen Time*

INTRODUCTION

The World Health Organization (WHO) declared the novel coronavirus (COVID-19) outbreak a pandemic on March 11, 2020 (1). In response to the rapid escalation of COVID-19 cases, many countries, including the United States, implemented lockdown measures (e.g., stay-at-home orders and movement control restrictions). These measures significantly curtailed daily activities, including business and educational activities. Prior to the COVID-19 pandemic, declining physical fitness, reduced physical activity (PA), and increased screen time were already recognized as child health concerns (2, 3). School closures, implemented to mitigate infection spread, have been reported to exacerbate these issues by increasing screen time, reducing PA and lifestyle changes, particularly among school-aged children. In 2018, a total of 26,000 school-aged Japanese children lived in North America, and 53% of these children were enrolled in Japanese Language Supplementary Schools (JLSS). JLSS are schools that children attend on Saturdays and weekday afternoons while regularly attending local schools. About 70% of the JLSS students are children of short-term residents who will return to Japan in the future. JLSS students carry a significant academic load as they balance double schooling, often supplemented by tutorials, taking private classes and correspondence course materials (4, 5).

By mid-March 2020, the JLSS campus was also closed, along with the local schools, and remote learning via computers began in April 2020. Despite the growing population of Japanese families and children living abroad, limited research has examined the lifestyles and PA of children attending JLSS, leaving a gap in understanding their actual circumstances. COVID-19 has spread to children in many regions and countries ; therefore, it is important to assess whether children in JLSS, a small community, show the same results as previous studies on lifestyle and PA in other countries and regions.

This study aimed to focus on school-aged children living abroad and attending a JLSS located in the southwestern region of the U.S. to evaluate the impact of COVID-19 on their lifestyles and physical activity.

METHODS

An online-based cross-sectional survey was conducted to assess the effects of the COVID-19 pandemic on the lifestyles and PA of kindergarten to grade 12 students, ages 6-18, who are also enrolled in a JLSS located in the southwestern region of the U.S., as of June 11, 2021. A total of 412 students residing in 298 households were registered, among whom 151 expressed interest in the survey and completed it, resulting in a response rate of 36.7%.

First, the questionnaire collected demographic data on the students, including age, gender, grade level, educational methods, residential history in the U.S., access to physical education classes, housing type, leisure activities, and experiences with PA using digital devices. Second, respondents were asked about 10 items related to PA and lifestyle, such as waking hours, bedtime, and screen time, before and during the COVID-19 pandemic. The questionnaire was administered in Japanese, the students' native language. A pretest was conducted with former students (n = 13) to ensure that the content was understandable. Based

Received for publication October 30, 2024 ; accepted December 20, 2024.

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on the pretest feedback, some of the questions and wording were re-written to make it easier for children to better understand.

Information on the survey was shared by a school office administrator with parents from 298 households representing 412 students, ages 6-18. Parents received explanatory documents and questionnaires via e-mail on the first day of the study, with a follow-up email sent one week later. Information about the study was also published in the school newsletter on June 26, 2021. Parents had the option to access the survey directly via a quick response code (QR code) or URL. They also had the option to complete the survey on their mobile phones, tablets, or desktop devices. The survey was limited to one response per participant and participants' email addresses were not collected. This was an anonymous survey, and data were shared without knowing the identity of each participant.

For the purposes of this study, the term "screen time" was used to refer to "the amount of time spent using a device with a screen such as a smartphone, computer, television, or video game console, excluding educational screen time." Lifestyle habits were assessed using the following variables : wake-up time, bedtime, screen time on weekdays and weekends. Wake-up time was divided into two groups : before 7:00 a.m. and after 7:00 a.m. Bedtime was divided into two groups : before 10:00 p.m. and after 10:00 p.m. The responses on screen time on weekdays and weekends were divided into two groups : less than 2 hours, more than 2 hours. Students were asked to compare their PA level in the week immediately preceding the date of response to this survey to their average weekly PA level prior to the COVID 19 pandemic (before March 2020). Responses on total PA hours per week were divided into two groups : less than 7 hours per week, and more than 7 hours per week. This group is based on the WHO Guidelines on PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR (2020), which recommend a minimum of 60 minutes of exercise per day, moderate- to vigorous-intensity PA across the week (6).

PA with Digital Device Use was defined as engaging in physical activities using digital platforms such as exercise applications, watching YouTube videos, visiting websites for PA, etc. Answer choices appeared in a checkbox format for single answer items and a pull-down menu for multiple-choice answers. For additional information, an open-ended question section was included at the end of the survey to allow respondents to share their thoughts or feelings. Parents were allowed to help students complete the survey by reading the questions, helping with answers, and typing responses if necessary. The survey was designed to take approximately 15 minutes to complete and was administered between June 11 and July 2, 2021. For the purpose of this study, March 1, 2021 was selected as the baseline date, with periods before and after this date designated as "Before COVID-19" and "During COVID-19" respectively. Due to various factors, including the different calendars of the various other schools the students attended and the survey being conducted during local schools' summer vacation, the date of May 1, 2021 was used as a reference dated for some questions about local school activities, recalling PA frequency and learning methods during COVID-19 (Figure 1).

Before distributing the survey, written consent was obtained and confirmed by the school principal. Upon initiation of the online survey, an outline of the research was provided, and only those who selected, "I agree" were allowed to proceed to answer the questions. This study was approved by the Ethics Committee of Tokushima University Hospital (ID11000161).

Data were analyzed using descriptive statistics (frequency, percentage, mean, and standard deviation), paired t-tests, and chi-square tests with adjusted standardized residual (ASR). ASR were calculated when there was an association between variables using the chi-square test.

The sample size calculation was conducted using G*Power 3.1.9.7 (Faul 2007 ; Faul 2009). For a two-tailed paired t-test with a medium size effect ($f = 0.4$), a significance level of 5%, and a power of 80%, the required sample size was 52 cases. A minimum of 50 cases were required for the chi-square test. A sampling error of ± 4.8% (36.7 ± 4.8 %) was calculated at a 95% confidence level. The significance level was set at $p < 0.05$.

RESULTS

Demographic Characteristics of Students

Table 1 shows descriptive statistics for the demographic characteristics of the participating students. The mean age and standard deviation (SD) were 9.55 ± 2.77 years old, with 46.4% male and 53.6% female students. The largest group of students were in elementary school, with 45.7% in 1st-3rd grades, and 27.2% in 4th-6th grades students, and they were attending local schools (Monday – Friday) at the end of December 2020. At the end of the school year, 82.1% of students attended local schools, whereas 16.6% took online classes. In addition, 70.9% of students live in a single-family homes with a yard and/or swimming pool and 25.2% of students live in an apartment complex with a gym, swimming pool and/or playground.

Lifestyle and COVID-19

The students answered questions about their current lifestyle habits, which were compared to their pre-COVID-19 habits (before March 2020).

Results indicated that bedtime was significantly later during COVID-19 than before COVID-19 ($\chi^2 = 4.058$, $p < 0.05$). However, there were no significant differences in wake-up times before and during COVID-19.

Screen time in hours on weekdays was significantly longer during COVID-19 compared to before COVID-19 (2.63±1.36 vs. 2.03 ± 1.03, $t = 8.71$, $p < 0.001$). Similarly, weekend screen time in hours was also significantly longer during COVID-19 than before COVID-19 (3.10 ± 1.32 vs. 2.67 ± 1.28, $t = 5.94$, $p < 0 .001$). No statistically significant differences were observed in the wake-up times before COVID-19 and during COVID-19 (Table 2).

As of May 1, 2021, 90.1% of students had access to Physical Education (PE) classes at their local schools, including 15.4% who took PE classes online. There was no significant difference in PE frequency between in-person and online/hybrid formats (2.87 ± 1.32 vs. 3.38 ± 1.47, $t = -1.61$, $p = 0.11$).

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Additionally, 91.4% of students spent their free time on non-physical activities, with 58.0% answering with the following activities : watching TV, playing online games, social networking and browsing the Internet.

Physical Activity and Screen Time

Table 3 showed no statistically significant differences between the groups ($\chi^2 = 0.037$, $p = 0.847$). Few students met the PA guidelines before and during the COVID-19 pandemic, and there was no statistically significant difference in PA levels before and during the pandemic. Students were divided into two groups based on the changes in screen time : Group A (increased screen time) and Group B (no change in screen time). The chi-square test of independence was conducted to examine the relationship

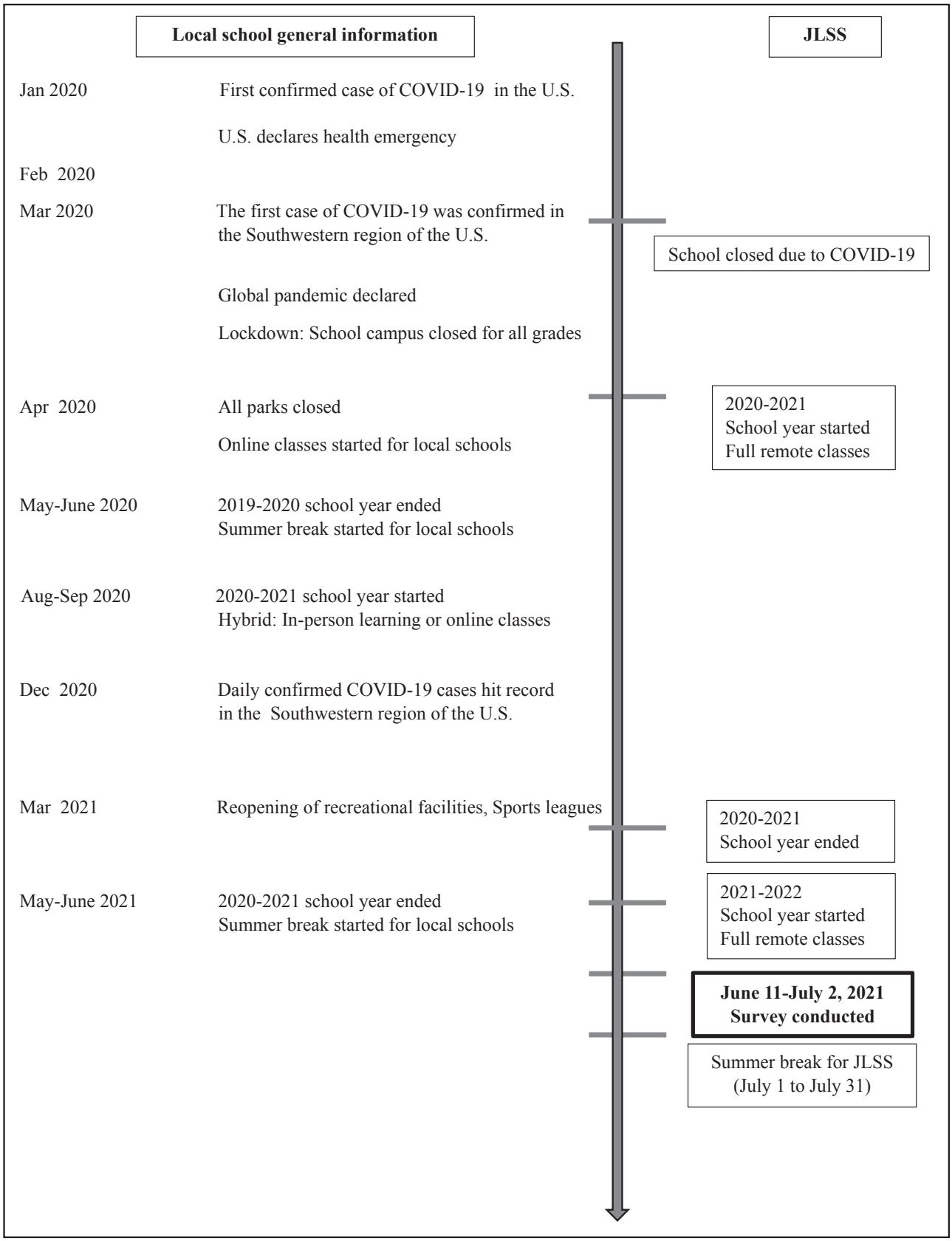

Figure 1. COVID-19 timeline in the Southwestern region of the U.S.

Table 1. Descriptive statistics on the demographic characteristics of students (N=151)

Variable		n (%)
Gender	Male	70 (46.4)
	Female	81 (53.6)
Grade at school	Kindergarten	10 (6.6)
	1-3rd grade	69 (45.7)
	4-6th grade	41 (27.2)
	7-9th grade	28 (18.5)
	10-12th grade	3 (1.9)
Residency in the U.S.	Less than 5 years	96 (63.6)
	More than 5 years but less than 10 years	24 (15.9)
	More than 10 years and born in the U.S.	30 (19.9)
	Other	1 (0.7)
Type of Housing	Single-family homes with yard and/or pool	107 (70.9)
	Single-family homes without yard and/or pool	5 (3.3)
	Apartment/Condo with gym, pool and/or play area	38 (25.2)
	Apartment/Condo without gym, pool or play area	0 (0.0)
	Unknown	1 (0.7)
Age in years	Mean ± SD = 9.55 ± 2.77	

Table 2. Lifestyle changes due to COVID-19

Variable	Before COVID-19		During COVID-19				
	Mean (SD)	n (%)	Mean (SD)	n (%)	*t*	χ^2	p-value
Wake-up time [a]							
< 7 am		84 (55.6)		71 (47.3)		2.07	0.149
≧ 7 am		67 (44.4)		79 (52.7)			
Bedtime [a]							
< 10 pm		102 (67.5)		85 (56.3)		4.06	0.044
≧ 10 pm		49 (32.5)		66 (43.7)			
Screen-time in hours [b]							
Weekday	2.03 (1.03)		2.63 (1.36)		8.71		< 0.001
Weekend	2.67 (1.28)		3.10 (1.32)		5.94		< 0.001
Physical Activity frequency per week [b]							
	3.35 (1.93)		3.35 (2.13)		1.00		0.420
Physical Activity and recommended level [a]							
Met recommended level		14 (9.3)		16 (10.6)		0.15	0.700
Below recommended level		137 (90.7)		135 (89.4)			
PE classes in average per week during COVID-19[c] (n = 134)							
In-person (n = 124)			2.87 (1.32)		-1.61		0.110
Online/Hybrid (n = 10)			3.38 (1.47)				

[a] The relationship were analyzed by using a chi-square test of independence. [b] Paired t-test. [c] Student's t-test
Recommended Physical Activity level : At least 60 minutes of moderate- or vigorous-intensity physical activity per day.
SD : Standard Deviation, PE : Physical Education, n.s. : Not significant.

between screen time during COVID-19 and PA levels. PA levels were divided into three groups : Increased, No Change, and Decreased, comparing before and during COVID-19.

The results indicated no significant association between screen time and PA level, both during the week ($\chi^2 = 2.12$, $p = 0.347$) and on weekends ($\chi^2 = 1.95$, $p = 0.375$).

Physical Activity with Digital Device Use

A total of 99 students (65.6%) used digital devices for PA during COVID-19 pandemic. There were no significant differences based on gender or grade level related to PA with digital device usage ($p < 0.05$). Significantly higher PA levels were observed in the digital device use group ($\chi^2 = 4.01$, $p < 0.05$) (Table 4).

DISCUSSION

Characteristics of Students Attending Japanese the Language Supplementary School

The survey results reflected trends consistent with the basic school information of the students' living areas. Many students at JLSS are short-term residents in the U.S. and attend local schools during the week ; thus, they must balance their time between studying at home for the local school and studying for JLSS simultaneously (7).

All students (100%) reported having access to an online environment at home and a device for personal use. Many of these children live in urban areas with household incomes above average (8). By mid-April 2020, while JLSS had introduced remote learning, approximately 20% of students were still receiving paper-based instruction in their local schools (9, 10).

The residential profile of JLSS students indicates that they generally have a favorable environmental background. Over 95% of students live in single-family homes or apartment complexes with yards or swimming pools and easy access to parks and playgrounds.

Demographic Characteristics of Students, Lifestyles and COVID-19

About 70% of the participants in this study were children who had temporarily moved from Japan to the U.S. due to their parents' work and planned to return to Japan in the future. In a survey of Japanese junior high school students, they reported later bedtimes, longer screen time, and decreased PA as a result of school closures due to the COVID-19 pandemic (11). In particular, more than 80% of students reported a decrease in their exercise habits. In contrast, this study found no significant differences in PA among JLSS students. One factor may be that most of them live in single -family homes with yard and swimming pool or in apartment with gym and swimming pool. The results suggest that the living environment has a significant impact on children's PA when school is not in session.

Table 3. Relationship between physical activity and screen time changes during COVID-19 (N=144)

Screen-time		Physical Acticity changes			χ^2	p-value
		Increased	No changed	Decreased		
		n (%)	n (%)	n (%)		
Weekday	Increased (n = 62)	9 (6.3)	41 (28.5)	12 (8.3)	2.118	0.347
	No changed (n = 82)	6 (4.2)	61 (42.4)	15 (10.4)		
Weekend	Increased (n = 46)	4 (2.8)	30 (20.8)	12 (8.3)	1.959	0.375
	No changed (n = 98)	11 (7.6)	71 (49.3)	16 (11.1)		

Chi-square test of independence.

Table 4. Relationship between digital device use during exercise and gender, grade and frequency of exercise since COVID-19 began

Variable	Use digital device		Not use digital device		χ^2	p-value
	n (%)	ASR	n (%)	ASR		
Gender						
Male (n = 70)	41 (41.4)		29 (58.6)		2.83	0.093
Female (n = 81)	58 (71.6)		23 (28.4)			
Grade at school						
K-3rd grade (n = 79)	47 (59.5)		32 (40.5)		4.13	0.127
4-6th grade (n = 41)	32 (78.0)		9 (22.0)			
7-10th grade (n = 31)	20 (64.5)		11 (35.5)			
Physical Activity frequency per week						
0-2 per week (n =61)	34 (55.7)	-2.00	27 (44.3)	2.00	4.01	0.045
3-7 per week (n = 85)	61 (71.8)	2.00	24 (28.2)	-2.00		

Chi-square test of independence, ASR (adjusted standardized residual).

In addition, the findings on screen time of this study align with previous research, showing an increase in screen time during the COVID-19 period, both on weekdays and weekends, compared to before the pandemic. Students tended to spend more screen time on weekends than weekdays regardless of the study period. Therefore, it can be concluded that students' screen time increased during the pandemic. At the time of the survey, 82.1% of students had returned to school and were following their regular daily school routines. Therefore, the wake-up time appeared unaffected, but bedtimes were significantly later during COVID-19 compared to pre-COVID-19. Extended screen time may have contributed to later bedtimes. However, further research is required due to the varying ages within the sample group.

Physical Activity and Screen Time

Previous studies have reported that increased screen time is associated with decreased PA levels (12, 13). In contrast, this study found no statistically significant relationship between PA and screen time. One possible reason is that only about 10% of students met the PA guidelines prior to COVID-19. During COVID-19, more than 90% of children participated in either face-to-face or online physical education classes, which means that PA was maintained through school programs. Given that habitual physical activities, such as outdoor play, walking, cycling, and gardening, can lead to increased PA (14), it is essential to develop strategies to promote PA regardless of the limitations imposed by COVID-19.

Physical Activity with Digital Device Usage

In some regions and countries, school closures have led to unequal educational opportunities (15, 16). Therefore, COVID-19 has been a catalyst in introducing and expanding technological advances such as distance learning and telemedicine (17, 18). However, in this study group, all students (100%) had access to remote classes and could choose between remote or in-person instruction. Unsurprisingly, 65.6% of students used digital devices for PA. Exercise applications and YouTube exercise programs were popular among these students, with no differences in the type of digital device used based on gender or age. One of the most notable findings to come out of this study was that the students who used digital devices for PA engaged in PA more frequently than who did not. These results suggest that using digital devices contributed to increased PA frequency.

During the COVID-19 pandemic, digital device usage for PA were also favored because they allowed for safe, contact-free exercise (19-22). It is conceivable that there has been a shift from digital-device-based PA to organized sports and other activities. Additionally, higher satisfaction with digital device use for PA was correlated with higher continuity. Therefore, it is recommended that future studies explore the effective use of digital devices for PA and the introduction of age- and gender-appropriate programs.

Given that this survey covered a medium-sized JLSS in a specific U.S. region, it is not possible to generalize the results to other regions or schools. Moreover, the answers were given based on reflection and recollection of the time before COVID-19. It may not be an accurate memory. However, conducting a preliminary survey is valuable for understanding the characteristics of students in a particular school, identifying potential issues, and developing appropriate guidelines for addressing them. Even as lifestyles adapt to the new normal, practicing that and establishing healthy habits for children remain the most pressing issues.

CONCLUSION

This study revealed that the closure of JLSS due to the COVID-19 pandemic affected the lifestyle of Japanese students living in the U.S. who attended the JLSS school. There was no significant change in their wake-up time, but they delayed their bedtime. It also significantly extended screen time for the use of electronic and other digital devices. In other words, one would expect that extended screen time would have reduced sleep time, but PA was maintained. School closure did not affect PA, but students who used digital devices for PA during this period were significantly more physically active per week than those who did not. The use of digital devices may contribute to the promotion of PA in the future.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

ACKNOWLEDGEMENTS

The authors wish to express their gratitude and appreciation to the JLSS students and parents for their participation and contributed time to this survey.

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