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## Associations between Sports Videogames and Physical Activity in Children

### Authors' contribution:

- A) conception and design of the study
- B) acquisition of data
- C) analysis and interpretation of data
- D) manuscript preparation
- E) obtaining funding

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### Abstract

**Objective:** The aim of the study was to examine the associations of sports video gaming behaviour in the sociological concept of Physical Activity Relationships (PAR) and to see if sports video gaming differs by gender.

**Methods:** A convenience sample of children between 11–12 years of age ( $n = 114$ ) from three Finnish regions completed a questionnaire on perceptions of their video gaming and physical activity habits. Differences by gender were tested by contingency tables, and blockwise binary logistic regressions were used to examine the strength of association with physical activity behaviour in PAR.

**Results:** Almost all girls had low importance to video gaming and over two thirds (71%) reported their frequency in sports video gaming was less than monthly. Sports video gaming was positively associated with physical activity behaviours ( $OR = 3.4$ ,  $CI = 1.3–9.0$ ), but when combined with perceived physical activity importance and spectating in sports, the association was no longer statistically significant. There were no differences in gender for non-sports video gaming.

**Conclusions:** For children who partake in sports video games, the activity can be an integral part of their overall PAR. These preliminary results require further exploring prior to drawing societal implications or sports video games or applying them for intervention to promote physical activity.

**Keywords:** Health behaviour, sedentary, screen time, adolescence, physical activity relationships

### Introduction

Physical activity among children is known to improve physical, mental and social health, as well as be protective of lifelong physical literacy (WHO, 2020). Children at the beginning of adolescence (age 10–11y old) begin to develop skills to become socially aware such that interaction with peers is highly valued (Sawyer et al., 2018). In contemporary times, digital technologies have become part of this growing up, and one aspect of this is the participation in video games (gaming). Sedentary behaviour researchers have considered three hours of daily gaming to be associated with negative physical health (Puolitaival et al., 2020). Yet, as technologies have emerged to be part of the daily living, the role of video games may also have advantages to cognitive and social developments (Granic et al., 2014; Alho et al., 2022; Sauce et al., 2022). Moreover, there has been an expansion on video game genres,

creating a need to acknowledge differences in the concept of gaming and its relationships with health. One such genre is sports video games where individuals play sports on the computer screen (Consalvo et al., 2013; Brookey & Oates, 2015; Crawford, 2015; Conway, 2010), and this might offer new insights in the way individuals build their perceived relationships with physical activity (Koski, 2008).

Few studies have studied the links between sports video gaming and health (Chan et al., 2022). Etchells and colleagues (2016) examined the development of conduct disorder by types of video games played by children aged between 8 and 15 years old through a longitudinal study. They found weak evidence that those who selectively played sports video games were less likely to experience conduct disorders than those who chose to play (self-defined) shoot-em-up video games. In another longitudinal study, Wichstrøm and colleagues (2019) measured physical activity in children from age 8 to 12 and found organized sport participation predicted less gaming-related health problems; however, the effect vanished once social competence was included in the prediction model. In other words, participation in organized sport participation does not seem to “protect” children from potential gaming problems, but rather socially competent children tend to participate in organized sports activities. In a systematic review on the associations between esports and health in children, only three of the 36 included studies included physical activity as an outcome variable (Chan et al., 2022), to highlight low research output in the areas of physical activity and sports video gaming.

According to the Physical Activity Relationship (PAR) approach (Koski, 2008), sport and physical activities can be understood as a social world. The deeper individuals are in a certain social world, the more individuals can understand the meanings of that world and the more meaningful those are for others (Unruh, 1979). Individuals can encounter and learn the meanings of sport and physical activities not only by being physically active, but also, for instance, via spectating sports or playing sports video games. There is some evidence that those children and adolescents who are interested in spectating sports are also more active physically (Koski et al., 2016; Laine et al., 2021), yet the connection between being physically active and playing sports video games is less known.

In Finland, where our study takes place, organized physical activities are the second most common activities outside of school for children to socialize, with as much as nine out of ten Finns having had participated in organized physical activities before adulthood (Blomqvist et al., 2019). Approximately half of Finnish children (11 years: 58%, 13 years: 46%) participate regularly in organized physical activities (Blomqvist et al., 2019), and those who do tend to perceive themselves as more autonomous, competitive, healthy, and goal oriented compared to others (Koski, 2008). On average, Finnish boys are more physically active than girls, especially in externally organized physical activities (Koski et al., 2019); however, in recent times, these gender differences in organised sport (Blomqvist et al., 2019) or overall physical activity (Ng et al., 2019) have almost diminished. The differences remain large in activity choices; for instance, boys typically choose sports that are perceived as masculine, like football and ice hockey (Koski et al., 2019). One explanation for these differences is culture, as children are provided with gendered cues and role models, which shape their choice-making potentially until adulthood (Tähtinen et al., 2007). These cultural factors are also present in technology use, including gaming activities (Williams et al., 2009).

Given the gaps in knowledge in how sports video gaming plays a role in the PAR approach, the aims of this study are to examine the associations between sports video gaming, physical activity levels, participation in organised sport, spectating and sense of importance of both activities in Finnish children. A further aim of the study is to examine gender differences in sports video gaming.

## Methods

According to the Finnish National Board on Research Integrity, the study did not require a separate ethics committee approval. A convenience sample from three primary schools was recruited in 2015 from Eastern, Southern, and Western Finland. These three regions were chosen to avoid participant bias. Children between 11–12 years of age were recruited (i.e., 6<sup>th</sup> grade) from the last year of primary education. The data have been deposited in the Finnish Social Science data archive [link <http://urn.fi/urn:nbn:fi:fsd:T-FSD3560>].

Based on the concepts of PAR (Koski, 2008), separate items were formulated on physical activity participation, importance in sport and spectating sports. The items were also mirrored for the sports and non-sports video gaming. All items were written in child appropriate language. In Table 1, the variables, response categories and the way variables were recoded for analyses.

**Table 1.** Survey items, response options and recoded variables

Item wording	Response options	Recoded variables
How often do you exercise self-organized PA?	1 = less than once a week, 2 = once a week, 3 = 2–3 times a week, 4 = 4–6 times a week, 5 = every day	Low intensity, 1–3 times a week High intensity, 4–7 times a week
Organised sport	0 = not at all, 1 = less than once a week, 2 = 1–3 times a week, 3 = 4–6 times a week, 4 = every day	Less than weekly At least weekly
How important is PA to you?	0 = not at all, 1 = slightly important, 2 = rather important, 3 = important, 4 = very important.	Not at all, Slightly important, Rather important = Low importance, Importance & Very important
How often do you go spectating?	1 = never, 2 = rarely, 3 = 1–2 times/year, 4 = 3–5 times/year, 5 = 6–10 times/year, 6 = more than 10 times/year	Infrequent, less than 6 times/year Frequent, 6 times/year or more
How important is spectating to you?	0 = not at all, 1 = slightly important, 2 = rather important, 3 = important, 4 = very important.	Not at all, Slightly important, Rather important = Low importance, Important & Very important.
How often do you play sports video games?	1 = not at all, 2 = less than once a month, 3 = about 1–2 times a month, 4 = about 1–2 times a week, 5 = 3–6 times a week, 6 = every day	Infrequent, less than monthly Frequent, once month or more frequently
How often do you play non-sports video games?	1 = not at all, 2 = less than once a month, 3 = about 1–2 times a month, 4 = about 1–2 times a week, 5 = 3–6 times a week, 6 = every day	Infrequent, less than monthly Frequent, once month or more frequently
How important is video game play to you?	0 = not at all, 1 = slightly important, 2 = rather important, 3 = important, 4 = very important.	Not at all, Slightly important, Rather important = Low importance, Importance & Very important

Based on our power calculation, a sample size of  $N = 111$  would be needed to detect differences between two groups with an effect size of  $r^2 = 0.2$  and a power of 0.95 with alpha set at 0.05. Due to the exploratory nature of the study, we did not control Type 1 error in the alpha level.

### Statistical Methods

Descriptive statistics were performed to test differences between genders through contingency tables. Statistical tests within the categorical variables were through Chi-square test of independence and Fisher Exact tests. A block-wise binominal logistic regressions with regular PA as the outcome was performed to examine the associations with the independent variables. The reference category was low intensity (1–3 times a week) with the alternative category as high intensity (4–7 times a week). At each stage of the logistic regression analyses, gender, sports video gaming, non-sports video gaming, organized sport, PA importance and sport spectating, were added one at a time. Statistics were performed on R-statistics through the Jamovi user interface v 1.2.27, with alpha set to 0.05 to detect statistically significant differences between gender (contingency tables) or level of association (logistic regressions) with the outcome variables.

### Results

Over half of the six graders (11–12 years old;  $N = 114$ ) in this study were boys ( $n = 60$ ; 52.6%) and slightly fewer girls ( $n = 54$ ; 47.4%). The majority of children reported physical activity was important for them (86.8%) and this was relatively the same between boys and girls (Table 2). Although more boys than girls reported spectator

sports (Chi-square  $p = .019$ ) and (video) gaming importance (Chi-square  $p < 0.001$ ), participation in weekly physical activity or organized sport was not different between boys and girls. Over half of boys reported they participated in sports video gaming (55.9%) or non-sports video games (62.7%) and was significantly more than girls' weekly participation (Chi-square  $p < .001$  and  $p = 0.032$  respectively).

**Table 2.** Differences between boys and girls in perceived importance in physical activity and games and behaviours.

	Boys % n = 60	Girls % n = 54	Total % N = 114	$\chi^2$ p-value	Fisher p-value
PA Importance				0.620	0.783
Low Importance	11.7	14.8	13.2		
Important	88.3	85.2	86.8		
Spectator importance				0.019	0.029
Low Importance	54.2	75.5	64.3		
Important	45.8	24.5	35.7		
Gaming importance				<.001	<.001
Low Importance	69.0	94.3	81.1		
Important	31.0	5.7	18.9		
Physical activity				0.563	0.685
Less than weekly	28.3	33.3	30.7		
At least weekly	71.7	66.7	69.3		
Organised sport				0.963	1.00
Less than weekly	68.3	67.9	68.1		
At least weekly	31.7	32.1	31.9		
Spectator				0.058	0.086
<6/year	48.3	66.0	56.6		
6+/year	51.7	34.0	43.4		
Sports video gaming				<.001	<.001
Less than monthly	25.4	71.2	46.8		
At least monthly	74.6	28.8	53.2		
Non-sports video gaming				0.290	0.307
Less than monthly	25.4	34.6	29.7		
At least monthly	74.6	65.4	70.3		

In the blockwise regression, sports video gaming was associated with weekly physical activity participation when gender, non-sports video gaming and organized sport participation were included. The association was no longer statistically significant when physical activity importance was added to the model (Table 3). Although, physical activity importance (OR = 5.9, CI = 1.5–22.8) and spectating (OR = 3.6, CI = 1.2–10.7) were associated with weekly physical activity when all examined variables were included. These results would suggest possible moderator effects of perceived physical activity importance and spectator habits of over six times per year with sports video gaming on the association with weekly physical activity among children in this study. The Nagelkerke  $R^2$  increased from 0.08 to 0.028 after each step to demonstrate improvements of the model.

**Table 3.** Blockwise binary logistic regression for weekly physical activity

	P	OR	LCI	UCI	r <sup>2</sup>
Block 1					0.08
Gender	0.720	1.19	0.462	3.06	
Sports video gaming	0.021	3.07	1.183	7.95	
Block 2					0.09
Gender	0.745	1.169	0.456	3.00	
Sports video gaming	0.013	3.412	1.289	9.03	
Non-sports video gaming	0.335	0.620	0.235	1.64	
Block 3					0.12
Gender	0.802	1.129	0.438	2.91	
Sports video gaming	0.019	3.221	1.212	8.56	
Non-sports video gaming	0.595	0.761	0.277	2.09	
Organized sport	0.133	2.169	0.789	5.96	
Block 4					0.22
Gender	0.785	1.151	0.4203	3.15	
Sports video gaming	0.062	2.684	0.9499	7.58	
Non-sports video gaming	0.894	0.932	0.3277	2.65	
Organised sport	0.475	1.471	0.5105	4.24	
PA importance	0.005	6.792	1.8112	25.47	
Block 5					0.28
Gender	0.659	1.261	0.4504	3.53	
Sports video gaming	0.169	2.131	0.7259	6.25	
Non-sports video gaming	0.921	0.946	0.3184	2.81	
Organised sport	0.919	1.060	0.3456	3.25	
PA importance	0.009	5.945	1.5472	22.84	
Spectating sports	0.023	3.578	1.1948	10.71	

Note: values in **bold** for statistically significant associations. OR = Odds Ratio, LCI = Lower 95% Confidence Interval, UCI = Upper 95% Confidence Interval, r<sup>2</sup> = Nagelkerke r<sup>2</sup>. Reference categories: gender = male, sports video gaming = less than monthly, non-sports video gaming = less than monthly, organised sport = less than weekly, PA importance = low importance, spectating = less than 6 times per year. Outcome: Weekly PA.

## Discussion

The aim of this study was to examine the associations of sports video gaming and physical activity participation of children. More boys than girls reported regular sport video gaming behaviours, although physical activity and non-sport video gaming behaviours were similar between boys and girls. Furthermore, although sports video gaming was initially associated with physical activity behaviours, when adjusted for physical activity importance and spectating, the association was no longer statistically significant. This would suggest a moderating effect between sports video gaming, physical activity importance and spectating in physical activity behaviours.

Researchers have previously indicated that sports video games have a distinct cultural status from those of many other video games (Consalvo et al., 2013; Brookey & Oates, 2015; Crawford, 2015). This is important to note, considering the change of gaming cultures that arose from the COVID-19 pandemic (Navarro, 2021; Zhu et al., 2021). Despite some health-related research (Etchells et al., 2016), knowledge on the association between sports video games and physical activity habits among children is underdeveloped (Chan et al., 2022). The cultures of



sports video gaming may be supportive of good health habits by potentially strengthening the relationships they have with physical activity. It is more likely that sports video games are associated with high physical activity more than non-sports video games are, due to the similar domains of activities. In fact, based on our analyse of the data, the association with perceived high levels of physical activity was stronger with frequent sports video gaming than participation in organized sport. If findings like this could be reproduced in future studies, there may be opportunities for the promotion of health behaviours through sports video games to encourage more physical activity.

The associations between sports video games and physical activity diminished when the importance of physical activity and sports spectatorship were taken into consideration. One theoretical explanation for these exploratory findings could be the PAR approach (Koski, 2008), according to which physical activities and their related habits form a united cultural part of life. From this perspective, physical activity habits, physical activity importance, sports spectating, and sports video gaming – all of them – together form a social world where various behaviours are networked and support each other. More studies are needed to explore these relationships. For instance, we do not know if sports video gaming increases children's sports spectatorship and perception of physical activity importance, or if sports video gaming is an upshot of existing sports spectating habits and physical activity importance. Understanding similar associations with esports video games – the goal-oriented playing of which has tentatively been found associated with high physical activity (Kari et al., 2018) – could help to answer these questions.

Regarding gender, we found boys perceived sports video gaming as more important for them than girls did. Yet, we did not find significant gender differences in physical activity habits or importance, although boys were significantly more active sports video game players. Such findings may lead to promising future hypotheses whereby involvement in team sports such as floorball, ice hockey, and football – that have, in Finland, traditionally been more popular among boys than girls (Mononen et al., 2016) – invite the participants of their social worlds to also play parallel video game simulations (NBA, NHL, FIFA) or virtual reality experiences (Maloney, 2021) As reported by Thorhaug and Gregersen (2019), gender may also explain why video games are engaged differently in the first place, as “boys use [video] gaming to gear into a social domain of cooperative team play where social connections with male peers are established .... in contrast, most girls seem to use gaming to get away from the otherwise intensely social lives” (p. 1460). These gender differences can be further magnified by male-dominated video game representations (Ivory, 2006). In particular, the simulated male athletes are more likely to encourage boys to play more sports video games. Recently game developers have started actively including also female athletes in titles like FIFA 22 Pro Clubs. With these changes, benefits from social competitive play may be realized also among girls.

### Limitations

Although the self-report nature of questionnaires may present some reporting bias, it can be challenging to obtain non-biased responses on the perceptions of behaviours and their importance. The measures were created specifically for the study, after modifying pre-existing questionnaires and have not been fully tested with the age group. The sample came from three regions of Finland, and was from a convenience sample, which may represent some bias when considering generalizable findings. Since the cultures of gaming alter rapidly and our data was collected in 2015, a more recent sample would also take into consideration new genres, technologies, and forms of sports video gaming that all potentially complicate the findings.

### Conclusion

For children that take part in sports video games, the activity can be an integral part of their overall physical activity relationships that include physical activity participation, organised sport participation, perceived importance in physical activity, and sports spectating. The effects of sports video games were greater among boys than girls despite levels of physical activity being not different between genders. Further studies are needed to examine the strength and validity of these relationships for all age groups as actions to protect mental, social and physical health.

### Ethics approval and informed consent

According to the Finnish National Board on Research Integrity, the study did not require a separate ethics committee approval. All participants had been given consent from parents to participate in the study.

### Competing interests

Authors have no competing interests.

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## References

- Alho, K., Moisala, M., & Salmela-Aro, K. (2022). Effects of media multitasking and video gaming on cognitive functions and their neural bases in adolescents and young adults. *European Psychologist*, 27(2), 131–140. <https://doi.org/10.1027/1016-9040/a000477>
- Blomqvist, M., Mononen, K., Koski, P., & Kokko, S. (2019). Urheilu ja seuraharrastaminen [Sport club participation]. In S. Kokko & L. Martin (Eds.), *Lasten ja nuorten liikuntakäyttäytyminen Suomessa: LIITU-tutkimuksen tuloksia 2018*. [Finnish-School-age Physical Activity Behaviours: 2018 Results] (pp. 47–55). Helsinki: National Sports Council.
- Brookey R.A., & Oates, T.P., (2015). *Playing to win: Sports, video games, and the culture of play*. Lexington: Indiana University Press.
- Chan, G. Huo, Y., Kelly, S., Leung, J., Tisdale, C., & Gullo, M. (2022). The impact of eSports and online video gaming on lifestyle behaviours in youth: A systematic review. *Computers in Human Behavior*, 126, 106974. <https://doi.org/10.1016/j.chb.2021.106974>
- Consalvo, M., Mitgutsch, K. & Stein, A. (2013). *Sports video games*. Abingdon, Oxon: Routledge.
- Conway, S. (2010). ‘It’s in the Game’ and Above the Game: An Analysis of the Users of Sports Video games. *Convergence*, 16(3), 334–354. <https://doi.org/10.1177/1354856510367560>
- Crawford, G. (2015) Is it in the Game? Reconsidering play spaces, game definitions, theming, and sports video games. *Games and Culture*, 10(6), 571–592. <https://doi.org/10.1177/1555412014566235>
- Etchells, P. J., Gage, S. H., Rutherford, A. D., & Munafò, M. R. (2016). Prospective investigation of video game use in children and subsequent conduct disorder and depression using data from the Avon Longitudinal Study of Parents and Children. *PLoS one*, 11(1), e0147732. <https://doi.org/10.1371/journal.pone.0147732>
- Granic, I., Lobel, A., & Engels, R. C. (2014). The benefits of playing video games. *American Psychologist*, 69(1), 66–78.
- Ivory, J.D. (2006). Still a Man’s Game: Gender Representation in Online Reviews of Video Games, *Mass Communication and Society*, 9(1), 103–114. <https://doi.org/10.1037/a0034857>
- Kari, T., Siuttila, M., & Karhulahti, V. (2018). An extended study on training and physical exercise in esports. In B. Dubbels (Ed.), *Exploring the Cognitive, Social, Cultural, and Psychological Aspects of Gaming and Simulations* (pp. 270–292). Hershey, PA: IGI Global.
- Koski, P. (2008). Physical activity relationship (PAR). *International Review for the Sociology of Sport*, 43(2), 151–163. <https://doi.org/10.1177/1012690208095374>
- Koski, P., Laine, A., & Matilainen, P. (2016). Urheilun ja liikunnan seuraaminen [Following sports]. In S. Kokko & L. Martin (Eds.), *Lasten ja nuorten liikuntakäyttäytyminen Suomessa: LIITU-tutkimuksen tuloksia 2016* [Finnish-School-age Physical Activity Behaviours: 2016 Results] (pp. 51–56). Helsinki: National Sports Council.
- Koski, P., Lehtonen, K., & Vehmas, H. (2019). Sports Participation in Finland. In K. Green, K., T. Sigurjónsson & E. Å. Skille (Eds.), *Sport in Scandinavia and the Nordic Countries* (pp 40–62). Abingdon, Oxon: Routledge.
- Laine, A., Koski, P., & Matilainen, P. (2021). Urheilun ja liikunnan seuraaminen paikan päällä sekä tiedotusvälineistä [Following sports on the ground and in media]. In S. Kokko, R. Hämylä & L. Martin (Eds.), *Nuorten liikuntakäyttäytyminen Suomessa. LIITU-tutkimuksen tuloksia 2020* [Finnish-School-age Physical Activity Behaviours: 2020 Results]. (pp. 96–103). Helsinki: National Sports Council.
- Maloney, D., (2021). *A Youthful Metaverse: Towards Designing Safe, Equitable, and Emotionally Fulfilling Social Virtual Reality Spaces for Younger Users*. Clemson University Dissertations. 2931.
- Mononen, K., Blomqvist, M., Koski, P., & Kokko, S. (2016). Urheilu ja seuraharrastaminen [Sport club participation]. In S. Kokko & A. Mehtälä (Eds.), *Lasten ja nuorten liikuntakäyttäytyminen Suomessa. LIITU-tutkimuksen tuloksia 2016*. [Finnish-School-age Physical Activity Behaviours: 2016 Results] (pp. 27–35). Helsinki: National Sports Council.



- Navarro, J. (2021). Fortnite: a context for child development in the U.S. during COVID-19 (and beyond). *Journal of Children and Media*, 15(1), 13–16. <https://doi.org/10.1080/17482798.2020.1858435>
- Ng, K., Sainio, P., & Sit, C. (2019). Physical Activity of Adolescents with and without Disabilities from a complete enumeration study ( $n = 128,803$ ): School Health Promotion Study 2017. *International Journal of Environmental Research and Public Health*, 16(17), 3156. <https://doi.org/10.3390/ijerph16173156>
- Puolitaival, T., Sieppi, M., Pyky, R., Enwald, H., Korpelainen, R., & Nurkkala, M. (2020). Health behaviours associated with video gaming in adolescent men: a cross-sectional population-based MOPO study. *BMC Public Health*, 20(1), 1–8. <https://doi.org/10.1186/s12889-020-08522-x>
- Sauce, B., Liebherr, M., Judd, N., & Klingberg, T. (2022). The impact of digital media on children’s intelligence while controlling for genetic differences in cognition and socioeconomic background. *Scientific reports*, 12(1), 1–14. <https://doi.org/10.1038/s41598-022-11341-2>
- Sawyer, S., Azzopardi, P., Wickremarathne, D., & Patton, G. (2018). The age of adolescence. *The Lancet Child & Adolescent Health*, 2(3), 223–228. [https://doi.org/10.1016/S2352-4642\(18\)30022-1](https://doi.org/10.1016/S2352-4642(18)30022-1)
- Thorhauge, A. M., & Gregersen, A. (2019). Individual pastime or focused social interaction: Gendered gaming practices among Danish youth. *New Media & Society*, 21(7), 1444–1464. <https://doi.org/10.1177/1461444818823546>
- Tähtinen, J., Koski, P., & Kaljonen, A. (2007). *Kaupunkilaisperheiden pikkulapset liikkeessä* [Young children movement in urban families]. Thesis from University of Turku.
- Unruh, D.R. (1979). Characteristics and types of participation in social worlds. *Symbolic Interaction*, 2, 115–129. <https://doi.org/10.1525/si.1979.2.2.115>
- WHO (World Health Organization) (2020). *WHO guidelines on physical activity and sedentary behaviour*. World Health Organization.
- Wichstrøm, L., Stenseng, F., Belsky, J., von Soest, T., & Hygen, B. W. (2019). Symptoms of internet gaming disorder in youth: predictors and comorbidity. *Journal of Abnormal Child Psychology*, 47(1), 71–83. <https://doi.org/10.1007/s10802-018-0422-x>
- Williams D, Consalvo M, Caplan S & Yee N. (2009). Looking for gender: Gender roles and behaviors among online gamers. *Journal of Communication*, 59(4), 700–725. <https://doi.org/10.1111/j.1460-2466.2009.01453.x>
- Zhu S, Zhuang Y, Lee P, Li JC, Wong PWC. (2021). Leisure and Problem Gaming Behaviors Among Children and Adolescents During School Closures Caused by COVID-19 in Hong Kong: Quantitative Cross-sectional Survey Study. *JMIR Serious Games*, 9(2), e26808. <https://doi.org/10.2196/26808>

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