Finnish young adolescents' digital gaming and physical activity behaviour

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ABSTRACT
In this cross-sectional study of Finnish adolescents, we investigated the rates of digital game playing and examined the associations between playing a lot of digital games and physical activity or sport club participation. A national representative sample (n = 1979) from Finland aged between 11y–15y old completed a self-report survey in 2022. Analyses were carried out by chi-square tests and logistic regression analyses. More males (74%) than females (26%) played digital games at least once a day. Playing at least daily decreased from 11y (53%), 13y (30%) to 15y (17%) olds. Positive associations were found with playing ball sport simulations and taking part in >4 days/week of physical activity or sport club participation (OR = 2.8, CI=1.7–4.4). Negative associations were found between playing a lot of first-person shooter games and sport club participation (OR = 0.6, CI=0.4–0.9). The results imply that representational features in genres may be relevant for their links to physical activity.

Keywords
sport simulations, children, first person shooter, sport club, survey, gender, esports,

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INTRODUCTION

There is robust evidence of the health advantages of physical activity (PA) for virtually everyone at every stage of life (Warburton & Bredin, 2017). For children and adolescents, a general rule seems to be that more is better regarding physical activity and its effects on health outcomes (Janssen & LeBlanc, 2010). However, global concern has been raised as 81% of adolescents aged 11–17 years are insufficiently physically active (Guthold et al., 2020) increasing the risk of many adverse health conditions (Lee et al., 2012). According to WHO (2018), the yearly global cost of physical inactivity is INT$ 54 billion in health care and INT$ 14 billion in lost productivity.

In the Finnish context, a steady decrease in physical activity can be observed among 7–17-year-old children and adolescents' PA (Report Card 2022). The recommendation of at least 60 minutes of moderate-to-vigorous PA is met by 47–53% in the age group of 7–12, 20–26% in the age group of 13–15 (Mehtala et al, 2022), and less than 20% in the age group of 16–18 (Ng et al, 2021). Also, physical activity levels of males were higher than female adolescents across all adolescent age groups (Kokko et al, 2018; 2020).

As a result of the COVID 19-pandemic, Finnish adolescents' PA decreased during the weekdays due to distance learning and the interruption of organized hobbies (Finland's Report Card, 2022). The difference wasn't visible on weekends, so the decrease seems to be a consequence of reduced PA at school and during the school commute. Based on accelerometer measurements, a pupil in basic education accumulated 1000–3000 steps more per day in the spring of 2018 than during the pandemic in the spring of 2020 (Vasankari et al., 2020). Moreover, the pandemic appeared to increase polarization in PA rates between highly active and the least physically active young people (Finland's Report Card, 2022).

Physical Activity Relationships

The relationship between people and their PA is often examined from the perspective of motives and motivation. Another approach to the topic is the concept of Physical Activity Relationship (PAR) (Koski, 2008), according to which sports and physical activities can be understood as a social world (e.g. Unruh, 1979). Instead of just focusing on short-term motivational factors, PAR is particularly interested in the long-term process of socialization to a physically active lifestyle. Motivation can vary even in a short period of time (e.g. Recours et al., 2004), but in the PAR approach, the central concept is meaning, which is considered to form in the long run before the concrete activity takes place. In short, PAR reflects how deeply one is involved in the social world of physical activities. The more and stronger the PA-related meanings are perceived, the deeper the involvement in the social world of PA is considered to be (Koski, 2008). Studies regarding the PAR suggest that the number of important meanings correlates with PA regardless of the target group (e.g. Grénman et al., 2018; Koski et al. 2022; Koski & Zacheus, 2012). Moreover, a positive association between sports digital gaming and PA behaviours was found (Ng et al., 2022). This preliminary finding suggests that sports digital gaming can be an integral part of overall PAR alongside one's PA habits and sports spectating.

Digital gaming in Finland

According to the latest Finnish Player Barometer, a large proportion of Finnish (80%) have played some digital games, and 65% are active digital game players (defined by having played digital games during the past month) (Kinnunen &

al., 2022). From the Finnish Player Barometer, the youngest age group included 10-19 years old 58 % are active players of first-person shooter (FPS) games, 22% active players of sport simulation games, and 39% of driving simulation games (Kinnunen & al., 2022). In general, these and other characteristics of gaming in Finland are very similar to many often-studied countries, such as Canada and Japan (Vahlo et al., 2018).

There was a rise in digital gaming activity in Finland during the COVID-19 restrictions, although the Player Barometer 2022 showed that, even though the activity has now decreased from 2020, it is still higher than in 2018. It is notable, that while mobile gaming has been constantly getting more popular among the Finns ever since the very first Player Barometer in 2009, the year 2022 is the first time when the popularity of mobile gaming has stalled or even decreased. There are no notable changes in the popularity of other game genres. Esport games are not included as a separate genre in the Player Barometer, but the following of Esport game streams has risen considerably. (Kinnunen & al., 2022).

According to the displacement hypothesis, time taken when using screens, such as digital gaming take away the opportunity to be physically active (Mutz et al, 1993), and thus leads to lower levels of health among gamers compared to non-gamers (Ballard et al, 2009). In a review of the literature, Biddle and colleagues (2003) reported the displacement hypothesis has little evidence to support it, more recent evidence would suggest that overall sedentary behaviours and sleep make up the overall movement behaviours in a 24h period, even among young children (Chen et al, 2020). Given the uncertainty of digital gaming behaviour as a means that reduces physical activity levels, the aim of this study is to investigate the associations between digital gaming with PA and sport club participation among young adolescents in Finland.

METHODS

Procedures

The Finnish School-age Physical Activity (F-SPA) study is a biennial national monitoring survey of a national representative sample. It is a cross-sectional study where respondents complete the survey on one occasion in the school classroom environment under teacher supervision. The F-SPA 2022 study took place from March-June 2022 across Finland. Schools were selected through a stratified random sample that used probability proportion sampling methods across the capital, south, central and northern Finland. From the schools, one class was selected from 5th, 7th or 9th grade classes. In Finland, the average age of 5th graders is 11y, 7th graders are 13y, and 9th graders are 15y old. Special and hospital schools were not included in the sample, as the F-SPA used a different sampling technique for coverage for these schools. There are students with different support needs in the recruited schools and if they were in the selected class, they were not excluded from the invitation.

All parents of children in the selected classes were asked to give passive consent for their child to take part in the study. Of the children who had permission, at the time of data collection, the respondents were informed that they complete the survey voluntarily, they could stop the survey at any point without any consequences and that it would remain anonymous. The study was approved by the University of Jyväskylä institutional ethical committee as the data collection was coordinated at that institute. Data sharing requests were made by us to the F-SPA coordinators. Because Finland is

a bilingual country, the survey was translated from Finnish to Swedish so that students in both Finnish and Swedish speaking schools could complete the survey.

Variables

The background variables used in the study include gender (male or female), age based on school grade (11y, 13y, 15y). Disability status was measured by the self-report version of the Washington Group Child Functioning Module (Ng et al, 2020). Respondents were considered to have disabilities when they reported at least one functional difficulty where it was reported as "a lot of difficulty". Family affluence was used as a proxy measure of socio-economic status as it is a self-report item that consists of 6 items on material wealth at home. A riddit score was created from the respondents to provide a relative family affluence scale (FAS) and grouped into quintiles, with the bottom 5th as low FAS, the upper 5th as high FAS, and all the rest as medium FAS. FAS is now in its third version and has acceptable validity for socio-economic status (Levin et al, 2015).

Physical activity variables included self-reported PA through a widely used single-item recall of the last 7 days measure of moderate to vigorous intensity iPA (MVPA) (Prochaska et al, 2001). This included plain description on typical MVPA is given to the respondents prior to responding to the number of days in the last 7 days where they had carried out at least 60 minutes of MVPA in the day. Response options ranged from 0 to 7 and were recoded from 0–2 days (inactive), 3–4 days (low active), 5–6 days (active), and 7 days (daily active). This grouping has been carried out in previous studies that examined correlates of PA (Mehtala, 2020) and has acceptable levels of reliability among young adolescents (Ng et al, 2018). The measure itself has acceptable levels of agreement with accelerometers (Hardy-Murphy, 2015).

The second measure of PA was participation in sport clubs. Another single item was used where respondents answered if they were part of a sport club. The four-point response scale ranged from, no and never was, no and used to be, yes but not active, and yes and active. The variable was dichotomized so that both 'yes' responses were grouped together, with the reference category as 'no'. This measure has been used in the F-SPA study for several iterations and has been tested for face validity in pilot studies with positive results (Kokko et al, 2016).

There were two types of digital gaming items used in F-SPA. The first item was about the amount of digital gaming the respondents took part in. The response options ranged from "none", "1–2 times a month", "1–2 times a week", "nearly daily", "daily", and "many times a day". Three groups were formed so that 'none' and '1–2 times a month' were combined. This group was later removed from further analyses. The second group was a combination of '1-2 times a week' and 'nearly daily', and the final group were those gamers who played at least once a day.

For respondents who reported some gaming at least once a week, there were genre specific questions about the amount that is played in sport simulation games, such as, 1. ball sports (e.g. FIFA, NHL, NBA, Madden, etc), 2. driving sports (e.g. F1, Forza, Grand Turismo, etc), 3. other sport simulations (e.g. Tony Hawk, Trials, Mario & Sonic Olympic Games, PGA Tour, etc), as well as esport games, such as 4. Multiplayer online battle area MOBA (e.g. Dota2, League of Legends, Smite, Arena of Valor, etc), 5. First person shooter (FPS) (e.g. Counter Strike, Overwatch, Valorant, Call of Duty, etc), 6. Fantasy fighting (e.g. Tekken, Mortal Kombat, Street Fighter, Super Smash Bros, etc), 7. Other esports (e.g. Clash Royale, Fortnite, Hearthstone, Farming Simulator, etc). For each of the genres, respondents selected the perceived amount of playing games from none to a lot on a 5-point Likert scale. The items were grouped into three categories (none, some, and a lot). Playing genres were grouped into sport simulation games, and

the first past the post system was used to code the amount of gaming they are playing in a subgenre. In other words, if a person selected 'a lot' for ball sports, but none or some for driving sports or other sports simulations, the variable of sport simulation would have been coded as 'a lot'. The same was applied for esports with a combination of the four gaming genres (MOBA, FPS, Fantasy Fighting, and Other esports). The items used were tested for face validity during the F-SPA pilot test and the results were positive, given the examples for each genre of game were given in the question.

Statistical methods

Data were analysed by descriptive and inferential statistics. Descriptive statistics were performed using the Chi-Square test of independence for categorical variables and to describe the sample. Investigations of the frequency of playing digital games were tested against individual characteristics as potential confounders such as gender, age, disability status and FAS. A further examination was performed on the frequency of playing digital games by the genres and the genre group (i.e. Sport simulation or esports) by Chi-square test of independence, with alpha set to 0.05.

Associations between PA and sport club participation with the frequency of digital game playing were analysed by Chi-square tests of independence. Inferential statistics were performed through multinominal logistic regression analyses based on the amount of PA, with 0–2 days as the reference category. Final analyses included gender, age, disability status and FAS as covariates and the individual genres as independent variables. This was carried out for sport simulation genres and esport genres separately. The associations with sport club membership were analysed by binary logistic regression analyses with no membership as the reference category. For all logistic regressions, the reference category for gaming genres was not a lot (from none to some) and the alternative binary outcome was 'a lot'. Also, 95% confidence intervals were used to detect statistical significance with the range of confidence intervals as an indicator for the size of the effect.

RESULTS

Sample Characteristics

A total of 1979 respondents completed the items on digital gaming. The sample characteristics can be found in Table 1. Over a quarter (29%) reported to have "not played" digital games (n = 322) or played "less than once or twice a month" (n = 266). The remaining 1505 respondents reported playing digital games genre more regularly. More boys played digital games daily than females (p<.001). There appeared to be a decline in daily gameplay with age (p<.001).

		Digital Game play				
		none - 1-2/month (n=574) (%)	**1-2/week-nearly daily (n=907) (%)**	**daily and more (n = 498) (%)**	**Total (n = 1979) (%)**	**χ^2 p-value**
Gender						<.001
	Boys	13.1	49.7	73.9	45.2	
	Girls	86.9	50.3	26.1	54.8	
School year						<.001
	11-y	36.1	50.6	52.7	47.0	
	13-y	32.8	30.5	30.4	31.2	
	15-y	31.1	18.8	16.9	21.9	
Disability Status						0.14
	No Disability	77.0	77.4	73.0	76.2	

	Disability	23.0	22.6	27.0	23.8	
FAS Groups						0.018
	Low FAS	1.1	1.8	4.3	2.2	
	Medium FAS	79.1	79.2	76.5	78.5	
	High FAS	19.7	18.9	19.2	19.2	
Physical Activity 4 categories						<.001
	0–2 days	8.2	7.9	15.1	9.8	
	3–4 days	24.0	28.7	28.2	27.2	
	5–6 days	32.9	31.6	28.0	31.0	
	7 days	34.9	31.7	28.7	31.9	
Sport Club Member						0.268
	Not member	43.1	42.4	46.7	43.7	
	Member	56.9	57.6	53.3	56.3	

Table 1. Frequency of digital games (mobile, console, computer, etc) play

Rates of Gaming

Over half the digital game players reported playing esports (53%), with FPS played a lot by over a third (36%). Low numbers of playing a lot of MOBA (9%) and fighting games (11%) were reported, yet 36% reported playing some other type of esport such as Clash Royale, Fortnite, Hearthstone, Farming Simulator, etc. One in five digital game players (20%) never played sport simulation games, and less than one in seven (13%) never played esport games (Table 2). Sport simulation games are less played than esports, although ball sports, such as FIFA and NHL were played a lot by a quarter of the respondents (25%).

	Digital Game play			
	less than daily (n=548) (%)	daily (n = 338) (%)	Total (n=886) (%)	χ^2 p-value
Esport 3 groups				<.001
Never	16.8	8.0	13.4	
Some	40.1	22.5	33.4	
A lot	43.1	69.5	53.2	
MOBA – a lot	6.5	12.0	8.6	0.006
FPS – a lot	24.3	54.2	35.8	<.001
FG – a lot	7.5	16.1	10.8	<.001
Other esports – a lot	31.7	43.5	36.2	<.001
Sport Simulations 3 groups				0.6
Never	19.3	21.7	20.2	
Some	44.9	41.9	43.7	
A lot	35.8	36.4	36.1	
Ball Sports – a lot	25.5	24.8	25.3	0.826
Drive Sports – a lot	14.1	20.7	16.6	0.013
Other Simulations – a lot	6.5	10.2	7.9	0.055

Table 2. Frequencies of playing sport simulation and esport games by genres

Association between Gaming and Physical Activity

Just under a third of the respondents who reported to play digital games reported daily MVPA (32%) and one in ten (10%) reported the lowest amounts of PA of 0–2 days. Over half (54%) of the respondents reported being a member of a sports club.

Esport participation

There were no statistically significant associations between playing a lot of esports and MVPA.

		OR	LCI	UCI
0–2 days		REF		
3–4 days				
	MOBA	1.64	0.78	3.45
	FPS	1.17	0.38	3.63
	FG	0.77	0.37	1.61
	Other	0.65	0.21	1.97
5–6 days				
	MOBA	1.44	0.69	3.01
	FPS	0.98	0.32	3.02
	FG	1.03	0.50	2.11
	Other	0.53	0.18	1.62
7 days				
	MOBA	1.59	0.77	3.31
	FPS	1.12	0.37	3.41
	FG	0.54	0.27	1.12
	Other	0.58	0.19	1.73

Table 3. Multinominal regression (adjusted Odds Ratio and 95% confidence intervals) of physical activity by esport genres after controlling for age, gender, disability and FAS

Sport simulation

Playing a lot of ball sport simulations was positively associated with 5-6 days (OR = 4.5, CI = 1.3–15.5) and 7 days (OR = 7.6, CI = 2.2–25.9) of MVPA compared to 0–2 days of MVPA and not a lot of ball sport simulation game play (Table 3). There were no other statistically significant associations with differences of MVPA from 0-2 days and sport simulation games.

		OR	LCI	UCI
0–2 days		REF		
3-4 days				
	Ball sims	2.75	0.77	9.75
	Driving sims	1.86	0.59	5.87
	Other sims	0.65	0.19	2.23
5–6 days				
	Ball sims	**4.49**	**1.30**	**15.54**
	Driving sims	1.65	0.53	5.16
	Other sims	0.85	0.26	2.80
7 days				

	Ball sims	**7.62**	**2.24**	**25.93**
	Driving sims	1.72	0.56	5.32
	Other sims	0.66	0.20	2.18

Table 4. Multinominal logistic regression (adjusted Odds Ratio and 95% confidence intervals) of sport simulation and MVPA after controlling for age, gender, disability and FAS

Gaming and sport club participation

In relation to sport club membership, there were statistically significant associations with a lot of simulation ball sport gaming (OR = 2.7, CI = 1.7–4.4) (Table 5). The inverse were observed for a lot of FPS, where sport club membership was negatively associated (OR = 0.6, CI = 0.4–0.9).

	OR	LCI	UCI
Ball sims	**2.75**	1.71	4.40
Driving sims	0.84	0.49	1.42
Other sport sims	0.81	0.39	1.69
MOBA	1.21	0.58	2.52
FPS	0.59	0.39	0.88
Fighting games	1.85	0.92	3.73
Other esports	1.48	1.00	2.20

Table 5. Binary Logistic Regression (adjusted Odds Ratio and 95% confidence intervals) of sport club membership by gaming genre after controlling for age, gender, disability and FAS

DISCUSSION

Through our analyses of data from a nationally representative study, we found that Finnish adolescents' gaming habits were male-dominated and decreased with age. Furthermore, there were positive associations between sport simulation activities, particularly from ball sport games, with both PA and sport club participation, whereas playing a lot of FPS was negatively associated with sport club participation. In contrary to the displacement hypotheses, that digital gaming has no association on PA levels or sport club participation. Other than FPS, esport gaming was not associated with increases in PA or sport club participation. This study builds on the knowledge that gaming behaviour can be independent of PA and sport participation, and that sport simulation gaming genres may be part of the PAR model.

Digital gaming patterns

Our study demonstrates that, at least in Finland, the gendered preference of digital gaming is present as young as 11 years old. This lack of female presence in games does not encourage more females to adopt gaming on a regular basis (see Thorhauge & Gregersen, 2019). Specifically, in esports, historically masculine game types, role models, and overly representation of male characters have been proposed as key reasons for the relatively low prevalence of engagement by women players (e.g., Ruotsalainen & Friman, 2018; Paassen et al, 2017). The low number of female game developers is a likely contributor as well (Lima et al, 2020). In adolescent development, socialisation is a highly important factor especially among females (Patton et al, 2018). The knock-on effect of fewer females involved means fewer female social interactions would need to be reversed to stimulate the interest of females to participate in digital games. Socialisation among males who are unaware of the culture generated may make it less open for female participants, particularly if players normalize derogatory comments on gender (Kelly et al, 2023). Some future research would need to be carried

out on the effect of newer team sport simulation games that included female athlete characters on the rates of digital playing among females.

According to a novel theory called Digital Gaming Relationship (DGR), both internal and external factors influence individuals' relationships with digital games (Meriläinen, 2023). The gender imbalance in games and the cultures surrounding them are prime examples of DGR's idea of how cultural and social structures are part of one's relationship with gaming. It is likely that steps to promote gender equality in the gaming world could increase the perceived importance and meaningfulness of the subject among female players. Based on the DGR model, the grown significance could act as a key driver in increasing one's involvement with games and gaming.

Physical activity relationship

The idea that sport digital gaming can be part of one's physical activity relationship (PAR) model (Koski, 2008) was partly supported by the strong associations with PA and sport participation with adolescents who reported a lot of ball sport gaming. Earlier evidence of this phenomenon in Finland was among children aged 10 years from a convenience sample (Ng et al, 2022). In our study, a national representative sample was used and it included adolescents between 11y to 15y old. There were similar findings, to suggest there is some robustness with the relationships in sport simulation and physical activity. The PAR model seems to fit well with the sport fan model where sport digital games are a way to engage with sports as the games make use of acquired skills, configurations and competition built over time (Conway, 2020). Games that simulate sport draw on the same meanings and meaning structures as traditional sport. Being able to perform the sports as the professional sport athlete can be of great entertaining value, particular in ball type sports. These experiences can be shared and discussed among friends, providing possibly more conversational content than seeing a professional player perform a trick maybe just once in a real match. Also, training and practice on digital games require an extended engagement that may enhance the PAR.

The opposite was noted among most adolescents who reported to play a lot of esports. This could be due to these immersive experiences , having their meanings and semiotics largely disconnected from physical activity cultures, whereas sport simulations are, by definiton, simulations giving an "authentic sporting experience" (Conway, 2010, p. 338). Esports might be considered as a standalone leisure time activity with varying frequencies and intensities of play. Although current meta-analytic knowledge presents little evidence for a displacement of physical activity through digital gaming (Marker et al. 2022), our results suggest that the heterogeneity of effects might be partially explainable by the lack of participation in sport clubs particularly among adolescents who report a lot of FPS play.

The majority of young adolescents in Finland end up being sport club members, and this phenomenon has been growing for several decades (Ng et al, 2016). Although COVID-19 had an impact on the participation of sport clubs during lockdown periods (Kokko et al, 2020), by the time data were collected, the rates seem to return to pre-pandemic levels. At the same time, there seemed to be a growing interest and participation in participating in digital gaming during the COVID-19 pandemic restrictions and did not appear to drop off, particularly at a time when sport club levels returned. As such, the negative association with sport clubs among digital gamers may require further investigation. It would be purposeful to find out what are the leisure time preferences of adolescents who report a lot of FPS gaming and to find interventions to increase their PA levels. One promising area is to create physically active interventions that cross over with games (Strum et al, 2011). However, such programmes need to be mindful not only of mechanical, but also aesthetic genre

features (Karhulahti 2011), which appear to serve as important representational links to the social worlds of sports. For instance, formally connecting active *esports clubs* to established *sports clubs*—which is already happening in some countries—could bring the social worlds of sports closer to those of esports and thus further encourage players to engage in physical activity (Cranmer et al, 2021).

Study limitations

This study was performed through self-report surveys that were teacher administered in school and may have led to some reporting biases in the frequency of game playing and PA participation. Different types of behaviours that can be measured through device-based measurements of PA and regular recall of gaming may provide more details of the gaming frequency, intensity and timing. A split sample was used for analyses and may not have been as accurate to form a representative sample as if they full sample completed the items used in this study. There may have been some missing data, although the sampling method would have meant any biases were random.

CONCLUSION

From a national representative cross-sectional sample of Finnish adolescents aged between 11y to 15y old, digital gaming declined with age and the evidence suggests even at these ages, it is male-dominated. Furthermore, there is evidence to suggest that playing sport simulations are part of adolescents' relationship to PA. Conversely, playing a lot of esports, particularly FPS, was negatively associated with sport-club membership and may be at least partially explained through the displacement hypothesis. As a result, more information is needed to investigate the leisure time interests of digital game players to promote healthy lifestyles that include organised physical activities.

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