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Sedentary lifestyle, concomitant with video game playing, is reflected in the gamers' body weights: A study from Hungary

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Abstract: In Hungary, 3.5 million adults played video games regularly in 2022. Video gaming is most common in the 18-25 years age group, and among schoolchildren, almost half of students are players. Excessive gaming is a recognized disease (*DSM-5:* internet gaming disorder; ICD 11: gaming disorder). The aim of our study was to examine the health status of video gamers in a complex way, including their sociodemographic characteristics, lifestyle, mental and physical health. Further goal was to develop an effective questionnaire, which can identify the lifestyle-related risk factors. The sample was divided into gamers (playing >1h/day) and casuals (<1h/day). Most of gamers were men in their twenties. More than two-thirds started to play >10 years prior. The proportion of overweight and obese individuals was significantly higher among gamers compared to casuals (p=.001). Mean body mass index (BMI) of both gamers and casuals was 23.69±4.17 kg/m^2. Gamers ate less often (p=.001), omitted breakfast more frequently (p=.030), ate snack during gaming (p=.020), consumed soft drinks (p=.010) and energy drinks (p<.001). Almost half of respondents performed intense physical activity ≥3 times/week and more than two-thirds slept <8 hours/day. No connection was found between video games and having chronic illnesses or taking prescription drugs as part of treatment. Self-declared presence of video game addiction was 16.2% in the gamer's group. The next step should be a nationwide survey with our improved questionnaire, focusing more on the lifestyle characteristics and distinguishing between time spent sitting while video gaming or while working or studying.

Keywords: Videogame, Gamer, Lifestyle.

Introduction

The number of video game users keeps increasing exponentially. More and more people are playing video games on computer, consoles (PlayStation, Xbox, Nintendo) or especially on smartphone (ESA, 2022; G&M News, 2022). Generally, we call them „gamers". The significance of the problem is also reflected in the fact that the new version of the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)* contains "internet gaming disorder" (IGD) as a new diagnosis; and World Health Organization's *International Classification of Diseases 11th Revision (ICD 11)* has the new diagnosis "gaming disorder" (GD) (Parekh, 2018; World Health Organization, 2019). DSM-5 considers only online gaming, ICD 11, in contrast, does not make difference between online and offline games. Several publications deal with the criteria, validity or possible errors of these two classifications (Bányai et al., 2018; Chia et al., 2020; Deleuze et al., 2017; Kim et al., 2016; King et al., 2020; O. Király et al., 2016; D. J. Kuss et al., 2019; Rumpf et al., 2018).

According to a questionnaire-based survey by a market researcher company (eNET), at least 56% of Hungarian adults played video games regularly (eNET, 2022b). The total number of gamers (included adolescents) in Hungary was 3.5 million in 2022 (eNET, 2022a). A WHO-collaborative Cross-National Study (Health Behaviour in School-aged Children [HBSC]) reported in 2014 among Hungarian schoolchildren: 48% (boys: 57%, girls: 35%) of students were regular players (Németh et al., 2016). Importantly, in another Hungarian study 45.5% (n=2861) of the gamers were students; and the adult gamers came, in terms of education and occupation, from all social classes (Fromann, 2018a).

Video gaming in itself is considered as a lifestyle factor with a potential effect on the health status of the gamers, stereotypically connected to negative beliefs as players are considered to be overweight and lazy (Bean, 2018). Several studies reported that gamers have higher body mass index (BMI), consume unhealthy food as snacks, as well as sugary soft and energy drinks more often, and eat less fruits/vegetables (Bauer et al., 2017; Chung et al., 2019; Oflu & Yalcin, 2019; Puolitaival et al., 2020; Rudolf et al., 2020; Tanner et al., 2020). Moreover, there exists a link between using video games regularly and having poorer sleep quality and physical inactivity (Akçay & Akçay, 2020; Bauer et al., 2017; Bittner et al., 2013; Puolitaival et al., 2020). Other studies, however, suggest those connections mentioned above are not so clear or do not exist (Huard Pelletier et al., 2020; Rudolf et al., 2020). Additionally, video gaming is almost identical to working in front of the screen and to sedentary lifestyle which have proven negative health effects and can cause specific chronic diseases (musculoskeletal etc.) later in life (Migliore et al., 2021).

It is indisputable that the lifestyle of gamers is highly popular and apparently unstoppable among young people (eNET, 2022c), which indicates the importance of this topic from health and public health point of view and the need of further research. While several studies have been

conducted on mental health and gaming disorder in Hungary (Bányai et al., 2018, 2019, 2020, 2021; Orsolya Király et al., 2019), little information is available on gamer's lifestyle and related bodily health issues among Hungarian adults (Bauer et al., 2017; Bittner et al., 2013; Domokos et al., 2020). The main goal of our study was to examine the health status of video gamers in a complex way, including their sociodemographic characteristics, lifestyle, physical and mental health. Our further goal was to develop an effective questionnaire that can give a realistic picture of the lifestyle and health behavior of the target group and to identify the lifestyle-related risk factors. The obtained results can highlight on the importance of early recognition of problems and necessity of primary prevention strategies.

Method

Study design and participants

A cross-sectional study was delivered in the South-Eastern part of Hungary in 2019 before the outbreak of the COVID-19 pandemic. A convenience sampling method was applied to choose the participants from the guests of BarCraft Szeged (a gamer pub in Szeged) and from the students at the University of Szeged. The sample consisted of one hundred thirty-six people. Participation was voluntary, and participants were assured about anonymity and confidentiality. All participants were informed about the goals of the study, and all provided informed consent. Parental consent was sought for the minors (those younger than eighteen years of age.) User groups of various offline and online PC and console games, but not those gaming on smartphones, were included in the study. The exclusion criteria were incomplete questionnaire, age under fourteen, and playing video games seldom or never.

Measurements

A paper-and-pencil self-administered questionnaire was used to collect data. We used modified questions from our previous study (Nédó & Paulik, 2012) and newly developed questions on topics of gaming characteristics and activity. The questionnaire contained a total of sixty-three questions (predominantly closed-ended ones: dichotomous and single-select multiple-choice questions) and was structured as follows: The first part was about socio-demographic information such as sex, age, place of residence, educational level, marital status, current occupation, and financial situation. Marital status was classified into four categories: married, relationship, single and young adult (the latter were those who identified themselves as adults but were living with their parents). In other categories they live alone (single) or with their partner (relationship/married) independently from their parents. The second part addressed (using closed-ended questions) the activity of video gamers such as gaming hours per day; number of played games per month; lifetime number of played games with playtime of over 100 and 1000 hours. Answers about daily video gaming time was obtained by single-select

multiple-choice question (<1 hour, 1–2 hours, 2-3 hours, 3-4 hours, 4-5 hours, >5 hour). Answers about costs and preferences were collected by open-ended questions: "How many Hungarian Forints do you spend on video games in an average month?" (1 USD ~ 350 HUF) and "Which video games do you play most often? Please list the three most common ones.". Later, depending on the results, the above variables were categorized into groups. The amount spent on video games was divided into 3 groups: <1000 HUF (~3 USD); 1000-5000 HUF (~3-15 USD); >5000 HUF (~15 USD). Video games were grouped to online (partially or primarily played through the internet or where constant internet connection is required to play) and offline ones (playable without an internet connection). The third part concerned different lifestyle factors, including body image, eating habits, and physical status. Participants were asked about their height (cm) and weight (kg), from which Body Mass Index (BMI; kg/m^2) was calculated. Data were collected about eating habits (meals per day; having breakfast, lunch, dinner; snacking during playing games; frequency of consuming fast food, sweets, fruits/vegetables) and drinking habits (frequency of consuming sweetened and energy drinks) by single-select multiple-choice questions. If participants consumed snacks, they could report the most frequently consumed products by an open-ended question. The answers given were categorized into healthy (natural ingredients, no added sugar or other chemicals: e.g., apples, kefir, oilseeds) and unhealthy (added sugar, salt, or other chemicals, convenience food: e.g., chips, gummy candy, instant pasta) snacks. Like the snacks, type of drinks (multi-select multiple choice question) was merged into three categories such as water (tap and mineral water, soda), healthy (100% juice, sugar free tea) and unhealthy drinks (sugary tea, soft drinks). As to physical activity, the following single-select multiple-choice question was provided: "How often do you do physical exercise? Is that a 10 to 30 minutes sports activity or heavy physical work in which you sweat or run out of breath?" Physical activity and sleep time were categorized by WHO recommendations for adults, the cutting points were at the minimum recommended times (intense physical activity: three or more times weekly (World Health Organization, 2020), and sleep time: 8 (7 – 9) hours daily (Baumann, 2020; Centers for Disease Control and Prevention, 2022). In the fourth part, data about using prescription drugs (general and antihypertensive [hypertension as the most common chronic disease in Hungary (Központi Statisztikai Hivatal, 2019)]) currently, frequency of smoking currently, and frequency of alcohol consumption in the previous 12 months were obtained by self-reported closed-ended questions. Any existing chronic illness was asked about by a self-reported open-ended question: "Do you have any kind of chronic illness or health problem that was present in the previous six months and is expected to last another six months? If yes, please describe it below." The last question was related to the mental part of video gaming. A dichotomous question about the subjective, self-declared prevalence of video game addiction: "Do you feel yourself addicted on video games?"

Statistical analysis

For statistical analysis, two groups were created, by merging the above defined categories of daily average time spent playing games. The median playing time in our sample was 1.5 hours and the distribution was right-skewed. Based on this, and the small number of participants in the sample, merging was opted for, considering analogies in the literature (Orsolya Király et al., 2014; Marchica et al., 2021; Puolitaival et al., 2020; Zhai et al., 2020). People who were playing video games regularly (more than one hour daily) were classified as gamers (n=68), while those playing less than one hour daily, as casuals (control group; n=68). The participants of the created groups were recruited mixed from both locations (University of Szeged and BarCraft Szeged). We examined the differences of socio-demographic variables (sex, age, residence, financial situation, employment, educational and marital status), gaming characteristics (type of platforms, age of starting to play, gaming activity, money spending for games), lifestyle- and health-related characteristics (body image, BMI, eating and drinking habits, physical activity, sleeping) among gamers and casuals. The data were processed by using IBM SPSS 28.0. Chi-square test between nominal variables, effect sizes by Cramer's V were used to quantify the magnitude of findings, and Cochran-Armitage test of trend between ordinal and nominal variables were performed to show the basic characteristics of two groups. The level of statistical significance was $p<0.05$.

Results

The sociodemographic characteristics of the all participants and both subgroups are shown in Table 1. The proportion of men was significantly higher among gamers than among casuals [χ^2 (1) =32.594 p<.001], while the age distribution was similar. The association was relatively strong, Cramer's V =.49.

Table 2 shows the gaming characteristics of the total sample and the comparison of gamers and casuals. Most of the participants (69.7%, n=92) started to play video games more than ten years ago, the proportion of this was significantly higher among gamers than casuals. The most preferred platforms were PC and offline games. All gaming characteristics showed significant differences between gamers and casuals: e.g., gamers preferred online, while casuals preferred offline games [χ^2 (1) =45.019 Cramer's V =.39 p<.001]. The association was moderate. Majority of the subjects spent less than one thousand HUF (approximately three USD) on games monthly, but the Cochran-Armitage test of trend showed a statistically significant linear trend (p<.001), with gamers spending significantly more for games. There were further significant differences between gamers and casuals in the number of games per month, and in the number of games lasting more than one hundred or one thousand hours (Table 2).

Table 1 Socio-demographic characteristics

variables, No. (%within group)	Type of groups			
	total [n=136]	casuals (<1h/day) [n=68]	gamers (>1h/day) [n=68]	
Sex				Chi-Square Test, Cramer's V
male	80 (59.3)	24 (35.3)	56 (83.6)	$\chi2$ (1) 32.594 V = .49 p = <.001
female	55 (40.7)	44 (64.7)	11 (16.4)	
Age, year				Cochran-Armitage test
<18	2 (1.5)	1 (1.5)	1 (1.5)	0.022 df = 1 p = .880
18-25	77 (56.6)	37 (54.4)	40 (58.8)	
25-35	53 (39)	29 (42.6)	24 (35.3)	
>35	4 (2.9)	1 (1.5)	3 (4.4)	
Residence				Chi-Square Test, Cramer's V
village	23 (16.9)	8 (11.8)	15 (22.1)	$\chi2$ (4) 9.240 V = .26 p = .055
Budapest	22 (16.2)	16 (23.5)	6 (8.8)	
Szeged	52 (38.2)	22 (32.4)	30 (44.1)	
another city	36 (26.5)	21 (30.9)	15 (22.1)	
Employment status				Chi-Square Test, Cramer's V
employed	40 (29.4)	12 (17.6)	28 (41.2)	$\chi2$ (3) 18.036 V = .36 p = <.001
student	72 (52.9)	48 (70.6)	24 (35.3)	
employed student	22 (16.2)	8 (11.8)	14 (20.6)	
unemployed	2 (1.5)	0 (0)	2 (2.9)	
Educational status				Cochran-Armitage test
elementary school	7 (5.1)	3 (4.4)	4 (5.9)	0.585 df = 1 p = .444
vocational school	6 (4.4)	0 (0)	6 (8.8)	
high school	95 (69.9)	52 (76.5)	43 (63.2)	
university	28 (20.6)	13 (19.1)	15 (22.1)	
Marital status				Chi-Square Test, Cramer's V
married	4 (2.9)	3 (4.4)	1 (1.5)	$\chi2$ (3) 9.702 V = .27 p = .020
relationship	23 (16.9)	6 (8.8)	17 (25)	
young adult	70 (51.5)	42 (61.8)	28 (41.2)	
single	39 (28.7)	17 (25)	22 (32.3)	
Financial situation				Cochran-Armitage test
bad	3 (2.2)	1 (1.5)	2 (2.9)	2.908 df = 1 p = .088
moderate	49 (36.3)	20 (29.9)	29 (42.6)	
good	83 (61.5)	46 (68.7)	37 (50.4)	

Note: for marital status the term of "young adult" are participants who identified themselves as adults, but were living with their parents.

Detectable positive connections were found between male gender with (i) those who have been playing video games for more than ten years [χ^2 (1) = 23.465 Cramer's V =.42 p<.001], the association was relatively strong; and with (ii) those who have played at least one thousand-hours game [χ^2 (1) = 20.306 Cramer's V =.39 p<.001], the association was moderate. Regarding the role of gender, a significant linear trend was detected by the Cochran-Armitage test between male gender and (i) those who played more than two games monthly (p<.001), and (ii) those who have played at least two games for more than one hundred hours (p <.001).

Table 2 Gaming characteristics

variables, No. (%within group)	Type of groups			
	total [n=136]	**casuals (<1h/day) [n=68]**	**gamers (>1h/day) [n=68]**	
Starting to play with videogames				Chi-Square Test, Cramer's V
<10 years ago	40 (30.3)	32 (47.8)	8 (12.3)	$\chi2$ (1) 19.635 V = .39 p = <.001
>10 years ago	92 (69.7)	35 (52.2)	57 (87.7)	
Type of platforms (single choice)				Chi-Square Test, Cramer's V
PC	58 (46)	22 (37.9)	36 (52.9)	$\chi2$ (2) 9.330 V = .27 p = .010
PC and consoles	55 (43.7)	25 (43.1)	30 (44.1)	
consoles (PS, Xbox and Nintendo)	13 (10.3)	11 (19)	2 (2.9)	
Playing games monthly				Cochran-Armitage test
one game	36 (29)	27 (48.2)	9 (13.2)	19.166 df = 1 p = <.001
2-5 games	71 (57.3)	26 (46.4)	45 (66.2)	
>5 games	17 (13.7)	3 (5.4)	14 (20.6)	
Games over 100 hours in lifetime				Cochran-Armitage test
one game	29 (25.2)	20 (37.7)	9 (14.5)	11.103 df = 1 p = .001
2-5 games	47 (40.9)	22 (41.5)	25 (40.3)	
>5 games	39 (33.9)	11 (20.8)	28 (45.2)	
Games over 1000 hours in lifetime				Chi-Square Test, Cramer's V
yes	60 (45.5)	15 (23.4)	45 (66.2)	$\chi2$ (1) 24.290 V = .43 p = <.001
no	72 (54.5)	49 (76.6)	23 (33.8)	
Money spending for games monthly				Cochran-Armitage test
<1000 HUF (~3 USD)	91 (66.9)	58 (85.3)	33 (48.5)	23.220 df = 1 p = <.001
1000-5000 HUF (~3-15 USD)	35 (25.7)	10 (14.7)	25 (36.8)	
>5000 HUF (≥15 USD)	10 (7.4)	0 (0)	10 (14.7)	
Type of games (multiple choice)	**total [n=303]**	**casuals [n=118]**	**gamers [n=185]**	Chi-Square Test, Cramer's V
offline	177 (58.4)	97 (82.2)	80 (43.2)	$\chi2$ (1) 45.019 V = .39 p = <.001
online	126 (41.6)	21 (17.8)	105 (56.8)	

Note: for multiple choice questions, the participants could endorse more than one choices per person and this is reflected in the larger total sample size for these variables.

Regarding lifestyle issues, the mean BMI of both gamers and casuals was 23.69±4.17 kg/m^2. The Cochran-Armitage test of trend found a statistically significant linear trend (p=.001) between the objective (BMI based) nutritional status and type of players (casuals/gamers), that is, the proportion of overweight and obese persons (BMI≥25.00 kg/m^2) was higher among the gamers (43.3%, n=29) than among casuals (17.6%, n=12). Compared to casuals, gamers ate less often (occurrence of ≤3 meals/day: 67.6%, n=46 vs. 41.2%, n=28; Cochran-Armitage test of trend, p=.001), omitted breakfast more frequently [38.2%, n=26 vs. 20.6%, n=14; χ^2 (1) =5.1 Cramer's V =.19 p=.03], with weak association, and consumed snacks during gaming more frequently [48.5%, n=33 vs. 28.4%, n=19; χ^2 (1) =5.798 Cramer's V =.21 p=.02], with moderate association. Consumption

of unhealthy snack (e.g., chips, chocolate, candies) was higher among gamers than among casuals, but the difference was not significant. (Table 3)

Table 3 Lifestyle characteristics - eating habits, physical activity

variables, No. (%within group)	Type of groups					
	total [n=136]	**casuals (<1h/day) [n=68]**	**gamers (>1h/day) [n=68]**			
Intense physical activity weekly				Chi-Square Test, Cramer's V		
<3 hours weekly	73 (54.5)	35 (53)	38 (55.9)	χ2 (1) 0.110	V = .029	p = .740
≥3 hours weekly (WHO recommended)	61 (45.5)	31 (47)	30 (44.1)			
Body image				Cochran-Armitage test		
underweight	9 (6.6)	4 (5.9)	5 (7.4)	2.562	df = 1	p = .109
normal weight	92 (67.6)	52 (76.5)	40 (58.8)			
overweight+obese	35 (25.7)	12 (17.6)	23 (33.8)			
BMI, kg/m2				Cochran-Armitage test		
<18.5	5 (3.7)	4 (5.9)	1 (1.5)	11.285	df = 1	p = .001
18-24.9	89 (65.9)	52 (76.5)	37 (55.2)			
>25	41 (30.4)	12 (17.6)	29 (43.3)			
Frequency of eating daily				Cochran-Armitage test		
≤3	74 (54.4)	28 (41.2)	46 (67.6)	11.507	df = 1	p = .001
4	29 (21.3)	16 (23.5)	13 (19.1)			
≥5	33 (24.3)	24 (35.3)	9 (13.2)			
Breakfast eating				Chi-Square Test, Cramer's V		
yes	96 (70.6)	54 (79.4)	42 (61.8)	χ2 (1) 5.100	V = .19	p = .030
no	40 (29.4)	14 (20.6)	26 (38.2)			
Eating snack during playing games				Chi-Square Test, Cramer's V		
yes	52 (38.5)	19 (28.4)	33 (48.5)	χ2 (1) 5.798	V = .21	p = .020
no	83 (61.5)	48 (71.6)	35 (51.5)			
Type of snacks (multiple choice)	**total [n=76]**	**casuals [n=26]**	**gamers [n=50]**	Chi-Square Test, Cramer's V		
healthy	22 (28.9)	10 (38.5)	12 (24)	χ2 (1) 1.739	V = .15	p = .190
unhealthy	54 (71.1)	16 (61.5)	38 (76)			

Note: for multiple choice questions, the participants could endorse more than one choices per person and this is reflected in the larger total sample size for these variables.

Gamers also more frequently consumed soft drinks (p=.010) and energy drinks (p=<.001) than casuals, as shown by the Cochran-Armitage tests of trend. (Table 4). There was minimally significant difference in drinking during gaming between casuals and gamers, but the answers showed that gamers drank more unhealthy drinks (those with added sugar such as soft drinks, tea, coffee) than casuals. Majority of the participants in either group had lunch (95.6%, n=65 vs. 91%, n=61) and dinner (92.6%, n=63 vs. 97.1%, n=66) daily. Furthermore, most of the subjects ate fast foods rarely (85.1%, n=57 vs. 80.9%, n=55; ≤3 times/month). In addition, no significant difference was found with gaming in case of tobacco and alcohol use.

Around one-third of our participants were smokers: 16.2% daily (n=22) and 16.9% occasionally (n=23). Half of them (51.9%) started this habit before the age of 18 years. As to alcohol consumption in the previous 12 months, most participants (37.5%; n=51) reported 2-4 times of drinking monthly.

The WHO recommendation on physical activity was met by 45.5% (n=61) of the respondents. However, 69.1% (n=94) of the respondents slept less than eight hours daily. No significant difference was found between casuals and gamers in physical activity and sleeping time (see Table 3). Moreover, having chronic illnesses and taking any kind of specific drugs as part of treatment were not found independently or connected to video gaming, by self-reporting in the total sample and separately in the groups. Self-declared presence of video game addiction was 8.1% (11 out of 136) in the whole group, and 16.2% among gamers (11 out of 68).

Table 4 Lifestyle characteristics - drinking habits, sleeping

variables, No. (%within group)	**Type of groups**					
	total [n=136]	**casuals (<1h/day) [n=68]**	**gamers (>1h/day) [n=68]**			
Sleep time on weekdays				Chi-Square Test, Cramer's V		
<8 hours	94 (69.1)	47 (69.1)	47 (69.1)	$\chi2$ (1) 0.000	V = .000	p = 1.000
>8 hours (WHO recommended)	42 (30.9)	21 (30.9)	21 (30.9)			
Frequency of soft drink consumption				Cochran-Armitage test		
>1 daily	14 (10.4)	4 (6)	10 (14.7)	6.635	df = 1	p = .010
1/day + 4-6/week	25 (18.5)	8 (11.9)	17 (25)			
1-3/week	30 (22.2)	17 (25.4)	13 (19.1)			
<1 weekly	66 (48.9)	38 (56.7)	28 (41.2)			
Frequency of energy drink consumption				Cochran-Armitage test		
>1 daily	4 (3)	1 (1.5)	3 (4.4)	17.917	df = 1	p = <.001
1/day + 4-6/week	15 (11.1)	0 (0)	15 (22.1)			
1-3/week	18 (13.3)	7 (10.4)	11 (16.2)			
<1 weekly	98 (72.6)	59 (88.1)	39 (57.4)			
Weekly frequency of energy drink consumption				Chi-Square Test, Cramer's V		
>1 weekly	37 (27.4)	8 (11.9)	29 (42.6)	$\chi2$ (1) 15.994	V = .34	p = <.001
<1 weekly	98 (72.6)	59 (88.1)	39 (57.4)			
Drinking during playing games (multiple choice)	**total [n=170]**	**casuals [n=71]**	**gamers [n=99]**	Chi-Square Test, Cramer's V		
water	94 (55.3)	45 (63.4)	49 (49.5)	$\chi2$ (2) 5.806	V = .19	p = .060
healthy	31 (18.2)	14 (19.7)	17 (17.2)			
unhealthy	45 (26.5)	12 (16.9)	33 (33.3)			

Note: for multiple choice questions, the participants could endorse more than one choices per person and this is reflected in the larger total sample size for these variables.

Discussion

The aim of our questionnaire-based survey was the complex observation of the socio-demographic characteristics, lifestyle, prevalence of chronic illnesses in relation with video game addiction among young adult video gamers in the region of South-East Hungary. By means of the self-reported questionnaire, a more detailed picture of the health status and lifestyle of the gamers. The lifestyle-related risk factors found among the target group, such as obesity, unhealthy eating habits such as skipping breakfast, consuming snacks and sweet soft drinks or energy drinks can, if permanently present, result in early appearance of chronic illnesses.

The majority of the participants in the study were students in their twenties and most of them had been playing video games for at least ten years. Worldwide and also in Hungary, the two most popular platforms are smartphones and personal computers (PC) (Bauer et al., 2017; Domokos et al., 2020; eNET, 2019b; Fromann, 2018b; NPD, 2018). Additionally, according to the Hungarian Youth Research 2020, 20% (n=1600) of young (15-29 years old) Hungarians have a game console at home (Domokos et al., 2020). The type of game preferences showed that casual players are offline users and hardcore players prefer to play online. Based on international data, even though female players exist, men are still the dominant ones, especially in hardcore gaming (Fromann, 2018a; Orsolya Király et al., 2019; Ramos-Diaz et al., 2018). Researches demonstrated that men are more likely to become addicted to video gaming, while women tend to develop addictive use of social media (Andreassen et al., 2016; D. Kuss et al., 2014). In Hungary, according to an online survey, 92% of players were men, which was higher compared to the ratio of males in our study in the total sample or among gamers (59.3% vs. 83.6%, respectively) (eNET, 2019a).

A study by the Pew Research Center showed that 90% (n=669) of US teens were playing video games (Anderson & Jiang, 2018); in Turkey, the rate of gamers among secondary school students was 82.5% (n=245) (Oflu & Yalcin, 2019). In Hungary, an online survey by eNET presented that 48% of Hungarian children (57% of boys and 35% of girls) played video games (eNET, 2019b). Another Hungarian study reported that 49.7% (n=3058) of boys and 29% (n=1784) of girls use computers for playing on weekdays, in the weekend these rates were 72.7% (n=4473) and 45.8% (n=2818) (Németh et al., 2016). Increasing prevalence of video games in Hungary is also indicated by the size of gaming market that was twelve billion HUF in 2017, twenty-four billion in 2019 and grew to sixty-five billion four hundred million HUF by 2022, obviously in connection with the increasing number of players (eNET, 2017, 2019b, 2022b).

Several international studies observed that obesity is more frequent among gamers while the percentage of normal BMI is lower among them than in the general population in the same age group (Oflu & Yalcin, 2019; Puolitaival et al., 2020; Rudolf et al., 2020). Our results are in line with these data: overweight and obesity were more frequent among those who

played games more than one hour daily. Obesity is a known risk factor of chronic, non-infectious diseases such as cardiovascular diseases and diabetes (Apor et al., 2023). Weight management with increased level of physical activity could prevent these diseases. In contrast, the results of Marker et al. do not support the assumption of a strong link between body mass and video gaming (Marker et al., 2019).

In a Finnish study among young gamer men it was found that almost one-third of the responders consumed snacks daily and that was positively correlated to video gaming, and another study found that gamers skip breakfast often (Puolitaival et al., 2020; Tanner et al., 2020). Omitting breakfast seems counter-productive for gamers, it might create a negative energy balance and decrease cognitive function (Baumann, 2020; Migliore et al., 2021). According to the Hungarian Youth Research, in 2016 4% (n=80), and in 2020 7% (n=140) of youth (15-29 years old) consumed fast food on daily basis (Bauer et al., 2017; Domokos et al., 2020). In contrast to this data, in our study it was only 1.5% (n=1) among gamers.

Like international findings, our study showed unhealthy eating habits among gamers. E.g., less than three meals a day, skipping breakfast, snacking while playing video games (48.5%, n=33) also showed a moderate correlation with playing time, but we found no significant association with having lunch and dinner, type of snacks and drinks, frequency of visiting fast food restaurants. To keep a healthy diet is important as different and varied food items will provide all essential nutrients necessary for general well-being and for preventing chronic non-infectious diseases. For gamers, having well-regulated blood sugar by slowly digested meals is important for optimal cognitive performance during their gaming sessions (Baumann, 2020; Migliore et al., 2021).

Among young Finnish men, consumption of sweetened and energy drinks at least once a day was 22% (n=1880) and 8.7% (n=743), respectively, according to findings of Tanner et al. (Tanner et al., 2020); and the findings of the Hungarian Youth Research 2016, 23% (n=460) and 10% (n=200), were similar (Bauer et al., 2017). Furthermore, in the Hungarian Youth Research 2020, increased percentages were measured for both drinks: 26% (n=520) and 13% (n=260) (Domokos et al., 2020). In our study population, however, daily consumption of sweet soft drinks and energy drinks was remarkably higher among gamers (39.7%, n=27; 26.5%, n=18), similarly to the findings of Puolitaival et al. (Puolitaival et al., 2020). Beyond excess sugar, too much caffeine in the energy drinks will inhibit cognitive function and may cause other side effects such as gastrointestinal and cardiac problems, dental issues, and risk-seeking behaviors (Baumann, 2020). In the above-mentioned Finnish study on the frequency of dental caries related to snack and sugar consumption among young gamer men, around 20% of the participants were completely free of caries (Tanner et al., 2020). In Hungary it was found that, in 2016-2017, 40% of the schoolchildren (12-year-olds) consumed sweets or soft drinks, and 52.4% of children had dental problem (pain or discomfort) or dissatisfied by the

appearance of their teeth (Szöke & Petersen, 2020). For better oral health, public health programs should be implemented for the effective reduction of sugar consumption.

Regarding water consumption, the proportion of water drinkers was lower among the gamers (49.5%, n=49) than in the casuals (63.4%, n=45), the latter figure being almost identical with that in the Hungarian Youth Research (2016: 63%, n=1260; 2020: 64% n= 1280), but it should be noted here that our question was only about water intake during playing and not about daily consumption (Bauer et al., 2017; Domokos et al., 2020).

No relationship was found in our study between gaming and alcohol drinking. This was in line with a Canadian study where the authors did not find any connection with alcohol drinking at gamer adolescents (Boers et al., 2020). However, a higher number of our participants consumed alcohol more frequently (daily and weekly) in a month than the participants of the Hungarian Youth Survey 2020 (37.5% vs. 28%) (Domokos et al., 2020). In contrast to the former, Norwegian research found an inverse relationship in university students between high-level gaming and alcohol, which suggests that playing video games at high level may protect against drinking. A possible explanation is that during the game there is no time to drink, and alcohol reduces the gaming performance/experience; or in other context, gaming motivations, such as escape, are satisfied by playing, without the need of alcohol consumption (Erevik et al., 2019).

Data from the Hungarian Youth surveys on physical activity showed that in 2013, 29% (n=580), in 2016, 36% (n=2880), and in 2020 32% (n=2560) of the young adult population complied with the WHO recommendation on intense exercise (Bauer et al., 2017; Bittner et al., 2013; Domokos et al., 2020), where the four percent decrease of physical activity in 2020 might come from the effect of COVID-19 pandemic (Domokos et al., 2020). In contrast, 45.5% (n=61) of our study participants achieved the WHO's recommendation on physical activity for adults. A Finnish study reported, in contrast, that gamers more often had low physical fitness (Puolitaival et al., 2020). It would be, however, important that every adult reach at least the WHO recommendation for physical activity (150-300 minutes moderate or 75-150 minutes strong aerobic training weekly), because physical inactivity is a well-known risk factor of a range of diseases such as cardiovascular and pulmonary diseases, diabetes, cancer and sleep apnea (Apor et al., 2023).

Similar to our data, several publications have found correlation between video gaming and poorer sleep hygiene, including sleep time, sleep quality, later bedtime and wake up time, and daytime sleepiness (Akçay & Akçay, 2020; Rudolf et al., 2020). Especially video games that last until late night can cause sleep problems (Huard Pelletier et al., 2020; Peracchia & Curcio, 2018; Rudolf et al., 2020). Approximately seven to nine hours of sleep daily should be crucial to reach optimal health benefits for an average adult (Baumann, 2020). Additionally, there is a lack of evidence on

supplementation for vision health to provide recommendations for gamers (Migliore et al., 2021).

The research background of the relationship between smoking and video gaming is scarce. Our results did not confirm any connection between smoking and video gaming. Comparing to the Hungarian Youth Survey 2020, "smoking daily" was similar to our study results (16.2% vs. 17%) (Domokos et al., 2020). An American study found positive relationship, nevertheless the situation is still unclear, further investigations are required (Forsyth & Malone, 2016). Moreover, researchers should pay attention on the different streaming platforms (e.g. Twitch), where e-cigarette promotional contents by influencers might have an impact on viewers, especially on adolescents (Vassey et al., 2021). In contrast, health interventions (e.g. smoking prevention) embedded in video games can have promising effect on participants' knowledge and beliefs about tobacco product use (Hieftje et al., 2021).

Furthermore, chronic diseases related to video gaming and corresponding drugs were absent in our sample. This may result from the age of the participants in our study: vast majority of them (97.1%) were under thirty-five and more than half of them (58.1%) were under twenty-five. However, a Japanese study reported that self and environmental exposures to gaming addiction was associated with adult hypertension, heart and cerebrovascular diseases, allergy, self-rated health and happiness (Shiue, 2015). Moreover, the ergonomics of playing video games on almost every platform are similar to postures and positions occurring in office work, except in virtual reality especially where the movements are similar to traditional sports (Migliore et al., 2021). Extended desk times (watching the screen and sitting), poor posture, core weakness and inactivity can compound and predispose gamers to a multitude of degenerative changes such as upper and lower extremity disorders, neck and back disorders, hearing and vision disorders that can later play a role in the development of chronic diseases (Migliore et al., 2021). Consequently, it should be important to take effort to build up prevention routes and health education programs to improve gamers' health awareness (e.g. sitting in correct posture, keeping right distance from the monitor, taking a break regularly during the game) and of course to create more ergonomic accessories (mouse, keyboard, controller, monitor, desk and chair).

Finally, the number of those gamers in our sample who felt as having video game addiction was higher than in other Hungarian studies. The prevalence of problematic online gaming was 4% in 2020, a percentage similar to that of previous Hungarian researches (Kotyuk et al., 2020). Important to notice, these numbers are not comparable, because we did not use a validated scale. However, the reason of the high numbers may come from our convenience sampling method: we collected data among others in a gamer pub, where tournaments were often organized hence hardcore gamers were present there more frequently. This also means that this kind

of gamer pubs may be interesting places to collect more data for the future studies.

Limitations

The study has the following limitations: the use of convenience sampling limits the generalizability of our data. Due to the circumstances of sampling, men (gender imbalance), urban residents and university students are overrepresented in our study. Furthermore, there might be socio-economic differences between the groups because the gamers are more likely to have jobs and the student sample may be from a wealthier background. The way of data collection (printed questionnaires) limited our access to the target population because this method is not preferred by gamers. The location of recruitment was not recorded for each participant separately. The results may be inaccurate due to the small number of participants and this circumstance limited the range of statistical tests that could be performed. The mental aspect of video games (video game addiction) was not the main goal of our study, but due to the nature of our aims, it had to be touched upon, so that it was examined only tangentially, which makes it difficult to compare with other results. Moreover, we did not take difference between sitting time daily and game playing time.

Strengths

One strength of our study is the inclusion of physical health and sleeping patterns in a study of video gaming. We tried to focus and demonstrate wherever we could to define the possibility of the prevention as the best route in the case of this specific sedentary behavior.

Conclusions

Data of the Hungarian players and video game market clearly indicate that video gaming is becoming increasingly popular among young people in our country, which implies the risk of premature development of chronic diseases, and deterioration of the quality of life (Migliore et al., 2021). Therefore, it is extremely important that primary care system continuously monitor the lifestyle of these young adults with an efficient and fast tool and identifies possible risk factors that can be changed, so that the development of more serious conditions can be avoided with preventive public health interventions at the right time. In order to map all aspects of the video game lifestyle, the next national survey with our improved questionnaire will focus more on the lifestyle characteristics of the target group and will make distinction between daily time spent playing video games and time spent sitting with work or other kind of hobbies.

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Availability of data and materials
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Author's contributions
All authors participated in study design. MJ collected the data. All authors conducted the data analysis. MJ wrote the first draft of the manuscript. EH drafted, revised, critically reviewed the manuscript. EP drafted, revised, critically reviewed, and approved the final submitted draft of the article.

Ethics and informed consent
The study procedures were carried out in accordance with the Declaration of Helsinki. The Human Institutional and Regional Biomedical Research Ethics Committee of the University of Szeged approved the study (Identification number: 4288). The participation was voluntary and anonymous. All subjects were informed about the study, and all provided informed consent. (If applicable: Parental consent was sought for those younger than eighteen years of age.)

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