What hurts, Pikachu? Physical symptoms in Pokémon Go players

Lukasz D. Kaczmarek¹, Maciej Behnke¹, Marzena Dżon¹

¹Adam Mickiewicz University, Faculty of Psychology and Cognitive Science, Poznan, 61-664, Poland

ABSTRACT

Individuals benefit from Pokémon Go (PG) gaming because this mobile video game provides an attractive opportunity to increase physical activity outdoors and socialize. However, based on gaming and electronic media studies, intense involvement with PG is likely related to adverse phenomena, such as arm pain or eye-related problems. We aimed to test how PG use (problematic vs non-problematic gaming and gaming time) is related to physical symptoms (pain in three body regions and computer vision syndrome). To dissect game-specific effects, we controlled for general problematic smartphone use, phubbing, and electronic media usage. PG players ($N = 455$) completed an online survey. We found that PG players with problematic game use reported more pain and vision problems. Problematic PG use was a better predictor of physical symptoms than PG gaming time and variables related to electronic media use. Problematic PG use and problematic smartphone use were correlated but independent predictors of physical symptoms. We conclude that the type of participation rather than the time spent playing predicts poorer physical health among PG players.

Introduction

Pokémon Go (PG, Niantic Inc., USA) is an augmented reality game in which gamers explore their real world collecting virtual characters called Pokémon. Launched in 2016, PG continues to be the most popular and profitable mobile video game. PG gaming has been related to positive physical and social outcomes [1,2,3]. However, little is known about the adverse phenomena among PG gamers, and most of the harmful health evidence is anecdotal. Some PG players can become preoccupied with the game to the extent that they have problems with deliberate control over game use; symptoms indicative of problematic game use [4]. This problematic use, in turn, is likely to increase the risk of pain and vision problems through frequent and prolonged periods of inadequate body posture and bad visual habits [5,6]. We aimed to fill this gap by addressing pain and vision problems among PG players.

Pokémon Go and problematic video games use

Some individuals develop an intense interest in video games resulting in problematic gaming [7,8,9]. Problematic gaming presents a compulsive use of video games that negatively influences their lives [10]. Problematic gaming affects 8.5% of gamers, and it is an individual and public health problem that predicts lower educational achievements [11,12,13], attention deficits [14], aggressive behavior, depression, and anxiety [15], and deficits in real-life relationships [16]. The primary problematic gaming mechanism is related to built-in reward systems with repetitive conditional rewards that facilitate intensely pleasurable experiences through increased dopamine release [17,18]. This mechanism is similar to behavioral addictions, such as gambling [8].

Although PG's beneficial aspects are often emphasized, PG's design and monetization scheme share adverse psychological effects of other free-to-play mobile games. For instance, PG has developed a system of rewards with gambling mechanisms, i.e., players wager their resources (e.g., time and effort) on events with an uncertain outcome expecting to obtain a payoff. The core of PG is the wild Pokémon hunt. Individuals walk around their neighborhood expecting to find desired Pokémon (e.g., rare species with a low probability of spawning or specimens missing in their collection). Players can intensify the collecting process by purchasing items (e.g., lure modules or egg incubators) with real-world money that provides more opportunities to draw a Pokémon. Finding and catching a rare Pokémon is a rewarding experience that motivates the continuation of behavior by fueling the excitement related to the anticipation of future rewards. Such mechanisms in which individuals invest their time, physical effort, or money with an expectation of in-game prizes (e.g., unique Pokémon) copy a psychological mechanism typical for slot machines, roulette wheels, or capsule toys vending machines [19]. Several other possible mechanisms increase the potential of PG for problematic gaming. For instance, PG can be played every day and all day [20], and players are rewarded for regular daily use [21,22].

PG gaming and physical health

PG players are more likely to maintain inadequate body posture related to heavy electronic device use, termed iPosture, Nintendo neck, or tech neck [5,23]. Consequently, structural changes are likely to occur and produce chronic headaches, neck, and shoulder pain [24,25,26]. Highly engaged PG players walk a lot in the bowed-over position, with arms bent in their elbows and stretched wrists to hold their smartphones. This behavior can lead to other adverse health effects in the form of back pain [27], deformation of the hands [28], and leg strain [29].

PG players spend too much time in front of screens [30,31]. For these reasons, intense PG gaming is likely to lead to vision problems such as computer vision syndrome (digital eye strain or visual fatigue) related to accommodation (e.g., difficulty refocusing from one distance to another) and to dry eye (e.g., irritated/burning eyes) [6]. CSV issues affect most heavy computer users [32].

To date, there has been only one study that examined physical symptoms among PG players [33]. That study reported no differences between players and non-players. However, that study had some limitations because it used a scale that mixed symptoms that were likely to be related to mobile gaming (e.g., neck pain) with symptoms that were not likely to be affected by video gaming (e.g., constipation and diarrhea).

Pokémon Go gaming, phubbing, and problematic smartphone use

No studies have investigated the mechanisms linking PG gaming with adverse health outcomes. We suggest that negative effects of excessive PG gaming operate by developing problematic behaviors related to the heavy use of mobile phones, such as problematic smartphone use [34] and phubbing [35]. Problematic smartphone use is a psychological or behavioral dependence on smartphone-based activities that distracts users from their daily life and undermines their self-regulation capacity [34]. Furthermore, phubbing (a combination of the words "phone" and "snubbing") occurs in social situations when individuals maintain their focus on their mobile phones at the expense of the interlocutor, who may feel ignored or snubbed [36,37]. These more fundamental aspects of smartphone use are essential to control effects specific for PG gaming.

Present Study

We aimed to address the health risks related to PG gaming, emphasizing the problematic PG gaming manifested in gaming behavior control difficulties. By accounting for gaming time (how much players play) and gaming type (how involved players are), we distinguish between players who engage with a problematic approach (i.e., due to compulsive urges) and those who engage with a functional approach (i.e., satisfying the need for entertainment). We expected problematic PG gaming to be related to physical health problems, i.e., pain and computer vision syndrome.

Methods

Participants

The participants were 455 PG players (43.9% women) aged 18 to 53 years ($M = 26.45$, $SD = 6.17$). A power analysis indicated that to detect the expected small effect sizes $B = .20$, with a power of .80, at least 444 participants would be required [38]. We used Facebook ads targeted at PG players. Participants did not receive any compensation for their participation. The study was in accordance with the Declaration of Helsinki and institutional ethical guidelines. All participants were informed about the study, and all provided signed informed consent.

Measures

Problematic PG use

To measure problematic PG use, we adapted eight items from the Game addiction scale and the Internet addiction scale [39], accounting for preoccupation with PG ("I dream about the times to play Pokémon Go when I don't play the game"), PG withdrawal ("I feel anxious when I don't play Pokémon Go"), self-control difficulties ("I cannot stop playing Pokémon Go, although I want to"), and the negative influence of PG gaming on daily life ("I neglect my duties to be able to play Pokémon GO"). We adjusted the original items so that they fit the PG context. Participants responded on a 7-point scale ranging from "I strongly disagree" to "I strongly agree." The scale had satisfactory internal consistency ($\alpha = .81$).

Problematic smartphone use

We used a 7-item Mobile Phone Use Addiction Scale [39] to quantify problematic smartphone use (eg 'I never turn off my mobile phone', 'I cannot think of a life without my mobile phone,' I had times when I forgot to do things since I was very busy with the mobile phone'). Participants answered on a 7-point scale ranging from "I strongly disagree" to "I strongly agree." The scale had satisfactory internal consistency ($\alpha = .78$).

Phubbing

We used a 4-item Phubbing Scale [39] to measure the problematic usage of a smartphone daily (e.g., 'My eyes start wandering on my phone when I'm together with others.', 'People complain about me dealing with my mobile phone.', 'I'm busy with my mobile phone when I'm with friends.'). Participants answered on a 7-point scale ranging from "I strongly disagree" to "I strongly agree." The scale had satisfactory internal consistency ($\alpha = .88$).

Visual symptoms

Participants reported eye accommodation problems (e.g., blurry vision and refocusing time) with four items and eye strain (e.g., dryness and tired eyes) with five items using subscales from a validated instrument for the measurement of symptoms related to heavy computer use [40]. The reliability was $\alpha = .80$ for accommodation problems and $\alpha = .85$ for eye strain.

Physical symptoms

Participants reported discomfort in the upper extremities with five items for arms (fingers, hand/wrist, elbow/forearm), four items for the back (neck, shoulder, upper back, lower back), and three items for legs (ankle/foot, lower leg, thigh/knees) [40,41]. The validity of brief rating scales of physical symptoms has been supported by comparing subjective ratings with clinical evaluations [41]. Participants estimated the intensity of musculoskeletal symptoms using a scale ranging from 0 "none" to 6 "severe." The internal consistency of the scales was $\alpha = .76$ for the upper limbs, $\alpha = .59$ for legs, and $\alpha = .79$ for back.

Pokémon Go gaming time and media usage time

Participants reported how many days and for how long in hours and minutes they 1) played PG; 2) used electronic media such as TV, PC, game console, and smartphone in the last seven days [3, 42,43]. We calculated the total gaming time and media usage time by multiplying the number of days by daily minutes.

Statistical analysis

We performed path analysis to test whether physical symptoms were predicted by problematic gaming, problematic smartphone use, and phubbing after controlling for gaming time, electronic media exposure, age, and gender. To address multicollinearity between predictors, we calculated variance inflation factor (VIF), with values < 5.00 , and Tolerance (TOL) with values $> .20$ indicating an acceptable level of multicollinearity between variables. We evaluated the model fit with the Root Mean Square Error of Approximation (RMSEA; values $< .06$ indicating a good fit [44]) and Comparative Fit Index (CFI; values $> .90$ indicating a good fit [44]). The maximum likelihood estimator with Satorra-Bentler adjustment (MLM) was used with mPlus 8.5. Outliers (above 3.29 standard deviation) were excluded [46].

Results

Table 1 presents descriptive statistics and intercorrelations. There was no problems of multicollinearity between predictors with all VIF's < 1.63 , and TOL values > 0.61 . The model (Figure 1) fit the empirical data well, $\chi^2 (38) = 66.89$, $p < .01$, RMSEA = .04, 90% CI [.02, .06], CFI = .95. Insignificant paths had no effect on the model fit, $\Delta\chi^2 (32) = 42.41$, $p = .10$, thus, they were removed.

We found that individuals with more problematic smartphone use reported more severe physical symptoms in vision and back pain. Supporting our hypothesis, PG players with higher levels of problematic PG gaming reported even more severe symptoms regarding vision (eye focus and eye dryness) and pain (back, legs, and arms). In addition, we observed longer gaming time among more problematic PG gaming. However, the time spent playing PG was not predictive of physical symptoms. Similarly, individuals with problematic smartphone use, particularly men, reported longer media usage time. However, media use time was not predictive of physical symptoms.

Discussion

We examined physical symptoms among PG players and their relationship with PG gaming time and PG participation ranging from non-problematic to problematic. We found that PG players with more problematic gaming levels (but not longer gaming time) were more likely to exhibit physical symptoms. The effects of PG-related variables predicted the outcomes above the effects of problematic smartphone use and general exposure to electronic media. Our findings contribute to the literature by documenting adverse effects among problematic PG gamers that could be considered to determine the overall health of PG gamers.

We found that problematic PG gaming was moderately related to problematic smartphone use. This indicates that some PG players have a general problem with controlled smartphone use. Intense participation in PG gaming provides strong motivation for smartphone preoccupation and compulsive use. However, a substantial number of problematic PG players have no problems with smartphone overuse. Further studies might use prospective or experimental study designs to determine to what extent problematic PG gaming leads to problematic smartphone use and to what extent individuals with problematic smartphone use are more likely to get hooked on PG. Studies might be extended to children who might be initially attracted to smartphones by the Pokémon franchise and develop general smartphone problematic use starting with this type of gaming experience. Finally, problematic PG gaming was weakly related to phubbing. This suggests that the gaming activity of PG players weakly interferes with their social relationships [36,37]. It might indicate that phubbing is less relevant to PG players because their use of mobile phones during social interaction is more acceptable due to the augmented reality game conventions.

Problematic PG gaming was substantially predictive of physical complaints' severity. Problematic PG gaming was related to greater vision problems and pain. It is noteworthy that problematic smartphone use predicted only back pain. Problematic PG gaming also predicted more pain in legs and arms – the parts of the body characteristic of games that require walking while holding smartphones in a flexed hand with an arm bent. Problematic PG players also complained of computer vision syndrome, i.e., dry eye and problems with efficient eye focusing that resulted in decreased visual acuity. These findings review a common belief among problematic PG players who expect more benefits from PG gaming compared to casual users [47]. Evidence of the adverse effects of PG gaming might serve as a persuasive argument to promote health for PG players – especially those at risk of developing problematic PG use, i.e., strongly motivated and passionate about playing PG [48,49,50].

Practical implications

Our results correspond to previous recommendations that excluded video games as an optimal method of facilitating health [51,52]. Previous studies documented increased physical activity among PG players as evidence that PG players are healthier than non-players, and players who play more are healthier than those who play less [1,3]. Our study, however, indicates that heavy players suffer from physical problems typical of electronic media overuse. PG players might benefit from increasing their awareness of vision problems and pain prevention. For instance, they should monitor their posture to relieve the intense pressure on the spine. Although similar recommendations have long been formulated regarding smartphone use [53], it is imperative to extend these recommendations to PG players.

Limitations

First, our research design was cross-sectional. Longitudinal designs would provide direct evidence of causality. Although regressive models allow for the interpretation of causal effects [54], experimental designs that manipulate gaming behaviors provide direct evidence of causality. Further studies might test whether problematic PG gaming reduction interventions cause reduced physical symptoms [55,56]. Second, the reliability of leg pain measurement was below the conventional threshold. Therefore, results related to the legs should be interpreted with caution. Finally, although pain self-reports and clinical evaluation are highly correlated [41], more substantial support for our hypothesis would result from health problems documented with objective methods.

Conclusions

We report novel findings that problematic PG gaming is related to physical health problems. This is in line with evidence that gaming styles and intensities determine gaming costs and benefits. These findings are essential since PG is often presented as promoting healthy activity during leisure. On the contrary, we emphasize that problematic PG users are at increased risk of psychological, social, and physical health problems. Understanding the possible adverse effects and correlates of PG gaming is vital to develop engaging games that facilitate health behaviors (e.g., outdoors walking) and minimize the possible harm to other aspects of physical health.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Authors' contributions

L.D.K. and M.D. designed the research; L.D.K. and M.D wrote the main manuscript text; All authors interpreted the data and reviewed the manuscript.

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11
1. Problematic PG gaming	16.64	8.22											
2. Problematic smartphone use	27.47	8.67	.38**										
3. Phubbing	12.62	5.26	.24**	.52**									
4. Eye focusing	3.13	4.31	.19**	.20**	.17**								
5. Eye dryness	7.34	6.48	.26**	.34**	.25**	.46**							
6. Pain back	5.30	5.05	.23**	.23**	.16**	.34**	.50**						
7. Pain arms	2.08	2.92	.23**	.08	.11*	.30**	.32**	.47**					
8. Pain legs	1.58	2.53	.11*	.05	.08	.18**	.38**	.37**	.40**				
9. PG gaming time	11.79	10.09	.18**	-.01	.02	-.04	-.05	-.07	.01	-.06			
10. Media use time	47.56	29.92	-.02	.12*	.02	.02	.10*	.06	.04	.07	.10*		
11. Age	26.45	6.17	-.05	-.16**	-.03	.05	-.03	.07	.05	.07	.06	.03	
12. Sex	-	-	-.01	.06	-.04	-.06	-.05	-.07	.02	-.06	.06	-.11*	.04

Table 1. Descriptive statistics and correlations among study variables. Sex coded as 0 = men, 1 = women. Time in hours.
Note. PG = Pokémon Go. * $p < .05$. ** $p < .01$.

Figure 1. Physical symptoms among Pokémon Go players. Phubbing and age were unrelated to other variables and are omitted from presentation. PG = Pokémon Go. Gender coded as 0 = men, 1 = women.
* $p < .05$, ** $p < .01$, *** $p < .001$