CHAPTER 2

Fit to Game

The experience of exercising indoors using games during the COVID pandemic

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ABSTRACT:

We report data from an online survey that queried the player experience of using video games to exercise indoors during the year 2020, when many countries imposed strict social isolation rules and outdoor movement became limited for millions of people. Indoor exercise games such as the *Nintendo Wii Suite* are known prior to the pandemic to be effective exercise replacements in clinical settings, however little is known about people's experience using these games to maintain exercise during COVID-19 isolation. We also report on contextual enablers and barriers that influence this indoor exercise experience, offering inside to the practical considerations involved in deploying indoor exercise games to users in real life.

KEYWORDS:

Serious game, exergame, COVID-19, implementation

1. INTRODUCTION

During the initial days of the pandemic, physicians warned of the possibility of adverse effects caused by the social distancing measures used to combat the spread of COVID-19 (Ashikkali et al., 2020; Hall et al., 2021), noting that the radical modifications to daily routines risked many falling prey to unhealthy habits. Among these, a general decline in physical activity was noted as a particular concern, given the closures of gyms, offices, schools, and the adoption of remote work across many industries. Such a decline, they argued, would constitute an "inactivity pandemic" (Ferrante et al., 2021; Hall et al., 2021), with dire consequences for the population's general well-being, given the important role that regular physical activity has been found to play in preventing chronic disease (Zhu, 2019), managing weight (Chou et al., 2012), promoting immune response (Simpson et al., 2015), and mood and sleep pattern regulation (Byrne & Byrne, 1993).

Given the importance that physical activity plays in maintaining well-being, with public health guidelines (Bull et al., 2020) recommending that all adults undertake at least 150 minutes of moderate-to-vigorous activity a week, private organizations and public bodies devoted a great deal of attention and funding to strategies to encourage people be more active (Bauman & Chau, 2009; Haskell et al., 2007; Kahn et al., 2002). These strategies included financial incentives (i.e. offering reduced cost access to fitness programs) (King et al., 2019), community campaigns to help people choose more active options (i.e. walking instead of driving short distances) (Kahn et al., 2002; Nocon et al., 2010), crafting well-designed physical education programs at school (Lonsdale et al., 2013), or designing environments so that being active is either seen as convenient or is simply unavoidable. Examples include designing corporate campuses to require individuals to get up and walk to reach bathroom facilities, meetings rooms, and the like. Such strategies that utilize group dynamics and alter patterns of movement and behavior through environmental design have proven to be effective (King et al., 2019) at increasing physical activity and relatively cost effective, providing a disproportionate impact for the investment they require (Müller-Riemenschneider et al., 2009) – at least, prior to the pandemic.

Many of the fundamental assumptions of social and behavioural strategies

were invalidated in the context of the COVID-19 pandemic and the social restrictions implemented. These assumptions include individuals having prior interest in exercise, individuals having an emotional investment to a group, and individuals having access to physical spaces that allows intensive physical activity. The closure of physical spaces such as workplaces and gyms, and the consequent loss of emotional connection to that social community, had weakened the implementation of the social theories of behaviour change (Fancourt et al., 2020). While organizations have switched to chat programs, phone conversations, and videoconferencing (Watson et al., 2020) to try and retain a sense of community, these alternatives could not replace face-to-face connections. To many, these alternate channels seem less "human" (Watson et al., 2020), with detrimental effects on relationship-building, which has had negative consequences for existing community-based strategies to promote physical activity.

Alternative strategies are thus required, preferably those which do not involve tapping into a pre-existing interest in exercise, which do not rely on individuals being part of a pre-existing community, and which can be done at home, without requiring an individual to travel. Video games which require players to engage in moderate-to-vigorous physical activity in order to progress, often called active video games (AVGs) or exergames (Oh & Yang, 2010), have been suggested as one such alternative (Ferrante et al., 2021; Gonzalez et al., 2016). Exergames can be played at home alone and are an attempt to reframe exercise as entertainment, and prior research (Primack et al., 2012; Rozental-Iluz et al., 2016; Satava et al., 1995; Warburton et al., 2007) showed that the use of exergames both mediates physical exercise and is associated with cognitive, physical, and psychological benefits.

With the public health emergency posed by COVID-19 presenting great challenges to maintaining physical exercise, and with consumption of video games reaching an all-time high at 82% of global consumers playing video games during the lockdowns (The Nielson Company (US), 2020), perhaps it is time to examine the viability of exergaming as an alternative to traditional approaches. With the World Health Organization partnering with the game industry to encourage people to stay at home, play video

games, and practice physical distancing, games have been shown to be a viable part of a highly successful public health strategy (Interactive Software Federation of Europe, 2021). With so many people turning using games as entertainment, might they also turn to exergames when their usual venues for exercise are inaccessible?

1.1 RELATED WORKS ON THE IMPACT OF GAMES ON EXERCISE DURING COVID

To date, there have been few studies that examine the impact of games on exercise during COVID. While it is known that overall physical activity did decline during COVID-19 (Ferrante et al., 2021; Hall et al., 2021), giving rise to the very "inactivity pandemic" that some warned of, it is unclear what role games played in this, as opposed to the wide-scale disruptions of people's daily routines.

What little literature exists regarding the impact of games on exercise during the pandemic is mostly either speculative (dos Santos et al., 2021) or look at the effects of screen time and exercise on perceptions of mental and general health (Colley et al., 2020). To the authors' knowledge, only one study (Ellis et al., 2020) examined the impact of gameplay on exercise, finding that there was a significant positive relationship between total hours of participation in gaming and total hours of exercise per week during the pandemic among players of *Pokémon GO,* and that while there was a decrease in physical activity during the pandemic, the average *Pokémon GO* player was still physically active for an average of 6.5 hours a week – or 390 minutes – well above the minimum of 150 minutes (2.5 hours) of moderately-intense activity recommended per week (Bull et al., 2020). This finding was supported by qualitative results, with players consistently mentioning that the structure that *Pokémon GO* provided and the sense of accomplishment they received from accomplishing goals in the game provided them with motivation to exercise during the pandemic.

1.2 RELATED WORKS ON INDOOR EXERGAMES

The earliest versions of video games intended for the public were indoor exergames. They were non-sedentary and very social activities. In the

earliest instances of gaming in the arcades in the 1970s, playing a game requires players to stand in an upright position in front of an arcade cabinet for extended amounts of time while engaging in vigorous jostling of the controls – often with a great deal of body English, body movement in excess of what was needed to manipulate the controls, involved. It was only when video games shifted to being primarily played on home computers and home consoles in the 1980s that gaming became more sedentary.

There is a considerable body of literature on the physiological benefits of indoor exergames such as *Dance Dance Revolution* (DDR) or *Nintendo Wii Suite* (Bonetti et al., 2010; Maddison et al., 2007; Penko & Barkley, 2010; Primack et al., 2012; Warburton et al., 2007), with many finding that they can be effective exercise replacements in the short term. These indoor exergames are comparable to standard exercise on parameters such as heart rate (Bonetti et al., 2010), oxygen consumption (Penko & Barkley, 2010), electrocardiogram activity (Maddison et al., 2007) and self-motivated duration of exercise (Warburton et al., 2007). However, such studies have also shown that when players feel forced to use a game, efficacy suffers. Studies (Heeter et al., 2011; Madsen et al., 2007) found game engagement driven by enforced or prescribed play is often short-lived, with players losing their sense of enjoyment within weeks, and often discontinuing play altogether.

Further, few studies touched on the various real-life constraints which might impact adoption of indoor exergames. In studies involving indoor exergames, users are provided with the game and relevant hardware for the duration of the study period, or are provided with a dedicated space and time where they can use the intervention. However, not everyone has the correct hardware at home and most home environments are not designed to facilitate vigorous exercise for only one person. This presents many practical challenges to implementation that no study has adequately addressed.

To address the existing gaps in the literature, this study examines the experience of individuals who used video games to exercise indoors during the COVID-19 pandemic, with a focus on whether these games functioned as viable exercise alternatives. If they did not, we aim to identify what factors need to be addressed to make them viable in the future, given the

continuing impact of pandemic-driven behaviour and policies on outdoor exercise.

2. METHODS

2.1 RECRUITMENT

The recruitment methodology has been described in detail elsewhere (Ellis et al., 2020). Briefly, a mixed-methods survey was conducted online via convenience sampling over 2 weeks in May 2020 on subreddit Pokémon GO and Harry Potter: Wizards Unite forums. The study's ethics approval was obtained from the Macquarie University Human Research Ethics Committee for Medical Sciences (Reference No: 52019601512435. Project ID: 6015).

2.2 SURVEY

This paper is a part of a larger survey regarding exercise via games during the pandemic. Players were eligible to participate if they were over 18 years of age and played either Pokémon GO or HPWU for at least a week in English in 2020. We present demographic data regarding gender, play style (ranging from "casual", "midcore", "hardcore", and "not sure"), and age.

Quantitative data in this paper involves two questions. The first question is "Prior to the covid-19 shutdown, how many hours a day were you exercising during the days that you did physical exercises?". The second question is "How many hours a day do you exercise during the shutdown, during the days that you do physical exercises?" These two questions are chosen to examine whether there was a difference in exercise during the pandemic for those participants who exercised indoors versus those who did not.

The qualitative question analysed here is "What has your experience been regarding using video games (e.g. Wii/Xbox/VR) to exercise indoors?". This question reveals how people have used video games to exercise indoors in a holistic manner.

2.3 DATA ANALYSIS

Self-reported quantitative data was extracted from Qualtrics and directly imported into Excel, where the Real Statistics software was used to calculate inferential statistics (Zaiontz, 2021). This work was carried out by KY.

Qualitative responses were analysed through thematic analysis using NVivo v12 Plus (QSR International). The participants' answers for the qualitative question were extracted and entered into NVivo. The data was coded inductively by the researchers KY and CK. Codes were developed according to the Braun and Clarke model of thematic analysis (Braun & Clarke, 2008). The entire research team was consulted throughout the qualitative analysis process to resolve disagreements until consensus was reached.

3. RESULTS

3.1 DEMOGRAPHICS

The survey received valid answers from 1052 participants, with 284 (27%) having used video games to exercise indoors in 2020. Demographics data for the indoor exergaming population are presented in Table 1.

Table 1. Demographics data of those who played indoor exergames

Characteristic	Number of participants (Out of participants who played indoor exergames)
Gender	
Male	152 (54%)
Female	120 (42%)
Other/unindicated	12 (4%)
Age	
18-25 years old	80 (28%)
26-35 years old	124 (44%)
36-45 years old	46 (16%)
46-55 years old	15 (5%)
> 55 years old	3 (1%)
Unindicated	1 (0.4%)
Playstyle	
Casual	112 (39%)
Midcore	88 (31%)
Hardcore	79 (28%)
Unsure/No answer	4 (1.4%)

Table 1. Demographics data of those who played indoor exergames

The players who exercised indoors with video games during the COVID-19 pandemic were roughly equally distributed between female and male (42% vs 54%). They were mostly between 26 and 35 years old, and were equally spread across Casual, Something in-between, and Hardcore playstyles.

The percentage of players who exercised indoors based on total survey participants are shown in Table 2. Between 10 to 15% of all participant segments have exercised indoors using video games. The groups with the largest percentage of indoor exergame participation are those who identify as neither male or female, between the ages of 36 to 45 years old, and have a hardcore playstyle.

Table 2. Percentage against total participants

Characteristic	Percentage (Out of total survey participants)
Gender	
Male	12.90
Female	14.67
Other/unindicated	25.53
Age	
18-25 years old	12.97
26-35 years old	13.19
36-45 years old	16.03
46-55 years old	14.71
> 55 years old	6.82
Unindicated	1.00
Playstyle	
Casual	12.13
Midcore	13.35
Hardcore	20.05
Unsure/No answer	2.55

Table 2. Percentage against total participants

3.2 INDOOR EXERGAME PLAYERS DID NOT EXPERIENCE A REDUCTION IN EXERCISE HOURS

The group that did not use indoor exergames experienced a statistically significant decrease in exercise hours during COVID-19 social isolation compared to before the pandemic (p-value = 0.02), while the group that used indoor exergames did not do so (p-value = 0.25). This indicates that the group using indoor exergames maintained their level of daily exercise hours during the pandemic, while the group that did not use indoor exergames suffered a decrease in daily exercise.

Differences in exercise before and during COVID social distancing was not found to be significant between participants who played indoor exergames and those who did not (P-value = 0.63 for exercise hours before COVID. P-value = 0.56 for exercise hours during COVID).

Table 3 presents the mean and median values for the two participant groups regarding exercise per day (in hours) before and during COVID social distancing measures.

Table 3. Exercise during COVID isolation

Exercise before COVID social distancing (hours per day)	
With indoor exercise	Without indoor exercise
Mean = 1.69 (SD = 1.56)	Mean = 1.63 (SD = 1.76)
Median = 1.10	Median = 1.20
Exercise during COVID social distancing (hours per day)	
With indoor exercise	Without indoor exercise
Mean = 1.55 (SD = 1.24)	Mean = 1.49 (SD = 1.41)
Median = 1.0	Median = 1.0

* SD = standard deviation

Table 3. Exercise during COVID isolation.
** SD = standard deviation*

3.3 THEME 1 – EXERGAMES WERE FUN AND A GOOD EXPERIENCE

Many participants indicated that exergames were in general fun, good, and a positive experience during COVID-19 social distancing. Overall, participants found it to be a fun alternative to outdoor exercise, bringing in some entertainment as well as working up a sweat. Those living with family also indicated that the indoor exergames were conducted with other family members and helped with family bonding. This positive experience was reported by many segments of the participant population. Various participants highlighted that using these games to exercise was "*enjoyable*" (22 years old, male, United Kingdom, hardcore gamer), "*fun and provides a good way to exercise*" (27 years old, female, Portugal, midcore gamer), and "*a nice family activity*" (18 years old, female, Hungary, casual gamer).

The two major contributors to participants feeling the exergame was fun were stated as 1) having a purpose to physical movement and 2) having a feeling of social connection and solidarity. Games where exercise has in-game and is not merely making the player move made participants feel more motivated to come back to the game. At the same time, games that provided a social exercise and made players feel connected to other people (real people or game characters) also motivated players to keep coming

back to play, since such games provided the bonus benefit of emotional and social interaction during COVID-19 social isolation. One participant put this effect very succinctly in her answer.

"*Currently I use the app Zombies Run for their Home Front missions. These missions have a story to go with the workouts, involving game characters having to be isolated too. This metafictional solidarity is really encouraging for me, it's motivating while being a step removed from Covid19*" (28 years old, female, United States, casual gamer).

Interestingly, many participants stated that the exergames "*gets boring quickly*" (36 years old, male, United States, casual gamer) and "*Seems more fun and interesting when first starting. Sometimes it gets old and stale*" (44 years old, female, United States, casual gamer). Such findings indicate that the engagement of these exergames did not always last for a long time, especially in the absence of other factors – such as social connections – that encouraged maintained engagement.

3.4 THEME 2 – EXERGAMES WERE BORING AND NOT AS ENGAGING AS REAL EXERCISE

As stated above, participants often find the indoor exergames quickly lose their lustre. The main factor attributed to this loss of interest is that some games are not engaging and are even less fun as standard exercise or outdoor exercise. Participants ascribe their negative attitudes towards indoor exergames to reasons such as "*not as fun as the outdoors*" (33 years old, male, United States, hardcore gamer) and "*not really the same feel [as outdoor exercise]* (21 years old, male, United States, hardcore gamer)", indicating these games are not able to keep the fun over a long time.

Specifically, some exergames are described as being less fun than normal games and normal exercise. They have the repetitive routine of exercises and an arbitrary gamification on top of the exercise, and thus unable to provide continuous engagement. Participants stated "*It's hard to stick with it. The exercise video games are good, but they feel too much like exercise!*" (38 years old, female, Canada, midcore gamer). Moreover, participants indicated they would cease playing with the exergame based on

engagement, rather than perceived physical benefit, with participants indicating "*if I am not engaged in the experience I likely won't follow through*" (21 years old, male, Canada, hardcore gamer).

3.5 THEME 3 – EXERGAMES WERE SPECIFICALLY DESIGNED FOR CARDIO EXERCISES

Participants also pointed out that exergames were only good for specific types of exercise, namely cardio exercises aimed at increasing heart rate and maintaining it. This could either be a positive or negative influence, depending on what kind of exercise the participants desired. Some participants were simply trying to look for a way to get their body moving, and thus found the brief burst of cardio as a welcome addition to their day.

One type of indoor exergames that is highlighted as very good cardio is the dancing game genre. These games, which involved whole body movement, were favoured for cardio compared to other games. "*I love Dance Dance Revolution. It's a great cardio routine."* (36 years old, male, United States, casual gamer) "*DDR (PS2) is fun and I'm counting it as cardio."* (24 years old, non-binary gender, United States, midcore gamer) Dancing games have the added benefit of being a very social game that involved the entire family, which increases the amount of fun and engagement felt by the participants. "*Good, dancing with family is fun*" (36 years old, male, United States, midcore gamer). "*Use Just Dance routines (with child and partner)"* (36 years old, female, Australia, casual gamer).

On the contrary, participants who were looking for more comprehensive fitness activities were disappointed in exergames for their lack of variety. Participants who were used to more diverse or comprehensive exercise regimes that focused on more than simply burning energy want something more than cardio and were unable to get it from existing exergames. "*It's a little fun, but I think just working out following an exercise routine is more efficient. I would probably use a game like that just to add some variety or to add some cardio into my week, but I would not use it for my other goals of strength and flexibility."* (35 years old, female, United States, casual)

3.6 THEME 4 – EXERGAMES WERE LIMITED BY REAL-LIFE

CONTEXTS

The experience of indoor exercise was also hindered by its implementation in a home setting and the myriad of contexts in daily life. Participants reported the hardware of the exergames can cause physical discomfort, which leads to terminating the experience. Consoles that required specialised handheld equipment were highlighted as the main culprit, with pain at the hand or wrist noted as the major concern. "*The wii fit hurts my joints."* (26 years old, non-binary gender, United States, midcore gamer) "*I've been using the Nintendo Switch. It's a fun side diversion, but also hurts my wrists if I use it for too long."* (33 years old, female, United States, midcore gamer)

The physical confines of a house and apartment also limits the extent of indoor exergaming. As the games are not the same as specialised exercise equipment and does not provide noise control, soft contact surfaces, or limit the range of movement or force, participants cited these issues as reasons why they don't conduct indoor exergaming. Hitting physical barriers in the house, getting hurt due to not having soft contact surfaces, having to share their exercise space with other people, and creating excess noise for other people living in the same dwelling were all cited as reasons that limited participation in indoor exergames. *"Jumping Hardwood floors bookcases are not a good exercise space."* (35 years old, male, United States, casual gamer) "*Broke a wall."* (40 years old, male, Australia, gamer type unsure)

4. DISCUSSION

4.1 DEMOGRAPHIC DIFFERENCES IN USING INDOOR EXERCISES DURING COVID-19 ISOLATION

An equal percentage of males and females indicate they have played indoor exercise games during the COVID-19 social isolation. Approximately 12-14% of the wider male and female participants played indoor exercise games in our cohort, a ratio that is maintained in all other demographic segments of our participant pool. The groups that differ from this number are those who identify as other than male or female in gender (25.53%) and hardcore gamers (20.05%), and may reflect how these groups are

emotionally invested gaming and virtual worlds to satisfy their psychological needs and as a lifestyle choice (Manero et al., 2016; Morgan et al., 2020).

The participants who did not use indoor exergames suffered a statistically significant decrease in their daily exercise hours during COVID-19 social isolation compared to before the pandemic, as expected in light of widespread decline in exercise hours on a global level (Colley et al., 2020). However, the group that *did* use indoor exercise retained the same level of exercise as per before the pandemic, indicating that indoor exercise may have had a positive effect in maintaining physical activity in this population. This is comparable to our prior work on *outdoor exergames* during the pandemic, where users of such outdoor games such as *Pokémon GO* and *Harry Potter: Wizards Unite* also report using such games to maintain physical exercise levels (Ellis et al., 2020). Indeed, there is precedent to show adults not engaged by traditional exercise can use indoor exergames as effective alternatives to increase physical activity (Street et al., 2017). It is thus likely that indoor games can also be a positive alternative to standard exercise during social isolation.

4.2 Differences between "real exercise" and exergame

The biggest issue with indoor exergames, highlighted in our data and in literature, is how engagement is often short-lived and participants profess to lose interest in such games very quickly. Engagement to these games can start to drop off as soon as a few weeks into studies (Madsen et al., 2007), ultimately resulting in reducing play and exercise hours and discontinuing the game completely (Heeter et al., 2011). This is observed in our participants where many reported indoor exergames became boring very quickly and play was ceased within weeks or months, and indicated a lack of engagement with the game resulted in this reduction in interest. Such data had been highlighted before regarding how exergames have issues in being used as a long-term health promotion strategy (Cacciata et al., 2019; Street et al., 2017). As such, exergames may need to re-evaluate its design principles and include more long-term engagement into its game design, moving from a model where scores and badges are providing superficial external motivation to where the physical activity has intrinsic

meaning in the game. Immersion both in real-life and within the software should be valued by designers of these exergames to promote movement, adding value and purpose to these movements, and thus achieving intrinsic motivation for exergames. The games that our participants reported to have the best engagement with, such as *Zombie Run!*, provided in-game value to the exercise conducted in real life, as well as giving a sort of companionship and support to isolated players during the pandemic. These factors add to immersion, contributing to the desire to exercise, together with external factors such as social interactions.

Social companionship and support are indeed some of the biggest components of exergames that modern indoor games lack. *Dance Dance Revolution* (DDR), one of the most popular exergames in our participants, is a franchise that goes back to the 1990s and has always been a social game in arcades. Even before the age of rapid digital communication, DDR players created websites and message boards such as DDRFreak.com to continue socializing with one another online (Ko, 2005; Liu, 2004). These online spaces provided a place where DDR enthusiasts could interact outside of the arcades. Online, people would trade gameplay tips, discuss how to best add their own improvisations to their DDR performances, share where the newest machines were located, or make plans to gather offline. Indeed, even individual play was often done with the community in mind, with many buying the game so they could improve their performance at home and show off their skills during the next meetup (Webster, 2009). In more modern times, while exergames can be played individually, Wii *Sports* is considered a social game as much as it is an exercise game (Espineli, 2019). In the case of mobile exergames, most players are connected either with a larger community invested in the franchise the game is part of (in the case of *Pokémon GO*), or with a larger cultural moment that the game happened to be part of (like *Zombies, Run!*). The importance of this sense of relatedness to engagement is congruent with findings in other gaming genres (Przybylski et al., 2010; Ryan et al., 2006), yet has not been formally examined for exergames, aside from what little work has been done on the factors determining engagement with and benefit from *Pokémon GO* and *Harry Potter: Wizards Unite* (Smith et al., 2021; Yin & Lee, 2019)

4.3 EXERGAMES BEYOND SIMPLY CARDIO EXERCISES

Our players raised a concern that most exergames on the market are only concerned with cardio exercises, and very few addressed other types of exercise that would be present in a professional fitness regimen. Indeed, in the exergame literature, the major standard via which exergames were measured for their efficiency had been cardio parameters such as heart rate and oxygen consumption (Bonetti et al., 2010; Penko & Barkley, 2010). While there are games that function as a fitness coach and offers a larger repertoire of exercise types (Consumer Reports, 2013), the most popular exergames in our cohort – such as dance games (DDR), the Wii Suite, and virtual reality (VR) exergames – remain focused on providing an intensive burst of cardio. As these off-the-shelf exergames are limited to utilizing the corresponding console's in-built motion sensors, perhaps exploring different hardware and design philosophies would help to include other aspects of fitness into these games.

Work has already been done to combine treadmills, cycling, and other fitness equipment with games. Blue Goji Infinity, a patented home treadmill that combines walking on a treadmill with a screen where games can be displayed or a VR headset that allows for VR experiences, seeks to gamify the prolonged running regimens conducted over the treadmill (BlueGoji, 2021). There is also a large variety of commercial makers of indoor bicycles that combine VR to facilitate VR cycling, where users can conduct cardio and body toning workouts on the indoor bicycle while wearing a VR headset or watching a monitor that shows them cycling through a virtual track (Holodia, 2022; Zwift, 2022). Lastly, the versatility of VR has also given rise to a niche family of games that allows for lifting weights for strength training, yoga for flexibility, rowing for upper body strength and dodging/tennis for coordination and lower body movement (Dingman, 2022). These games offer a large variety of exercises, but struggle to become as popular as older games such DDR and Wii Suites. This is due to contextual limitations such as the high costs of VR gear, the spatial and special requirements of VR, the limitations in the modern home, and the incapacity of making VR into a family and social activity.

4.4 CONTEXTUAL LIMITATIONS TO EXERCISING IN THE HOME

It is also significant to remember that these indoor exergames are conducted inside people's homes, where there is often a lack of space, time, and proper equipment. Our participants reported spatial constrictions (especially those living in urban apartments) the prevented them from exercising to the capacity permitted by the game, potentially decreasing the effectiveness of the games. In contrast, many studies for exergames were either done in a controlled laboratory environment, facilitated by staff who checked-in with the participants, or had consoles/ other hardware provided to the participants (Bogost, 2005; Bonetti et al., 2010; Maddison et al., 2007; Penko & Barkley, 2010; Warburton et al., 2007). These studies would also have provided detailed instructions on how to use the hardware and how long to use it for, while our participants using exergames in real life reported wrist and hand pain from overuse. Given that not everyone has a console or other hardware needed to play an indoor exergame, and that the home environment is not designed to facilitate vigorous exercise, with many spaces used for gaming being shared by others and used for multiple purposes, this presents many practical challenges to implementation that no study has adequately addressed.

Considering these contextual limitations, it is no surprise that the most popular exergames remain simple console games such as Wii Sports, which require nothing more than the Nintendo Wii console to function, and mobile exergames, which can be played with nothing more than a phone. The few exceptions to the equipment issue include These have both been effective at attracting new demographics to gaming, especially mobile games, where the game itself is usually free to download (Espineli, 2019; Wijman, 2020). However, in terms of indoor exercise, neither fully address how exergames require more space than others for movement during play, or how the shared recreation spaces of a modern home may need to be reconfigured prior to and after play sessions.

5. CONCLUSION

Our study indicates that indoor exergames exerted a positive influence to

maintaining physical exercise during the pandemic, but their effects were limited by low engagement in design, monotonous exercise types, and contextual limitations regarding space and time involved. More engaging software design that incorporates purpose and social connection, and more innovative hardware that incorporates a holistic regimen of fitness activities, could be the key to further improve the efficiency of these games for populations in isolation.

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