Pokémon Go is an augmented reality (AR) mobile game that requires players to explore their surrounding communities while hunting for a variety of virtual treasures and monsters (i.e., Pokémon) using smartphone technology. With smartphone GPS and Google Maps, it provides users with an AR experience where they encounter, catch and collect virtual species of Pokémon while exploring the real world. Once caught, these species are added to the players’ personal collection. As the game evolves, players can use their Pokémon as more powerful forms and compete with other players’ Pokémon.

Satoshi Tajiri, who designed the first Pokémon game in 1996 wanted to create a preindustrial play world for urban children based on his childhood experience of collecting insects and crayfishes.[1-3] Unlike traditional platform-based video games that call for less active play at home, Pokémon Go requires physical exploration in an outdoor setting with unique features that encourage social interaction and physical movement. Given its relatively new status as a global phenomenon since 2016, this paper aims to evaluate the health effects of Pokémon Go.

Positive psychology refers to a subset of psychology that examines how individuals achieve more satisfying lives. A central variable in this field is well-being, which is generally conceptualized as a multi-faceted concept that includes happiness and comfort, as well as “eudaimonic” (i.e., meaningful) life experiences.[4,5]

A considerable fraction of global burden of disease today comprises of noncommunicable diseases (NCD), such as ischemic heart disease, stroke and diabetes, which are ranked in the top 10 causes of death in 2015 according to WHO’s report. These NCDs tend to be chronic diseases where behavioral or lifestyle factors have a significant effect. For instance, apart from a healthy diet, physical activity has been shown to play a significant role at risk reduction and prevention of NCD. Physical inactivity is responsible for 6%–10% of NCD burden of disease, 9% of premature mortality or 5.3 million deaths in 2008. Despite these alarming statistics, one in four adults are not active enough, and more than 80% of the world’s adolescent population is insufficiently physically active.[4,6-8]

There has been increasing efforts to use technology to incentivise people into participating in physical activity,
such as the use of physical activity trackers (Fitbit, Jawbone, Microsoft Band) or mobile phone activity tracking applications, which allow individualised setting of goals, direct feedback, checking of progress and participation in a social community. More recently, AR games such as Ingress, Zombies Run! and Pokémon Go take advantage of the location tracking feature of smart devices to add another dimension to gaming and may be a more interactive alternative to incentivising physical activity. Pokémon Go has also been downloaded over half a billion times, but again, not everyone who downloads, may be playing the game.[8-10]

**Pokémon Go and Physical Activity**

Over the years, there have been anecdotal reports of increased physical activity due to novel games that embed gameplay in the physical world.[6-13] A study, using physical activity measured and collected from 32,000 Microsoft Band users over 3 months before and after the commencement of play of Pokémon Go, has shown that Pokémon Go users have a significant increase in physical activity, 192 (3%) to 1473 (26%) increase in daily number of steps for light and heavy users respectively, as compared to non-Pokémon Go users, who clocked an average of 50 steps decrease in daily number of steps.

Pokémon Go is an application which tends to encourage players to explore real world destinations while “catching” Pokémon. Players are encouraged to walk certain distances, such as 5 km, to incubate Pokemon eggs.[8] Although there is a large variation in effect on player’s physical activity depending on how much time they spend playing the game, it seems promising that there is a positive influence on amount of physical activity whether large or small. Some of these observations may have implications for public health planning.[8,10-12,14]

Another study compared self-reported levels of physical activity amongst university students who were either current Pokémon Go players, ex-players or nonplayers, and found no significant difference between the three subject groups. However, when stratified according to amount of time spent outdoors before playing Pokémon Go, they found that Pokémon Go has in fact lead to an increase in time spent outdoors doing physical activity in subjects who claimed to have originally rarely spent time outdoors.[9] This seems to suggest that Pokémon Go and similar AR games could be employed in the future to target sedentary individuals.[1,9]

However, it is interesting to note that the average physical activity for all Pokémon Go users studied in Althoff’s study, decreased at 3–4 weeks after the first experiential query, which was the proxy for the start of Pokémon Go play. This raises the question of whether Pokémon Go is able to produce sustained increase in physical activity levels.[9]

Each person has the same 24 h a day, and one might wonder if playing Pokémon Go would meant sacrifices in other activities such as work, school, and even sleep! Locally, there have been several news reports of late night playing at certain locations like Pokéstops, where creatures spawn more frequently. Each night, crowds would gather to play at these strategic locations. Not only do these people sacrifice sleep at night but also one might question if there was significant gains in physical activity from camping out at the same spot the entire night.[16-18]

**Psychological Health Benefits**

Like most video games, AR games are structured such that they should produce positive thoughts and feelings; however, unlike most video games, they also have unique features that encourage social interaction and physical movement.[10]

A study, on whether Pokémon Go benefited players’ psychological well-being, was done through an online survey of 399 U. S adult players aged 18–75. The results showed that playing Pokémon Go was positively associated with increased positive affect, nostalgic reverie, friendship formation, and friendship intensification. These various responses were predictive of enhanced psychological well-being. There was also a significant indirect relationship between gameplay and decreased incidence of depression ($P < 0.05$) through increased exercise, which is associated with lower depression. At the same time, the importance of associated increased social behavior should not be understated, especially when during a time perpetuated by concerns that gaming media may encourage social isolation. However, it is still unclear whether the improved well-being arose from increased social interaction or from the actual mechanism of gameplay itself.[10]

The same study also offered an insight on the psychological aspect of Pokémon Go in players with self-reported social anxiety. The results showed that social anxiety did not negatively impact an individual’s willingness to play Pokémon Go as it seemed that despite the game’s public nature and necessity for outdoor interaction or fear of social situations did not seem to diminish play.[9]

Despite this, there was a weaker relationship between gameplay and increased positive affect in these players. However, there was also significant reduction in nostalgic regret (predictor of reduced psychological wellbeing) with a $P < 0.05$. A possible explanation for this was that the reward mechanism in Pokémon Go facilitated positive gameplay experiences and reduced the tendency to dwell on past negative social experiences.[9]

These findings were very intriguing in that they may have revealed a possible therapeutic role in AR gameplay for helping socially anxious people deal with their everyday experiences. This is, especially true as AR gaming has shown some success in treatment of other phobias such as acrophobia and arachnophobia. However, regardless, plenty more research should be done to examine the specific features of this unique form of gaming that can promote this beneficial outcome.[9]

Currently, there is a dearth of research on AR video games with regards to psychological well-being, and what little
research there is has focused primarily on educational outcomes. Future research must be carried out which does not necessarily have to be limited to Pokémon Go alone. These should examine closer the specific features that most AR games share (e.g. opportunities for social engagement, required physical activity, etc.) to provide insights into how these truly can benefit a person’s mental health.

**Hazards of Pokémon Go**

On the road, hazards can arise when pedestrians and vehicle drivers are distracted by Pokémon Go. Research done by San Diego School of Medicine, Johns Hopkins University, the University of Southern California and American Automobile Association Foundation for Traffic Safety assessed for road users distracted by Pokémon Go through mining social and news media reports.[20]

345433 Twitter postings containing the terms “Pokémon” and “driving,” “drivers,” “drive,” or “car” were obtained for July 10 through 19, 2016 with a random sample of 4000 tweets generated. Each tweet was reviewed to determine if[21] a driver was playing,[22] a passenger was playing, or[23] a pedestrian interacted with traffic while playing Pokémon GO. In addition, Google News reports published 321 story clusters.

In the same time period that included “Pokémon” and “driving,”[24]

Pokemon Go’s innovative nature of distraction generates certain risks in road users and vehicle drivers. There have been incidences of pedestrians too who have been hit or got involved in road accidents due to playing Pokemon Go while crossing the road. Health-care providers should be aware of their role and possible prevention strategies based on their direct interaction with road accident victims.[21-24]

From the Ayers et al. study, 33% of tweets indicated that a driver, passenger, or pedestrian was distracted by Pokémon GO, suggesting there were 113 993 total incidences reported on Twitter in just 10 days. 18% of tweets indicated a person was playing and driving and 11% indicated a passenger was playing. Four percent indicated a pedestrian was distracted. There were 14 unique crashes – with 1 player’s car colliding into a tree – attributed to Pokémon GO in news reports during the same period.[20,22]

Being a location-based game, the format also poses specific threats to the safety and physical well-being of children. Besides the above mentioned road safety hazards, children may also be at risk of trespassing as often Pokémon Go can be found in nonpublic spaces causing players to often congregate or even venture into backyards of private property. Children are also more likely to be so engrossed in the excitement of the game that they forget that it is inappropriate to enter such property and thus, potentially endangering themselves in the process.[21,23,25]

This geo-locating feature is a new threat to children in particular as it has the potential to provide child predators with information regarding children’s whereabouts and location. The combination of proximity, shared common interests and ability to attract players to an isolated location also puts children at risk and in a vulnerable position.[25]

**Conclusions and Recommendations**

AR games like Pokémon Go are an effective way to improve physical activity through motivating the players to engage in walking, running and even cycling as part of the gameplay. However, increasing reports of road traffic accidents and injuries while playing Pokémon Go suggest that these games could pose a significant risk to all road users because players, be they pedestrians or drivers, may become distracted and ignore surrounding hazards.

Some suggestions to improve safety in the age of AR games include measures targeted at game developers and game consumers. On the front of game developers, having clear and visible warnings on driving and pedestrian safety on the gaming platform itself. Making the game inaccessible for a period after any driving speed has been achieved may serve as a deterrent to distracted drivers. Meanwhile measures targeted at game consumers could include education campaigns targeted at different age groups on road safety and to highlight the prevalence of road traffic accidents associated with distractions.

At the end of the day, the popularity of this global phenomenon was fleeting. The number of people actively playing dropped within a month of the game’s release. However, even it is short-lived pervasiveness offers an unprecedented opportunity for further research into the specifics and nature of AR gaming, which is certainly going to become increasingly prevalent in coming years. Emphasis of such studies should be looking at especially their potential to produce positive life outcomes in the various aspects of health that we have discussed above.[26]

Pokemon Go demonstrates that cleverly implemented AR games can reach millions of people and trigger substantial behavioral changes. AR games can help increase physical activities and exercise provided people’s interest can be sustained.

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There are no conflicts of interest.

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