



Review article

Digital Gaming Interventions in Psychiatry: Evidence, Applications and Challenges

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ABSTRACT

Human evolution has regularly intersected with technology. Digitalization of various services has brought a paradigm shift in consumerism. Treading this path, mental health practice has gradually moved to Digital Mental Health Interventions (DMHI), to improve service access and delivery. Applied games are one such innovation that has gained recent popularity in psychiatry. Based on the principles of gamification, they target psychosocial and cognitive domains, according to the deficits in various psychiatric disorders. They have been used to deliver cognitive behaviour therapy, cognitive training and rehabilitation, behavioural modification, social motivation, attention enhancement, and biofeedback. Research shows their utility in ADHD, autistic spectrum disorders, eating disorders, post-traumatic stress, impulse control disorders, depression, schizophrenia, dementia, and even healthy aging. Virtual reality and artificial intelligence have been used in conjunction with gaming interventions to improve their scope. Even though these interventions hold promise in engagement, ease of use, reduction of stigma, and bridging the mental-health gap, there are pragmatic challenges, especially in developing countries. These include network quality, infrastructure, feasibility, socio-cultural adaptability, and potential for abuse. Keeping this in the background, this review summarizes the scope, promise, and evidence of digital gaming in psychiatric practice, and highlights the potential caveats in their implementation.

1. Introduction

The prevalent treatment gap for mental disorders ranges from 50 to 90 percent across the world (Patel et al., 2010). While this treatment "gap" entails people who are completely deprived of treatment, there exists a substantial number who probably ends up getting sub-optimal care (Patel et al., 2010). With these challenges in hand, the world witnessed a gradual shift to Digital Mental Health Interventions (DMHIs) in the last three decades (Aboujaoude, 2018). Digital gaming interventions initially targeted physical health conditions like cancer (Kato et al., 2008). For example, games were devised such that children with cancer had to fight the cancer cells. This led to an improvement in compliance with treatment, self-efficacy, and improved knowledge about the illness (Kato, 2010). Subsequently, the application of gamification extended to mental health conditions. Various mobile apps were launched for mental health conditions like depression, anxiety, and PTSD primarily to track symptoms and psychoeducation. Gradually, game-based applications transformed from unstructured, primitive, and augmentative services to complete interventional programs. Today, we have a game-based

intervention for most of the disorders identified in Psychiatry. However, these interventions are still in various experimental stages. This intersection between technology and mental health appears promising as it has the potential to tackle some of the challenges related to conventional intervention methods like accessibility, availability, affordability, and societal stigma (Aboujaoude et al., 2015). DMHIs also have the advantage of having greater appeal and wider acceptability in situations where individuals wish to maintain relative anonymity (Burns et al., 2010). The delivered interventions are not exclusively limited to tele and video-consultations. DMHIs of varied nature have been introduced like (a) psychotherapeutic techniques in the form of internet-based cognitive behavior therapy (CBT), mindfulness training, virtual-reality based exposure therapy, biofeedback, etc., (b) cognitive remediation for disorders like schizophrenia and ADHD and (c) tele-psychiatric social work. Most of these interventions are easily available on various platforms like tabs, smartphones, and computers with a reasonably standard internet connection. On the flip side, several mental health applications available in the market are not evidence-based which may dilute the potential benefits of effective

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DMHIs (Donker et al., 2013). DMHIs also come with several challenges like (a) potential for a security violation, (b) confusion related to jurisprudence as it has a potential connect different parts of the world, (c) potential competition to mental health professionals and lack of need for a "coach", (d) "lag effect" as research is unable to keep pace with the rapidly evolving technology, (e) lack of a "therapeutic alliance" which is considered to be a major driving factor for motivation and (f) high attrition rates in research compared to conventional interventions (Aboujaoude et al., 2015). Keeping this in the background, this review looks at the digital game-based interventions in psychiatry, which are novel modes of DMHIs. It attempts to collate the research done so far in terms of its scope, application, and challenges of digital gaming interventions in psychiatry.

2. What are "applied" games?

'Applied games' is a widely used term for the application of games for purposes other than pure entertainment. The term applied games is interchangeably used with terms like "gamification", "serious games", "productivity games", "surveillance entertainment", or "behavioral games" (Deterding et al., 2011). The term "gamification" has been conceptualized and defined in several ways. It was first used in the year 2008 by Bret Terrill at the Social Gaming Summit. It became popular in 2010, after Jane McGonigal's groundbreaking TED Talk, "gaming can make a better world" (The History of Gamification - Journey from 1896 to the 21st Century [WWW Document] n.d). To conceptualize gamification, Deterding et al. (2011) described two dimensions. While the first dimension ranged between gamefulness and playfulness design, the second ranged between parts (elements) and the whole of a game. So, essentially gamification was understood as the use of gaming elements (rather than full-fledged games) characteristic for games (rather than play or playfulness) in non-game contexts. A gamified intervention, therefore, is not a full game experience but has gaming elements to it like rewards, point tabulation, character, rules, etc. (Fleming et al., 2017). This differentiates gamification from "serious games" (which uses full-fledged games rather than elements) and design for playful interactions (which focusses on playfulness rather than gamefulness). This conceptualization gives an excellent fundamental understanding of how to differentiate 'gamification' from other games. There however appears to be a component of subjectivity in this approach as the perception of 'playful experience' can vary widely (Huotari and Hamari, 2012).

Huotari and Hamari defined gamification as "a process of enhancing a service with affordances for gameful experiences to support the user's overall value creation". This definition emphasizes the goal of gamification which is to enhance service provision by the addition of gameful elements (Huotari and Hamari, 2012). It is therefore evident that there are various ways to define gamification and to date, it has been mainly described in terms of its structure and purpose. While gamification is a new concept, the term "Serious games" is relatively old. Serious games have been conceptualized as videogames that have an added pedagogical value (Abt, Clark C, 1970). They are widely used for educational and training purposes in various fields like health, engineering, politics, architecture, etc. Board and card games are also widely used as interventional measures in various mental health disorders like schizophrenia, autism spectrum disorders (ASD), attention deficit hyperactivity disorders (ADHD), and specific learning disability (SLD). This review will discuss only digital applied game interventions.

2.1. What are the types and elements of applied games?

Table 1 summarizes the various classifications of applied games and gamification elements. As the definition of applied games and gamification itself is quite varied, the classification is quite heterogeneous. Various studies have provided some direction to game developers for gamification in psychiatric practice, as they are generally not from a mental health background. These inputs from mental health

Table 1

Classification and scope of applied games in mental health interventions

Study	Study type	Inclusion criteria	Types of applied games and main therapeutic modality	Scope and promise of game-based interventions in mental health
Fleming et al., 2017	Scoping review	1. Systematic review of serious games and/or gamified interventions for mental health including treatment or prevention. 2. Published between the years 2010 and June 2016, in the peer-reviewed literature. 4. English language.	1. Exergames: exercise, behavioral activation; 2. Virtual reality: exposure therapy 3. CBT-based serious games: CBT 4. CBT-based gamification: CBT and positive psychology 5. Biofeedback: psychoeducation and relaxation-based exercises paired with biofeedback 6. Entertainment computer games for mental health: redirection of cognitive resources.	Three reasons cited: (a) Appealing potential (b) Engaging potential (c) Effectiveness potential
Shah et al., 2018	Review	1. Peer reviewed 2. English language 3. Any digital game interventions developed for the purpose-specific mental disorder intervention. 4. Studies must have been empirical with a pre-post intervention statistical outcome on a psychological self-report measure.	Any digital game interventions developed to intervene with a specific mental disorder	Convenience, accessibility, engagement, and sound basis were the most common reasons for recommending gaming interventions as supplemental practice in the management of mental illnesses.
Cheng et al., 2019	Systematic review	1. Published between the years 2013 and 2018. 2. Describe an app or technology which is related to mental health improvement and well-being outcomes. 3. Define their app as being gamification, gamefulness, or game based 4. English language 5. Should not	Five (mean) gamification elements were identified in which progress feedback/ levels were the most commonly applied element. Other commonly used elements: points, rewards, personalization, badges, quests, and varying social features Elements of social features like normative influence, cooperation,	2 main themes: (a) Promoting engagement (b) Enhancing an intervention's intended effect 5 sub-themes: (i) Encouraging usage of app or technology (ii) Decreasing barriers to engagement (iii) Behavior change (iv) Intervention efficacy (v) Intervention efficiency

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Table 1 (continued)

Study	Study type	Inclusion criteria	Types of applied games and main therapeutic modality	Scope and promise of game-based interventions in mental health
		be labeled as a serious game.	competition, or social comparison.	

professionals are pertinent to design a game tailored to suit the target population and mental health condition (Brezinka, 2014; Shah et al., 2018; Shandley et al., 2010). These include accessibility, feasibility in various age groups, consistency with the goals of treatment, 'real-world' reflection, gameplay and difficulty levels targeted for skill-building, user-engagement, systematic feedback and involvement of the social media. Though a detailed discussion of such guidelines is beyond the scope of this review, the general suggestions for game-developers are considered to be affordability-utility balance, real-time game design, proficiency of game designers in the subject matter, relatability of the gamers and disorder as well as domain-based research of the designed games in mental health (Shah et al., 2018). An active liaison between technology services and mental health professionals boosted by the use of artificial intelligence and virtual reality, as well as a timely feedback from the users (patients/clients) and physicians would help the improvisation of digital gaming in mental health, which need to be consistent and updated to suit the evolving needs.

3. What are the scope and promise of gaming-based interventions in mental health?

Table 1 summarizes the same evidence related to the scope and promise of digital gaming interventions in mental health. The scope of applied games in mental health interventions will be discussed under the following headings:

- **Appeal:** As per the 2019 essential facts about the computer and video game industry in America, 65% of the adults play video games, 75% have at least one gamer in their household, 54% of the gamers are male, 79% of the gamers feel that gaming provides them mental stimulation, 78% of the gamers report of feeling relaxed and having stress relief with gaming and 74% of parents believe that gaming can be of educational value to their children ("2019 Essential Facts About the Computer and Video Game Industry - Entertainment Software Association [WWW Document] n.d.). These are important facts that emphasize the penetrance of gaming in daily lives. These facts also reflect the beliefs and attitudes towards gaming. There appears to be wide acceptability for playful and non-playful purposes of gaming including educational forms among both genders. This medium of intervention, therefore, might be more acceptable and appealing to patients.
- **Engagement:** An intervention needs to be engaging to ensure its completion. The addition of gaming elements with potential for engagement like novelty, randomness, open-world approach could prove to be useful. Hamari and Tuunanen have identified achievement, exploration, sociability, domination, and immersion as key features supporting engagement (Hamari and Tuunanen, 2014).
- **Accessibility:** Smartphones are most commonly utilized to deliver gaming interventions for mental health-related conditions (Bakker et al., 2016; Fleming et al., 2017). As per a recent survey, 81% of Americans own a smartphone and 90% use the internet ("Demographics of Internet and Home Broadband Usage in the United States | Pew Research Center," n.d., "Demographics of Mobile Device Ownership and Adoption in the United States | Pew Research Center," n.d.). This reflects that the platform for game-based interventions is quite accessible in developed countries. The provision of care to

remote areas appears feasible through this platform. This also averts the need to travel long distances for accessing healthcare.

- **Availability:** There is a global shortage of health workers trained in mental health, 2018). This is one of the major contributing factors to a high treatment gap in the area (Patel et al., 2010). Game-based interventions would demand lesser trained manpower which could potentially help bridge the treatment gap. The world is currently battling the Coronavirus disease 2019 (COVID-19) pandemic and concerns related to social distancing have been appraised. The pandemic and the consequent lockdown have led to several psychosocial consequences including exacerbation of pre-existing mental illnesses (Kola, 2020). In this context, task shifting, and the use of digital mental health intervention are highly recommended (Kola, 2020).
- **Special population:** Older adults are the fastest-growing age segment in the American population (Zelinski and Reyes, 2009). Pediatric, pregnant and geriatric patients have unique requirements and challenges in their treatment. These include adverse effects of medications and concerns due to the same which can be potentially averted by the use of game-based interventions. In many cases, the interventions are complementary to pharmacotherapy but might aid dose-reduction.
- **Stigma:** Game-based interventions offer preservation of anonymity and privacy which can potentially tackle the stigma associated with help-seeking behavior. This increases the feasibility of and access to mental healthcare.

4. What are the applications of game-based interventions in psychiatry and psychotherapy?

This section aims to provide a bird's eye view of the various mental health conditions in which digital gaming interventions have been explored and utilized. Table 2 provides a brief overview of the targeted mental health condition, broad categories of games used for these conditions, specific target areas, and a summary of the evidence for such interventions.

- **Targeted mental health conditions:** As per the systematic review by Cheng et al. (2019), the most commonly targeted mental health domains in research have been anxiety disorders (32%) followed by mental wellbeing (20%). Mental health interventions are available to healthy aging, mild cognitive impairment, dementia, addiction, impulse control disorders, schizophrenia, depression, anxiety, post-traumatic stress disorder, eating disorder, autism spectrum disorders, and ADHD. There are available interventions for non-specific conditions like sleep disturbances, motivational impairment, impulsivity, self-injury, and suicide. There have been no gamified apps and technologies identified for bipolar disorders and conduct disorders (Wan et al., 2019). It is interesting to note the target symptoms of these interventions. Targets are therefore identified as (a) broad targets like mood, traumatic memories, anxious ruminations, etc., and (b) fundamental targets focusing on cognitive functioning like attention, impulsivity, visuospatial orientation, social cognition, etc. providing broader scope for generalization and utilization in various disorders at the level of acute treatment as well as rehabilitative purposes. Thus, gaming interventions have a wide scope ranging between preventive aspects, acute treatment, and long term rehabilitation. Self-reports and/or clinician-administered assessment tools have been utilized in the studies. The intervention facilitators have been either the therapist, clinician, parent, or self.
- **Evidence for digital game-based interventions:** Even though the research in game-based interventions, on one hand, is in its infancy (Fleming et al., 2017), US-FDA has already approved a game called "EndeavorRx" for the treatment of Attention Deficit Hyperactivity Disorder ("FDA Permits Marketing of First Game-Based Digital Therapeutic to Improve Attention Function in Children with ADHD |

Table 2
Summary of targeted mental health conditions by game-based interventions

Healthy aging and dementia				
Broad categories of games used	Cognitive domains	Example of a game	Remarks	
1. Exergames(Li et al., 2018)	1. Learning & memory	Fitt & Hick(Byun and Park, 2011)	Games are mainly available for (Ning and Member, 2020) (Kaufman and Sauvé, 2020): (i) Healthy aging, (ii) Mild Cognitive Impairment, & (iii) Mild & moderate stage of dementia	
2. Entertainment games(Kaufman and Sauvé, 2020)	2. Language	Big Brain Academy(McLaughlin et al., 2018)		
3. Specific cognitive training games(Al-Thaqib et al., 2018)	3. Perceptual motor ability	Smart Aging(Bottiroli et al., 2017)		
	4. Complex attention	Wii(Jung et al., 2018)		
	5. Executive function	Lumosity(Nouchi et al., 2012)		
	6. Social cognition	Dragon Age(Toma, 2015)		
Addiction and impulse control disorders				
Broad categories of games used	Target	Example of a game	Remarks	
1. Skill development through a series of mini-games	Relapse prevention	Guardian Angel (Bowers C, et al. 2011)	Craving management & assertive skills	
2. Stimulus control game	Cue induced craving	Clean House(Verduin et al., 2013)	To remove all substance-related cues within a given time.	
Schizophrenia				
Broad categories of games used	Target	Example of a game	Remarks	
1. Exergames	Increase physical activity and social functioning	Kinect(Leutwyler et al., 2018)	Clinically meaningful improvement in walking speed. Cheering and coaching one another	
2. Virtual reality games		Quality of life & Frontal lobe functioning	Nintendo Wii(Shimizu et al., 2017)	Improves prefrontal cortex functioning and quality of life
		Neuro-cognition	The Virtual town(Amado et al., 2016)	Improvement in attention & all components of memory
		Positive symptoms and extrapyramidal symptoms(EPS)	Internet Video games(Han et al., 2008)	Greater improvement in delusion subscale & EPS in the intervention group
Depression				
Broad categories of games used	Target	Example of a game	Remarks	
1. CBT based	Negative automatic thoughts	SPARX(Merry et al., 2012)	Significantly improved depression, anxiety, and hopelessness compared to treatment as usual	
2. Biofeedback-based	Physiological arousal	Freeze Framer(Knox et al., 2011)	significantly lowered posttest depression scores compared to the control group	
Anxiety disorders				
Broad categories of games used	Target	Example of a game	Remarks	

Table 2 (continued)

1. CBT based	Relaxation, exposure	Camp Cope A lot(Khanna and Kendall, 2010)	Improvement in anxiety
2. Biofeedback-based	Physiological arousal	Loom(Dillon et al., 2016)	Significantly improved levels of stress & heart rate when compared to the control group
3. Combination of CBT & biofeedback	Attentional bias modification and neurofeedback	Mindlight(Schoneveld et al., 2016)	"Free Flow" improved anxiety but not when compared with "Max and the Magic Marker"
4. Skill development	Assertive skills	Dealing with Others(Zielhorst et al., 2015)	improve coping skills & burnout syndrome more than therapy alone when combined with therapy
Post-Traumatic Stress Disorders (PTSD)			
Broad categories of games used	Target	Example of a game	Remarks
1. CBT game	Emotion recognition & cognitive restructuring	Coping Coach(Marsac et al., 2013)	It is a game for the prevention of PTSD after a medical event
2. Entertainment game	Reducing PTSD symptoms	Tetris(Kessler et al., 2018)	Reduction in the number of flashbacks after a stressful event
Eating disorders			
Broad categories of games used	Target	Example of a game	Remarks
1. Biofeedback-based	Impulse control	PlayMancer(Fernández-Aranda et al., 2012)	Used as an adjunct to CBT for bulimia nervosa with positive outcomes
2. CBT based	Overweight young adults with underlying maladaptive behaviors & cognitions related to food	SIGMA(Podina et al., 2017)	Proposed protocol for an RCT study
Autism Spectrum Disorders			
Broad categories of games used	Target	Example of a game	Remarks
1. Biofeedback-based	Balance training	Novel in-lab video game(Travers et al., 2018)	Significantly improved balance compared to Wii fitness games
2. Exergames	Fitness and cardio-pulmonary functioning	Nintendo Wii & Mario And Sonics at the Olympics(Dickinson and Place, 2014)	Significant improvement in Eurofit fitness test except for flexibility
3. Serious game	Emotion recognition	Emotiplay(Fridenson-Hayo et al., 2017)	Improvement in emotion recognition, integrative tasks, and adaptive socialization
Attention Deficit Hyperactivity Disorders (ADHD)			
Broad categories of games used	Target	Example of a game	Remarks
1. Exergame	Response inhibition and executive	EndeavorRx(Kollins et al., 2020)	FDA approved for the treatment of
2. Serious game			

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Table 2 (continued)

3. Biofeedback-based	functioning (multitasking)	ADHD in children between 8 & 12 years of age
	Decreasing ADHD symptoms	Adventurous Dreaming Highflying Dragon(Weerdmeester et al., 2016)
	Life skills	Plan-it Commander(Bul et al., 2016)
	Arousal	Journey of the Wild Divine(Amon and Campbell, 2008)
		Greater improvement in the intervention group in teacher-rated ADHD symptoms
		Improvement in time management, working memory, and social skills
		Improvement in ADHD behaviors

FDA," n.d.). Randomized controlled trials and other systematic studies have looked at the role of applied games in mental health-related interventions with promising results(Christie et al., 2019). However, a majority of the games currently available for use are not evidence-based(Bakker et al., 2016). Several gaming interventions are merely a translation of an evidence-based intervention in a game format. For example, CBT for depression is already an approved form of intervention. Therefore if a gaming application is providing CBT for depression, while assessing the effectiveness, one would be assessing how effectively the application can deliver it, rather than looking at the efficacy of CBT in depression. As per the systematic review by Cheng et al., 5% of the papers reviewed by them considered gamification to be a cost-effective intervention (Wan et al., 2019).

5. What are the challenges associated with applied game interventions?

As described earlier, there are potential advantages in using digital game-based interventions. However, these interventions come with a host of challenges, especially when applied in the context of developing economies. Diversity, feasibility, and socio-cultural adaptability are other barriers that need addressal. As evident from the review, most of the studies described are from developed countries and urban areas. Simple issues like network bandwidth, penetration, ease of internet access, and lack of supportive infrastructure in remote and rural areas can cause frequent disruption in these interventions which challenges their availability and acceptability. Also, for people who are already predisposed to unhealthy use of technology, the very nature of 'digital games' and the increased digital-screen time might contribute to their misuse or abuse. Research is limited in this controversial area. Table 3 summarizes some of these difficulties related to game-based digital interventions.

6. Are things differently applicable to developing nations? Perspectives from India

Internet usage, penetrance, and bandwidth speed: In 2020, India has nearly 700 million internet users across the country. India was marked as the second largest online market after China in 2019(“•(Total internet users in India 2020 | Statista,” n.d.). In 2019, rural areas in India had a 10% higher usage of the internet compared to urban areas in terms of absolute numbers(Knowledge Centre - IAMAI [WWW Document] n. d). It is also encouraging to see that there was almost an equal number of smartphone users as internet users in the country(“• (Total internet users in India 2020 | Statista,” n.d.). While the data is encouraging in

Table 3

Summary of challenges associated with game-based digital interventions

Broad problem area	Specific challenges
1. Cost-benefit analysis	There is some evidence to suggest that game-based interventions are cost-effective(Wan et al., 2019), however, more research is required in this area
2. Cultural humility and sensitivity	Lack of cultural validation which might be essential for acceptability of these interventions as “therapeutic”
3. Infrastructure	(a) Technical support required in operating the games (b) Might require troubleshooting
4. Internet connectivity issues	(a) Bandwidth and speed of the internet might be slow which could lead to erratic gameplay (b) Poor coverage in the rural and remote areas of the country
5. Impact on conventional psychiatric practice	(a) Digital game-based interventions can be self-administered by patients thereby reducing their reliance on trained mental health professionals. This may lead to abuse of the available game-based interventions, further perpetuating “substandard” mental health care. (b) “Therapeutic alliance” which is considered the essence of mental health interventions might be grossly lacking in game-based interventions which might reinstate a need for ‘in-person’ interactions
6. Legal and ethical concerns	(a) Risk of unauthorized access, data theft, abuse or misuse, cyber crimes (b) Medico-legal caveats might arise in terms of jurisdiction across intra-country and inter-country borders
7. Policy	(a) Concerns related to access to game-based intervention without authorized permission or prescription (b) Lack of appropriate guidelines and legislations for use in mental health
8. Research	The rapid evolution of technology may outrun the pace of research making game-based intervention outdated even before they are tested systematically. This becomes a concern as all our interventions go through several phases of testing and research before they are licensed. These phases may take several months to years by which time the technology utilized in the game might get outdated.
9. Special population	(a) Limited accessibility for the socially impoverished and vulnerable population (b) Possible potential for abuse in certain groups (externalizing spectrum disorders, Cluster B & C personalities, substance abuse disorders, etc.)
10. Technological “mindedness”	(a) Deviation from the ‘usual norm’ (b) Socio-cultural beliefs and traditional ‘rules’ of consultation might affect digital services (c) Feasibility of using smartphones, computers, or tabs

terms of its absolute statistics, a closer look at the internet penetrance levels and distribution of broadband speed reflect the reality. Within the Asia Pacific region, India and the Philippines had the lowest bandwidth speed in 2018(“•(APAC: share of broadband speeds by country 2018 | Statista,” n.d.). In 2020, the internet penetration in India had been recorded to be around 50% while it was 85.8% in America (“• U.S. internet user reach 2025 | Statista,” n.d., “Internet usage in India - statistics & facts | Statista,” n.d.). Also, there is significantly lower internet access in the older population, women, and lower socio-economic class (“Internet usage in India - statistics & facts | Statista,” n.d.). However, if we assess longitudinally, India had an internet penetrance of 27% five years ago. This means that the usage has nearly doubled in merely half a decade(“Internet usage in India - statistics & facts | Statista,” n.d.). This indicates a huge market potential for internet-based services in the country.

Need for task shifting and use of digital mental health interventions: India has 0.75 psychiatrists per 100,000 population compared to 6 psychiatrists per 100,000 population in high-income countries(Garg et al., 2019). The availability of other trained mental

health professionals like psychologists and psychiatry social workers is lesser than psychiatrists in the country. Also, as per the National Mental Health Survey 2015-16, the treatment gap for mental health conditions in India is 85.4% (Gururaj et al., n.d.). Given the dearth of trained mental health professionals and the high treatment gap, it is extremely important to venture into alternate intervention models, and in this context, game-based interventions hold immense promise. There is limited research on game-based interventions from developing nations, as most of the literature available in this area are from developed nations. There are other unique challenges like the socio-cultural heterogeneity in India which harbors close to two thousand ethnic groups, several regional languages, and religions. The help-seeking behavior of the patients is also highly dependent on their cultural beliefs. Therefore, it would be pertinent to ensure adequate acceptability of digital interventions as modes of "treatment" apart from entertainment for which they are widely used. One way could be to uphold the cultural values of the people and also make intervention contextualized to their age and gender. Various online games have already been using themes of famous cartoons, folklore, and mythology which have become instantly famous and acceptable by its users (Mukherjee, 2013). Incorporation of such socio-culturally sensitive features and linguistic variations in digital mental health gaming interventions might resonate better with the ideas of its use and improve acceptance. This might be even more important for the children, adolescents and older adults due to the enhanced 'real-world reflectivity', better engagement and improved feasibility, all of which can improvise the use and effectiveness of the gaming interventions in these special populations. Research in this area incorporating local folklores, culturally sensitive elements, fables, tales and stories in digital gaming interventions, especially in developing countries, is still in its infancy but has a potential for better understanding and implementation of these modalities in mental health in socio-culturally diverse and populous countries like India.

7. Conclusion: The way forward

Gamification is undoubtedly one of the most prominent 2020 buzzwords. Given its immense potential, it holds a special promise that can lead to a paradigm shift in mental health interventions. It is already widely applied for various psychiatric conditions both as preventive and therapeutic interventions with promising results. Artificial intelligence (AI) and Virtual Reality (VR) have also been used in conjunction with digital gaming for environmental simulation in various cognitive tasks studied in healthy aging and cognitive disorders. Even though there are various challenges in its application, especially in developing countries, the recent trend of increase in internet penetrance may potentially help overcome major barriers in the use of game-based interventions. As future directions, the following can be suggested: (a) need for more systematic research on game-based interventions from developing countries including their validation in a given cultural context, (b) need to explore the application of digital game-based interventions in specific disorders, (c) other special populations apart from the children and older adults, (d) standardization of guidelines for their tailored use in psychiatric conditions, (e) comparative and longitudinal studies in various disorders (f) Domain-specific digital-gaming interventions (like attention, working memory, spatial cognition, recall, etc. in cognitive rehabilitation), (g) Incorporating AI and VR in digital-gaming to improvise the effects, and (h) to understand the abuse potential for these interventions. The future of this modality holds innovative promise, however, whether their implementation makes a clinically significant difference in mental health, continues to stand as a test of time.

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