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SYSTEMATIC REVIEW **OPEN ACCESS**

The Effectiveness of Gamification in Changing Health-related Behaviors: A Systematic Review and Meta-analysis

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Abstract:

Introduction: In the current era, different health issues exist because of the lifestyle we have adopted. Mostly, people suffer from different deadly disorders like diabetes because of their own behavior. Gamification is considered to be a good source to maintain a healthy life. Gamification has benefits over other games as it involves changing the behavior of the individual. It helps in giving support to unhealthy people and by changing their behavior, makes their health better.

Objective: Gamification has several advantages, but little is known about it. In this systematic review, we examined studies that illustrate the benefit of gamification in health and well-being. For this objective, we recognized the benefits of gamification based on existing research and performed a complete literature review of empirical studies on gamification for health and well-being.

Methodology: We collected 30 papers containing empirical evidence on the influence of gaming on health and well-being. The inclusion criteria entailed peer-reviewed articles published from 2012 to 2023. The studies were published in English language and their methodology was randomized controlled trials.

Results: The majority of the studies indicated positive impacts, less than half mixed effects, and some of the evidence was intermediate. The results for health-related behavior were clear, whereas the results for cognitive outcomes were varied. According to the collected information, gamification could promote health and wellness, particularly behaviors related to health. Several studies, however, demonstrated a mixed or neutral influence.

Conclusion: From the findings of the studies, it could be easily stated that gamification helps in changing the behavior of the individual. However, due to fewer studies used in the review and due to restrictions in certain limits in articles, it could not clearly be concluded that gamification provides the same response in individuals of varying ages. A greater number of studies should be included, and the findings should be carefully examined to know clearly about the effect of gamification in response to the changing behavior of individuals of varying ages.

Keywords: Gamification, Health, Behavior change, Empirical studies, Well-being, Cognitive outcomes.

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1. INTRODUCTION

Behavior changes result in serious diseases like diabetes, obesity, hypertension, and high cholesterol. These issues are currently the leading global causes of mortality and chronic illness [1]. These risks are intimately associated with modern lifestyle behaviors, chronic stress,

and increased intake of calorie-dense meals. With popular techniques like persuasive technology or positive computing, computing technology has rapidly advanced over the past two decades for health habit modification and well-being. This includes many different applications for consumers for gathering and analyzing self-data [2, 3]. Games that promote positive health outcomes are helpful in changing behavior. Most of these influence healthy habits. The main things that need to be focused on are exercise, diet, and stroke recovery. Health games have expanded quickly, with multiple systematic assessments evaluating their efficacy. The ability of games to motivate players is a major reason for their usage in serious situations. Games are programs designed expressly to be entertaining and engaging. According to studies, well-designed games are engaging and enjoyable because they provide a sense of accomplishment and satisfaction. Thus, creating games out of health communication or behavior modification programs might be a useful strategy for encouraging consumers to interact with them regularly [4, 5]. Gamified systems, like games, can naturally promote the onset as well as the persistence of healthy and beneficial behavior. Wide accessibility is made possible by omnipresent sensors and mobile technologies. Smartphones and monitoring tools are excellent and generally available platforms for incorporating gaming elements into everyday health procedures. This could increase the accessibility of gamified apps compared to health games that need specialized gaming technology [7, 8]. Gamification applications help to support good health (*i.e.*, fitness and nutrition apps, physical therapy apps). Interacting with gamified applications may directly promote well-being as well as drive healthy behaviors by creating pleasurable experiences of basic emotional satisfaction, in addition to other aspects of well-being, including satisfaction, participation, and interactions. Contrary to health games (*i.e.*, cycling, football, dancing, swimming), which require players to dedicate more time and space to manage their lives, gamified systems based on digital devices can include nearly all accessible daily activities. In the present systematic review and meta-analysis, greater emphasis was placed on the use of games to change individuals' behavior and improve their lives by preventing major diseases, as well as the link between gamification and health and well-being. The few articles collected in this review also provide theories demonstrating how gamification aids in learning.

1.1. PICO Question

Adults and children (P) with behavioural problems or major diseases can use gamification as an intervention (I) compared to standard care without gamification, resulting in improved behavior, adherence to life-changing behaviours and a possibility of preventing a major illness.

1.2. Research Problem and Goals

The overall quality of healthcare gamification applications has received little attention. Despite the fact that they provide substantial and essential information, none of these assessments have examined the exact link between gamification and health and well-being together. All the data collected demonstrated that gamification helps in changing the behavior of an individual. Articles were reviewed to determine whether gamification helps in maintaining good health by exhibiting behavior that is beneficial, has no impact, or shows undesirable behavior by disrupting the individual's health.

1.3. This study Primarily Focuses on two Research Issues

1.3.1. What is the Role of Gamification in the Case of Health?

Which part of the game design is tested? These factors involve whether health gamification genuinely improves well-being through good experiences and whether it exerts effects using the same intrinsic incentive systems that make games interesting. On what platforms are testing and deployment performed? This study investigates if current health gamification lives up to its promises of enhanced availability, widespread distribution, and incorporation into daily life through cell phones or other types of devices.

1.3.2. Does Gamification show Positive Behavior in Response to Changing Health?

How many and what kind of impact studies are there? This is in response to the finding that good effect studies on gamification are missing. What results have been reported? This comes after the query of whether or not health gamification works.

2. METHOD

2.1. Search Strategy

The five scientific databases, including the Web of Science Core Collection, Wiley Online, Emerald Insight, ScienceDirect, and Taylor and Francis, were searched from 1st May, 2023 to 7th July, 2023 to find pertinent material. The research was done by following the guidelines of "Preferred Reporting Items for Systematic Reviews and Meta-Analyses". To find articles on gamification, specific keywords should be used, like "gamification for health", well-being, change in behavior, positive behavior, and negative behavior. The search string was used to explore all publications related to gamification in terms of title, abstract, and author keywords.

2.2. Screening Strategy

The three steps of the screening procedure were title, abstract, and full-text screening. Only peer-reviewed journal papers, reviewed journal articles, and other materials were included in the final sample to ensure the study's quality. Articles that discuss studies on the usage of gamification and its response in changing the conduct of an individual, as well as whether the change in behavior was positive or negative, were included.

2.3. Inclusion Criteria

The inclusion criteria considered only peer-reviewed articles to ensure the quality of the output. Only studies involving human participants were deemed fit in this study. Also, the study participants were not limited to gender or geographical location/ health status. It was observed that not all individuals with behavior problems or requiring change suffered from a health problem. The included studies focused on the exposure or intervention in relation to the effectiveness of gamification in changing health-related behaviours. Therefore, gamified applications, programs and platforms were not an exception. With respect to comparison, this current study investigated studies that included non-gamified approaches, traditional approaches or standard care procedures. The outcomes related to the quantifiable health-related behavior change the current outcomes. Therefore, expected outcomes in the included studies involved changes in medication adherence, dietary habits, and physical activities. Other factors included in the inclusion criteria related to articles published in the English language are as follows:

1. Peer-reviewed studies
2. Studies published in the English language
3. Studies published since 2012
4. Studies on exposure or intervention on the effectiveness of gaming
5. Health and non-health-related behaviours
6. Only randomized clinical trials

2.4. Exclusion Criteria

Exclusion criteria were in line with the emphasis on a high-caliber academic study that examines the benefits and efficacy of entertainment for health and well-being. Papers having the following qualities were disregarded: articles in which the study was not complete or extended abstracts, study procedures not appropriate, and focus on other games that did not involve digital devices.

2.5. PRISMA Diagram

A PRISMA (Preferred Reporting Items for Systematic Reviews) diagram indicates how information flows in the different phases throughout the meta-analysis and the systematic review. The PRISMA considers the data from identification to inclusion for analysis. In this regard, the visual diagram below presents the total studies identified, included and excluded in definite stages within the study.

Nineteen thousand nine hundred records were identified concerning the impact of gamification on health-related behaviour. However, 6560 records majored in animal studies while 7500 records were duplicates. Both duplicates and animal studies did not meet the inclusion criteria. Only 5850 records underwent screening, whereas 2200 records were published from 2011 and below. This study included records from 2012 to 2023. Also, 3400 records applied other methodologies; this study included records conducted under RCTs. Only 250 records were sought for retrieval. However, 167 records lacked sufficient data to qualify for inclusion. Eighty-three studies were assessed for eligibility, where 21 records did not provide the required outcome, 17 were not peer-reviewed, and 15 did not provide full text. In addition, the 17 records did not offer concluding evidence to support the objectives of this study. Therefore, only 30 records qualified for inclusion.

Mamede *et al.* (2021) discussed the effectiveness of combining gamified digital applications and physical nudges. The authors observed increased sedentary behaviour and physical activity among the participants. Similarly, the study by Patel *et al.* (2021) discovered increased physical activity through behaviourally designed gamification. Monroe *et al.* (2023) showcased the efficacy of digital gamification in promoting physical activity. Also, Ahole *et al.* (2023) exemplified how gamified intervention increased physical activity among adolescent men. Fang *et al.* (2019) and Kelders, Sommers-Spijkerman and Goldberg (2018) investigated the metabolic and cognitive impact of gamification on changing moods, interests, and aspirations among participants. Similarly, Litvin *et al.* (2020) reported a significant increase in behaviour change that reduced anxiety and panic in raising mental health awareness. Kurtzman *et al.* (2018), Klaassen *et al.* (2018), and Timpel *et al.* (2018) studied how gamification using smartphone applications could help in self-management and promote weight loss interventions. The studies concluded the positive influence of gamification supported by mobile applications in helping patients with chronic illnesses, such as diabetes, self-manage and get motivated to achieve positive health outcomes. El-Hilly *et al.* (2016) argued that gamification could lead to behaviour change, especially regarding smoking cessation. Generally, all the studies above reported how collaboration and intrinsic support gamification intervention could provide health-related solutions, especially targeting behaviour change. The studies demonstrated that gamification and social incentives supervised gaming reduced adverse health outcomes, such as obesity and other metabolic conditions. It was found that gamification for exercises and physical activities can help manage adverse cardiovascular disease (Table **1**).

2.6. Meta-Analysis

Meta-analysis applies a statistical concept to combine the summary of statistics and provide results in subgroup sections. This section provides the quantitative summaries of the included summaries in answering the research questions that adults and children (P) with behavioural problems or major diseases can use gamification as an intervention (I) compared to standard care without gamification, resulting in improved behavior, adherence to life-changing behaviours and a possibility of preventing a major illness. The meta-analysis was conducted using a random effects model (Fig. **1**).

Table 1. Characteristics table.

Author(s) and Year/Refs.	Methodology	Sample Size	Intervention	Control	Objectives	Results	Implications
Aboalshamat *et al*. 2020 [9]	Randomized Clinical Trials	93	46	47	The intervention investigated knowledge promotion among the public in Saudi Arabia about Antimicrobial Resistance (AMR) using gamification.	There was a significant difference in health promotion among the intervention group compared to the control group.	Gamification is effective in improving AMR knowledge promotion.
Agarwal *et al*.(2021) [10]	Randomized Control Trials	180	60	60	Examine the effectiveness of gamification with social support, with and without financial incentives, on PA among veterans with overweight and obesity.	There was a modest increase in PA, but it was not sustained during the follow-up period.	Gamification without financial incentives does not significantly change activities.
Ahola *et al*.(2013) [11]	Randomized Control Trials	1500	640	640	Provide new evidence-based knowledge for promoting health and well-being in young men.	Online social features have reduced health behavior change interventions.	This unique intervention to activate young men can also be tailored to other populations or age groups.
Bannell *et al*. (2023) [12]	Randomized Controlled Trials	420	210	210	The development of novel exercise intervention for supervised exercise in improving poor behaviours and metabolic health.	The intervention, which included the gamification design and social incentives, provided change for unhealthy behaviours and improved metabolic health.	Gamification and social incentives in supervised gaming reduced negative health outcomes, such as metabolic disorders and obesity.
Chen *et al*.(2020) [13]	Randomized Control Trials	602	451	151	Test the effectiveness of supportive, competitive, and collaborative social incentives to increase physical activity in a gamification intervention.	The study identified three behavioral phenotypes among overweight and obese adult participants in the trial of a gamification intervention to increase physical activity.	An approach considering behavioral phenotyping can reveal differences in intervention response and identify those most likely to benefit.
Corepal *et al* 2018 [37]	Randomized Control Trials	1500	640	640	Gamified intervention would increase physical activity among adolescent men.	There was a reduced sedentary behavior and increased activation in the intervention compared to the control group.	The gamified model is unique and can be applied as a translational model for community use.
Dadaczynski *et al*.(2017) [14]	Randomized Control Trials	144	80	64	Evaluate the effectiveness of a tracking-based online intervention on the promotion of PA on worksites.	There were significant improvements in levels of PA, with walking time increased by 125 min/week.	Gamification elements can have positive effects not only on health promotion parameters but also lead to an increase in PA behaviour.
De Oliveira *et al*. (2022) [15]	Randomized Control Trials	46	23	23	Investigate the effectiveness of online behavior change intervention to promote PA and reduce sedentary behavior in adults with asthma.	The intervention is easy to perform and has a low implementation cost.	The promising results imply easy asthma management and global health of this population.
El-Hilly *et al*. (2016) [16]		16	7	6	mHealth gamification intervention can lead to behavior change with respect to smoking cessation.	Intrinsic motivation and gamification highly contributed to the anticipated behavioral change.	The use of mHealth gamification solutions can supplement behavior change interventions.
Fang *et al*. (2019) [17]	Randomized Control Trials	420	210	210	Improving metabolic health and poor behaviors among overweight and obese children.	Improvement in healthy behavior changes, including PA, diet pattern, sleep health and screen media usage.	The intervention provides important evidence for guidelines to prevent and improve metabolic health and healthy behavior.

(Table 1) contd.....

Author(s) and Year/Refs.	Methodology	Sample Size	Intervention	Control	Objectives	Results	Implications
Gil-Cosano *et al*. (2020) [18]	Randomized Control Trials	116	58	58	Test the effects of an online exercise program on bone health in paediatric cancer survivors.	Has shown promise to improve health behavior.	The study contributes to the existing knowledge of how physical activity affects the quality of life and mental health in this population.
Granado-Font *et al*. (2015) [19]	Randomized Control Trials	70	35	35	Evaluate the effectiveness of a weight loss intervention based on the recommended standard diet plus a free mobile app and wearable device.	There was a challenge to maintain weight loss for longer than a year.	The potential to provide a validated weight loss tool for patients seeking primary health care and who want to lose weight.
Haug *et al*. (2020) [20]	Randomized Control Trials	1318	659	659	The efficacy of a mobile app for the prevention of addiction among apprentices in Switzerland.	The study anticipates a reduction in substance and internet use, as well as increased self-efficacy.	Counselling and training *via* the smartphone app are economical, correspond with the habits and lifestyle of the target group and can be translated into other languages for program dissemination.
Höchsmann *et al*. (2017) [21]	Randomized Control Trials	42	21	21	Examine the effect of the game app on daily PA in T2DM patients.	The exergame promotes exercise adherence and saves the face-to-face time needed in structured group sessions.	The MOBIGAME exergame app can be transferred to the use of other chronic illnesses.
Kelders, Sommers-Spijkerman, and Goldberg (2018) [22]	Randomized Control Trials	76	39	37	The study investigated the direct impact of gamification on cognitive, behavioural and effective engagement for a web-based mental intervention.	The gamified intervention provided higher scores in relation to changes in aspiration, interests and emotions. No difference was observed regarding satisfaction, usability, and enjoyment.	The study concluded that gamification produces a positive direct impact in relation to aspirations, interests, emotions, flow and involvement. Therefore, gamification leads to positive cognitive engagement.
Klaassen *et al*. (2018) [23]	Randomized Control Trials	21	14	7	A self-management gamification program for young patients with diabetes.	Engaging in gamification intervention increases the motivation to change behavior.	Gamification can help in behavior modification because it is easy to use and more intuitive. Games are also appealing to the users, which leads to positive health impacts.
Kurtzman *et al*. (2018) [24]	Randomized Control Trials	150	130	66	Effectiveness of gamification interventions to promote weight loss.	The study observed no significant differences in weight loss between the control and intervention arms.	The use of gamification interventions was not effective at promoting weight loss.
Leach *et al*. (2022) [25]	Randomized Control Trials	220	110	110	To determine whether exercise incentives affect step count and overall PA.	The outcome is to determine if incentive-based gamification leads to increased PA in the KOA population.	The study quantifies the efficacy of corticosteroids on pain and physical activity.
Lewey *et al*. (2022) [26]	Randomized Control Trials	127	63	64	To determine whether a digital health intervention can improve physical activity in postpartum individuals with hypertensive disorders of pregnancy.	Observed increased physical activity among postpartum individuals at elevated cardiovascular risk throughout the 12 weeks.	Remote monitoring and gamification with social incentives lead to increased physical activity.
Litvin *et al*. (2020) [27]	Randomized Control Trials	709	440	269	The study examined the influence of gamification.	There was a significant increase in behavior change. There was a reported decrease in anxiety and raised mental well-being.	Gamification mobile applications provide an effective platform for mental and well-being interventions.

(Table 1) contd.....

Author(s) and Year/Refs.	Methodology	Sample Size	Intervention	Control	Objectives	Results	Implications
Mamede *et al*. (2021) [28]	Randomized Control Trials	298	118	116	Effectiveness of the combined physical nudges with a gamified digital app on increasing sedentary behavior (SB) and physical activity (PA) among the participants.	Participants in the intervention group reported increased SD and PA during gamification more than those in the control group.	The use of gamification supported by social support features can promote behavioral changes (SD) and PA, respectively.
Matheson *et al*. (2021) [29]	Randomized Control Trials	2800	1400	1400	Address disparities in body image prevalence and readily available resources.	Receipt of no intervention was deemed appropriate due to the scarcity of body image interventions for adolescents.	The chatbot has the potential to address adolescents' body image concerns at scale and reduce the disparities between healthcare demands and supply.
Monroe *et al*. (2023) [30]	Randomized Control Trials	116	57	59	The efficacy of digital gamification physical activity promotion.	TECH and gamification increased activity compared to the control group.	Gamified intervention targeting physical activity is favorable for activity participation.
Patel *et al*. (2021)[31]	Randomized Clinical Trials	500	215	285	Intervention to increase physical activity through a behavioral designed gamification.	The intervention group reported a significant increase in physical activity compared to the control group.	Gamification can increase physical activity for individuals with adverse cardiovascular disease.
Patel *et al*. (2021) [32]	Randomized Control Trials	361	274	87	An intervention to promote healthy behavior for adults with type 2 diabetes and hemoglobin A greater than normal.	An increase in physical activity was observed for patients with uncontrolled type 2 diabetes.	The gamification only increased physical activity, but no difference was observed with respect to collaboration and competition.
Podina *et al*.(2017) [33]	Randomized Control Trials	104	52	52	To work as a standalone app for weight maintenance or alongside a calorie-restrictive diet to achieve weight loss.	The user-friendly game interface offers a cost-effective and preventive self-help tool for young, overweight adults with maladaptive eating habits.	The SIGMA intervention may provide a cost-effective (*i.e.*, always available) and preventive self-help tool for young overweight adults with maladaptive eating habits.
Silva *et al*. (2022) [34]	Randomized Control Trials	180	90	90	Indicate the effectiveness of m-health tools and virtual assistance in encouraging behavioral change in PAD patients.	Virtual assistance has shown success in promoting adherence to self-care in patients.	The m-health tools and virtual assistance have the potential to fill in the gap in access to quality healthcare services and reduce the burden on healthcare systems.
Smyth *et al*. (2020) [35]	Randomized Clinical Trials	788	394	394	The intervention explored the benefits of smartphone gamification on the behavior of workers during vacations.	The study witnessed a change in behavior.	Gamification can help workers during holidays to overcome stress-related behaviours and their psychological outcomes.
Timpel *et al*. (2018) [36]	Randomized Control Trials	108	54	54	The efficacy of gamified smartphone apps in weight loss program for obese and overweight adolescents.	The study observed a midterm positive effect in weight reduction for obese and overweight adolescents.	Gamification smartphone application improves self-monitoring physical activity and food habits, which leads to lifestyle change among obese and overweight children.
Wong *et al*. (2020) [37]	Randomized Control Trials	33	27	6	To enhance the well-being of children and parents through gamified exercises.	There was a significant increase in children's PA levels and a decline in psychosocial problems.	The gamified app is a possible intervention to increase children's PA levels and psychosocial well-being through parent-child exercises.

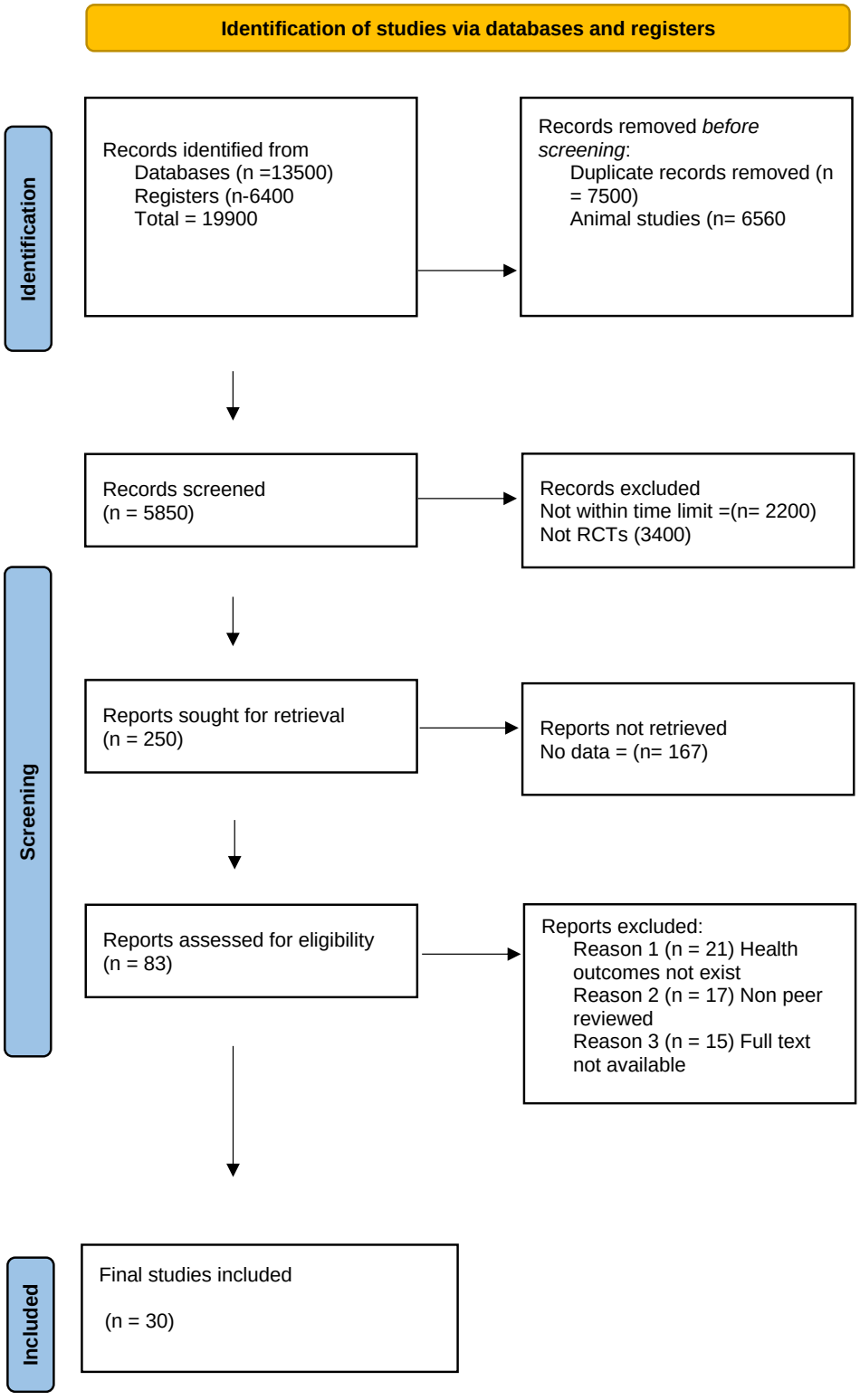

Fig. (1). PRISMA flowchart diagram.

2.7. Forest Plot

The forest plot below provides a summary of the confidence intervals and the point of estimates of the effect sizes from each study. The horizontal line in the forest plot represents the null value, such as the odd ratio or risk ratio, while the vertical axis represents the individual studies. The diamond shows the point of estimate for each study, while the horizontal bar is the confidence interval (CI). Overall effect is presented at the bottom of all the studies showcased by a diamond. The heterogeneity statistics assess the degree of variability among the studies, while the subgroup analysis is a division of how the included data is stratified. This study applied the random effect models for the odd ratios, proving that heterogeneity exists among the studies. It is an assumption that there exist varied effect sizes explained by the sampling error. The odd ratio provides the direction and strength of the relationship between gamification and the health outcome. The odd ratio is applicable in binary outcomes, as represented below.

Fifteen out of 30 randomized controlled trial studies that qualified in the inclusion criteria had an odd ratio of 1. The odd ratio of 1 indicates that the changes in the event in the experimental group compared to the event in the control group is 1. In this respect, few studies [10, 11, 12] reported an odd ratio of 1, which means that the intervention had no significant change in behaviours. In addition, other studies [15, 17, 18, 19, 20, 21] also reported an odd ratio of 1, which means that the gamification for health outcome behavior change did not offer a significant change. It means that a positive change was observed, but the change was not significant enough to conclude that gamification can lead to health interventions. Either as noted in the studies, effective gamification intervention requires motivation and supervision. Studies [13, 14, 16, 22, 23, 24, 27, 28, 29, 30]- [36] reported an odd ratio of more than 1 which means that the experimental event reported more than the control group. It indicates that the use of gamification intervention significantly increased behavior change in 10 studies. Other studies reported an odd ratio of less than 1, which indicates that the gamification did not show any change in behavior. The study showed heterogeneity of 95%, which means considerable variability between the studies. The variability arose from the difference in the big and small sample sizes. The p-value was less than 0.05, which means that the Z-value was 9.06, indicating that the overall effect of gamification is statistically significant at a change of 9.06 (Fig. **2**).

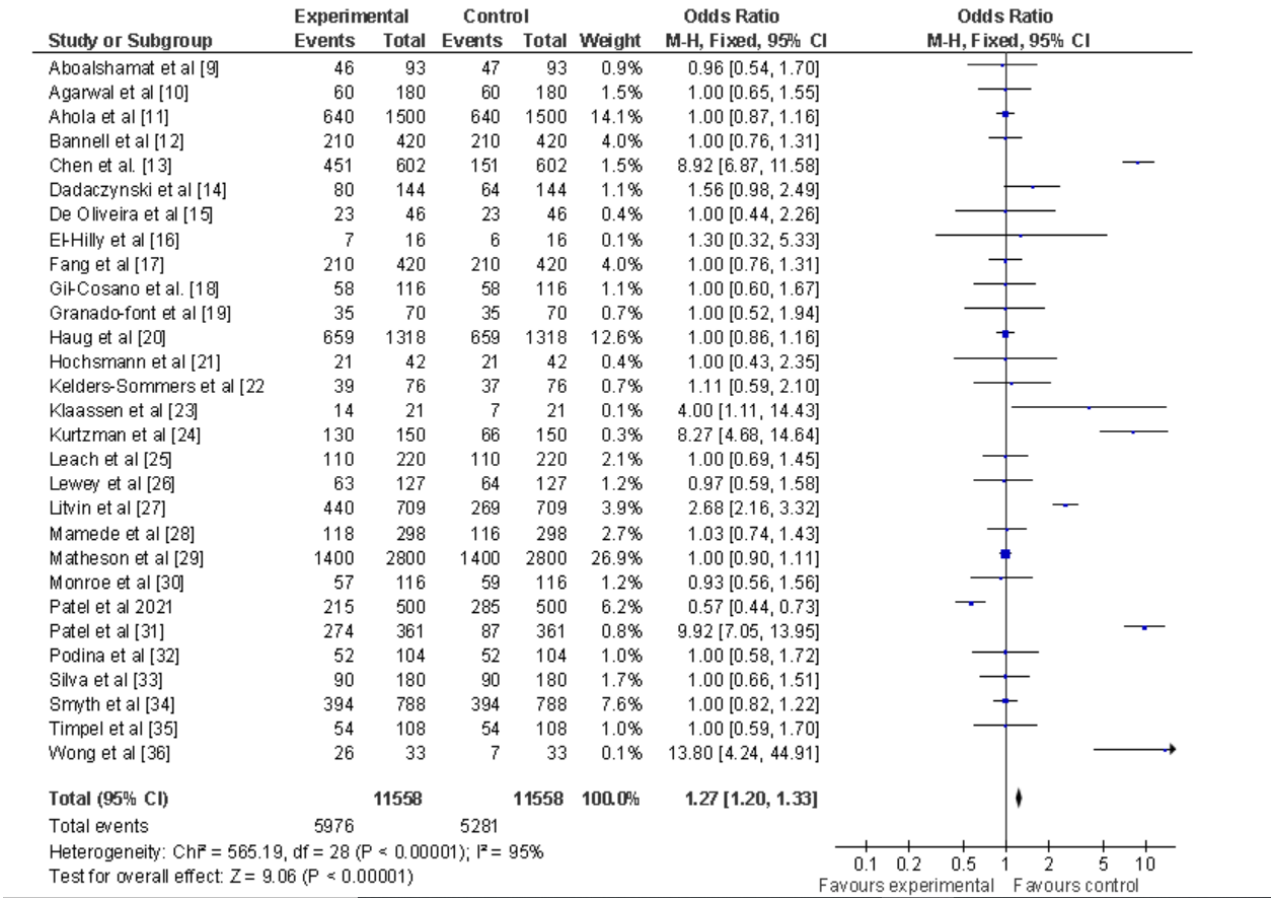

Fig. (2). Forest plot.

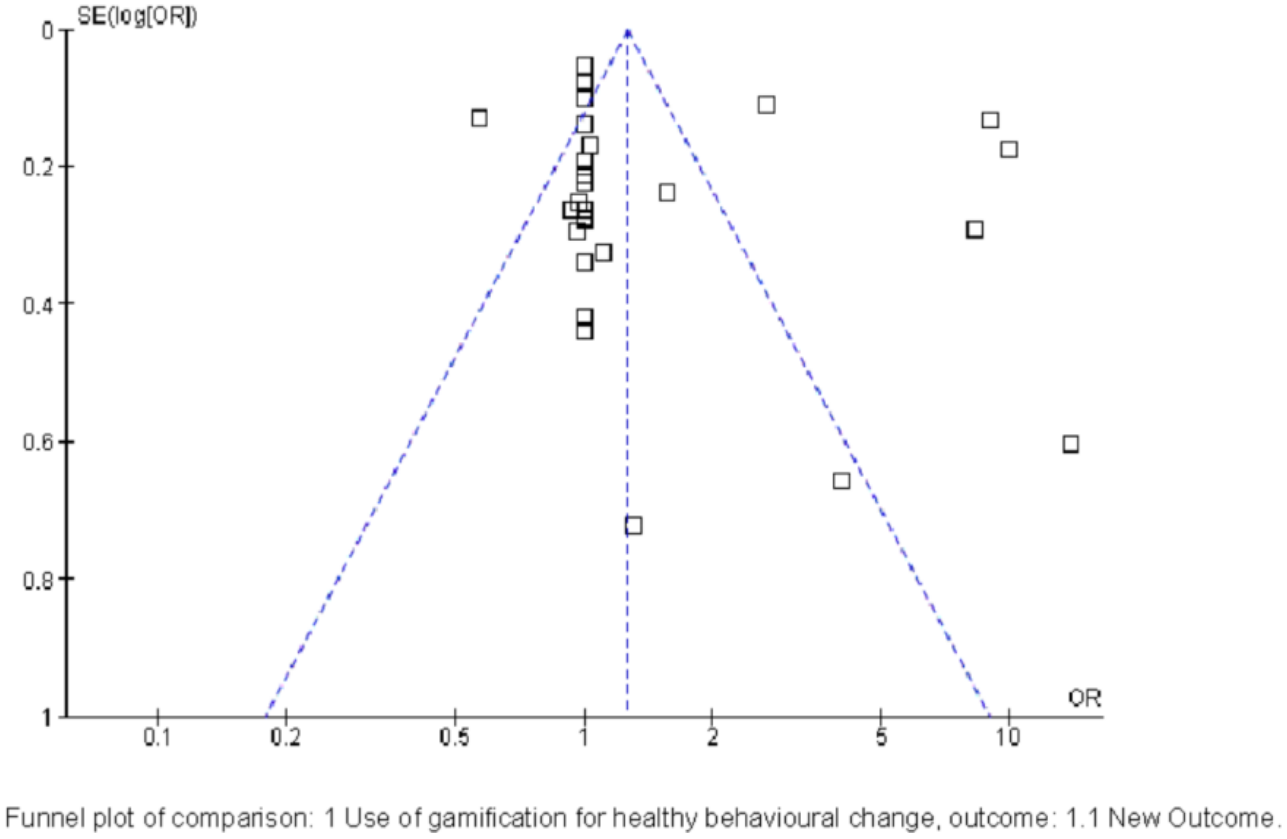

Fig. (3). Funnel plot.

2.8. Funnel Plot

A funnel plot is a graphical tool used in meta-analysis to assess the presence of publication bias or small-study effects. Meta-analysis combines the results of multiple studies to provide an overall estimate of the treatment effect or relationship between variables. However, if there is publication bias or if smaller studies with non-significant results are missing, it can affect the validity of the meta-analysis (Fig. **3**).

The funnel plot above consists of a scatterplot, where the X-axis represents the odd ratio while the y-axis represents the sample size. In this regard, the studies have provided an inverted funnel, which indicates an absence of bias. The distribution could mean the difference between the large and the small sample sizes.

3. RESULTS AND DISCUSSION

In the realm of health, the application of gamification has the potential to address a variety of behavioral challenges, ranging from promoting physical activity and encouraging healthy eating to medication adherence and stress management. This study revealed different advantages of gamification in improving health outcomes. For example, gamification is ideal for increased engagement. Games are inherently engaging, and gamification health interventions can capture and maintain individuals' attention, fostering a sense of enjoyment and involvement. In addition, gamification can help in modification and behavioural reinforcement. Gamification provides immediate feedback and rewards for desired behaviors, reinforcing positive actions and encouraging users to continue engaging in healthy activities. In addition, healthcare can use gamification to increase social interaction among patients, especially with mental health challenges. Such engagement can foster a sense of community and healthy competition, motivating individuals to strive for better health outcomes. Individuals who engage in gamification learn the skill of goal setting and achievement. Gamification allows for the setting of achievable goals and the celebration of milestones, promoting a sense of accomplishment and empowerment among users. Moreover, gaming is about learning and skills development that can be used in health settings to educate individuals about their health conditions, treatment plans, and the benefits of adopting healthier behaviors.

The theoretical foundations delve into the causes and methodologies of learning, drawing primarily from social psychology. The majority of these theories, including the sociocultural view of cognitive development, social learning theory, and social cognitive theory, underscore the pivotal role that sociocultural interactions and influences play in effective learning processes. A key concept in both social learning theory and social cognition

theory is vicarious learning, where individuals learn through observing others. This concept has direct implications for the development of game-based educational interventions, such as incorporating social observation mechanisms or creating role-model game characters for simulated learning [33].

Derived from the sociocultural view of cognitive development, the Zone of Proximal Development refers to the disparity between a child's current developmental level and the potential growth achievable through teaching, peer collaboration, or mentoring. Rooted in sociocultural theory, serious games and gamification employ adaptive and personalized designs to scaffold learners within their zones of proximal development [32].

Constructivist learning theory encompasses the expansive process of knowledge formation and the initiation of learning processes by integrating motivational elements as essential criteria for effective learning. Gamified applications leveraging constructivist concepts aim to enhance intended learning outcomes by combining learning through experience, engagement, and self-reflection. Experiential learning theory emphasizes that learning occurs iteratively through personal and contextual experiences rather than traditional teaching methods. According to the contextual learning hypothesis (19, 34, 35), conceptual information cannot be isolated from the contexts in which it is learned and applied.

Consequently, authentic learning environments must be established to enable students to engage in learning activities while connecting their prior knowledge to real-world events. Consequently, the design of virtual settings in serious games is informed by both situated learning theory and experiential learning theory, ensuring reflection of real-world surroundings and problem-solving contexts. Theories of cognitive load and multimedia learning theory delve into the mind's ability to process information and the myriad of mental operations required to organize and connect new information to existing knowledge. In this context, redundant processes or additional cognitive load hindering active examination of learning material are discussed. These theoretical foundations provide a basis for empirical discussions on whether gamification is intended to reduce unnecessary cognitive strain or if it increases cognitive load, impeding learning [36-45].

For instance, in a study [40], it was found that presenting individuals with type 1 diabetes with points as incentives increased the frequency of blood glucose measurements. Furthermore, Riva S. *et al.* [46] demonstrated that leaderboards and points positively impacted outcomes for individuals with chronic back pain, resulting in reduced medication use, decreased pain intensity, and increased activity. Dennis TA and O'Toole LJ [41]. reported that providing incentives was associated with reduced stress and anxious reactions in individuals with high trait anxiety. Points and accomplishments, as rewards, were linked to increased exercise motivation, according to a study conducted by Hamari J. and Koivisto J [43]. It was observed that when combined with leaderboards, points significantly increased physical activity. Chen Y. and Pu P [39], noted that rewards (badges and points) and leaderboards enhanced exercise in cooperative couples. In a study [3], it was found that incentives (medals connected to leaderboards) were associated with increased activity, self-determination, and reduced healthcare usage in arthritis patients.

Kuramoto I. *et al*. [44] reported that avatars in a gamified app became stronger as users stood up instead of sitting down on public transportation, indicating heightened standing motivation. Virtual characters used in gamified mobile anxiety training significantly reduced subjective anxiety and stress reactivity compared to placebo training, as reported by Dennis TA and O'Toole LJ [41]. Avatars, in conjunction with rewards, levels, and a story, boosted children's intake of fruits and vegetables, according to Jones BA *et al*. [42]. Furthermore, it was found that training motivation was positively influenced by a gamified set designed to limit alcohol intake [6]. Despite this, concerns were raised about user experience and usability when task specifications were included in the gamified software. Social engagement emerged as another effective motivator, enhancing users' feelings of fulfillment and drive when alcohol use was restricted, with positive impacts on physical activity and mental health. In the articles reviewed, various types of rewards were employed in gamification to encourage positive behavior.

Despite the positive findings, few studies have thoroughly examined the efficiency of gamification based on relevant theory. Limited data specifically examine motivational theory, and even fewer investigate whether motivational aspects are associated with effective outcomes. Self-determination emerges as a frequently discussed topic regarding gamification's role in maintaining individuals' health. Topics examined in the reviewed articles include design strategies to decrease turnover, behavioral modification, and empowerment ideas. The challenge lies in the simultaneous examination of various aspects of gamification in these articles, making it difficult to isolate the impacts of specific components. Hamari J. and Koivisto J [43], reported that when linked to social influence, social norms, and acknowledgment, gamification has a favorable impact, supporting the self-determination theory.

However, Kuramoto I. *et al.* [44] reported contra dictory results, indicating that rewards (combined with leaderboards) resulted in an immediate rise in moderate to intense physical activity but had no long-term effects. They also found that gamification had no effect on self-reported physical or emotional well-being. Primack BA *et al.* [47] observed no difference in usual walking behavior between participants using gamified (reward-based) and non-gamified versions of a smartphone application. Maher C. *et al.* [45] suggest that the same gamification features can have significantly varied effects on individuals. This indicates the need for further research on how gamification should be created and used for different phases of health behavior modification.

CONCLUSION

The reviewed articles suggest that gamification for wellness and health interventions can have positive effects, particularly on behavior, and is not expected to have adverse effects. However, caution should be exercised in the critical user experience, such as when users consciously choose whether or not to participate in the intervention. Poor usability of gamified running projects, for instance, led to many users giving up. Boendermaker WJ *et al.* [6] express concerns that including task specifications in the design of the interface could negatively impact user experience and usability.

Despite the focus on motivation in the reviewed articles, intrinsic motivation remains insufficiently studied concerning the influence of game design elements, either as a direct effect or as a secondary source for health outcomes. Positive reinforcement is the primary basis for the theoretical and practical aspects of the evaluated health gamification systems, primarily examining behavioral implications. The potential for inadvertently boosting health through game design lessons has not been thoroughly investigated and proven.

IMPLICATIONS

Several studies investigated mobile devices or the internet as delivery platforms, observing positive benefits outside the digital sphere, such as in classrooms when gamification was physically displayed. This aligns with the promises of gamification for life fitness and broad availability *via* mobile and easily accessible sensor technology. However, few articles have specifically examined and contrasted the differences and effects of daily lifestyle and availability in mobile device-based therapy *vs.* PC device-based therapy. Additionally, gamification did not consistently consider daily lifestyle as an independent criterion.

ABBREVIATION

PRISMA = Preferred Reporting Items for Systematic Review

CONSENT FOR PUBLICATION

Not applicable.

STANDARDS OF REPORTING

PRISMA guidelines and methodology were followed.

AVAILABILITY OF DATA AND MATERIALS

All the data and supportive information are provided within the article.

FUNDING

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CONFLICT OF INTEREST

The author declared no conflict of interest, financial or otherwise.

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SUPPLEMENTARY MATERIAL

PRISMA checklist is available as supplementary material on the publisher's website along with the published article.

Supplementary material is available on the publisher's website along with the published article.

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