

Digital and video games in health promotion: Systematic review of games and health behavior

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Abstract

Games have gained interest as a way to promote health, ability to function and rehabilitation in digital environments or conjoining physical and digital environments. Most studies have focused on risks and problems in using games for health. In this review, the aim is to describe the use of digital and video games in health promotion. Especially, what kind of games are used in health promotion and how they support the change in health behavior. MEDLINE Ovid, CINAHL (EBSCO), PubMed and Cochrane Library databases were searched using terms related to digital or video games and health behavior. A search focused on years 2005-2014 and identified 3237 publications.

Thirty studies met the criteria and two thirds of them used experimental design. The number of participants in the interventions were small in general. Most studies focused on physical activity and enjoyment of playing. Five studies considered nutrition and dietary habits. The most used video game console was Nintendo Wii. The results indicated that video games increased light- and moderate-intensity activities, adherence to medication, knowledge on disease and healthy behavior. Furthermore, games relaxed and alleviated depressive symptoms. There was no evidence that the games achieved sustained changes in health behavior. Only short-term changes were reported.

Our review suggests that games for health are suitable for all-aged and promote their short-term health behavior. More studies are needed in order to indicate the long-term effects of games for health. Furthermore, more effective, tailored and enjoyable games are needed in health promotion to achieve sustained changes in health behavior of all individuals.

Keywords: review, video games, health promotion, health behavior

Introduction

Playing video and digital games is convention in Finland today. Finns are playing games actively and they are in the second place in Europe [1]. According to Mäyrä and Erma ca. 90 percent of Finns, aged 10–75 years, are playing traditional or digital games at least once a month and 74 percent of them are playing digital games [2]. Especially, playing mobile games has increased lately. Every third Finn was playing mobile games during the last month [1,2].

The use of games in other purpose as entertainment has been increasing. These games are called serious games and their primary goal is education or other activities rather than entertainment. However, the element of enjoyment is an essential part of playing experience. Games which achieve health benefits are called games for health. They are used for rehabilitation, improving skills by training, promotion of physical activity, health education and therapeutic interventions. [3] There are no data how much people use the games for health to promote their well-being, but according to the Interactive Software Federation of Europe (ISFE), every third parent is playing with their child aiming at achieving benefits for health or fitness [1].

There is no clear definition what video and digital games really are. The definitions vary depending on disciplines and researchers [4,5]. Mostly digital games refer to the application or devices of information technology like computers, play consoles, tablet devices and smartphones, which are used for playing and interactive entertainment. [5,6,7] In addition to digitizing, there are other characteristics defining games. Firstly they include equal competition. Every player has similar chance to win or achieve result, which is better than other players. Games provide measurable results on playing, like scores, which can be compared with others. To achieve measurable results, games involve clear aims and purposes, which player can strive [3,4,5,8].

Secondly, games have virtual environment, where player can explore and interact. Virtual environment involves characters and stories creating narratives for games. The action of player in game produces instant

feedback, changes its environment or affects its events. Games have relevant challenges requiring different kinds of efforts from player to solve tasks, and enable other players to participate in the same game and share experiences [4,5,7,8].

Game and player's action are bound with rules. In traditional games, they amount to a set of declarative statements, but in video and digital games, rules mean possibilities for interaction and objectives that must be achieved [4]. Finally, safety and freedom belong to games. Everything what happens in game, happens only there having no consequences to real life. Everyone can also choose freely if he or she plays or not [4,5].

Most studies in health and behavioral sciences have been focused on games and their negative impact, e.g. finding a connection between gaming and addictive or aggressive behavior [3,7]. During the last decade, research findings have indicated more and more health benefits of video games. For example, changes have been achieved in health-related behavior, like diet, sexual behavior and physical activity. Games for health have also increased knowledge on nutrition and diseases and improved self-management of asthma and diabetes. Especially, children and youth have been target groups in these studies. [9-15] The aim of this review is to describe the use of digital and video games in health promotion. What kind of games are used in health promotion and how they support the change in health behavior? The study is a part of Health ProPeli -project, where the use of digital games and applications in health promotion is studied.

Material and methods

A systematic search and review implemented is presented in Figure 1. A literature search on health behavior and video games was conducted using databases MEDLINE Ovid, CINAHL (EBSCO), PubMed and Cochrane Library. The search was performed between April and June 2014. Search terms were: video games OR digital games OR serious games AND health behavior. Furthermore, manual search was performed on Games for Health Journal: Research, Development, and Clinical

Applications, published between 2012 and 2014. It is one of the essential journal in this topic and was not covered correctly in previous searches. 27 articles were added after manual search. The total number of relevant citations were 3237.

Published studies were included if they met all the following criteria: 1) English language; 2) the publication was an original study, published between 2005 and 2014 3) a full text available; 4) the game was used as the primary intervention; 5) the study was not related to addictive and aggressive behavior or screen-time; 6) the study was not a review of other studies or 7) the study was not focused on rehabilitation. There were no

limits on study participants nor study settings. Randomized controlled trials (RCTs), nonrandomized controlled trials, cohort studies, comparison studies and qualitative studies were all eligible.

The selection of reviewed studies was conducted in three stages. Firstly, 3093 irrelevant citations were excluded after screening titles. Secondly, the abstracts of the 144 articles were retrieved and screened using the inclusion criteria. The articles were reduced to 45 articles after screening abstracts. Finally, 30 articles were included after reading the full text. Included studies met all the criteria.

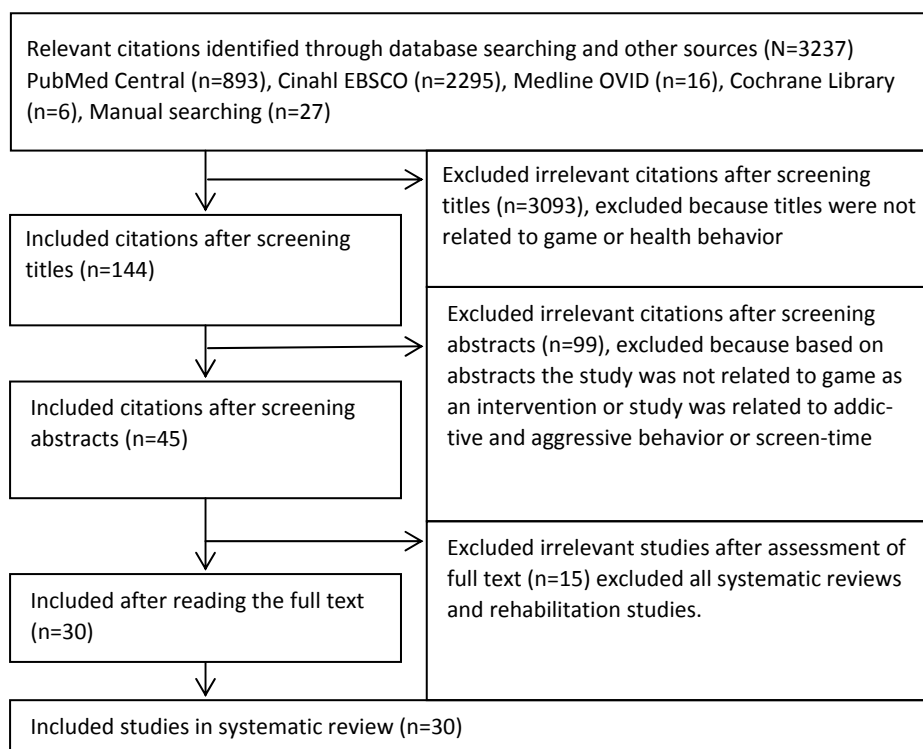


Figure 1. Search strategy and databases.

Results

Thirty studies were included to final review. The summary of these studies is presented in Table 1. Most of the studies (19 of 30) focused on physical activity and its physiological responses like energy expenditure,

heart rate and perceived exertion. Seven studies examined the enjoyment and flow experiences of playing games. Only five out of 30 studies focused on nutrition and dietary behavior. The rest of the studies investigated knowledge on disease (n=4), self-efficacy (n=3), adherence to medication (n=2), balance (n=2) and qual-

ity of life (n=3). Children and adolescents (7-16 years) were the main target group in studies. One third of studies (n=13) focused on them. The other group were young adults (n=8), adults (n=8) and the elderly (n=3).

Over half of the studies used experimental design as a study setting (n=18). Randomized controlled trials were used in seven studies, the pre-post-test design in five

studies and the other experimental trials/designs in six studies. Three studies reported the use of quasi-experimental design, and seven used non-experimental design, like repeated measures, comparison- and cross-sectional designs. The samples in studies were small, most of them were under one hundred. Only three studies were qualitative research and used interviews and observation in data collection.

Table 1. Summary of studies using games for health promotion.

Study & year	Study design & participants & DoI	Device(s) and game(s)	Outcomes	Key findings
Bailey & McInnis 2012 [16]	Comparison study 39 children, 9-13 years DoI not mentioned	Dance Dance Revolution (DDR), LightSpace (Bug Invasion), Nintendo Wii (Boxing), Cybex Trazer (Goalie Wars), Sportwall, and Xavix (J-Mat)	-energy expenditure -exergame enjoyment -body composition	-All forms of interactive gaming increased energy expenditure above rest. -Enjoyment of the games was generally high but was highest for children with BMIs in the highest percentiles. -Exergaming has the potential to increase physical activity and have a favorable influence on energy balance, and may be a viable alternative to traditional fitness activities for children of various BMI levels.
Baranowski et al 2012 [34]	RCT 84 children, 9-12 years 13 weeks	The Nintendo Wii: Active Life-Extreme Challenge, EA Sports Active, Dance Dance Revolution-Hottest Party 3, Wii Fit Plus, Wii Sports, Disney Sing It-Pop Hits, Madden NFL 10, Mario Kart Wii Wheel, New Super Mario Bros. & - Super Mario Galaxy	-PA level	-No evidence that children receiving the active video games were more active in general -These results provide no reason to believe that simply acquiring an active video game under naturalistic circumstances provides a public health benefit to children
Beale et al 2007 [28]	RCT 375 patients, 13-29 years 12 weeks	Re-Mission, video game	-cancer-related knowledge -acceptability and credibility of Re-Mission	-Knowledge test scores of both groups improved significantly over the follow-up periods, Re-Mission group improved significantly more. -Age, gender, prior video game experience and baseline knowledge test score were not found to be significantly associated with amount of improvement of knowledge following intervention
Beltran et al 2012 [39]	QR, semistructured interviews 16 parents	Kiddio-Food Fight, video game app	-Parents' game experience	-Parents generally liked the game. -Kiddio Food Fight could have positive acceptance among parents with minor modifications. A videogame play could help parents learn effective vegetable parenting practices.
Bosch et al 2012 [27]	Repeated measures 20 adults, 23-27 years DoI not mentioned	Nintendo Wii Sports (Boxing)	-heart rate	-Thirty minutes of Nintendo Wii Sports boxing provides a moderate to vigorous aerobic response in healthy young adults and can contribute to daily recommendations for physical activity.
Devereaux et al 2012 [35]	Repeated measures 12 adults Age and DoI not mentioned	Nintendo Wii Fit Plus	-perceived exertion -heart rate	-When compared to traditional exercise modalities the Nintendo Wii Fit Plus was perceived to require less effort. Using the Nintendo Wii Fit Plus is likely to result in higher exercise adherence rates.
Diaz-Orueta et al 2012 [40]	Cross-sectional study 35 adults, 20-40 years (18 patients 16-52 years) DoI not mentioned	Isla Calma, interactive VR	-usability -acceptability -game immersion -subjective experience	-IC was seen as a highly relaxing and pain distracting tool with potential clinical applications in different settings.
Graf et al 2009 [17]	Comparison study 23 children, 10-13 years DoI not mentioned	PS2: Dance Dance Revolution (DDR) Nintendo Wii Sports	-energy expenditure -heart and step rates -perceived exertion	-Energy expenditure during active video game play is comparable to moderate-intensity walking. Thus, for children who spend considerable time playing electronic screen games for entertainment, physically active games seem to be a safe, fun, and valuable means of promoting energy expenditure.

Hwang et al 2011 [41]	QR, Interview and observation 30 elderly, over 55 year	The Embodied Interactive Video Games	-flow experience -feelings of the subject in playing	-The female, the younger elders, and the elders with lower SES easily felt the flow experiences. - There were no significant differences found between age and SES groups in the flow experiences of the embodied interactive video game system
Jahn et al 2012 [29]	Exploratory study with mixed methods 7 adult patients with cancer, 47-70 years 5 days	Nintendo Wii	-PA level -health-related quality of life	- Participants showed a high degree of acceptance using this kind of physical activity -The majority of individuals felt stimulated to become physically active during hospitalization by playing Nintendo Wii -The majority of the patients reported an improved mood state. - The results indicate that a motion-activated game console could be useful to motivate adult patients with cancer to be physically active during hospitalization.
Janssen et al 2013 [32]	Non-Randomized Trials 29 nursing home residents, 65-90 years 12 weeks	Nintendo Wii Fit Plus	-balance -PA level	-An effect of Nintendo "Wii Fit Plus" gaming on physical activity of nursing home residents, but not on their balance.
Kato et al 2008 [37]	RCT 375 patients, 13-29 years 12 weeks	Re-Mission, PC-game Indiana Jones the Emperor's Tomb 55	-adherence -self-efficacy -knowledge -stress -quality of life	-Adherence to trimethoprim-sulfamethoxazole and 6-mercaptopurine was greater in the intervention group. -Self-efficacy and knowledge increased in the intervention group -The intervention did not affect self-report measures of adherence, stress, control, or quality of life.
Khalil 2012 [38]	Pre- & post tests 48 students, 18-29 years DoI not mentioned	Re-Mission	-intention to seek information -perception of cancer risk -protect motivation	-young adult players of "Re-Mission" increased in perception of cancer risks, protective motivation, and intentions to seek cancer-related information.
Kloos et al 2013 [30]	controlled, single-blinded trial 18 patients, 36-65 years 6 weeks	Dance Dance Revolution (DDR)	-game play performance and adherence -participant perceptions of the game -safety and quality of life -spatiotemporal gait measures	-significant changes were noted in dynamic balance during walking -DDR did not significantly impact functional mobility, balance confidence, or quality of life -DDR appears to be a feasible, motivating, and safe exercise intervention for individuals with Huntington's disease.
Li et al 2011 [45]	Quasi-experimental pre & post-test design 122 children, 8-16 years DoI not mentioned	PlayMotion	-anxiety -depression	-children in the experimental group reported statistically significant fewer depressive symptoms -no differences in children's anxiety scores
Lu et al 2012 [42]	RCT 97 children, 10-12 years 8 weeks	Escape from Diab	-story immersion -Fruit and vegetable consumption -PA level - Intrinsic motivation -Self-efficacy	-Story immersion correlate positively with an increase in Fruit and Vegetable Preference, instinct motivation for water, vegetable self-efficacy and physical activity self-efficacy - Effectively embedding characters with similar phenotypic features to the target population in interactive health videogame narratives may be important when motivating children to adopt obesity prevention behaviors.
Lyons et al 2011 [18]	Quasi-experimental design 100 young adults, 18-35 years DoI not mentioned	PS3 and Nintendo Wii: Medal of Honor: Airborne, Resident Evil 4, Resident Evil, Medal of Honor: Heroes 2, Resident Evil: The Umbrella Chronicles, Guitar Hero III: Legends of Rock, Rock Band 2, Dance Dance Revolution: Universe 2, Nintendo Wii Fit mini games (aerobic, balance, yoga, and strength)	-energy expenditure -enjoyment	-All games except shooter games significantly increased energy expenditure over rest -Fitness and dance games increased energy expenditure -Enjoyment was higher in band simulation games than in other types -AVGs can significantly increase energy expended during screen time, but these games are less enjoyable than other more sedentary games -Less active but more enjoyable video games may be a promising method for decreasing sedentary behavior.

Maddison et al 2013 [26]	RCT 322 children, 10-14 years 24 weeks	PlayStation Eye-Toy and a selection of games e.g. Play3, Kinetic, Sport and Dance Factory	-body composition -PA level -sedentary behavior -snack food consumption	-There was no difference between groups for total physical activity levels, but there was an increase in self-reported AVG play and reductions in non-AVG play and snack food consumption in the intervention group. -AVGs have a small but definite effect on BMI and improving body composition in overweight and obese children -Aerobic fitness may have served as a proxy measure of increased physical activity and reduced sedentary behavior
Maloney et al 2012 [19]	RCT 65 families with child 9-17 years 12 weeks	Dance Dance Revolution (DDR)	-anthropometric measurements -PA level	-PA increased significantly from baseline to 12 weeks for the treatment group and declined for the comparison group. -Based on self-report measures, DDR may have increased PA levels in obese and overweight children - Accelerometer results indicate that although DDR did not boost PA, it may have helped to slow the decline in moderate to vigorous PA over time
McCarthy et al 2013 [33]	Pre & post-test control group design 32 university students, 4 weeks	Nintendo Wii Fit (yoga training)	-flexibility -heart rate	-Significant improvements in both upper and lower body flexibility were noted for the Wii Fit users -The Wii Fit can be effectively utilised as part of overall flexibility training
Miller et al 2013 [23]	Randomized crossover design 104 children, 8-15 years DoI not mentioned	Winds of Orbis: An Active Adventure Dance Dance Revolution (DDR)	-energy expenditure -PA level	-Energy expenditure was significantly greater from Traditional Physical Education (PE) compared with "Orbis" and DDR. -After adjustment for sex, grade, and body mass index, we observed that among children in grades 3-5 energy expenditure from all three activities was sufficient to meet recommended intensity criteria for vigorous activity.
Miyachi et al 2010 [24]	Experimental design 12 adults, 25-44 years DoI not mentioned	Nintendo Wii Sports (golf, bowling, tennis, baseball, and boxing) Nintendo Wii Fit Plus (63 activities classified as yoga, resistance, balance, and aerobic exercises)	-energy expenditure	-Forty-six activities (67%) were classified as light intensity and 22 activities (33%) were classified as moderate intensity. -There were no vigorous-intensity activities.
Moore et al 2009 [43]	pre & posttest, quasi-experimental design 126 students DoI not mentioned	The Blast-Off, online game	-nutrition knowledge -self-care practices -activity levels -nutrition status -PA level	-The program increased nutrition knowledge -Game increased activity time from pretest to posttest and decreased systolic blood pressure for children in both groups: no significant differences in BMI percentiles
Ni Murchu et al 2008 [20]	RCT 20 children, 10-14 years 12 weeks	EyeToy active games		-Playing active video games on a regular basis have positive effects on children's overall physical activity levels.
Nitz et al 2010 [31]	pre & posttest 10 women, 30-58 years 10 weeks	Nintendo Wii Fit	-balance -mobility -cardiovascular fitness	-Balance (unilateral stance, eyes open) and lower limb muscle strength showed significant improvement but changes in touch, vibration, proprioception, cardiovascular endurance, mobility, weight change, activity level and well-being were not significant.
Norman et al 2013 [36]	Randomized trial 63 adolescents 11-15 years 4 weeks	Xavix Bowling, Xavix Tennis, Boxing and aerobic fitness training "Jackie Chan Studio Fitness" (J-MAT)	-behavioral contingencies -PA level	-AVGs with more behavioral contingencies, compared with AVGs with fewer behavioral contingencies, result in more physical activity. -AVG play decreased substantially after the first week.
O'Donovan & Hussey 2012 [25]	Cross-sectional study 28 adults, 19-27 years DoI not mentioned	Nintendo Wii Sports Boxing, Tennis and Baseball, Nintendo Wii Fit Free Jogging	-energy expenditure -heart rate -experience of gaming	-Wii Sports Boxing, Tennis and Baseball are light-intensity activities, and Wii Fit Free Jogging is a moderate-intensity activity. -Experience of gaming may affect the exercise intensity of games.
O'Donovan et al 2014 [21]	Cross-sectional study 60 children, 7-17 years DoI not mentioned	Nintendo Wii Sports Boxing Nintendo Wii Fit Free Jogging	-energy cost -heart rate -PA level	-AVG play can result in light-to-moderate intensity physical activity -No significant difference was seen between groups in the energy cost of playing Boxing. -There seems to be some differences in how children with obesity and children of a healthy weight play AVGs. This could result in those with obesity expending less energy than their lean peers during AVG play

Schneider et al 2012 [44]	pre & posttest 97 elementary students a week	Fitter Critters	-knowledge of nutrition and activity -attitude -self-efficacy	-Significant increases in positive attitudes toward healthy eating and healthy eating self-efficacy and marginally significant increases in nutrition knowledge were observed. -The "Fitter Critters" health videogame engages students in learning about healthy eating and activity
Sell et al 2008 [22]	pre & posttest 19 male students 18-25 years	Dance Dance Revolution (DDR)	-energy expenditure -playing experience -PA level	-Participants with greater playing experience can work at higher intensities, promoting greater energy expenditure

DOI=Duration of Intervention, RCT=Randomized controlled trial, PA=Physical Activity, AVGs=Active video games.

Most studies used video game consoles; Nintendo Wii, Sony PlayStation, Microsoft Xbox or Xavix and their commercial games. All these consoles represented so called active videogames (AVGs) and they were designed to increase movement during playing. Furthermore, different kind of devices have been plugged into video game consoles. In studies of this review, the most used device was a mat-based game Dance Dance Revolution (DDR), which has been released on various consoles. The main idea of this mat-based game is that players follow a preprogrammed pattern of dance movements. The results of DDR were reported by eight studies in this review. The other devices of video consoles were PlayMotion and Eye-Toy by Sony PlayStation. All of them were designed for users to control and interact with game using motion, gestures or spoken commands. Of the 30 studies, 14 have used Nintendo Wii and its games like Wii Sports, Wii Fit Plus and DDR.

Almost all children and young adults have been benefited from the use of DDR and the other active video games (AVGs). Their physical activity and energy expenditure increased during the intervention [16-23], even if traditional exercise was indicated to be more effective than DDR and other AVGs [21,23]. Playing AVGs was comparable to light- and moderate-intensity activities like walking [17,21,24,25]. Especially, overweight children benefitted from playing AVGs [19,26] providing them an alternative to traditional exercise [16]. AVGs contributed to physical activity level in children and young adults [17,18,27]. Playing was better than sitting back, and it provided enjoyment and flow experiences for all aged [16,24,28,29]. Furthermore, patients became physically active by playing AVGs during hospitalization [29] and adults with Huntington's disease got significant improvements in their balance

during walking [30]. However, the results of balance were conflicting. The use of Nintendo Wii Fit improved the balance of middle-aged women [31] but Wii Fit Plus had no effect on the balance among the elderly [32]. McCarthy et al [33] noted improvements in the upper and lower body flexibility of university students, when they used Wii Fit Yoga training.

In review, some challenges were perceived with AVGs. There was no evidence that AVGs intrinsically activated children to exercise [34], but according to Devereaux et al [35] they added exercise adherence, especially among adults. Lyons et al [18] noted that AVGs were less enjoyable than other sedentary games, and Norman et al [36] reported that playing decreased after the first weeks. Furthermore, according to included studies, there were no connection between video games and quality of life. Playing did not affect self-reported quality of life [37,38].

Only ten studies reported results on using and developing new online games for computers and smartphones to support health behavior change [28,37-45]. Most of the games were designed for children and youths. Three studies were focused on Re-Mission, a PC- and video game designed to be played by young people undergoing treatment for cancer [28,37,38]. Players controlled a nanobot "Roxxi" and only their engagement in self-care behaviors and knowledge about cancer helped them to complete missions. According to studies knowledge on cancer and self-efficacy improved significantly [28,37,38]. Khalil [38] indicated that players' perception of cancer risks, protective motivation and intentions to seek cancer-related knowledge increased. Prior video game experience, age and gender were not associated with the knowledge [28]. Kato et al

[37] reported that in “Re-Mission” players’ adherence to medication was greater than in other players.

Increasing knowledge about healthy eating and physical activity was the aim of the online video games Fitter Critters and Blast-Off [43,44]. They were designed for improving healthy diet and activity in students. In Fitter Critters, player was responsible for a virtual pet “Criter” and its health. The duration of intervention was only a week and they measured significant increases in positive attitudes towards healthy eating, self-efficacy and marginally increase in knowledge on nutrition. [44] The Blast-Off was a part of MyPyramid online intervention for students to increase their knowledge about the basic food groups, physical activity, and making healthy food choices. In the game, players selected food and physical activity times and placed them on a rocket ship. They tried to get an appropriate balance of fuel to reach Planet Power. There was no significant evidence for weight changed just playing the game, even if activity levels somewhat increased [43].

Healthy lifestyle and its adopting was the aim of the game “Escape from Diab”. It was a game about youth, Deejay, who accidentally falls into a world “Diab”. By adopting a healthier lifestyle, Deejay and his friends tried to escape from Diab. Story immersion was realized to be powerful tool for game-based health intervention and it correlated positively with an increase in fruit and vegetable preference and physical activity [42].

Kiddio-Food Fight was a smartphone application for parents, in which they tried to get the child “Kiddio” in the game to taste vegetables. Players selected parenting statements or manipulation of the environment to control situation or encourage tasting vegetables. Successful selections moved players a stage closer to winning. This pilot test indicated that the usability, story and feedback were key elements of games for health and parents liked the game [39].

Hwang et al [41] used The Embodied Interactive Video Games (EIVG), where vectorial animation for the interaction with user via webcam were created in project. In the first game, the elderly players categorized healthy food and in the second game, players identified and

selected the symbols of countries. The aim of the games was to develop cognitive process. The elderly’s perceptions and flow experiences on game were positive and the usability of the game was high [41].

An interactive virtual reality was represented by two games Isla Calma (IC) and PlayMotion. The aims of IC were to relax the user and try to distract attention from pain or anxiety. In game, players searched for and collected magical stones, placed them and thus brought life to a silent island. Study reported preliminary results on dental clinical settings and it indicated that patients were more relaxed and comfortable than during the previous visit to dentist. They felt less anxious and fear. [40] PlayMotion is a device, which transforms walls and floors into interactive virtual playground. Only the shadows of moving arms are needed. Li et al [45] reported that children with cancer had fewer depressive symptoms than control group, when they used PlayMotion. There were no differences observed in anxiety levels.

Discussion

This review highlighted that digital and video games for health are suitable for all-aged. All groups liked the games, felt flow experiences and enjoyment [16,18,29,41]. It is clear, that video games provided something extra for players. Playing is fun, but mostly games for health are less enjoyable than other games [28]. Story immersion and the other main elements of games should be better taken into consideration in developing new tailored games for health. Good narratives can motivate people to play and adopt healthy behaviors at the same time [42]. It will require collaboration with game industry, story writers and health professionals. Only, when the good qualities of games: usability, stories, feedback and enjoyment, combine with health subject, we can get effective games for health. The results of this review can be used to recognize the mutual interests in game development.

The studies of this review focused on the existing commercial video games and game consoles. Most of them considered physical activity and active video games.

This finding supported the previous study, in which physical activity was the most covered health topic in active assistance technology [46]. Active video games represent a new approach to interaction via webcam and other wireless devices, in which players' movement affect directly into game actions. This approach diminishes the barriers to use video games in new groups, who have never played video games and thus provide a tool for health promotion in all-aged. The studies of this review included all-aged people from children to the elderly. It is noteworthy that so far only some new games are developed to people of various ages with a view to promote health behavior. It is probable that we need more games for health and health promotion. Further studies and efforts are needed in order to develop effective and enjoyable games and to assess their usefulness in health promotion.

According to included studies, there were no connection between video games and quality of life. Probably, a short-term playing has no impact to general well-being of individuals. There was no evidence that video or digital games achieved positive long-term effects on players' physical activity, healthy dietary behavior or knowledge on medication. All studies included in this review were short-term interventions, from few days to 24 weeks at most and the samples were mainly small. While the results of video games in health promotion are promising, further evidence including larger sample sizes and longer follow-up are needed in order to indicate the long-term effects of the games for health.

The existing research provides information on the effects of games for health among those who in the interventions are using the games. However, there is no research on what factors are motivating people to use the games for health. It would be extremely important to understand can we get those in most need for behavior change to use digital games as a tool to support the initiation, action and maintenance of new behavior. Games themselves do not change health behavior. They can only help people to reflect their behavior and set the goal for healthy lifestyle [46]. Games at their best can support behavior change and give feedback on progress. Further evidence is needed in order to conjoin

games and other interventions and information on the change of health behavior.

This review only includes original articles published between 2005 and 2014. There were studies published before 2005, but the aim of this review was to gain the newest knowledge on the use of video games as an intervention in health promotion. Therefore, studies on addictive- and aggressive behavior, screen-time, rehabilitation and earlier reviews were excluded.

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