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The Use of Technology in Quarantine: A Way to Maintain and Promote Physical Health

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Abstract

Background: Along with the outbreak of coronavirus and quarantine practices in many countries, physical activities have certainly been severely restricted. The purpose of this review was to investigate the role of technology in maintaining and improving physical health. **Method:** For this systematic review study, the research method in this study included searching on PubMed and Google Scholar databases. Articles written in English and Persian in peer reviewed journals that examining the effect of electronic games and virtual reality on physical fitness were selected for analysis. Then, the eligible studies classifieds based on the study population ages. **Results:** Of 12563 studies found, 14 studies were eligible to enter the study. Research has shown that the use of technology significantly affect gait, balance, strength, flexibility, and mental functioning of the elderly, as well as balance, strength, endurance, and cognitive abilities in adults and children's physical endurance. **Conclusions:** According to studies under review, the use of technology has a significant effect on improving and maintaining the physical and mental fitness of people in different ages. So, we can suggest using exergame and virtual reality exercises as a possible intervention to promote and maintain physical and mental fitness in quarantine.

Keywords: Exergames physical fitness, COVID-19, Technology, Quarantine

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INTRODUCTION

The Corona virus was introduced in Wuhan, China, in December 2019, and despite of all the efforts that the Chinese government made to stop the virus, it spread around the world. Most epidemiologists believe that much of the success in controlling the virus in China and elsewhere has been due to the swift action taken by the authorities to impose quarantine conditions on most of the population. Thus, a bulk of countries that were heavily influenced by China, such as Italy and Spain, adopted similar strategies several weeks later (Jimenez-Pavon, Carbonell-Baeza, & Lavie, 2020).

In line with the increase in the number of governments applying quarantine to prevent the spread of COVID-19 across their own countries, numerous problems have arisen. A major problem with the destructive effects of quarantine is physical inactivity deficiency due to personal restrictions. Many companies and organizations have forced telecommunications. All sports competitions have been suspended or canceled. It seems that community and other forms of individual contacts should be avoided to prevent the virus (Lippi, Henry, & Sanchis-Gomar, 2020).

On the one hand, while a quarantine period is the best option and suggestion to stop contagious infections, it can have serious effects on other health dimensions. The onset of a sudden quarantine situation requires a fundamental change in people's lifestyle that greatly contributes to their mental and physical health (Lavie, Ozemek, Carbone, Katzmarzyk, & Blair, 2019). Limited physical activity or even more worrying, the inability to walk regularly as an important repercussion of quarantine may be associated with many adverse metabolic effects. This inactivity may increase the risk of many severe and debilitating disorders such as diabetes (Bhaskarabhatla & Birrer, 2005), cancer (Sanchis-Gomar et al., 2015), osteoporosis (Castrogiovanni et al., 2016), and cardiovascular diseases (Lippi & Sanchis-Gomar, 2020). In addition, the psychological effect of quarantine has recently been investigated through which negative psychological effects such as post-traumatic stress symptoms, confusion and anger have been reported (Brooks et al., 2020). Therefore, it seems quintessential to perform sports activities during quarantine to prevent such complications.

Virtual Reality (VR) which has recently been developed offers enjoyable and engaging sports experiences, even for the elderly (Rahman & Rahman, 2010) . VR can be defined as an artificial world of images and sounds created by a computer that is affected by one's actions (Dictionary, 2015). VR can also be described as multimedia or computer-simulated life, in which the environment simulates physical presence in real-world locations or imaginary worlds. Virtual reality can create sensory experiences such as virtual taste, sight, smell, and sound.

Currently, Exergames which are a VR-based games, are known as an effective training that makes physical activities more attractive and attracts a large audience from different groups (Lieberman et al., 2011). The fact is that these games allow for real-time feedback, which encourages people to finish the competition (Anderson-Hanley, Snyder, Nimon, & Arciero, 2011). Also, since these games have the ability to rank based on people's abilities, it ensures increased motivation to complete the game (Lange, Flynn, & Rizzo, 2009).

Given the current situation and quarantine in most countries, the use of Exergames due to the ability to simulate the external environment and motivate more activities can be a good option for home exercise. Although there are studies on the effect of these tools on one age group and some aspects of physical health, it is necessary to examine the role of these tools on different physical and psychological dimensions in different age groups. Accordingly, the aim of this study is to review the role of technology in maintaining and improving physical health.

METHOD

For this systematic review research, the titles, and abstracts of scientific resources available in the electronic database of PubMed and Google Scholar were searched in English and Persian without any time limit.

First, the titles and abstracts of the sources searched were reviewed by two researchers and in cases where there was disagreement, the researchers decided to enter or not to enter the sources into systematic review process in consultation with each other. Finally, the sources were divided into three age groups. In the search process, only the sources published in English and Persian were extracted. Only studies that examined the effect of exercise using technology or VR on physical health were selected and cross-sectional or retrospective studies were not

included. It should be noted that only the articles published in peer-review journals were taken into consideration.

RESULTS

Initially, a total of 12521 articles in PubMed database were found. From this number, 60 articles were selected based on the abstract review and their titles. After a closer look at the texts, 14 papers were eligible for the study, which were classified under the rubric of age due to the heterogeneity of the studies. Keywords were also searched on Google Scholar's database to find possible sources. The results of this research are presented based on age, below.

Elderly people (over 65 years)

Strength and endurance: One study had examined the effect of exergames on the strength and flexibility of the elderlies:

In their study, Keizo et al. reported that 24 sessions of exergames using Kinect including: Apple game, Tightrope standing game, Balloon popping game, and One-leg standing game for 45 minutes to an hour significantly improved the Functional Reach Test (FRT), and the 30-second chair stand (CS-30) by the elderly with an average age of 69 years old (Sato, Kuroki, Saiki, & Nagatomi, 2015). According to this study, video games using Kinect were effective in increasing performance in functional reaching tests, and 30 second chair-stand test for the elderly.

Gait: Two studies (Park, Kim, & Lee, 2015; Sato et al., 2015) examined the effect of VR game exercise on elderly gait:

Park et al. examined the effect of VR game exercise on the gait of 30 elderlies over 60 years old. Individuals were divided into two groups: ball practice and VR game. They practiced 30 minutes for three times per week for eight weeks. VR Exercises were performed by Wii Fit Balance Exercise Game and Soccer Heading, Snowboard slalom, and Table Tilt. The results showed that the step length increased significantly (Park et al., 2015). Keizo et al. also observed a significant reduction in double standing time after 24 sessions of exergames in the elderly (Sato et al., 2015).

Balance: In addition, due to the risk of falls in the elderly, many studies (Fazel Khakhoran, 2018; Park et al., 2015; Rendon et al., 2012; Sato et al., 2015) have examined the effectiveness of exergaming on the balance of the elderly.

Moradi et al. investigated the effects of 8 weeks of VR-based balance exercises on static, dynamic and functional balance of the elderly between the ages of 65 and 78 years old. The exercises included hula hoop, skiing, and other yoga movements. They reported a positive and significant effect of these games on the static, dynamic and functional balance of experimental group subjects compared to the control group (Fazel Khakhoran, 2018). In their study, Keizo et al. reported that 24 sessions of exergames, including one-legged standing, apple-playing, strapping, and balloon-tapping for 45 minutes to an hour, significantly improved Berg Balance Scale (BBS), in elderlies with an average age of 69 years old, (Sato et al., 2015). Randen et al. reported that three types of VR-based balance training with the Wii Fit device for three days per week for three weeks had a significant effect on improving balance of people with age range of 60-95 years old. (Rendon et al., 2012).

Park et al. reported that 6 weeks of VR-based training had a significant effect on average sway speed and timed up and go time of the elderly over 60 years of age (Park et al., 2015). In general, it can be concluded that VR gaming has a significant effect on improving the static, dynamic and functional balance of the elderly. Exergames are also significantly effective in improving BBS of the elderly, and training with the Wii Fit Nitro can be used to increase balance.

Physical and Mental Performance: In addition to these cases, two studies (Maillot, Perrot, & Hartley, 2012; Wollersheim et al., 2010) examined the effect of VR exercises on physical and mental performance of the elderly. Maillot et al. found the positive effect of physical-activity video-game training on physical and cognitive function in older adults (Maillot et al., 2012). Wollersheim et al. examined the effect of Wii Fit game on physical and cognitive function, speed of functional process, executive control on woman's physical and mental aspect for 6 weeks, which included a variety of sports such as tennis, boxing, bowling, etc. They found no significant improvement, but individuals were more eager to engage in physical activity, and their sense of well-being, social well-being, and psychological well-being improved (Wollersheim et al., 2010). Finally, the use of VR-based games seems to have a significant effect on the speed of the functional process and executive control. In addition, the use of Wii Fit devices increases the sense of well-being, sense of activity and social sense in a meaningful way.

It seems that exergames could be used not only on the factors associated to physical activities like static, dynamic, and functional balance, BBS, Functional Reach test, 30-second chair sitting, but also on the improvement of mental factors such as a sense of well-being, and an increased desire to engage in physical activity. Since aging is associated with metabolic regression changes in tissues, bones, and other organs, the use of these games as a low-risk tool in a completely safe environment leads to improved and maintained physical fitness and health

Adults (age range of 18-65 years old)

Balance: 4 studies (Cone, Levy, & Goble, 2015; Ibrahim, Mattar, & Elhafez, 2016; McConville & Virk, 2012; Prasertsakul, Kaimuk, Chinjenpradit, Limroongreungrat, & Charoensuk, 2018) have examined the effect of Exergames on various balance factors:

In a study, Ibrahim et al. reported that 15 minutes of VR-based balance training with the Nintendo® Wii Fit Plus (NWFP) and 15 minutes of dynamic balance training with Biodex for 4 weeks and 3 sessions per week had a significant effect on increasing the overall balance and decreasing the time of the balance test of people aged 35-55 years old and there was no significant difference between the two groups, but the results of the enjoyment questionnaire were better in the VR group (Ibrahim et al., 2016). McConville et al. reported that exergames had a significant effect on the balance of the 22-34 age group, performing for three weeks and three times per week, on the balance board and Tandem Romberg test (McConville & Virk, 2012). Cone et al. investigated the effect of Wii Fit training on dynamic balance in 40 people aged 18-35 years old. The NeuroCom Balance Manager was used to assess the dynamic balance. The Wii Fit device and its balance game program were used for intervention. Exercises were performed for 18 sessions within 6 weeks, and movement velocity and reaction time increased significantly in the exercise group (Cone et al., 2015)). In a VR-based balance test on postural control of the individual with the age range of 40-60-year-olds, Prasertsakul et al. reported that VR-based balance exercises compared to prevalent balance exercises caused significantly more improvement balance (Prasertsakul et al., 2018). According to the study results, it seems that balance exercises with Wii Fit device have a significant effect on impaired balance, reduced balance

time, reaction time and speed of movement. Also, electronic games have a significant effect on balance board test and Romberg test's results.

Strength and endurance: Also, a study (Huang, Wong, Lu, Huang, & Teng, 2017) examined the effect of exergaming based exercises on adult's strength and endurance:

Huang et al. reported that 12 weeks of exergame training had a significant effect on long-term fitness in 20-24 year olds, who trained 12 weeks, three times a week for 30 minutes - (Huang et al., 2017). According to this study, exergaming seems to have a significant effect on 3-min step test and 3 sit-up tests.

Cognitive Dimensions: Given the significance of psychological and cognitive dimensions, one study (Anderson-Hanley et al., 2012) addressed the effect of exergaming on the cognitive aspects of adults:

Anderson et al. examined the effect of exergaming on cognitive aspects of people over 55 years old in two groups: a regular exercise group with a stationary bike and a cybercycling group that exercised for 45 minutes per session and 5 times per week for 3 months and reported that people who took part in cyber cycling exercises cognitively outperformed those who practiced regular cycling (Anderson-Hanley et al., 2012). It can be concluded that exergaming has a significant effect not only on improving physical aspects but also on cognitive function.

Child (6-17 years old)

Physical activity level: 2 studies (Baranowski et al., 2012; Fogel, Miltenberger, Graves, & Koehler, 2010) examined the effect of exergames on physical activity level among people aged 6-17 years old:

Victoria et al. examined the effect of exergaming on the physical activity of sedentary children in a sports class. The sample included two boys and two girls with an average age of 9 years old who were overweight and less active than the rest of the class. A 10-session standard training course on skill and activity modeling, and a 10-session course that included 10 exergaming exercises, were designed for people who were more involved in exergaming exercises. The results revealed that using exergame may more effectively leads to an increase in the time of sports activities in these children (Fogel et al., 2010). Baranowski et al. examined the effect of exergames on children's physical activity. The participants included 78 children aged 9-12 years old, who were divided into two groups: active video game groups and passive video games. The

physical activity was measured using aaccelerometer before intervention, at weeks 6 and 7, and after week 12. The results showed there was no significant difference between the two groups (Baranowski et al., 2012)(26).

Endurance: One study examined the effect of Exergames on one mile running (Gao, Hannan, Xiang, Stodden, & Valdez, 2013):

Gaw et al. investigated the effect of Video Game-Based Exercise on physical health of 208 individuals with the age range of 10-12 years old and reported that in exercise group who did dance exercises using video games three times a week for 30 minutes, a significant improvement was observed in one mile of running (Gao et al., 2013). According to this study, it can be concluded that dance exercises using exergames resulted in a significant improvement in children's running in one mile. It seems that using VR training program is appropriate to increase children's endurance and increase motivation to exercise. Given that there has been a disagreement in the results of the studies, more studies are needed in this age group as well.

DISCUSSION

This review study focused on the use of technology to increase physical fitness in quarantine. In so doing, the available studies were classified based on age, and the results showed that the use of technology has had a significant effect on various aspects of physical fitness. There were also discrepancies in the reports, which could pertain to differences in the age of the samples, the type of game in question, the sample size, and the evaluation methods.

This study has gathered evidence on which the use of technology helps maintain physical fitness in quarantine and that people can use it as a suitable and low-risk tool to maintain their physical fitness. The following results can be expressed as the effect of technology use on increasing physical fitness:

The elderly

Balance: Studies have shown that various exergames have a significant effect on improving overall, static, and dynamic balance, and BBS, and average sway velocity, and Timed Up and Go time.

Mental health: Exergames have a significant effect on the physical and mental health of the elderly

Gait: Exergames have a significant effect on increasing the gait velocity of the elderly.

Flexibility: Exergames have a significant effect on the flexibility of the elderly.

Strength: Exergames have a significant effect in the strength of the elderly.

Adults

Balance: The use of exergames has a significant effect on the static and dynamic balance of adults.

Strength: Using exergames has a significant effect on adult's strength

Cognitive: The use of exergames has a significant effect on adult's cognitive performance.

Children

Endurance: Exergames have a significant effect on children's endurance.

Physical activity: Exergames have a significant effect on increasing physical activity.

Given the variety of Exergames as well as the variety of training protocols, it may not be possible to make a precise comparison among the articles; however, what is obvious is the positive impact of such games on the psychological and physical aspects of people after using it and most importantly its ease of use at home environment away from contact with others, which is the most important advantage during quarantine, and prevents the spread of COVID-19. On the other hand, a review article showed that regular exercise led to increased immunity and reduced risk of infection compared to sedentary individuals (Kruger, Mooren, & Pilat, 2016). Moderate-intensity exercise is recommended for healthy people; however, due to the high prevalence of COVID-19, it is more logical for different people to exercise at home and with personal tools. This program can include aerobic, strength, stretching and balance exercise, or a combination of these (Chen et al., 2020). Due to the fact that these tools are suitable for all ages, and given that their use is attractive, and given that its multi-step nature leads to increased motivation and encourages the individual to continue and finish the activity, it is recommended to people during this period.

Given that most studies have focused on factors such as balance, further studies on the effectiveness of exergames on other physical fitness factors like strength, endurance, and flexibility are needed. Also, most of the studies have been performed among the elderly age group and more studies are needed to be carried out on the other age groups, especially children and adolescents.

CONCLUSIONS

According to studies under review, the use of technology has a significant effect on improving and maintaining the physical and mental fitness of people in different ages. So, we can suggest using exergame and virtual reality exercises as a possible intervention to promote and maintain physical and mental fitness in quarantine.

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