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ORIGINAL ARTICLE

The Effect of Virtual Reality Application on Pain, Functional Independence, and Depression in the Older Adults: A Pilot Study

Sanal Gerçeklik Uygulamasının Yaşlı Bireylerde Ağrı, Fonksiyonel Kapasite ve Depresyon Üzerine Etkisi : Pilot Çalışma

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ABSTRACT

Purpose: The aim of the study is to determine the effects of virtual reality (Kinect game called Dance Central) experience on pain, depression and functional ability in elderly adults living in nursing homes.
Design and Methods: This study was carried out for a total of 3 weeks, by applying it twice a day, 15 minutes in the morning and 15 minutes in the evening, 3 days a week.
Findings: A statistically significant difference (χ2=13.455; p=0.001) was found between the depression scales of the elderly in the experimental group. In the pain scale, it was determined that there was a significant difference (t=2.317; p=0.039) between the experimental group and the control group in the 1st month.
Practice Implications: Nurses creating appropriate interventions in long-term care facilities can have an impact on the pain and depression of older adults.

Keywords: Older adults, Exergaming, Geriatric pain, Geriatric depression

ÖZ

Amaç: Çalışmanın amacı, huzurevinde yaşayan yaşlı erişkinlerde sanal gerçeklik (Dance Central adlı Kinect oyunu) deneyiminin ağrı, depresyon ve fonksiyonel yetenek üzerine etkisini belirlemektir.
Tasarım ve Yöntemler: Bu çalışma haftada 3 gün sabah 15 dakika ve akşam 15 dakika olmak üzere günde 2 defa olmak üzere toplam 3 hafta süreyle uygulandı.
Bulgular: Deney grubundaki yaşlıların depresyon ölçekleri arasında istatistiksel olarak anlamlı fark (χ2=13,455; p=0,001) bulundu. Ağrı ölçeğinde deney grubu ile kontrol grubu arasında 1. ayda anlamlı fark olduğu (t=2,317; p=0,039) belirlendi.
Uygulama Çıkarımları: Hemşirelerin uzun süreli bakım tesislerinde uygun müdahaleler oluşturması, yaşlı yetişkinlerin ağrı ve depresyonu üzerinde etkili olabilir.

Anahtar Kelimeler: Yaşlı yetişkinler, Exergaming, Geriatrik ağrı, Geriatrik depresyon

Introduction

The aging population is increasing at an unprecedented rate all over the world. The World Health Organization estimates that there were 900 million people aged 60 and over in 2015, and this number will have reached 2 billion by 2050. As a result, the demand for health services for the aging population is constantly increasing. Accordingly, concerns about the lifestyles and health conditions of older adults are raised (1).

It is stated that most older people suffer from chronic pain, functional dependence, and depression, which significantly alter their daily activities and place an enormous burden on healthcare (2, 3). It has been stated that musculoskeletal problems such as the degenerative spine, arthritic conditions and immobilization are the most common causes of chronic pain in older adults (2). It is estimated that the prevalence of chronic pain worldwide is between 25% and 50% in the older living in the community and up to 83% in those living in nursing homes (4). Functional dependence in older adults may occur with alienation from the dynamic environment. Older adults settled in nursing homes may become functionally dependent due to environmental changes (5). It is stated that an older adult individual may experience a temporary addiction while adapting to the new environment, but later on, as he learns new skills and adapts to his new environment, he may transit to less dependence and even independence (6). Placement of older adults in a nursing home causes depression in them (7). Depression in older adults is seen as the leading cause of disability worldwide, and feelings of loneliness contribute significantly to depression (8). Nursing home residents often feel lonely, which can further increase their feelings of depression.

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Older adults living in nursing homes are characterized by functional dependence, cognitive deficits, depression, and very low physical activity (9). As it can be understood, the pain, functional dependence, and depression problems of the older adults living in nursing homes need to be eliminated. It seems that there is a need for studies focusing on eliminating such problems of older adults living in nursing homes.

Today, in addition to traditional therapy, applications based on "virtual reality" (VR) are gaining interest (10, 11). VR is an individualized application that allows patients to determine their performance levels and adjust their postures in a virtual environment. For this reason, VR has been stated as a self-rehabilitation tool that reduces the need for one-on-one supervision by care professionals (12, 13). In some studies, it has been stated that virtual reality applications provide active participation of individuals and can be tried in the management of functional addiction, depression, and pain in older adults (11, 14).

Exercise-based VR games are becoming popular because they combine physical activity with game mechanics such as challenges and achievements. It is stated that these games can be used among older adults to encourage physical activity. This study aims to evaluate the effect of exercising with a game included in the Kinect VR content on pain, depression, and functional independence of older adults living in nursing homes.

Methods

Study Design

This research is an experimental pilot study and was conducted in a nursing home.

Research Hypothesis

H1: Residents exposed to VR Kinect will experience a decrease in pain when compared to those exposed to routine care se tine post implementation.

H2: Residents exposed to VR Kinect will experience a decrease in depression when compared to those exposed to routine care se tine post implementation.

H3: Residents exposed to VR Kinect will experience an increase in functional dependence after administration compared to those exposed to routine care.

Sample

Initially, it was determined that 21 older individuals lived in the nursing home. One individual was not included in the study because he had a history of falling and one individual was using a hearing aid. Apart from this, three older individuals refused to participate in the study. As a result, a total of 16 older individuals who volunteered and met the inclusion criteria became the participants of the study. Then, the older adults were randomly divided into 2 groups; the experimental group and the control group by drawing lots. A very short time after the beginning of the study, 1 individual from the experimental and control groups left the study voluntarily. As a result, the research was completed with 14 older individuals.

Inclusion Criteria

Older adults with the following characteristics were included in the study: Those who had pain for the last 3 months, regardless of severity, did not have dementia, were independent in activities of daily living, could stand up unaided before 30 seconds, and walk at least 6 meters without assistance, pre-administration blood glucose of 90-200 mg/deciliter, blood pressure in the range of 130-70 mm/Hg before administration.

Exclusion criteria

Older adults who were in the rehabilitation process, had a history of falling, had hearing-vision impairment, could not communicate verbally and had neurological and psychiatric problems were not included in the study.

While determining the criteria, expert opinion was taken and cooperation was made with the nursing home care personnel.

Data Collection Tools

Introductory Information Form, Geriatric Pain Scale, Geriatric Depression Scale, and Functional Independence Scale were used to collect the data required for the study. In addition, a Microsoft Kinect game console and a monitor were used in the implementation of the research.

Introductory Information Form

It consisted of questions that included sociodemographic characteristics (age, gender, etc) created by researchers.

Geriatric Pain Scale

It was developed by Bruce A. Ferrell (2000) to describe pain in older adults and to evaluate the physical, emotional, cognitive, and behavioral responses that occur with pain (15). The scale evaluates the effects of pain on patients' lives. The scale also includes many components such as the definition of features such as location, severity, and quality of pain in older adults. The Cronbach alpha coefficient of the scale, which was adapted into Turkish by Dursun (2013), was 0.85. It has been determined that the …?.. version of the Geriatric Pain Scale is a valid and reliable tool consisting of 24 questions used to measure the quality, severity, physical, emotional, psychosocial, and behavioral dimensions of pain in older adults (16). Scores from the Geriatric Pain Scale are evaluated in the range of 0-42 points. For each yes answer given by the older adult, 1 point is given and the results are summed up. The results are multiplied by 2.38 and converted into a 100 system. Mild pain less than 0-30 points; moderate pain between 30-69 points; A score of 70 or more is defined as severe pain.

Geriatric Depression Scale

It was developed by Yesavage for the evaluation of depressive symptoms of older adults and includes a total of 15 questions. 5 questions (1, 5, 7, 11, and 13) are structured positively, while the other questions are structured negatively. In the evaluation of the scale, answers of no to positive questions and yes to negative questions were matched with 1 point each. A total score of 6 or more on the scale is considered significant for depression. However, the scale was also found to be valid in those under treatment for medical illness and individuals with dementia. The scale was adapted into …?. and the Cronbach alpha internal consistency coefficient was found as 0.92 (17).

Evaluation of Functional Independence

The Functional Independence Measurement (FIM) was used to assess the functional independence of older adults. FIM was developed in 1983 by the American Congress of Medical Rehabilitation and the American Academy of Physical Therapy and Rehabilitation.

Virtual Reality Game Console and Monitor

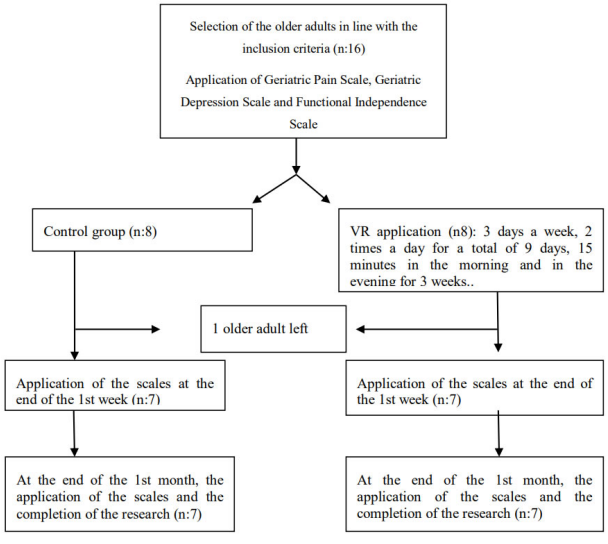
With Kinect, one of the most efficient products of rapidly developing computer technology and a virtual reality exercise application, human movements can be detected. Kinect's ability to detect human movements was first introduced in games. The system detects human movements and transfers them to the monitor. While playing the game, the individuals follow their movements on the monitor. If the gamer manages to do the movements he sees on the monitor, he sees a green ring on the screen. In this way, game lovers can play games with only their movements without using a controller or control card. With an infrared camera on the Kinect, the moving joints of the human can be detected and monitored. Kinect can detect 20 different motion points in a human. Kinect cameras can actively detect and monitor 20 different regions of two different people at the same time. In this study, the Kinect exercise game called Dance Central was applied to older adults.

Intervention

VR exercise application was introduced to the participants. The order of the area in the nursing home where the application would be made was ensured by the researcher and security measures were taken. VR exercise application was carried out in a room where older adults would feel comfortable and would not pose a risk of falling. The older adults were informed about the application. For the participant to feel comfortable, only the researcher and the older adult were present in the practice room. Then, introductory information form, geriatric pain scale, geriatric depression scale, functional independence scale were filled out.

The video game to be used during the application is played by performing the dance moves of the silhouette seen on the monitor. The silhouette seen on the monitor moves forward, backward, right, and left, taking small steps in rhythmic movements accompanied by music, and using the upper extremities at the same time. The older adult tries to do the movements at the same time with the silhouette. When the older adult can do the movements, a green ring forms around the silhouette. When the green ring is formed, the older adult is successful in imitating.

When the methods of similar studies in the literature are examined, it has been determined that the application times are 2-4 times a day for 3-12 weeks, and each application is done in periods of 15-30 minutes. In our study, the application was planned to be 15 minutes in the morning and evening, twice a day, 3 days a week, for a total of 3 weeks. The video used for the application lasts 3 minutes, and the older adult was put into practice at least for 30 minutes after breakfast and at least for 30 minutes after eating dinner in 3-minute periods. It was applied twice a day, for 15 minutes in the morning and in the evening. The application took 3 weeks in total. When the older adults felt tired, had dizziness, or had similar health problems during the application, the application was stopped and they were allowed to rest. In emergencies, necessary interventions were planned in cooperation with the physician. The scales were applied to the experimental group 1 week after the VR application was completed 1 month later. In the control group after the first evaluation, the scales were applied at the end of the 1st week and at the end of the 1st month.



Research Flow Chart

Permissions

Permission was obtained from the interventional research ethics committee of a university for the study. In addition, permission was obtained from the nursing home where the research was conducted. Informed

consent was read and signed by each older adult. In informed consent, older adults were assured that their participation was voluntary and that if they decided to withdraw from the study, there would be no change in the care provided by the staff. A signed consent form was obtained from all older adults. In addition, all principles of the Declaration of Helsinki were complied with throughout the study.

Statistical analysis

Statistical analyzes were performed using a package program called SPSS (IBM SPSS Statistics 20). Frequency tables and descriptive statistics were used to interpret the findings. Non-parametric methods were used for the measurement values that did not conform to the normal distribution. In accordance with non-parametric methods, the "Mann-Whitney U Test" (Z table value) was employed for comparing the measurement values of two independent groups, the "Kruskal-Wallis H Test" (χ2 table value) method for comparing the measurement values of three or more independent groups, and "Bonferroni Correction" was used for pairwise comparisons of these. The "Wilcoxon" test was used to compare the measurement values of two addicted groups, and the "Friedman Test" (χ2 table values) method was used to compare three or more dependent groups. Spearman correlation coefficient was used to examine the relationship between measurement values.

Results

Table 1. Experimental and control group sociodemographic characteristics

Variable	Experimental group (n=7)		Control group (n=7)	
	n	%	n	%
Age ranges				
75 years and below	4	57.1	2	28.6
76 years and older	3	42.9	5	71.4
Gender				
Female	4	57.2	3	42.8
Male	3	42.8	4	57.2
Number of medicines used				
2	1	14.3	1	14.2
3	2	28.6	3	42.9
4 and more	4	57.1	3	42.9
Number of chronic diseases				
1	1	14.3	2	28.6
2	6	85.7	5	71.4
Smoking				
Yes	2	28.6	3	42.9
No	5	71.4	4	57.1
Alcohol				
No	7	100.0	7	100.0

According to the findings, 57.1% of the participants are aged 75 and below while 42.9% of them are aged 76 and older; 57.1% of the participants take 4 or more medicines; the rate of the participants who have more than one chronic disease is 85.7%; 71.4% do not smoke; 100% of them do not take alcohol and are independent in daily life activities, and 42.9% of the participants define their health status as good (Table 1).

Table 2. Examination of the geriatric pain scale according to the experimental and control groups

Geriatric Pain Scale (N=14)	Experimental group (n=7) ±S.D.	Experimental group (n=7) Median [Min-Max]	Control group (n=7) ±S.D.	Control group (n=7) Median [Min-Max]	Statistical Analysis* ±S.D.
Prior to application (1)	20.86±5.37	9.43 [11.0-28.0]	17.57±2.51	5.57 [14.0-22.0]	z=-1.731 p=0.097
1st week (2)	16.14±5.76	8.14 [5.0-23.0]	15.86±1.68	6.86 [14.0-19.0]	z=-.583 p=0.620
1st month (3)	13.14±5.14	5.43 [7.0-22.0]	18.43±3.15	9.57 [15.0-22.0]	z=-1.880 p=0.060
****Statistical analysis**	χ^2=12.286 **p=0.002**			χ^2=6.348 **p=0.042**	
*****Difference**	**1>2** z=-2.379 **p=0.017** **1>3** z=-2.371 **p=0.018** **2>3** z=-2.043 **p=0.041**			**1>2** z=-2.070; **p=0.038**	

*Mann Whitney U test **Friedman test ***Wilcoxon test

When the geriatric pain scale between the experimental and control groups was evaluated; no statistically significant differences were found in the measurements before the application (z=-1.731; p=0.097), 1st week (z=-.583; p=0.620) and 1st month (z=-1.880; p=0.060), (p >0.05) (Table 2).

When the difference between geriatric pain scale values in the experimental group before the application, in the 1st week and the 1st month was evaluated; a statistically significant difference was determined (χ2=12.286; p=0.002). Paired comparisons were made between the groups to determine the difference between which measurements. Pre-application values in the 1st week (z=-2.379; p=0.017) and 1st month values (z=-2.371; p=0.018), 1st week values and 1st month values (z=-2.043; p= 0.041) were statistically significant (p<0.05). According to the results; Geriatric pain before the application decreased at the end of the 1st week. At the end of the 1st month, the level of geriatric pain further decreased compared to the 1st week (Table 2).

When the difference between geriatric pain scale values in the control group before the application, in the 1st week and the 1st month was evaluated; a statistically significant difference was determined

($\chi2$=6.348; p=0.042). Paired comparisons were made between the groups to determine the difference between the measurements. A statistically significant difference was found between the geriatric pain level before the application and the geriatric pain level in the 1st week (z=-2.070; p=0.038) (p<0.05). According to the results in the control group, geriatric pain before the application decreased at the end of the 1st week (Table 2).

Table 3. Examination of geriatric depression levels in experimental and control groups

Geriatric depression (N=14)	Experimental group (n=7) ±S.D.	Experimental group (n=7) Median [Min-Max]	Control group (n=7) ±S.D.	Control group (n=7) Median [Min-Max]	Statistical analysis*
Prior to application (1)	4.86±1.46	8.29 [3.0-7.0]	4.14±0.38	6.71 [4.0-5.0]	z=-0.820 p=0.412
1st week (2)	2.29±1.80	5.71 [0.0-4.0]	3.86±0.69	9.29 [3.0-5.0]	z=-1.712 p=0.087
1st month (3)	2.00±2.00	5.29 [0.0-4.0]	4.14±0.69	9.71 [3.0-5.0]	z=-2.128 **p=0.033**
**** Statistical analysis**	χ^2=13.455 **p=0.001**			χ^2=2.000 p=0.368	
*****Difference**	**1>2** z=-2.414 **p=0.016** **1>3** z=-2.392 **p=0.017**				

*Mann Whitney U test **Friedman Test ***Wilcoxon test

When the geriatric depression scale was evaluated between the experimental and control groups, no statistically significant differences were found in the measurements before the application (z=-0.820;p=0.412) and in the 1st week (z=-1.712;p=0.087) (p>0.05). However, a statistically significant difference was found between the experimental and control group's 1st month geriatric depression levels (z=-2.128;p=0.033). It was determined that the geriatric depression level of the control group was higher than that of the experimental group (Table 3).

When the difference between geriatric depression scale values in the experimental group before the application, in the 1st week and the 1st month was evaluated; a statistically significant difference was determined ($\chi2$=13.455; p=0.001). Paired comparisons were made between the groups to determine the difference between the measurements. A statistically significant difference was found between the values before the application and the 1st week (z=-2.414; p=0.016) and 1st-month values (z=-2.392; p=0.017) (p<0.05). According to the results; Geriatric depression before the application decreased at the end of the 1st week. The level of geriatric depression at the end of the 1st month decreased even more compared to the 1st week (Table 3).

When the difference between geriatric depression scale values in the control group before the application, in the 1st week and the 1st month was evaluated; no statistically significant difference was determined ($\chi2$=2.000; p=0.368) (Table 3).

Table 4. Examination of the FIM values of the experimental and control groups

FIM (N=14)	Experimental group (n=7) ±S.D.	Experimental group (n=7) Median [Min-Max]	Control group (n=7) ±S.D.	Control group (n=7) Median [Min-Max]	Statistical analysis**
Prior to application (1)	123.71±3.54	6.07 [116.0-126.0]	125.57±0.53	8.93 [125.0-126.0]	z=-1.389 p=0.165
1st week (2)	123.71±3.54	6.07 [116.0-126.0]	125.57±0.53	8.93 [125.0-126.0]	z=-1.389 p=0.165
1st month (3)	123.71±3.54	6.07 [116.0-126.0]	125.57±0.53	8.93 [125.0-126.0]	z=-1.389 p=0.165
***Statistical analysis**	-		-		
Difference					

* Since the scale scores before and after the application were the same, no difference was found. ** Mann Whitney U test

When the FIM values of the patients between the experimental and control groups were evaluated; No statistically significant differences were found in the measurements before the application (z=-1.389; p=0.165), 1st week (z=-1.389; p=0.165), and 1st month (z=-1.389; p=0.165) (p>0.05) (Table 4).

When the difference between the FIM values of the patients in the experimental and control groups before the application, in the 1st week and the 1st month was evaluated, it was determined that the scores were equal and there was no difference (Table 4).

Discussion

This study aimed to determine the effect of a virtual reality exercise experience on pain, depression, and functional competence in older adults' individuals living in a nursing home. It has been reported that physical activities can improve not only the physical health of older adults but also their happiness, pleasure from life, and quality of life (18, 19). In addition, Herz et al. (2013) reported that exercise with virtual reality exercise application can be effective in improving daily living activities and reducing depression (20). The VR application in our study reduced the pain and depression scores of nursing home residents. Our study adds new information to the literature.

The effect of VR exercise application on pain reduction has been shown in the literature. Fung et al. (2012) found that the mean age of the participants was 68.5, the pain decreased, and Yong et al. (2010) reported that the severity of pain decreased in individuals with

a mean age of 64.5 (21, 22). Additionally, Hsu et al. (2011) reported that the severity of pain decreased in individuals aged between 52 and 95, and this study was conducted to reduce the symptom burden in older adults (23). It is thought that the application of Kinect for at least 3 weeks may be effective in relieving the pain of nursing home residents experiencing pain.

This study also revealed the significant change in depression. Lee et al. reported that their depression decreased when virtual reality games were used by older adults (24). Song and Park concluded that virtual reality training was effective in improving balance, walking abilities, depression, and interpersonal relationships among stroke patients (10). Lee and Hong conducted a game-like group art therapy program for 30-year-old stroke patients and reported improvement in interpersonal relationships among those who participated in the therapy (25). In this study, the scores obtained from the geriatric depression scale of the group who applied Kinect changed significantly during the process. Virtual reality exercise application was effective in reducing the depression score of the experimental group. Our findings contribute to the literature in this area.

The literature provides evidence that Kinect practices improve functional independence (14, 26). The implementation period of similar studies in the literature on functionality varies as a minimum of 6 weeks and a maximum of 15 weeks (27). Our practice did not show any effect on the functional independence of older adults. We attribute this to the short duration of the implementation of our research. Compared to other similar studies in the literature, our study lasted 3 weeks. We think that more than 3 weeks should be applied for the improvement of functionality.

Limitations

The limitations of this study are that the study was conducted with only 14 residents of nursing homes, the implementation period was short, and the results were difficult to generalize. In addition, the attitudes of the participants attending this exercise game were not questioned after the end of this study.

Conclusion

This study shows that virtual reality-based exercise games can be an effective application for older adults. VR exercise games can be easily applied in older adults' care centers, nursing homes, hospitals. It can be easily adopted by older adults to improve pain, depression, and quality of life. We recommend that future studies be conducted in larger sample groups and on functionality in older adults. We think that the use of VR-based exercise games should be increased.

Implications for psychiatric nursing practice

There are benefits of conducting interventions in nursing homes with a focus on physical activity. If the goal here is an overall long-term benefit, these interventions need to be designed with the preferences of older adults in mind. The use of an exercise game with older adults has provided an interesting alternative way to encourage the continuation of physical activity. Based on the anecdotal comments of the participants, we can say that older adults have enjoyed this intervention.

Physical activity options for nursing home residents should be available regardless of barriers such as medical treatments and staff time. Integrating "exercise" into care as if it were a drug is becoming a new idea to help facilitate compliance. Nurses can program physical activity plans, such as scheduling pain medication before exercise, to facilitate adherence and maintenance of physical activity.

This VR intervention exposed participants to exergame technology and its potential health benefits. Creating appropriate interventions for older adults in long-term care facilities with exergame technology can have a positive impact on socialization and physical activity.

Author Contributions

Conception: G.U.,G.B.A., Design: G.U, G.B.A., Supervision: H.İ.T., G.U., G.B.A., Data Collection and/or Processing: G.U.,Analysis and/or Interpretation:H.I.T.,Literature Review: G.U, Writer: H.İ.T., G.U., G.B.A., Critical Review: G.B.A.

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