How to Cite:
Akhoundi, H., Ghadiri, F., & Yaali, R. (2022). Comparison of the effectiveness of exergame and dual task exercises on gait parameters and working memory and lower limb muscle strength in young elderly. *International Journal of Health Sciences*, *6*(S6), 4078–4095. https://doi.org/10.53730/ijhs.v6nS6.10299

Comparison of the effectiveness of exergame and dual task exercises on gait parameters and working memory and lower limb muscle strength in young elderly

Hosein Akhoundi
Master of Science Department of Motor Behavior, Faculty of Physical Education and Sport Sciences, Kharazmi University, Tehran, Iran
Email: Hosein.akhondi1375@yahoo.com
https://orcid.org/0000-0001-5662-0477

Farhad Ghadiri
Asistant professor Department of Motor Behavior, Faculty of Physical Education and Sport Sciences, Kharazmi University, Tehran, Iran
*Corresponding author email: Ghadiri@khu.ac.ir
https://orcid.org/0000-0002-1884-4899

Rasoul Yaali
Asistant professor Department of Motor Behavior, Faculty of Physical Education and Sport Sciences, Kharazmi University, Tehran, Iran
Email: r.yaali@khu.ac.ir
https://orcid.org/0000-0002-8159-4570

***Abstract*---**The aim of the present study was to compare the effectiveness of exergame and dual task exercises on gait parameters and lower limb muscle strength in young elderly. Participants in the training protocol included: 30 elderly aged 50-65 years. The training protocol lasted 18 sessions of 40 minutes and 6 weeks in two groups. The Exergame group played boxing and track and field games, and the dual task group practiced stepping exercises with 50-75% of the maximum beat along with the secondary cognitive task .According to the results of several components, of the lower limb muscle was improved and the effect of exergame was greater. The amount of changes recorded in the gait parameters indicates a lack of significant improvement in step length components stride length and a cadence. Also, the persistence of positive effects on the working memory component in the exergame group was slightly better.

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.
Manuscript submitted: 9 March 2022, Manuscript revised: 27 May 2022, Accepted for publication: 18 June 2022

Keywords---elderly, gait, working memory, muscle strength, exergame, dual task.

Introduction

With increasing age and reaching old age, there are many changes in the performance of motor tasks that lead to successful reduction of motor tasks and successful aging (Yasamy et al., 2013). Gait is considered a dynamic balance position in which the level of reliance on the center of gravity of the body while moving is very small(Hall & Fong, 2007; McCann & Higginson, 2008; Kuo & Donelan, 2010). Gait problems are one of the dangers associated with aging, with aging in the physiological and cognitive systems, the motor function of gait is impaired (Nutt et al., 1993; Pashler, 2001). These changes in motor function are due to cognitive factors associated with aging and disorders of the body's physiological systems (Yasamy et al., 2013). According to studies, the decrease in strength due to muscle wasting during this period may reduce the ability to perform fast movements, imbalance and increase the risk of falling (Yasamy et al., 2013).

Moubarez DA, et. al., 2019; Elmasry *DM, et. al., 2019; Ibrahim S, et. al., 2019)* . Falling in old age is directly related to neuromuscular factors such as muscle strength (Hurd et al., 2013) and cognitive factors such as working memory (Hurd et al., 2013). It can be argued that any reduction in muscle mass, strength, and efficiency with aging leads to gait impairment, disability, and falls (Pashler, 1994), according to the British Society of Geriatrics and the American Academy of Orthopedic Surgeons. And reduced physical fitness increases the risk of falling by 4-5 times (Kallin et al., 2005). working memory is one of the high-level cognitive processes that, as one of the components of executive functions (Baddeley, 1992; Bomyea et al., 2012), plays an essential role in controlling and regulating cognitive processes and low-level guided actions such as gait (Baddeley, 2000; Guare & Dawson, 2004; Klingberg et al., 2005). working memory is a concept that is strongly influenced by environmental factors and a person's level of anxiety and is very prone to harm (Chao & Knight, 1997; Gazzaley et al., 2005). working memory in the elderly experiences a significant decrease and directly affects the ability to plan tasks and organize important daily activities, and ultimately leads to a decrease in quality of life (Gazzaley et al., 2005).

Decreasing all age-related executive functions can affect the gait performance of the elderly and increase the risk of falls (Adcock et al., 2020). Increased instability in gait is especially evident during dual tasks, which is a key indicator of the role of cognitive abilities in gait performance (Chao & Knight, 1997; Gazzaley et al., 2005; Pichierri et al., 2011; Mirelman et al., 2012; Iosa et al., 2014). Considering the specific role of body muscle strength and working memory level in order to maintain balance and their contribution to motor directions, identifying the most effective intervention aimed at improving muscle strength, working memory and finally taking steps is the main challenge of this study (Pashler, 1994). Research in the field of dual task shows that a combination of physical and cognitive exercises is more successful than performing separate physical and psychological exercises, and its effects are evident in everyday life (Adcock et al., 2020).

Considering the significant effect of physical activity and separate cognitive exercises on different cognitive and motor dimensions in old age, it is assumed that a combination of physical and cognitive exercises is a promising training approach with excellent benefits (Alexander & Crutcher, 1990; Seidler er al., 2010; Zwergal et al., 2012; Beauchet et al., 2015; Beauchet et al., 2016; Joubert & Chainay, 2018). Most activities of daily living also require the simultaneous functioning of cognitive and physical functions (Liao et al., 2019). Therefore, simultaneous cognitive-motor training has ecological validity and is close to the needs of daily life (Beauchet et al., 2016). This feature may lead to a significant transfer of the effects of exercise to the daily life of individuals (Beauchet et al., 2016). Physical and cognitive interactions in humans cause movements to be controlled by the central nervous system, while feedback through environmental structures such as muscles and sensory organs affects brain activity (Morgan & Lilienfeld, 2000). Combined practice targets this interaction (Barkley, 2006; Denckla, 2007).

According to studies, dual-task training has been able to improve executive functions in the frontal lobe (Takeuchi et al., 2020), and in particular to improve the working memory of the elderly (Liao et al., 2019). The role of these exercises in gait has been well established (Falbo et al., 2016). Recently, studies have been performed that use exergame exercises to create an optimal interaction between physical and cognitive functions of the elderly (Kannus et al., 2005; Anderson-Hanley et al., 2017). The results of studies in this field have been very satisfactory, so that the improvement of cognitive function (mainly executive functions) (Kannus et al., 2005; Anderson-Hanley et al., 2017) and physical functions (cardiovascular or musculoskeletal system) by performing exergame-based exercises Confirmed (Scheffer et al., 2008; Anderson-Hanley et al., 2017). In the field of balance, studies show that exergame exercises have a superior effect on other exercises due to providing continuous feedback during exercise and creating opportunities for correction of motor responses, and is a powerful strategy to prevent the fall of old age (Morgan & Lilienfeld, 2000; Beauchet et al., 2016; Joubert & Chainay,2018; Liao et al., 2019).

Exergame-based balance and strength training also improves the gait parameters of the elderly in single and dual positions and raises the level of cognitive processing at high levels of the brain (Eggenberger et al., 2016). Schättin et al. (2019) also found that such exercises have a positive effect on the dual task of the elderly (Schättin et al., 2016). On the other hand, studies have shown that exergame interventions can facilitate the recovery of declining strength of the elderly and thus prevent them from falling (Nutt et al., 1993; McCann, D. J., & Higginson, 2008). According to review studies, exergame interventions have a sufficient effect to improve muscle strength and physical function in the elderly and can help improve their weak and fragile condition (Harada et al., 2013). Despite the similar and confirmed effects of exergame exercises and dual task on some cognitive and motor components of the elderly, so far no study has been used in young elderly (Schättin et al., 2016). Since many gait disorders start from this period, it is essential to study the effect of these interventions in this age group (Mirelman et al., 2012).

Therefore, the aim of the present study was to compare the effect of exergame and dual task exercises on the gait parameters, working memory and lower limb muscle strength in the elderly (Schättin et al., 2016). According to the authors' review, so far no research has comprehensively compared the effectiveness of these two intervention methods in different factors (Schättin et al., 2016; Adcock et al., 2020). Another goal of the present study is to investigate the changes in dependent variables over time (Harada et al., 2013). According to studies, the sustainability of the effect of the intervention is one of the main challenges in this area and makes the value of the intervention clearer (Harada et al., 2013).

Method

Research plan and participants

The present study was a quasi-experimental study with a pretest and posttest design with a comparison group of participants. The statistical population was the elderly aged 50-65 years in Qazvin and the statistical sample included 30 healthy elderly (17 women and 13 men) who were randomly called through the center of corrective movements in Qazvin and divided into two groups of exergame exercises (15 people) with The mean age was 57.20 and the exercise group was divided into dual task (59.40). After inviting the participants and checking the eligibility of the participants who were 30 years old 50-65 years old (17 women and 13 men) and receiving their consent and coordination with the emergency technician and master of pathology, first the necessary explanations about the importance of cooperation in This field was given to the participants. Then, before the start of the first training session, the participants were randomly divided into two experimental groups: exergame (n = 15) and dual task (n = 15). Also, all tests are taken by a tester to prevent possible bias. Participants were eligible for the study by meeting all login criteria: (1) living independently or in a nursing home (2) non-smoker (3) reporting their health (4) being able to walk at least 20 Meters with or without aids for walking (38).Participants are excluded from the study if they have one of the following: (1) movement disorders, (2) severe health problems (for example, a recent heart attack, uncontrolled diabetes, or uncontrolled high blood pressure), (3) orthopedic or neurological problems Diseases that prevent participation in education, (4) Alzheimer's disease or dementia, (5) Rapidly progressive or restorative disease, (6) Acute or chronic disease, (7) History of stroke Brain, (8) a history of dizziness or injury, (9) drugs that act on the nerve surface (e.g., psychotropic drugs), (10) cognitive impairment (MMSE <22 points), (11) symptoms of future depression (Schättin et al., 2016).

Measuring tools

Kinovea

In order to evaluate the gait parameters of the elderly, the components of step length, stride length and cadence were evaluated using Kinova motion analysis software. Also, in order to evaluate the components of step length, stride length and gait rhythm of the elderly using a Canon Power shot G7X camera on the sides and at a distance of 4.5 meters, the subject was evaluated by TUG test. The subject got up from the chair and, after walking three meters and returning, was placed on the chair again. In order to evaluate the components of step length (distance between the heel end to the heel end of the same foot), step length (distance from the heel end to the heel end of the next foot) and step rhythm (number of steps), after preparing the film using motion analysis software kinovea examined and determined the scores of the variables. The average score of the subject in three tests was considered as the final score (Hisham et al., 2017).

Wechsler

In order to measure the working memory of the elderly, the Wechsler working memory test was used, which was performed through the memory capacity of the figures. This type of assessment is one of the subtests of Wechsler IQ test (children and adults). This program is also based on the children's Wechsler memory test. This test is performed separately in the two sections of forward digit repetition and inverse digit repetition and the scoring range is from 0-2. This test was performed three times and its mean was determined as the working memory score (Adcock et al., 2020).

MMT

It was used to assess the muscular strength of the lower extremities, which included the strength of knee extensions, knee flexors, hip extensions, hip abductors, plantar flexors of the sole of the A manual dynamometer (Lafayette Model 01163) foot (Huang, 2020).

- Muscle strength of the knee extensor: Participants sitting on a chair with their hip bent 90 degrees at the front of the tibia, five centimeters close to the ankle on the upper leg, measured strength in two attempts.
- Muscle strength of the knee flexor: Participants sitting on a chair with their hip bent 90 degrees at the back of the leg, five centimeters close to the ankle on the upper leg, measured strength in two attempts.
- Muscle strength of the flexor hip: Participants sitting on a chair with their hip bent parallel to the surface at the front of the thigh, three centimeters close to the patella on the upper leg, measured strength in two attempts.
- Abductor hip muscle strength: Participants in the supine position with the thigh slightly bent at the side of the hip, five centimeters close to the knee at the upper leg, measured strength in two attempts.
- Plantar flexormus muscle strength: Participants in the supine position with the hip and knee bent 90 degrees and the ankle in the neutral position with the sole of the foot in the upper leg measured in two attempts (Huang, 2020).

Protocol

The training protocol consisted of 18 sessions for 6 weeks for both groups and each training session included 5 minutes of warm-up, 30 minutes of the main training protocol and 5 minutes of cooling (Marion & Thorley, 2016).

- Exergame excercises
  After pre-testing and assigning people to two experimental groups, first the necessary explanations were made by the instructor in order to perform the

exercises and the subjects in the exergame group played boxing and track and field (sprinting, obstacle running, long jump, throwing, Discus and javelin throw) and each training session consisted of 5 minutes of warm-up, 15 minutes of boxing and 15 minutes of track and field, with the final 5 minutes devoted to cooling the participants. All Exergim group training sessions were conducted using the Xbox 360 with Kinect, and participants were placed within 2 meters of a 42-inch LCD. The elderly faced more challenges in long jump and javelin throwing and javelin throwing, and discus throwing was the main focus of balance (Marion & Thorley, 2016).

- Dual task excercises
  Participants in the dual-task training group in accordance with the standards of the American College of Sports Medicine for the elderly for 40-30 minutes of physical and cognitive aerobic exercise, including: gait with 50-75% of the heart rate below maximum, gait and answering questions Math, pacing and counting random three-digit numbers in pairs, stepping forward and backward with cognitive task, pacing while reading poetry, pacing and drawing the clock with both hands in a clockwise and counterclockwise direction Was. Also, after completing 18 training sessions and taking the post-test, the components of gait and working memory and lower limb muscle strength similar to the previous two tests were evaluated (Liao et al., 2019).

Statistical Analysis

Descriptive and inferential statistics were used to analyze the data. Descriptive statistics have been used to calculate the main indicators and dispersion, to draw graphs and separately. In this study, in order to analyze the data, Manova, one-way analysis of variance, Shapiro goodnessof-fit test were used. We also used Mbox test to examine the equality of the observed covariance matrices of dependent variables between groups. This test tests the null hypothesis that the observed covariance matrices of the dependent variables are equal between the different groups. Levin test is used to test the assumption of homogeneity of variances of error of dependent variables in all groups. The significance level test is considered 0.05 and all analyzes are performed with SPSS22 software.

Result

Demographic information and descriptive statistics related to the research variables, gait parameters and working memory and muscle strength of the selected lower limb are given in Tables 1-4. Also, all subjects were able to complete the training protocol.

Tables

Table 1
Information of descriptive statistics related to the research variables

Variables	Exergame	Dual task
Age, y	57/20±4/61	59/40±4/35
Weight, kg	71/32±9/75	75/33±9/86

Height, cm	177/25±5/21	183/30±4/30

Table 2
Information of descriptive statistics related to gait parameters

Variables	Time	Exergame(Mean±SD)	Dual task(Mean±SD)
Step length	Pre test	48/69	48/14
	Post test	54/97	55/10
	Follow up	52/55	51/96
Stride length	Pre test	92/78	92/26
	Post test	105/43	105/95
	Follow up	101/57	100/49
Cadence	Pre test	15/60	15/80
	Post test	13/33	13/27
	Follow up	13/60	13/60

Table 3
Descriptive statistics information on working memory

Variables	Time	Exergame(Mean±SD)	Dual task(Mean±SD)
Working memory	Pre test	3/60	6
	Post test	5/93	8/20
	Follow up	10/67	7/27

Table 4
Information on descriptive statistics on lower limb muscle strength

Variables	Time	Exergame(Mean±SD)	Dual task(Mean±SD)
Hip abductor	Pre test	7/65	13/54
	Post test	23/81	20/75
	Follow up	15/48	15/17
Plantar flexor ankle	Pre test	12/25	14/62
	Post test	35/81	26/11
	Follow up	18/71	18/25
Knee extensor	Pre test	8/55	12/44
	Post test	23/59	19/09
	Follow up	13/05	14/83
Knee flexor	Pre test	8/34	9/90
	Post test	21	17/50
	Follow up	11/60	12/66
Hip flexor	Pre test	10/28	13/43
	Post test	32/94	24/37
	Follow up	19/85	17/63

Gait parameters

According to the results of one-way maneuver, there was no significant difference between the group effect for step length values in pre-test, post-test and follow-up (pre-test F = 0.069, P value = 0.795, Effecte size = 0.002) and (post-test 004 / 0 F = and P value = 0.953 and 0.000 Effecte size =) and (follow-up test F = 0.084, P7 value 0.775 and Effecte size = 0.003). Also, according to the one-way maneuver results, there was no significant difference in the stride length values in pre-test, post-test and follow-up. (Pre-test F = 013 and P value = 0/909 and 0.000 Effecte size =) and (Post-test F = 0/014, P value = 0/907 and 0.000 Effecte size =) and (Follow-up test / 0750 F = and P value = 0.785 and Effecte size = 0.003). According to the results of one-way maneuver, there was no significant difference between the cadence values in pre-test, post-test and follow-up. (Pre-test F = 0.247, P value = 0.623, 009/0 Effecte size =) and (post-test F = 0.027, P value = 0.870, 0.001 Effecte size =) and (follow-up test / 0000 F = and P value = 1 and Effecte size = 0.000). The comparative diagram of the two groups in the gait parameters from pre-test to follow-up test is shown in Figure 1-3.

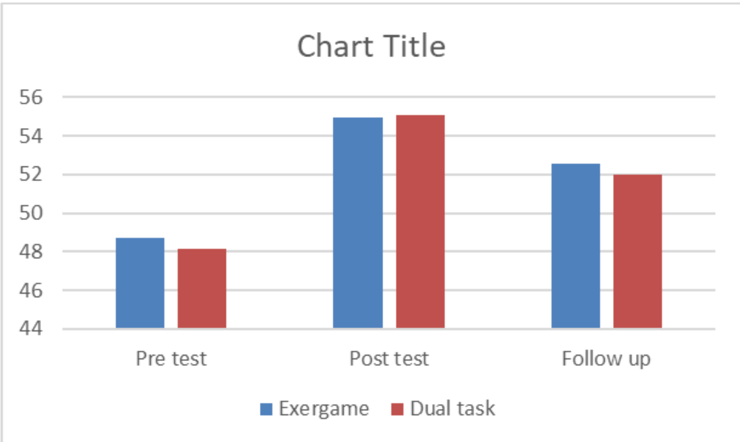

Figure 1. Changes in step length values from pre-test, post-test to follow-up

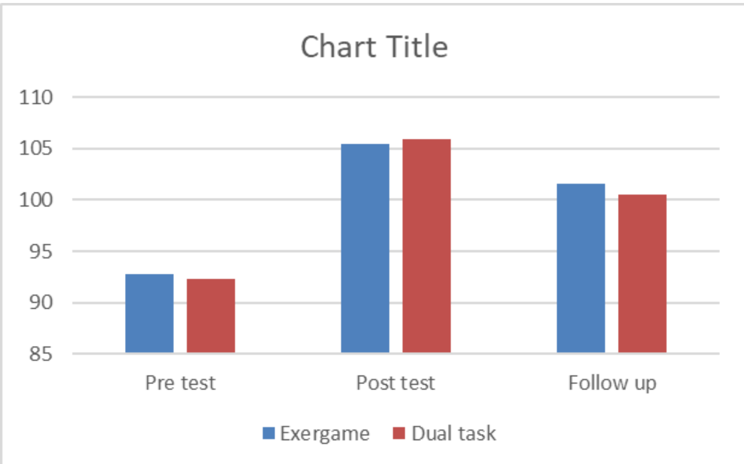

Figure 2. Changes in stride length values from pre-test, post-test to follow-up

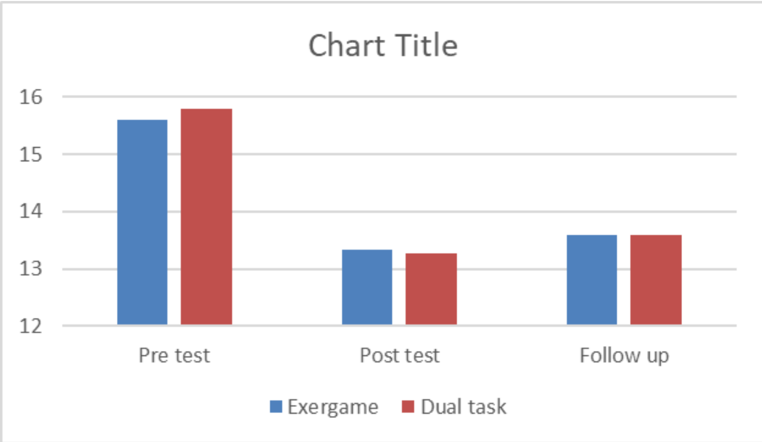

Figure 3. Changes in cadence values from pre-test, post-test to follow-up

Working memory

According to the results of Manova test, there is a significant difference between the post-test values of the groups in the values of working memory (F = 476.4 and P value = 0.038). But for the working memory values in the follow-up test, the effect of the group was not significant (F = 0.905 and P value = 0.350). A comparison chart of the two groups in working memory from pre-test to follow-up test is shown in Figure 4.

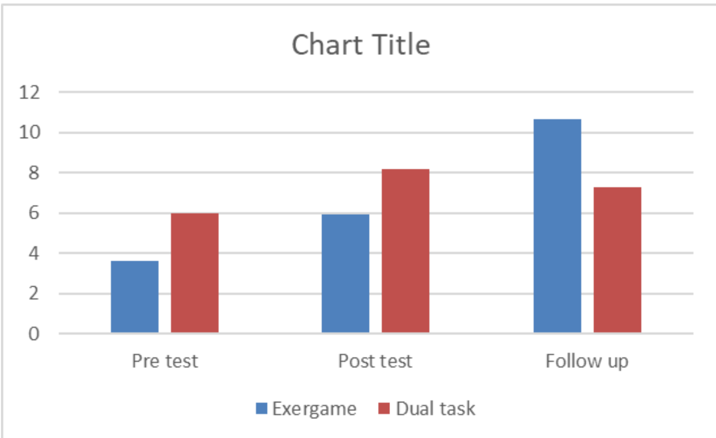

Figure 4. Changes in working memory values from pre-test to Follow up test

Lower limb muscle strength
Hip abductor

According to the one-way maneuver results, the effect of the group for pre-test, post-test and follow-up values in thigh abductor muscle strength was not significant, so there was no significant difference between pre-test, post-test and follow-up values of the groups. (Pre-test F = 578, P value = 0.107, 0.235 Effecte size =) and (Post-test F = 0.949, P value = 0.338 and Effecte size = 0.033) and (Follow-up test F = 0/020 and P value = 0.889 and Effecte size = 0.001). The comparative diagram of the two groups of hip abductor from pre-test to follow-up test is shown in Figure 5.

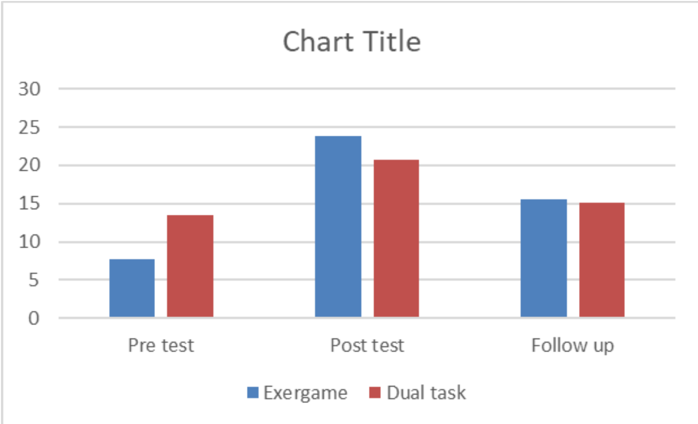

Figure 5. Changes in hip abductor strength values from pre-test to follow-up test

Plantar flexor ankle

According to the one-way Manua results, the effect of the group for pre-test values was not significant in any of the variables under study, so there was no significant difference between the pre-test values of the groups (F = 1/425, P value = 0.243 and Effecte size = 0 / 048). Also, the results of Manova test related to post-test values of plantar muscle strength of ankle flexors showed that there is a significant difference between the two groups (F = 6/699, P value = 0.001 and Effecte size = 0.312). Also, in the follow-up test, there was no significant difference between the two groups in the strength of the plantar muscles of the ankle flexors (F = 0.067, P value = 0.798 and Effecte size = 0.002). A comparison chart of the two groups of plantar flexors of the ankle from pre-test to follow-up test is shown in Figure 6.

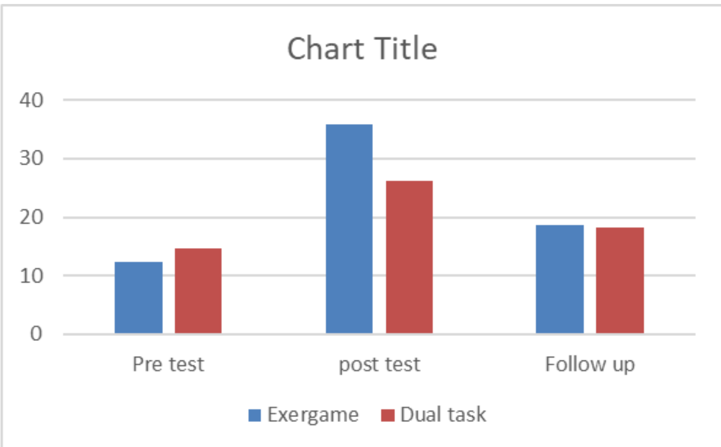

Figure 6. Changes in ankle plantar flexor strength values from pretest to follow-up test

Knee extensor

According to the results of one-way maneuver, the effect of group for pre-test, post-test and follow-up values in knee extensor muscle strength was not significantly different in the studied groups (pre-test F = 750.7, P value = 0.112 and 0.003 Effecte size =) And (post-test F = 3/384, P value = 0.076 and 108.0 Effecte size =) and (follow-up test / 7870 F = P value = 0.383 and Effecte size = 0.027). A comparison chart of the two groups in knee extensor from pre-test to follow-up test is shown in Figure 7.

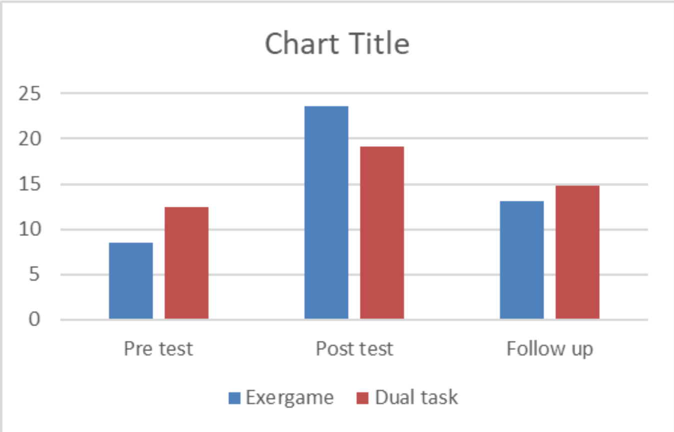

Figure 7. Changes in knee extensor strength values from pre-test to follow-up test

Knee Flexor

According to the results of one-way maneuver, the effect of the group for pre-test, post-test and follow-up values of the groups in the strength of knee flexor muscles was not significant (pre-test F = 0.809, P value = 0.376 and Effecte size = 0.028) And (post-test F = 675 and P value = 0.206 and Effecte size = 0.056) and (follow-up F = 0.192, P value = 0.665 and Effecte size = 0.007) comparison chart The group of knee flexors from pre-test to follow-up test is shown in Figure 8.

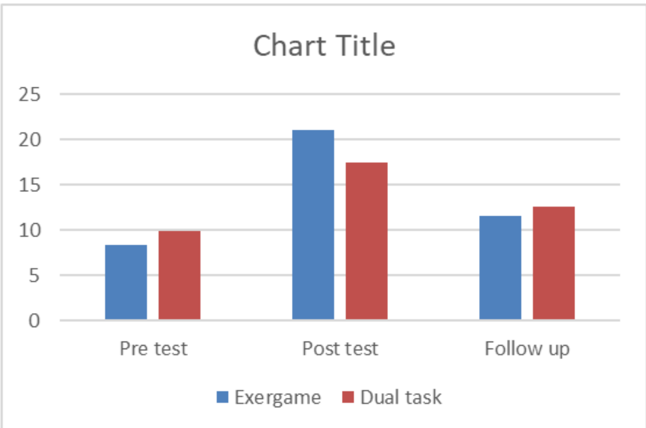

Figure 8. Changes in knee flexors strength values from pre-test to follow-up test

Hip flexor

According to the results of one-way maneuver, there was no significant difference in the effect of the group for the pre-test values of the groups in the strength of the hip flexor muscles (F = 505, P value = 0.125 and Effect size = 0.082). Also, the results of Manova test related to post-test values showed that there is a significant difference between the post-test values of the groups in this variable (F = 7/360, P value = 0.011 and Effect size = 0.208). But there is no significant difference between the values between the two groups (F = 1/292, P value = 0.265 and Effecte size = 0.044). A comparison chart of the two groups of hip flexors from pre-test to follow-up test is shown in Figure 9.

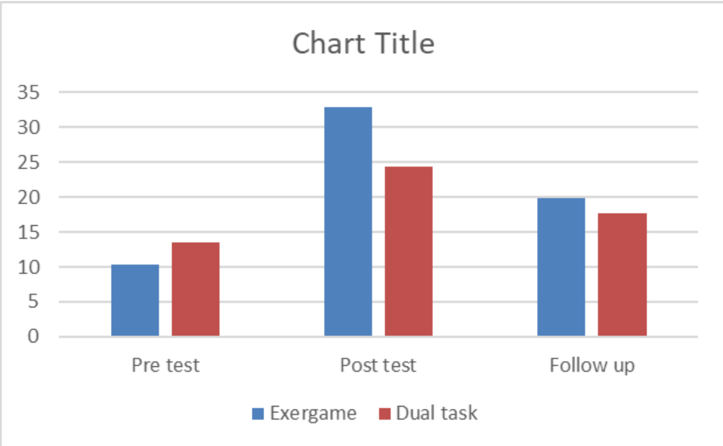

Figure 9. Changes in the strength of hip flexors from pre-test to follow-up test

Discussion

The aim of this study was to compare the effectiveness of exergame exercises and dual task training on gait parameters and working memory and lower limb muscle strength in young elderly and according to the results of the subjects in the gait parameters component despite the positive effects in both groups of exercises. We experienced exergame and dual task training, but this improvement did not occur significantly in post-test and follow-up. According to the results of Adcock et al. (2019) that exergame exercises were not performed despite significant improvement, Adcock stated that this rate of change is probably due to low progress because the rate of improvement in this component is more than the control group and It is also possible that the low progress in the gait parameters is due to the improvement of low values in the executive functions (Adcock et al., 2020). Other possible reasons include not controlling the intensity of exergame exercises and the resulting load on the subjects (Adcock et al., 2020).

According to the results, the subjects improved significantly in the working memory component in the post-test and we did not see a significant improvement in follow-up to the post-test despite the positive effects of the exercises and no significant difference was observed between the two groups. Positive changes in the follow-up test were more than the post-test, but this amount of changes compared to the post-test was not significant. Although one of the behavioral strategies to promote healthy aging is the use of physical exercise, but the main challenge for researchers is to design interventions that, in addition to prescribing physical activity, also design challenging environments and cognitive exercises, to simultaneously improve cognitive function and structures, They also alter certain areas of the brain that exergame and dual-tasking exercise by challenging physical and cognitive functions (Marion & Thorley, 2016; Nguyen et al., 2019; Arseneau et al., 2019). The productivity of the elderly is one of the benefits of cognitive training and the positive effect of interventions on gray matter and white matter of the brain in frontal, temporal (hippocampus) and partial areas has been reported (Engvig et al., 2010; Lövdén et al., 2010; Engvig et al., 2012; Reijnders et al., 2013; Lampit et al., 2015; Kühn et al., 2017).

Most researchers use the dual task technique (simultaneous efficiency) to examine the effect on executive and motor function such as gait by challenging individuals to perform multiple tasks simultaneously (Pashler, 2001; Al-Yahya et al., 2011). In addition to this intervention, exergame interventions have recently been introduced (Benzing & Schmidt, 2018). According to Huang (2019), the active memory of the elderly was improved by participating in virtual reality exercises, which are a physical and cognitive exercise (Huang, 2020). Also, in the study of Perrot et al. (2019), participation in active exergame exercises compared to cognitive exercises, which is only a virtual activity without involving physical functions, could lead to an improvement in the working memory of the elderly (Perrot et al., 2019). Also, in the study of Schättin et al. (2019), participating in exergame exercises as a combination of physical and cognitive exercises can lead to an improvement in the working memory of the elderly (Schättin et al., 2016). Anguera (2013) also states that exergame acts as a powerful tool to enhance cognitive abilities in the elderly (Anguera et al., 2013). Also, in a study conducted by Falbo et al. (2016), participation in dual task exercises that included gait along with cognitive tasks led to an improvement in the working memory of the elderly (Falbo et al., 2016).

Regarding the effect of exergame exercises and dual tasks on the muscle strength of the lower limbs, the results show a significant improvement in the strength of the hip flexor and plantar flexor muscles of the elderly. Also, in the case of knee extensor, knee flexor and hip abductor components, despite the positive effects of exergame exercises and dual task, these positive changes were not significant. In Santos (2019) study that improved the muscular strength of the elderly, Santos stated that exergame exercises by encouraging, interest and avoiding fatigue and social isolation of the elderly instead of spontaneous exercise and creating a pleasant sense of physical activity in The elderly were able to lead to more improvement in subjects than mere exercise. Also, according to the results of moderate and intense exergame exercises, it can lead to increased muscle strength in the elderly (Santos et al., 2019). Sato (2015) stated that exergame along with kinect due to giving feedback and feeling of differential movements continuously can provide sufficient load on the target muscles and thus lead to improvement (Sato et al., 2015). It has also been stated that exergame gait exercises are more enjoyable than traditional exercises And causes treadmills in the elderly; Therefore, exergame exercises have advantages that they can Be a good alternative to physical activity in the elderly (Graves et al., 2010).

The effects of the present study show that exergame exercises and dual task exercises did not lead to significant improvement despite the positive effects on gait parameters. Regarding the studied components of lower limb muscle strength, we witnessed positive and significant changes in the strength of hip flexor and plantar flexor ankle muscles in the elderly, and the exergame training group was significantly superior to the post-test exercise compared to the dual task. Also, regarding the components of knee extensor, knee flexor and hip abductor, although we saw positive changes, but these changes did not occur significantly, and it can also be said that in the present study, the positive effects of exergame exercises compared to dual task training It has been more on the muscular strength of the elderly.

Limitations

One of the limitations of the present study is the low number of subjects.

References

Adcock, M., Fankhauser, M., Post, J., Lutz, K., Zizlsperger, L., Luft, A. R., ... & de Bruin, E. D. (2020). Effects of an in-home multicomponent exergame training on physical functions, cognition, and brain volume of older adults: A randomized controlled trial. Frontiers in medicine, 6, 321.

Alexander, G. E., & Crutcher, M. D. (1990). Functional architecture of basal ganglia circuits: neural substrates of parallel processing. Trends in neurosciences, 13(7), 266-271. doi: 10.1016/0166-2236(90)90107-L

Al-Yahya, E., Dawes, H., Smith, L., Dennis, A., Howells, K., & Cockburn, J. (2011). Cognitive motor interference while walking: a systematic review and meta-analysis. Neuroscience & Biobehavioral Reviews, 35(3), 715-728.

Anderson-Hanley, C., Maloney, M., Barcelos, N., Striegnitz, K., & Kramer, A. (2017). Neuropsychological benefits of neuro-exergaming for older adults: a pilot study of an interactive physical and cognitive exercise system (iPACES). Journal of aging and physical activity, 25(1), 73-83.

Anguera, J. A., Boccanfuso, J., Rintoul, J. L., Al-Hashimi, O., Faraji, F., Janowich, J., ... & Gazzaley, A. (2013). Video game training enhances cognitive control in older adults. Nature, 501(7465), 97-101.

Arseneau, E., Landry, S., & Darling, E. K. (2019). The Polyamorous Childbearing and Birth Experiences Study (POLYBABES): a qualitative study of the health care experiences of polyamorous families during pregnancy and birth. CMAJ, 191(41), E1120-E1127. doi: 10.1503/cmaj. 051351

Baddeley, A. (1992). Working memory. Science, 255(5044), 556-559. https://doi.org/10.1126/ science.1736359.

Baddeley, A. (2000). The episodic buffer: a new component of working memory?. Trends in cognitive sciences, 4(11), 417-423. https://doi.org/10.1016/S1364-6613(00)01538-2.

Barkley, R. A. (2006). Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment (Vol. 3). New York: Guilford press.

Beauchet, O., Allali, G., Annweiler, C., & Verghese, J. (2016). Association of motoric cognitive risk syndrome with brain volumes: results from the GAIT study. Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences, 71(8), 1081-1088. doi: 10.1093/gerona/glw012

Beauchet, O., Launay, C. P., Fantino, B., Annweiler, C., & Allali, G. (2015). Episodic memory and executive function impairments in non-demented older adults: which are the respective and combined effects on gait performances?. Age, 37(4), 1-10. doi: 10.1007/s11357-015-9812-y

Benzing, V., & Schmidt, M. (2018). Exergaming for children and adolescents: strengths, weaknesses, opportunities and threats. Journal of clinical medicine, 7(11), 422. doi: 10.3390/jcm7110422

Bomyea, J., Amir, N., & Lang, A. J. (2012). The relationship between cognitive control and posttraumatic stress symptoms. Journal of behavior therapy and experimental psychiatry, 43(2), 844-848.

Chao, L. L., & Knight, R. T. (1997). Prefrontal deficits in attention and inhibitory control with aging. Cerebral Cortex (New York, NY: 1991), 7(1), 63-69.

Denckla, M. B. (2007). Executive function: building together the definitions of Attention Deficit/ Hyperactivity Disorder and Learning Disabilities. In L. Meltzer: Executive Function Education (2nd Ed), New York: Guilford Press. (pp. 5-18).

Eggenberger, P., Wolf, M., Schumann, M., & De Bruin, E. D. (2016). Exergame and balance training modulate prefrontal brain activity during walking and enhance executive function in older adults. Frontiers in aging neuroscience, 8, 66.

Elmasry, DM., Elnahas, NG., Khorshid, H., & Rahmy, AF. The effect of low frequency neuromuscular stimulation on sympathetic activity in advanced heart failure. Journal of Advanced Pharmacy Education & Research. 2019;9(4):29-35

Engvig, A., Fjell, A. M., Westlye, L. T., Moberget, T., Sundseth, Ø., Larsen, V. A., & Walhovd, K. B. (2010). Effects of memory training on cortical thickness in the elderly. Neuroimage, 52(4), 1667-1676. doi: 10.1016/j.neuroimage.2010.05.04

Engvig, A., Fjell, A. M., Westlye, L. T., Moberget, T., Sundseth, Ø., Larsen, V. A., & Walhovd, K. B. (2012). Memory training impacts short-term changes in aging white matter: A longitudinal diffusion tensor imaging study. Human brain mapping, 33(10), 2390-2406. doi: 10.1002/hbm.21370

Falbo, S., Condello, G., Capranica, L., Forte, R., & Pesce, C. (2016). Effects of physical-cognitive dual task training on executive function and gait performance in older adults: a randomized controlled trial. BioMed research international, 2016.

Gazzaley, A., Cooney, J. W., Rissman, J., & D'esposito, M. (2005). Top-down suppression deficit underlies working memory impairment in normal aging. Nature neuroscience, 8(10), 1298-1300.

Graves, L. E., Ridgers, N. D., Williams, K., Stratton, G., & Atkinson, G. T. (2010). The physiological cost and enjoyment of Wii Fit in adolescents, young adults, and older adults. Journal of physical activity & health, 7(3), 393-401.

Guare, R., & Dawson, P. (2004). Executive skills in children and teens–Parents, teachers and clinicians can help. Brown University Child & Adolescent Behavior Letter, 20(8), 1-7.

Hall, P. A., & Fong, G. T. (2007). Temporal self-regulation theory: A model for individual health behavior. Health Psychology Review, 1(1), 6-52. doi: 10. 1080/17437190701492437

Harada, C. N., Love, N., & MC, T. KL (2013). Normal cognitive aging. Clinics in Geriatric Medicine, 29(4), 737-752. doi: 10.1016/j.cger.2013.07.002.

Hisham, N. A. H., Nazri, A. F. A., Madete, J., Herawati, L., & Mahmud, J. (2017). Measuring ankle angle and analysis of walking gait using kinovea.

Huang, K. T. (2020). Exergaming executive functions: An immersive virtual reality-based cognitive training for adults aged 50 and older. Cyberpsychology, Behavior, and Social Networking, 23(3), 143-149. DOI: 10.1089/cyber.2019.0269.

Hurd, M. D., Martorell, P., Delavande, A., Mullen, K. J., & Langa, K. M. (2013). Monetary costs of dementia in the United States. New England Journal of Medicine, 368(14), 1326-1334.

Iosa, M., Fusco, A., Morone, G., & Paolucci, S. (2014). Development and decline of upright gait stability. Frontiers in aging neuroscience, 6, 14. doi: 10.3389/fnagi.2014. 00014

Ibrahim, S., Azhar, AS., Muneer, AS., Kaleem, AS., Habeebullah, M. Fatigue: Impact of Muscular Co-Ordination among Rifle Shooters. International Journal of Pharmaceutical Research & Allied Sciences. 2019 Jan 1;8(1):123-128.

Joubert, C., & Chainay, H. (2018). Aging brain: the effect of combined cognitive and physical training on cognition as compared to cognitive and physical training alone–a systematic review. Clinical interventions in aging, 13, 1267. doi: 10.2147/CIA.S165399

Kallin, K., Gustafson, Y., Sandman, P. O., & Karlsson, S. (2005). Factors associated with falls among older, cognitively impaired people in geriatric care settings: a population-based study. The American journal of geriatric psychiatry, 13(6), 501-509.

Kannus, P., Sievänen, H., Palvanen, M., Järvinen, T., & Parkkari, J. (2005). Prevention of falls and consequent injuries in elderly people. The Lancet, 366(9500), 1885-1893.

Klingberg, T., Fernell, E., Olesen, P. J., Johnson, M., Gustafsson, P., Dahlström, K., ... & Westerberg, H. (2005). Computerized training of working memory in children with ADHD-a randomized, controlled trial. Journal of the American Academy of child & adolescent psychiatry, 44(2), 177-186. https://doi.org/10.1097/00004583-200502000000010.

Kühn, S., Lorenz, R. C., Weichenberger, M., Becker, M., Haesner, M., O'Sullivan, J., ... & Gallinat, J. (2017). Taking control! Structural and behavioural plasticity in response to game-based inhibition training in older adults. NeuroImage, 156, 199-206. doi: 10.1016/j.neuroimage.2017.05.026

Kuo, A. D., & Donelan, J. M. (2010). Dynamic principles of gait and their clinical implications. Physical therapy, 90(2), 157-174. doi: 10.2522/ptj.20090125

Lampit, A., Hallock, H., Suo, C., Naismith, S. L., & Valenzuela, M. (2015). Cognitive training-induced short-term functional and long-term structural plastic change is related to gains in global cognition in healthy older adults: a pilot study. Frontiers in aging neuroscience, 7, 14. doi: 10.3389/fnagi.2015.00014

Liao, Y. Y., Chen, I. H., Lin, Y. J., Chen, Y., & Hsu, W. C. (2019). Effects of virtual reality-based physical and cognitive training on executive function and dual-task gait performance in older adults with mild cognitive impairment: a randomized control trial. Frontiers in aging neuroscience, 11, 162.

Lövdén, M., & Bodammer, N. C., Kü hn, S., Kaufmann, J., Schü tze, H., Tempelmann, C., Heinze, H. J., Düzel, E., Schmiedek, F., & Lindenberger, U. (2010). Experiencedependent plasticity of white-matter microstructure extends into old age. Neuropsychologia, 48, 3878-3883. doi: 10.1016/j.neuropsychologia.2010.08.026

Marion, S. B., & Thorley, C. (2016). A meta-analytic review of collaborative inhibition and postcollaborative memory: Testing the predictions of the retrieval strategy disruption hypothesis. Psychological Bulletin, 142(11), 1141. doi: 10.1037/bul00 00130

McCann, D. J., & Higginson, B. K. (2008). Training to maximize economy of motion in running gait. Current sports medicine reports, 7(3), 158-162. doi: 10.1097/01.CSMR.0000319711.63793.84

Mirelman, A., Herman, T., Brozgol, M., Dorfman, M., Sprecher, E., Schweiger, A., ... & Hausdorff, J. M. (2012). Executive function and falls in older adults: new findings from a five-year prospective study link fall risk to cognition. PloS one, 7(6), e40297. doi: 10.1371/journal.pone.0040297

Moubarez, DA., Mohamed, KA., El Din, SS., Basheer, MA., & El Baz, AA. Muscle ultrasound in assessment of critical illness neuromyopathy in comparison with nerve conduction. Journal of Advanced Pharmacy Education & Research. 2019;9(1):11-6.

Morgan, A. B., & Lilienfeld, S. O. (2000). A meta-analytic review of the relation between antisocial behavior and neuropsychological measures of executive function. Clinical psychology review, 20(1), 113-136.

Nguyen, L., Murphy, K., & Andrews, G. (2019). Cognitive and neural plasticity in old age: A systematic review of evidence from executive functions cognitive training. Ageing research reviews, 53, 100912. doi: 10.1016/j.arr.2019.100912

Nutt, J. G., Marsden, C. D., & Thompson, P. D. (1993). Human walking and higher level gait disorders, particularly in the elderly. NEUROLOGY-MINNEAPOLIS-, 43, 268-268. doi: 12.1212/WNL.43.2.268

Pashler, H. (1994). Dual-task interference in simple tasks: data and theory. Psychological bulletin, 116(2), 220.

Pashler, H. (2001). Johnston,¬ JC and¬ Ruthruff. E. ATTENTION AND PERFORMANCE. Annual Review of Psychology, 52, 629-651.

Perrot, A., Maillot, P., & Hartley, A. (2019). Cognitive training game versus action videogame: effects on cognitive functions in older adults. Games for health journal, 8(1), 35-40.

Pichierri, G., Wolf, P., Murer, K., & de Bruin, E. D. (2011). Cognitive and cognitive-motor interventions affecting physical functioning: a systematic review. BMC geriatrics, 11(1), 1-19. doi: 10.1186/1471-2318-11-29

Reijnders, J., van Heugten, C., & van Boxtel, M. (2013). Cognitive interventions in healthy older adults and people with mild cognitive impairment: a systematic review. Ageing research reviews, 12(1), 263-275. doi: 10.1016/j.arr.2012.07.003

Santos, G. O. R., Wolf, R., Silva, M. M., Rodacki, A. L. F., & Pereira, G. (2019). Does exercise intensity increment in exergame promote changes in strength, functional capacity and perceptual parameters in pre-frail older women? A randomized controlled trial. Experimental Gerontology, 116, 25-30.

Sato, K., Kuroki, K., Saiki, S., & Nagatomi, R. (2015). Improving walking, muscle strength, and balance in the elderly with an exergame using Kinect: a randomized controlled trial. Games for health journal, 4(3), 161-167.

Schättin, A., Arner, R., Gennaro, F., & de Bruin, E. D. (2016). Adaptations of prefrontal brain activity, executive functions, and gait in healthy elderly following exergame and balance training: a randomized-controlled study. Frontiers in aging neuroscience, 8, 278.

Scheffer, A. C., Schuurmans, M. J., Van Dijk, N., Van Der Hooft, T., & De Rooij, S. E. (2008). Fear of falling: measurement strategy, prevalence, risk factors and consequences among older persons. Age and ageing, 37(1), 19-24.

Seidler, R. D., Bernard, J. A., Burutolu, T. B., Fling, B. W., Gordon, M. T., Gwin, J. T., ... & Lipps, D. B. (2010). Motor control and aging: links to age-related brain structural, functional, and biochemical effects. Neuroscience & Biobehavioral Reviews, 34(5), 721-733. doi: 10.1016/j.neubiorev.2009.10.005

Takeuchi, H., Magistro, D., Kotozaki, Y., Motoki, K., Nejad, K. K., Nouchi, R., ... & Kawashima, R. (2020). Effects of simultaneously performed dual-task training with aerobic exercise and working memory training on cognitive functions and neural systems in the elderly. Neural Plasticity.

Yasamy, M. T., Dua, T., Harper, M., & Saxena, S. (2013). a Growing Concern. Mental health and older people, 4.

Zwergal, A., Linn, J., Xiong, G., Brandt, T., Strupp, M., & Jahn, K. (2012). Aging of human supraspinal locomotor and postural control in fMRI. Neurobiology of aging, 33(6), 1073-1084. doi: 10.1016/j.neurobiolaging.2010.09.022.

Parmin, P., Suarayasa, K., & Wandira, B. A. (2020). Relationship between quality of service with patient loyality at general polyclinic of kamonji public health center. International Journal of Health & Medical Sciences, 3(1), 86-91. https://doi.org/10.31295/ijhms.v3n1.157

Widana, I.K., Sumetri, N.W., Sutapa, I.K., Suryasa, W. (2021). Anthropometric measures for better cardiovascular and musculoskeletal health. Computer Applications in Engineering Education, 29(3), 550–561. https://doi.org/10.1002/cae.22202