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ARAŞTIRMA MAKALESİ/ORIGINAL ARTICLE

Computer-Based Exercise Program for Elderly (CLOSER): Pilot Study

Yaşlılarda Bilgisayar Tabanlı Egzersiz Programı (CLOSER): Pilot Çalışma

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ABSTRACT

Aim: The Computer Based Exercise Program (CLOSER), developed for the elderly, provides the elderly with the opportunity to do exercises by receiving feedback about the exercises thanks to its dynamic structure. The aim of our study is a pilot study to examine the applicability of this developed system in elderly.

Materials and Methods: 54 elderly (mean age:70.53±7.87 years) who applied to the Hacettepe University, Occupational therapy department Geriatric Clinic were included in the study. System includes a front landing page where the sociodemographic characteristics of the individuals are recorded, and 5 basic exercises involving all parts of the body, including maintaining balance, neck rotation, rhythmic gait, knee flexion and trunk rotation. Participants were asked questions covering the exercises in order to get their feedback on the content, applicability and accessibility of the system. A total of 38 cross-questions, consisting of 3 separate answers as agree, partially agree and disagree, were created by the researchers.

Results: It can be said that most of the participants (more than 80%) found the CLOSER system easy, understandable and enjoyable. All of the participants stated that they found the instructions given to exercise sufficient and understandable and encouraging to exercise. There are a small number of participants (11%) who stated that they had some difficulties and problems in using the application.

Conclusion: CLOSER is the first national health application developed for the elderly to exercise correctly in terms of scope and content. It is thought that it will contribute to future research in terms of giving visual and written feedback on the participants correct and motivated exercise at home.

Keywords: Elderly, Old Age, Exercise, Home Care

ÖZ

Amaç: Yaşlılara yönelik geliştirilen Bilgisayar Tabanlı Egzersiz Programı (CLOSER) dinamik yapısı sayesinde yaşlıların egzersizler hakkında geri bildirimler alarak egzersiz yapma fırsatı sağlamaktadır. Çalışmamızın amacı geliştirilen bu sistemin yaşlı bireylerde uygulanabilirliğinin incelenmesine yönelik bir pilot çalışmadır.

Gereç ve Yöntemler: Çalışmaya, Hacettepe Üniversitesi Ergoterapi Bölümü Geriatri Tedavi Ünitesine başvuran 54 yaşlı birey (yaş ortalaması: 70,53±7,87 yıl) dahil edildi. CLOSER sistemi pilot çalışması kapsamında, bireylerin sosyodemografik özelliklerinin kaydedildiği ön bir açılış sayfası ile denge koruma, boyun rotasyonu, ritmik yürüyüş, diz fleksiyonu ile gövde rotasyonu olmak üzere vücudun tüm uzuvlarını içeren 5 temel egzersiz içermektedir. Katılımcılara sistemin içeriği, uygulanabilirliği ve erişilebilirliği hakkındaki geri bildirimlerini almak amacıyla egzersizleri kapsayan sorular soruldu. Katılıyorum, kısmen katılıyorum ve katılmıyorum olmak üzere 3 ayrı cevaptan oluşan toplam 38 çapraz soru araştırmacılar tarafından oluşturuldu.

Bulgular: Katılımcıların çoğunun (%80 den fazlasının) CLOSER sistemini kolay, anlaşılır ve zevkli bulduğu söylenebilir. Katılımcı yaşlıların tamamı egzersiz yapmak için verilen talimatları yeterli ve anlaşılır ve egzersize de teşvik edici bulduğunu belirtmiştir. Uygulamayı kullanmada bazı zorluklar ve aksaklıklar yaşadığını belirtilen az sayıda (%11) olsa katılımcı mevcuttur.

Sonuç: CLOSER, kapsam ve içerik bakımından yaşlıların doğru egzersiz yapmasına yönelik geliştirilen ilk ulusal sağlık uygulamasıdır. Katılımcıların evlerinde doğru ve motive olarak egzersiz yapmasına yönelik görsel ve yazılı geri bildirim vermesi yönüyle de ileriki araştırmalara katkı sağlayacağı düşünülmektedir.

Anahtar Kelimeler: Yaşlı, Yaşlılık, Egzersiz, Evde Bakım

INTRODUCTION

Aging is a physiological process, a period in which changes and losses are seen in the body structure and functions of individuals, reducing or limiting their activity level and functionality, and making them socially, physically and emotionally dependent to varying degrees. Aging is a complex process that encompasses a wide range of components including genetics, lifestyle, and chronic disease (1). Norman, on the other hand, defines normal aging as the gradual loss of functionality of various systems of the body, excluding losses as a result of disability or disease (2). Since the concepts of aging and aging terms cannot be defined with a single definition, generally is referred as chronological, social, physiological and psychological aging and is divided into subgroups. Chronological aging is the aging that is calculated over the years an individual has lived since birth. The World Health Organization defines individuals over the age of 65 as elderly (3, 4) . Despite this, it can be observed that the age of 60 is accepted as the onset of old age in the documents of many international institutions and in various indexes and indicators on old age (5). According to the classification made by WHO and gerontologists, 65-74 years old is considered as young-old, 75-84 years old as middle-aged, and 85 years and over as old (3). According to the data of the United Nations, as of 2019, the elderly population constitutes 9% of the world population (6). Population aging experienced in a global context is expected to increase and by 2050 one in six people will be over 65 years old (7). As in the world, the average life expectancy increases in Turkey and the population ages rapidly. According to TURKSTAT's 2020 Statistics Bulletin for the Elderly, the elderly population, which was only 3.9% of the total population in 1935, increased to 9.5% in 2020 (8).

As age progresses, changes may occur in physiological, psychological, cognitive, and social areas, while the cognitive and functional capacity of the individual decreases, the number of chronic diseases increases. Cardio-vascular, respiratory, immune system and musculoskeletal systems are among the most frequently affected systems in old age. Considering the importance of all these body systems on vital functions, there is a need for health applications to keep the elderly under surveillance at all times and to minimize the deterioration in these systems.

One of the main causes of health problems that occur with advancing age is physical inactivity. A sedentary lifestyle, i.e., physical inactivity, is recognized as an important increasing health problem, given its association with all-cause mortality, chronic disease, and economic burden.

It is estimated that 3.3 million people die each year from physical inactivity, making it the fourth leading cause of death (9). Considering that it is stated that inactivity varies between 30-80% in the elderly living in all countries of the world, the need for various approaches and systems that will make individuals more active is increasing day by day (10). Leading a physically active life is very important in terms of health in old age, as it is in every age group. Many studies have shown that being physically active protects individuals from chronic diseases (10, 11). It is reported that an active life, i.e., doing regular exercise, can protect the elderly, especially from neurodegenerative diseases such as dementia, and it is stated that by improving their cognitive functions, it reduces the risk of falling, increases social interactions and helps individuals to strengthen their independence

as much as possible (12). Determining the level of exercise in the elderly is difficult and complex. Demographic characteristics such as culture, gender and age, diseases, motivation and cognitive functions are effective in determining the type/intensity of exercise. Exercises to be done in old age can be handled in a wide range from walking in a room to regular body movements to be done in short or long distances inside and outside the home. Exercises within the scope of the most recommended physical activity for the elderly are aerobics, muscle strengthening, flexibility and balance exercises aimed at protecting the elderly from risks against falls and fall injuries (13).

It is stated that especially the elderly people are more motivated to participate in the exercises performed in their own living spaces, such as non-clinical households (14). On the other hand, it is another point stated that it encourages them to do the exercises applied online more regularly. Therefore, the interest in online exercises is increasing day by day.

In the light of all this information, considering the need for exercise applications for the elderly, CLOSER, which enables computer-based exercise developed for the elderly within the scope of our TUBITAK invited project application, is an innovative Environment Supported life product that provides home care services for the elderly at affordable costs. It covers 4 main features that are Emergency Detection, Motion Sensitive Physical Condition Monitoring and Rehabilitation and Social Connection. The system is supported by sophisticated proprietary data analytics capabilities, including a depth sensor and cloud system in the home/elderly environment. CLOSER directly targets the improvement of the health, fitness and social life of the elderly and encourages them to exercise regularly in their daily lives. Thanks to its dynamic structure, the system adjusts itself according to certain individual characteristics of the elderly and provides the opportunity to do it by receiving feedback about the exercises without compromising the personal privacy of the elderly. The aim of pilot study is to examine the applicability of the CLOSER system, which offers the opportunity to do computer-based exercise, in elderly individuals.

MATERIALS AND METHOD

The study was performed on 54 elderly individuals who applied to Hacettepe University Geriatrics Treatment Unit between September and December 2022 (University Ethics committee approval was obtained 2022/187). In our study, which was planned in accordance with the Declaration of Helsinki (before starting the application, detailed information was given about the study to all participant), the elderly who met the inclusion criteria were obtained by signing the informed consent form that they volunteered to participate in the study. Inclusion criteria of the study; (1) Being over 65 years old, (2) Getting 24 points or more in the Mini Mental State Test (MMST), (3) Being able to read and write in Turkish, and (4) Metabolic equivalent (MET) >6. The exclusion criteria are; (1) Having a diagnosed mental or progressive disease such as Alzheimer's or dementia, (2) Having any diagnosed neurological disease, and (3) Not voluntarily participating in the study.

In order to obtain their thoughts on the applicability of the CLOSER system to the elderly included in the study within the scope of our pilot study a total of 38 questions created

by researchers were applied, consisting of 3 separate answers: agree, partially agree and disagree. The questions were created by taking the common views and opinions of clinicians and academicians who have at least 10 years of experience in the treatment and rehabilitation of the elderly, and software developers and hardware developers who are interested in the software aspect of the Closer system. These prepared questions consist of cross questions covering the accessibility of the system, verbal and visual explanation of the exercises, feedback mechanisms and motivation of the people. Within the scope of the pilot study, we conducted to examine the feasibility and effectiveness of the CLOSER system, which is the aim of our study, the answers to all questions were obtained from 54 elderly individuals using face-to-face interview method.

Within the scope of the pilot study, the Closer system includes a front landing page where the sociodemographic characteristics of the individuals are recorded, and 5 basic exercises that are related to all parts of the body, including maintaining balance, neck rotation, rhythmic gait, knee flexion and trunk rotation.

Balance Maintaining: After performing the standing calibration for the exercise, the individual stands sideways to the screen. In the side stance, it is requested that the shoulder joint be flexed to 90° "with the fingers facing forward". This exercise continues for 15 seconds. The exercise consists of 3 sets in 3 repetitions (Figure 1).

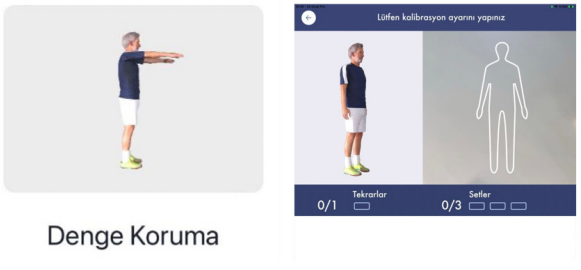

Figure 1. Balance Maintaining Exercise

Neck Rotation: after the individual has done the calibration while standing, they sit in a chair parallel to the screen. First, they turn their head to the right with the application's command and stay in this position for 5 seconds; after that, the application asks them to turn their head to the left in the same manner and stay for 5 seconds. The exercise has 3 sets with 3 repetitions (Figure 2).

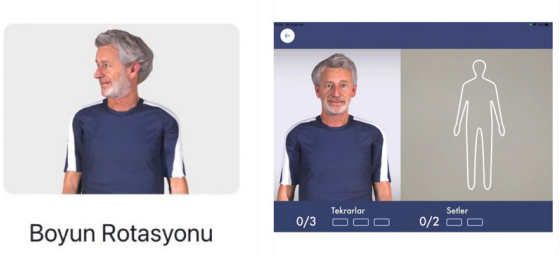

Figure 2. Neck Rotation Exercise

Rhythmic walk: after the individual has done the calibration while standing, they sit in a chair parallel to the screen. They put their hands on the chair edges. The vertical movement of the hip and knee flexion, every 2 extreme movements occur every 60 seconds. The exercise has 3 sets with 3 repetition (Figure 3).

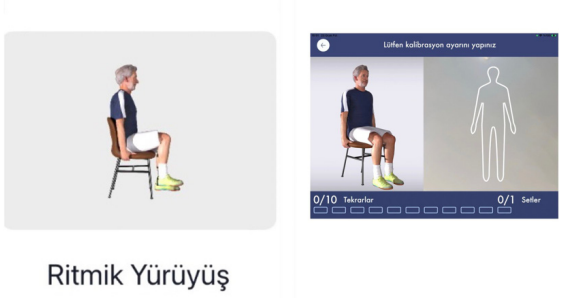

Figure 3. Rhythmic Walk Exercise

Knee Flexion: after the individual has done the calibration while standing, they go behind a chair that is put parallel to the screen. Holding on to the chair, the individual opens their legs as wide as their shoulders. After this, the individual flexes their knee by bending it where it goes exactly against the faced direction. They stay in this position for 15 seconds. This exercise is done for both extremes. This exercise has 3 repetition sets

(Figure 4).

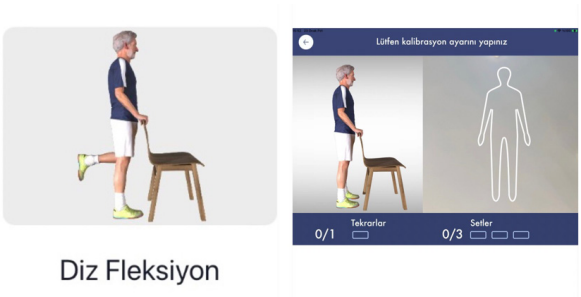

Figure 4. Knee Flexion Exercise

Body Rotation: after the individual has done the calibration while standing, they sit in a chair parallel to the screen. They hold the chair in a way where the shoulders would look down. After that, while one extreme is holding to the chair, the other extreme rotates from above. The individual stays in this position for 15 seconds. The individual then repeats the same rotation movements with the other extreme. This exercise has 3 repetition sets (Figure 5).

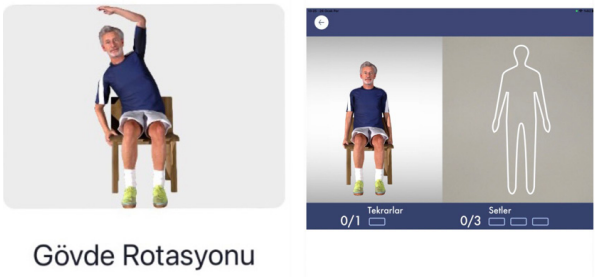

Figure 5. Body Rotation Exercise

Statistical Analysis

The statistical analyses were done using the SPSS 25.0 version software. Descriptive statistics were done as Arithmetic averages and standard deflection was used for numerical variables; frequency and percentage were used for categorical variables.

RESULTS

The average age of the 54 elderly people who joined the work was 70.53 ± 7.87 years. The sociodemographic properties that were gathered from the participants are shown in Table I.

Table I. Sociodemographic characteristics

	n	%
Gender		
Male	32	59.2
Female	22	40.8
Marital status		
Single	8	14.8
Married	34	62.9
Widowed	12	22.3
Educational Level		
Primary School	20	37
High school	22	40.7
University	12	22.3
Chronic Diseases *		
Cardiovascular Diseases	28	51.8
Hypertension	12	22.2
Diabetes	12	22.2
Respiratory Diseases (COPD)	4	7.4

*There are elderly people with more than one disease.

The answers to questions about the study that was executed to revise how appropriate and suitable the CLOSER system is for elderly people are shared in Table 2. According to these results, it can be said that the majority of participants (more than 80%) found the CLOSER system easy, understandable, and enjoyable. All the elderly participants reported that the instruction given to perform certain exercises were utterly understandable and encouraging. Nonetheless, there were a small number of participants (less than 11%) who had troubles difficulties using the application. When multiple feedback was revised, results such as the accuracy of exercise, motivation of participants and increase in participants' self-confidence while performing were obtained.

Table II. Opinion obtained about CLOSER System (n=54)

	Agreed		Partially Agreed		Disagreed	
	n	%	n	%	n	%
Application responds too late to inputs; transitions are very slow.	12	22.2	18	33.4	24	44.4
I can recommend this application to my friends.	50	92.6	4	7.4	-	-
The instructions are self-explanatory enough to exercise with the app.	54	100	-	-	-	-
I had many problems while learning to use the app.	-	-	12	22.2	42	77.8
Sometimes I don't know what to do while using the app.	5	9.2	12	22,2	37	68.6
I have a lot of fun using the application.	44	81.5	4	7.4	6	11.1
I think the help information given by the application is not helpful.	-	-	2	3.7	52	96.3
When the application stops working, it is very difficult to run it again.	6	11.1	10	18.5	38	70.4
It takes a lot of time to learn application commands.	-	-	10	18.5	44	81.5
Sometimes I am not sure if I am using the app correctly.	-	-	24	44.4	30	55.6
The application is useful for my daily workouts.	54	100	-	-	-	-
Applications functions are understandable.	40	74.1	14	25.9	-	-
I feel safe while using the application.	40	74.1	14	25.9	-	-
The application is insufficient for my daily exercise routine.	10	18.5	6	11.1	38	70.4
The application is incentive to exercise.	54	100	-	-	-	-
The application keeps track and shows how accurately I did the exercise, which increases my motivation.	48	88.9	6	11.1	-	-

Table II. (Countinued) Opinion obtained about CLOSER System (n=54)

	Agreed		Partially Agreed		Disagreed	
	n	%	n	%	n	%
I can't keep track of whether I'm doing the exercise correctly.	-	-	6	11.1	48	88.9
I feel that I have no difficulty using the application.	48	88.9	6	11.1	-	-
I don't want to use the application every day.	12	22.2	12	22.2	30	55.6
I have to read a lot before I start exercising.	-	-	4	7.4	50	92.6
Application sounds are annoying.	-	-	6	11.1	48	88.9
I think the exercises are beneficial for my body aches.	42	77.8	12	22.2	-	-
I think the user needs are fully taken into account for the application.	40	74.1	8	14.8	6	11.1
I feel nervous from time to time while using the application.	-	-	-	-	54	100
The organization of menus and buttons is very useful.	42	77.8	6	11.1	6	11.1
It takes a lot of steps to complete a process.	6	11.1	10	18.5	38	70.4
Error prevention messages are not enough.	6	11.1	8	14.8	40	74.1
The application did not meet my expectations.	2	3.7	12	22.2	40	74.1
The application looks visually nice.	48	88.9	6	11.1	-	-
You can easily switch from one process to another in the application.	36	66.6	18	33.4	-	-
Most of the time I need help when I use the application.	12	22.2	12	22.2	30	55.6
The application does not strain the eyes visually.	36	66.6	6	11.1	12	22.2
The texts in the application are in readable size.	30	55.6	12	22.2	12	22.2
I can easily perform the operation I want to do in the application.	44	81.5	10	18.5	-	-
I can easily communicate with anyone I want through the application.	24	44.4	12	22.2	18	33.4

Table II. (Countinued) Opinion obtained about CLOSER System (n=54)

	Agreed		Partially Agreed		Disagreed	
	n	%	n	%	n	%
When I used the application for the first time, I had no difficulties.	24	44.4	18	33.4	12	22.2
The application has some annoying features.	6	11.1	10	18.5	38	70.4
It's very difficult to remember where I am in the app.	-	-	6	11.1	48	88.9

DISCUSSION

In the results of the pilot study done to test the suitability of the computer-based exercise performance that the CLOSER system presents for elderly individuals, it was observed that the developed software is user-friendly, understandable and amusing, the picture and written explanations to perform exercises were beneficial, enough and enjoyable for elderly individuals.

One of the best ways for health development is well known to be physical activity (10). The role of physical movements and regular exercise in improving old-people health is important and certain (15). Regular exercises lower blood pressure, elevate blood flow, better lipid appearance, contribute to weight in control, decrease the risk of hypertension, regulate levels of hormone, enhance the immune system, improve the mineralization of bones and increase the quality of sleep. In a work done by Erdem and his friends in 2021, it is shown that as physical activity increased in elderly people, functional capability increased as well, and non-contagious chronic diseases were prevented, and the probability of death caused by chronic diseases was decreased (10). When the literature about elderly people and exercises is revised, however well the individual health, when working out for a short time, or even when simple exercises and movements are done, is it proved to be a lot better from inactivity, and long-term activity and regular exercises are of a better impact on the health (10, 16-18). The type and density of exercises elicit different outcomes to different people, medium-difficult exercise (60%, speed of heartbeat heating in 3 minutes, 3 minutes for cooling down, creating an average of 30 minutes/3 sets of exercises), aerobic exercises (walking, swimming, riding a bicycle, coordinated movements of arms and legs), power exercises (Quadriceps muscles, Hamstring muscles, and abdominal muscles), flexibility exercises (elevating and demoting on toes, squats with hands elongated in front, plate exercises to improve flexibility) and balance exercises (static and dynamic stands, two feet, tandem, and one-foot stand, etc) are safe-for-elderly recommended exercises (19-21). The developed work of computer-based CLOSER system that provides individuals from home or from distance exercises performance opportunities, under the light of the scientific data gathered, was aimed to create protective and healing exercises for elderly people. For these goals, it can be said that five basic and safe exercises that would impact the whole body were obtained by exploring the recommended exercises in literature (22-24). After analyzing the results gathered from our suitability study, it can be said that elderly people found computer-based system to be enjoyable and motivating, and their abilty to perform different exercises at home without the help of professionals with feedback on how correctand accurate were they is very valuable.

Due to the global pandemic, remote health services became the topic of the hour as they were dramatically sought, a lot of individuals were forced to though reasons caused by financial and moral factors (25,

26). For people with diseases caused by age or chronic diseases, especially that who need to join rehabilitation applications from their homes, here the value and term of tele rehabilitation can once again be re-evaluated (27). For lot of individuals, accessing remote rehabilitation is a way of facilitating. In this point, tele rehabilitation and its scope are day by day developing due to fast-growing technology. For this reason, it is valuable that the developed CLOSER system has the ability to respond to needs of the users. Even though there are similar soft wares, the usability and efficiency of evidence-based results are still not proven (23, 28). Taking all this information into consideration, we think that our pilot study results provide professional and academic benefits to all the healthcare workers.

When the problems of the system determined by the participants and the solution suggestions were examined, it was determined that it included suggestions such as increasing the speed of transition between applications, giving more motivating feedback after the correct application, and making visual inputs with more readable font size.

It has been affirmed that the CLOSER system with its features by accessing computer-based exercises system at any time and place will be the first pioneer software that is easily understandable and amusingly encourages elderly people to exercise using pictures and written instructions with motivating feedback. This result has shown the increasing need of such computer-based soft wares that provide remote rehabilitation and especially that include oriented correct and regular exercises.

CONCLUSION

CLOSER system software, regarding its content and features is the first national system oriented to meet this high need, and its usability will be of great benefit, especially to all professionals working on the health of elderly people. There is a need of more user population and elderly-function developments analyses and revisions in order to develop a CLOSER system version that includes more exercise types in the future.

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Conflict of Interest

There is no conflict of interest between the authors.

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Ethical Decleration

Ethical approval was obtained from Lokman Hekim University Scientific Research Ethics Committee on 15 November 2022 with the black number 2022/187.

Authorship Contributions

Concept: SŞ, AYY, İY, Design: SŞ, AAY Supervising: SŞ, MU, İY Financing and equipment: AYY, AAY, Data collection and entry: SŞ, MÖD, OA, Analysis and interpretation: SŞ, MÖD, İY, Literature search: SŞ, Writing: SŞ, Critical review: SŞ, MÖD, MU, İY.

*This study has not been published in any journal or congress booklet before.

REFERENCES

1. Mazzeo RS, Cavanagh P, Evans WJ, Fiatarone M, Hagberg J, Mcauley E, et al. Exercise and Physical Activity for Older Adults. Medicine and Science in Sports and Exercise. 1998;30(6):992-1008.

2. Van Norman KA. Exercise Programming for Older Adults: Human Kinetics Publishers; 1995.

3. Organization WH, Ageing WHO, Unit LC. WHO

Global Report on Falls Prevention in Older Age: World Health Organization; 2008.

4. Yildiz Ögr. Engelliliğin Tanimi, Siniflandirilmasi Ve Engelli Haklari. Bakim Ve Rehabilitasyon Giriş. 2020:81.

5. Con Wright G. Yaşlılık ve Toplumsal Cinsiyet Eşitliği Haritalama ve İzleme Çalışması. 2022.

6. Organization WH. Trends In Maternal Mortality 2000 To 2017: Estimates By WHO, UNICEF, UNFPA, World Bank Group And The United Nations Population Division. 2019.

7. Lafleur M. Art Is Long, Life Is Short: An SDG Classification System For DESA Publications. 2019.

8. TÜİK. İstatistiklerle Yaşlılar 2020. Haber Bülteni. 2020.

9. Organization WH. Global Health Risks: Mortality And Burden Of Disease Attributable To Selected Major Risks: World Health Organization; 2009.

10. Erdem Hr, Sayan M, Gökgöz Z, Ege Mr. Yaşlılarda Fiziksel Aktivite: Derleme. Yiu Saglik Bil Derg. 2021;2:16-22.

11. Soyuer F, Soyuer A. Yaşlılık ve Fiziksel Aktivite. Journal of Turgut Ozal Medical Center. 2008;15(3):219-24.

12. Lök N, Lök S, Editors. Yaşlıların Fiziksel Aktivite Düzeyleri ile Bilişsel Durumları Arasındaki İlişki. Yeni Symposium; 2016.

13. Duray M. Farklı Fiziksel Aktivite Düzeyine Sahip Olan Yaşlılarda Fiziksel Uygunluk, Düşme Riski ve Düşme Korkusu Ilişkisinin Incelenmesi: DEÜ Sağlık Bilimleri Enstitüsü; 2013.

14. Robinson L, Newton JL, Jones D, Dawson P. Self-Management And Adherence With Exercise-Based Falls Prevention Programmes: A Qualitative Study To Explore The Views And Experiences Of Older People And Physiotherapists. Disability And Rehabilitation. 2014;36(5):379-86.

15. Toğaçar Ş, Sezer SY, Demir MB. Yaşlılıkta Egzersizin Kas-İskelet Sistemi Değişikliklerine Etkisi. Spor, Sağlık Ve Eğitim Araştırmaları Dergisi. 2022;1(1):29-40.

16. İşleğen Ç. Yaşlılarda Fizik Aktivite Ve Hastalıklara Etkisi–II. Ege Tıp Dergisi. 2015;54.

17. Cifcili SS. Yaşlılarda Egzersiz. Aile Hekimliğinde Egzersiz. 2020;1:57-62.

18. Karan A. Yaşlılıkta Egzersiz ve Spor. Türk Fiz Tıp Rehab Derg (Özel Ek A). 2006:53-6.

19. Çakaloğlu E, BAYAR P. Sporcularda Orta Ve Yüksek Şiddetlerdeki Aerobik Egzersizin Bozucu Etkiye Direnç Üzerine Etkisi. Spormetre Beden Eğitimi Ve Spor Bilimleri Dergisi.16(4):266-74.

20. Dunsky A. The Effect Of Balance And Coordination Exercises On Quality Of Life In Older Adults: A Mini-Review. Frontiers In Aging Neuroscience. 2019;11:318.

21. Galip A. Yaşlanmada Fiziksel Aktivite Ve Egzersizin Yeri. Ahi Evran Üniversitesi Sosyal Bilimler Enstitüsü Dergisi. 2017;3(2):271-80.

22. Soroush S, Arefi MF, Pouya AB, Barzanouni S, Heidaranlu E, Gholizadeh H, Et Al. The Effects Of Neck, Core, And Combined Stabilization Practices On Pain, Disability, And Improvement Of The Neck Range Of Motion In Elderly With Chronic Non-Specific Neck Pain. Work. 2022;71(4):889-900.

23. Aksay E. Live Online Exercise Programs During The Covid-19 Pandemic–Are They Useful For Elderly Adults? Journal Of Physical Education And Sport. 2021;21(4):1650-8.

24. Nicolson PJ, Bennell KL, Dobson FL, Van Ginckel A, Holden MA, Hinman RS. Interventions To Increase Adherence To Therapeutic Exercise In Older Adults With Low Back Pain And/Or Hip/Knee Osteoarthritis: A Systematic Review And Meta-Analysis. British Journal Of Sports Medicine. 2017;51(10):791-9.

25. Kaye AD, Okeagu CN, Pham AD, Silva RA, Hurley JJ, Arron BL, Et Al. Economic Impact Of COVID-19 Pandemic On Healthcare Facilities And Systems: International Perspectives. Best Practice & Research Clinical Anaesthesiology. 2021;35(3):293-306.

26. Seçer M. Yaşlılarda Telerehabilitasyon. Geriatrik Bilimler Dergisi. 2022;5(2):46-55.

27. Şahin S. Tele-Rehabilitasyon. In: Kayıhan H, Editor. Yaşlılar İçin Ergoterapi: Hedef CS Kitapevleri; 2018.

28. Teixeira A, Pereira C, E Silva MO, Alvarelhão J, Silva A, Cerqueira M, Et Al. New Telerehabilitation Services For The Elderly. Handbook Of Research On Icts For Healthcare And Social Services: Developments And Applications, Isabel Maria Miranda, Maria Manuela Cruz-Cunha. IGI Global; 2013.