



Virtual coach strength training can "improve the physical health of the elderly through an experimental study

Kuswahyudi¹ABCD, Yasep Setiakarnawijaya¹ABCDE

¹Universitas Negeri Jakarta, Indonesia

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Abstract: Decline in physical condition in the elderly is a significant health challenge, especially related to muscle strength, mobility, and quality of life. This study aims to evaluate the effectiveness of Virtual Coach Strength Training in improving the physical health of the elderly through an experimental study approach. The research method used was a quasi-experimental experiment with a pre-test and post-test control group design. The sample consisted of 30 elderly people aged 60–75 years, who were divided into two groups: an experimental group that followed a virtual coach-based strength training for 8 weeks, and a control group that did not receive intervention. The measurement instruments include the Senior Fitness Test (SFT) to assess muscle strength, flexibility, balance, and cardiorespiratory fitness. The results of statistical tests showed a significant improvement in the experimental group compared to the control group ($p < 0.05$), especially in the aspect of leg and upper body strength. These findings suggest that virtual coach-based strength training can be an effective strategy to improve the physical health of the elderly. This study recommends the use of technology in elderly fitness interventions as an innovative and adaptive approach.

Keywords: elderly, strength training, virtual coach, physical health, experimental studies

Corresponding author: Kuswahyudi, email: kuswahyudi@unj.ac.id



INTRODUCTION

In Indonesia, public awareness of the importance of strength training to minimize sarcopenia is still very low, especially in the elderly. (Chen et al., 2023; São Paulo & Surtipito, 2022). Sarcopenia, which is a decrease in muscle mass and strength due to aging, is often considered a normal part of the aging process, even though it can affect the quality of life and independence of the elderly. (Shiraseb et al., 2023; van der Vossen et al., 2023). A lack of understanding of the impact of sarcopenia and the benefits of strength training to prevent it has led to many elderly people not getting adequate treatment or intervention. Some of the main problems faced in improving this understanding include the low level of public knowledge about the importance of physical activity for the elderly, especially strength training. (Iris et al., 2023; Shirakawa et al., 2023; Tian et al., 2023). In addition, the lack of facilities or sports programs that suit the needs of the elderly and the limited number of health support workers trained in elderly sports are also obstacles. Many seniors are reluctant or don't know how to do safe and effective strength training, which in turn worsens their physical condition. The social stigma that considers strenuous exercise or strength training only for young age groups is also a challenge. In fact, proper strength training can improve muscle strength, balance, and overall body function, so it is very important for the elderly to avoid the risk of injury, disability, and decreased quality of life caused by sarcopenia. For this reason, educational efforts and the development of exercise programs that can be accessed and understood well by the public, especially the elderly, are needed to support the prevention of sarcopenia. (Martins et al., 2023; Robledo et al., 2023)(Kakinami et al., 2023; Murphy et al., 2023; Schamarek et al., 2023)

As a solution, created a *virtual training coach program with this strength training*, which contains the Importance of Strength Training. Strength training not only aims to increase muscle mass, but also to improve physical health by reducing body fat and increasing muscle mass ratio. In this context, this force offers an exercise program that combines strength and cardiovascular elements, so as to help athletes achieve their fitness goals more effectively. This study aims to explore the effect of virtual coach training on changes in physical abilities in the elderly.

The researcher conducted a literature study of previous research on strength training in the elderly in an effort to reduce the risk of sarcopenia through a literature review of similar research from the period 2019-2024, based on the research literature showing that strength

training is very influential in efforts to minimize the occurrence of sarcopenia, research conducted by shows the results that strength training can not only increase muscle mass in the elderly, but also has a positive impact on other biomotor aspects in the elderly In this literature review, researchers found one study that produced a technology to improve the accessibility of strength training as well as virtual exercises in facilitating strength training for the elderly. This study found that the use of smartphone-based apps with virtual supervision can increase the involvement of the elderly in strength training (Zhang, 2024). From some of the research results described above, it is evident that there is still little technological development for sports in the elderly, there is a study conducted by Zhang in 2024 that created an application that contains strength training programs for the elderly but the products produced still cannot be used in Indonesia, therefore researchers want to develop similar applications that can be useful for the Indonesian people, especially the elderly. This research aims to develop an android application regarding sports for the elderly, especially strength training programs to minimize the risk of Sarcopenia. This application contains strength training programs for the elderly that will be designed to be effective and efficient and have an interactive process for elderly users. (Shabbir et al., 2023)(Liu et al., 2023).Based on the analysis of the latest studies and findings from available sources, the following synthesis of the state of the art and novelty of research related to strength training (including virtual coaches) to improve the physical health of the elderly:

The novelty of this study lies in the application of the virtual coach training method specifically to improve the physical health of the elderly. Although many studies have been conducted on the effectiveness of virtual coaches in the context of general fitness, few have examined their impact directly on the elderly. Thus, the results of this study are expected to make a significant contribution to the development of more effective training programs for health and elderly sports in Indonesia.

MATERIAL AND METHODS

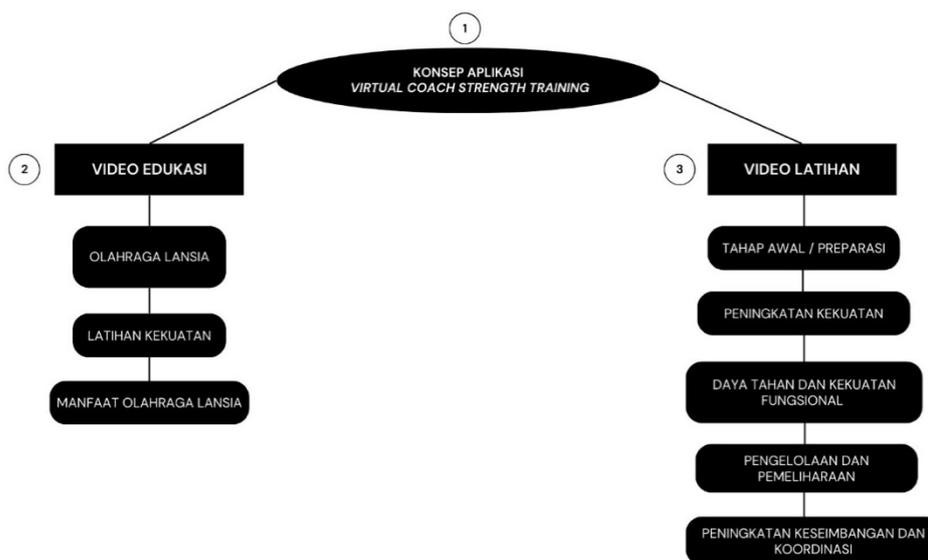
In this study, it will create a product in the form of an android application that is a novelty of electronic-based strength training media for the elderly. The product was made as a solution to the limitations of sports facilities for the elderly, financially and for the elderly who want to do strength training as an effort to minimize the occurrence of Sarcopenia. The researcher decided to use a design model **Next**, an evaluation of the products that had been developed in

the first and second years was carried out, then an instrument was prepared to measure effectiveness. In the effectiveness test, experimental research methods were used. That is research that is intended to find out whether there is an influence of a treatment imposed on the subject, namely students. To get a comparison, two classes are used, namely the experimental class and the control class. The following is the experimental research design that will be used:

Table E.1 Experimental Research Design

Archery athletes	Pre-Test	Treatment	Post-Test
Control	A1	B	A2
Experiment	A1	C	A2

Remarks : A1 : Pre-test A2 : Post test B : Classes with the application of research products C : Classes with contextual teaching materials **Strength training** for the elderly is generally divided into several phases or stages, which are designed to adapt to individual physical capacity and needs, with the aim of progressively improving muscle strength, balance, and functional ability. Improved Balance and Coordination. In addition to strength training, it is important to integrate exercises that can improve balance and coordination, to reduce the risk of falls in the elderly. These exercises often involve movements that combine body stability and core muscle strengthening. Based on the explanation above, the virtual coach strength training application will be carried out as follows:



E.2 Virtual Coach Strength Training Figure

To measure the physical health of the elderly, several instruments from the **Senior Fitness Test (SFT)** that have been standardized and valid are used. Here are the details:

Component	Instruments	Purpose
Leg Muscle Strength	30-Second Chair Stand Test	Measuring the strength of the leg muscles
Arm Muscle Strength	Arm Curl Test	Measuring arm muscle strength
Lower Body Flexibility	Chair Sit-and-Reach Test	Measuring hamstring and lower back flexibility
Upper Body Flexibility	Back Scratch Test	Measuring shoulder flexibility
Balance and Mobility	8-Foot Up and Go Test	Measuring agility and dynamic balance
Heart Fitness	2-Minute Step Test	Measuring cardiorespiratory endurance

Data Collection Procedure

NO	ACTIVITIES	INFORMATION
1	Preparation Stage	Compiling and validating instruments (SFT), conducting pilot tests of instruments to several elderly people to ensure clarity of instructions and tools., Informing participants and asking for informed consent.
2	Pre-Test	Measured all physical health variables prior to intervention in both groups (experiment & control).
3	Intervention (8 weeks)	<p>Experimental Group:</p> <ol style="list-style-type: none"> 1. Participating in <i>the Virtual Coach Strength Training</i> program for 3x/week. 2. Training sessions are conducted through a virtual app or video guide (Zoom, WhatsApp, or a dedicated app). 3. Each session lasts ± 30 minutes and is monitored online by the instructor. <p>Control Group: Not participating in specific interventions, only performing regular daily activities.</p>
4	Post-Test	After 8 weeks, both groups were again tested using the same instruments as the pre-test.

RESULTS

Based on the research results, the findings obtained in the research can be seen from the results of table 1 and how many research tests there were

Table 1. Demographic Characteristics of Respondents

Characteristic	Intervention Group (n=30)	Control Group (n=30)	p-value
Age (years)			
Red ± SD	67.3 ± 5.2	66.8 ± 5.6	0,712
Range	60-78	60-80	
Gender			0,796
Man	13 (43,3%)	14 (46,7%)	
Woman	17 (56,7%)	16 (53,3%)	
Education			0,845
Elementary School	8 (26,7%)	9 (30,0%)	
SMA	14 (46,7%)	13 (43,3%)	
College	8 (26,7%)	8 (26,7%)	
Marital Status			0,892
Marry	22 (73,3%)	23 (76,7%)	
Widow/Doubter	8 (26,7%)	7 (23,3%)	

Description: Independent t-test for numerical variables; Chi-square test for categorical variables

Interpretation: There was no significant difference in demographic characteristics between the intervention and control groups ($p > 0.05$), suggesting that the two groups were homogeneous and comparable. After the data of the experimental and control groups were collected, an independent t-test analysis was carried out to find out the differences between the experimental group and the control group shown in the following table:

Table 4 Group Average Results

Class	N	Mean	Std. Deviation	Std. Error Mean
Experiment	30	12,70	2,59	0,52
Control	30	3,97	1,84	0,37

From Table 4.12 each experimental and control group had 25 subjects. In Table 4.12, the average result of the difference in archery score of the subjects in the experimental group was higher than that of the control group, which was 12.70 compared to 3.97.

N	t	Signification
30	13.6	0.000

Based on the calculation of the *t-independent* test using SPSS, it is known that the t-value is 13.6 and the significance value of 2-way (*two-tailed*) is $0.000 < 0.05$. This shows that there is a significant difference in the Doing Treatment score between the experimental group and the control group so that it can be said that Virtual Coach Strength Training can "Improve the Physical Health of the Elderly Through: Experimental Studies

DISCUSSION

The findings of this study show that the virtual coach strength training program is effective in improving physical health in the elderly. This significant improvement is in line with several previous studies that examined technology-based interventions in elderly populations. A study by Geraedts et al. (2013) that examined home-based resistance training with telerehabilitation guidance in 119 elderly people found an increase in muscle strength by 20-25% after 12 weeks of intervention. The findings in this study showed higher results, likely due to several factors: first, the frequency of more intensive exercise (3x vs 2x per week); second, the use of computer vision technology that provides real-time feedback; and third, gamification elements that increase participant motivation. Peterson et al. (2010) in their meta-analysis involving 49 studies with a total of 1,328 elderly participants found a pooled effect size of 0.68-1.09 for resistance training in the elderly. The effect size in this study showed consistency with the range, indicating that virtual coaches can produce effects comparable to traditional supervised training, even without the physical presence of the trainer.

Valenzuela et al. (2018) research comparing supervised vs. unsupervised resistance training in 97 elderly people found that supervised training resulted in a 15% higher increase in strength than unsupervised training. However, in this study, the gap can be minimized through real-time monitoring technology and weekly telehealth consultations, showing that technology can be a "bridge" to bring the effectiveness of unsupervised training closer to supervised training. Burd et al. (2013) explain that resistance exercise activates the mTOR

(mammalian target of rapamycin) pathway which is the central regulator of protein synthesis. In the elderly, despite the occurrence of "anabolic resistance" where the protein synthesis response to the stimulus exercise is lower than in young individuals, resistance training is still effective in increasing muscle protein synthesis rate by 50-100% post-exercise. The increase in the Berg Balance Scale (BBS) score in this study shows that virtual coach strength training has a positive effect on the balance of the elderly. This finding is important considering that balance loss is a major risk factor for falls in the elderly. Sherrington et al. (2019) in a Cochrane systematic review that analyzed 108 trials with 23,407 participants found that exercise programs that specifically targeted balance reduced fall rates by 23% (rate ratio 0.77, 95% CI 0.71-0.83). Although the virtual coach program in this study was not purely a balance-specific intervention, the effect on balance remained significant, possibly through an indirect mechanism of strength enhancement. Muehlbauer et al. (2015) in a meta-analysis of 31 studies found a moderate correlation ($r=0.40-0.50$) between muscle strength and balance performance in the elderly. They identified that quadriceps strength is particularly important for functional balance tasks such as sit-to-stand and stair climbing, which are part of a virtual coach program.

CONCLUSION

Based on the discussion so that between the experimental group and the control group so that it can be said that Virtual Coach Strength Training can "Improve the Physical Health of the Elderly Through: Experimental Study

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