Range of motion on increasing muscle strength in the elderly

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Abstract:
Decreased muscle strength in the elderly often causes a decrease in quality of life and mobility. One intervention that can be done to increase muscle strength is active Range of Motion (ROM) training. This study aims to determine the effect of active ROM training on increasing muscle strength in the elderly at the UPT Social Services for the Elderly in Jombang. This research used a pre-experimental design with a one-group pretest-posttest approach. The research sample consisted of 36 older adults selected using purposive sampling. Data was collected by measuring muscle strength before and after active ROM exercises for four weeks. Data were analyzed using the Wilcoxon Signed-Rank Test statistical test with a significance level of α = 0.05. Before active ROM training, most respondents had level 3 muscle strength (61%). After active ROM training, most respondents experienced increased muscle strength to level 5 (75%). The statistical analysis results show a value of ρ = 0.000 ≤ 0.05, which shows a significant influence of active ROM training on increasing muscle strength in the elderly. Active ROM training is effective in increasing muscle strength in the elderly. Therefore, this exercise can be recommended as a routine program to maintain the physical health and mobility of the elderly. Further research with experimental designs and larger sample sizes is recommended to strengthen these findings.

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INTRODUCTION

The elderly population worldwide continues to increase as life expectancy increases due to advances in health and medical technology (Garmany et al., 2021). However, the aging process is often accompanied by various physiological changes affecting the quality of life, including decreased muscle strength and range of motion (ROM) (Bacanoiu & Danoiu, 2021). This decrease can cause limited mobility, increased risk of falls, and disruption of daily activities (Meer et al., 2023).

Range of motion (ROM) refers to the ability of a joint to move in a specific direction to its maximum limit. Optimal ROM maintains motor function, body stability, and balance (Putri et al., 2022). On the other hand, muscle strength is the main component in supporting physical activity and maintaining the independence of the elderly (Billot et al., 2020). Unfortunately, with increasing age, there is a decrease in muscle mass (sarcopenia) and soft tissue elasticity, which decreases ROM and muscle strength (Cruz-Jentoft et al., 2019). Therefore, it is important to explore the relationship between ROM and increased muscle strength as part of efforts to improve the quality of life of the elderly.

This study aims to evaluate the effect of ROM training on increasing muscle strength in the elderly. The main focus is to find out whether ROM intervention can effectively slow down the degenerative process that occurs in the elderly so that they can remain active and independent in living their daily lives. The problem of decreased ROM and muscle strength in the elderly is not an isolated phenomenon but a global problem that affects millions of individuals (Izquierdo et al., 2021). A study by Manini and Clark (2012) showed that approximately 30% of the elderly population

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experiences a significant decline in muscle strength, which is often accompanied by a decrease in ROM. In addition, research conducted by Fragala et al. (2019) reported that more than 50% of older adults experience difficulty carrying out basic activities such as walking, climbing stairs, or even getting up from a chair due to decreased muscle strength and ROM.

This figure is expected to continue to increase along with the growth of the elderly population in this country. Decreases in ROM and muscle strength affect physical aspects and have significant psychosocial impacts (Vita et al., 2020). Older adults who experience decreased mobility tend to experience social isolation, depression, and a decrease in overall quality of life (Skelton & Dinan-Young, 2019). Therefore, efforts to improve ROM and muscle strength in the elderly must be a priority in public health programs (Levinger et al., 2021). The aging process begins in early adulthood, but its impact becomes more apparent after age 60 (Escourrou et al., 2022). One of the main changes is a decrease in muscle mass, known as sarcopenia. Sarcopenia affects muscle strength and reduces the elasticity of tendons and ligaments, contributing to decreased ROM (Tomlinson et al., 2021).

Besides biological factors, lifestyle also plays an important role in accelerating the decline in ROM and muscle strength (Alcaraz et al., 2024). Older adults who are less physically active tend to experience a faster decline than those who remain active (Szychowska et al., 2022). Lack of physical activity causes muscles to become weak and stiff, so ROM becomes increasingly limited. Various approaches have been developed in the last few decades to overcome this problem (Handsfield et al., 2022). Physical exercise, including ROM exercises and strength training, has been recognized as an effective method for slowing degenerative processes in the elderly (Cadore et al., 2014). However, little research specifically explores this group's relationship between ROM and increased muscle strength. Therefore, this study aims to fill this gap by providing scientific evidence about the benefits of ROM training in increasing muscle strength in the elderly.

Decreased range of motion (ROM) and muscle strength in the elderly seriously affect their quality of life (Chen et al., 2022). With the increasing elderly population worldwide, developing effective strategies to slow this degenerative process is important. ROM exercise has excellent potential as a non-pharmacological intervention to increase muscle strength and mobility in the elderly (Petrasso et al., 2024). This research is expected to provide new insight into the relationship between ROM and muscle strength and its contribution to improving the quality of life of the elderly. The results of this research can be used as a basis for designing more effective physical rehabilitation programs for the elderly, both at the individual and community levels.

METHOD

The research design used was pre-experimental, with a one-group pre-post test design. This design involves one group of subjects who are measured before and after being given treatment. The subjects in this study were older adults with decreased muscle strength. Initial measurements were carried out to determine the condition of muscle strength before the intervention; then, active ROM exercises were given twice a day for one week. After that, repeated measurements were carried out to assess changes in muscle strength after the intervention. This research design provides a clear picture of the effect of the intervention provided.

This research was carried out at the Jombang Elderly Social Services UPT. The research location was chosen because it has an elderly population that meets the research inclusion criteria. The research population included all older adults at the Jombang Elderly Social Services UPT, totaling 70 people. The research sample was taken using a purposive sampling technique, namely selecting samples based on specific criteria set by the researcher. Inclusion criteria include willingness to be a respondent, age between 60 and 75 years, experiencing decreased muscle strength, and cooperation during the research process. Meanwhile, exclusion criteria include unwillingness to be a respondent, having complicated health problems such as heart disease, or older adults who have been on bed rest for a long time and cannot communicate with them. Based on these criteria, the number of samples meet the requirements is 36 respondents.

The research instruments consist of two types: SOPs for implementing active ROM exercises to measure independent variables and observation sheets and checklists to measure the dependent

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variable. The independent variable in this study was providing active ROM training, while the dependent variable was increasing muscle strength. Data analysis was carried out quantitatively using statistical tests, such as the Wilcoxon Signed Rank Test, with the help of the Windows version of the SPSS program. This test was chosen because it is based on the pre-experimental research design and aims to determine the significance of the effect of active ROM training on increasing muscle strength. The level of significance used is $\alpha = 0.05$. If the p-value <0.05, the alternative hypothesis is accepted, meaning the intervention has a significant effect.

This research complies with the principles of research ethics to protect the rights of respondents. Some ethical aspects applied include informed consent, anonymity, and confidentiality. Respondents were fully explained the study's purpose, benefits, and risks before agreeing to participate. The respondent's identity is not included in the research document; only a number code is used. Information obtained from respondents is guaranteed to be kept confidential and is only used for research purposes. Limitations of this research include limited research time, so the researcher cannot entirely focus because he has to arrange a schedule with lectures. Research costs are also relatively high due to the distance between the research location and the campus. In addition, this is the first time the researcher has conducted research, so the results obtained are still limited to the researcher's abilities. However, it is hoped that this research can significantly contribute to understanding the effect of active ROM training on increasing muscle strength in the elderly.

RESULT

This research involved 36 elderly respondents in Jombang Regency. Data was collected through research explanation and informed consent, followed by providing ROM training measures. Data collection was carried out during visits to elderly homes. The following is data on respondent characteristics and pre-post action data on respondents.

Table 1. Characteristics of Respondents

Variable	Category	Number (n)	Percentage (%)
Gender	Man	6	17
	Woman	30	83
Age	60–65 years	7	19
	66–70 years old	10	28
	71–75 years old	19	53
Education	No school	16	44
	Elementary School	14	40
	Junior High School	3	8
	Senior High School	3	8
Work	Farmer/Laborer	22	61
	Self-employed	12	33
	Civil servants/ Soldiers/ Police/Retired	2	6
Illness	Arthritis Rheumatoid	26	72
	Hypertension	3	8
	Diabetes mellitus	1	3
	Stroke	6	17

From this table, it can be concluded that the majority of respondents were women (83%), aged 71–75 years (53%), had no formal education (44%), worked as farmers or laborers (61%), and suffered from rheumatoid arthritis (72%).

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Table 2. Distribution of Muscle Strength before and after Active ROM

Muscle Strength Value	Before ROM	Presentation	After ROM	Presentation
0	0	0	0	0
1	0	0	0	0
2	5	14	0	0
3	22	61	0	0
4	9	25	9	25
5	0	0	27	75
Total	36	100	36	100
Statistical test using Wilcoxon, p-value = 0.000 ≤ 0.05				

Before doing active ROM exercises, most respondents had a muscle strength scale of 3 (61%), which means the muscles could only move the joints but could not fight gravity. After doing active ROM training for one week, most respondents experienced a significant increase to a scale of 5 (75%), namely that the muscles could move fully against gravity and resistance. Using statistical tests,the Wilcoxon signed rank test was obtained p-value = 0.000 ≤ 0.05, so that Ha is accepted; it can be concluded that active Range of Motion (ROM) training influences increasing muscle strength in the elderly.

DISCUSSION

The research showed that most respondents experienced decreased muscle strength before active ROM training. Of the 36 respondents, 22 people, or 61 percent, had a muscle strength scale of 3, which means the muscles can move joints but cannot fight gravity. The results showed significant improvement after the intervention in the form of one week of active ROM exercises. A total of 27 respondents, or 75 percent, reached a muscle strength scale of 5: the muscles can fully move against gravity and resistance. Statistical test results using the Wilcoxon Signed Rank Test show the value ρ = 0.000 ≤ α = 0.05, which means the alternative hypothesis is accepted. This proves that active ROM training has a significant effect on increasing muscle strength in the elderly.

These findings align with modern theory, which explains the mechanism of active ROM training's action in increasing muscle strength. According to recent research by Smith et al. (2021), active ROM training can stimulate the activation of calcium ions (Ca+), which improves muscle protein integrity. Ca+ activation enables interactions between actin and myosin, two key proteins in muscle contraction. This process produces better muscle tone, so the muscles become more assertive and resist gravity and external resistance. In addition, a study by Kruse et al. (2021) found that active ROM training also increased the number of myofibrils, myofibril size, and total contractile proteins, especially myosin. These anatomical changes contribute to significant increases in muscle strength.

Biochemically, active ROM training increases the concentration of creatine phosphate, ATP, and glycogen in muscle (Mohr et al., 2022). Research by Markus et al. (2021) shows that increasing the concentration of these substances plays an important role in accelerating muscle recovery after physical activity. In addition, nervous system adaptations occur during active ROM training, as explained by Warneke et al. (2024). These adaptations involve synchronization and recruitment of motor units, allowing muscles to work more efficiently and effectively. All of these changes contributed to a significant increase in muscle strength, as seen in the results of this study.

However, disease factors such as rheumatoid arthritis also influence the decline in muscle strength before intervention. According to research by Letarouilly et al. (2021), rheumatoid arthritis sufferers often experience a decrease in muscle mass due to a lack of physical activity. Lack of physical activity disrupts active Ca+ transport, which inhibits the interaction between actin and myosin. As a result, muscles become weak, making moving difficult (Ran et al., 2024). This finding is based on the results of this study, where most respondents who experienced a decrease in muscle strength before active ROM exercise were rheumatoid arthritis sufferers.

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After active ROM training, disease factors no longer significantly affect muscle strength (Rahiminezhad et al., 2022). This shows active ROM training can effectively overcome muscle strength problems in older adults with certain health conditions. According to Sobrinho et al. (2023), active ROM training increases muscle strength and maintains cardiorespiratory function and joint flexibility. This exercise also prevents contractures or stiffness in the joints, often a problem for older adults with limited mobility.

In a practical context, the findings of this research have important implications for social service institutions such as the Jombang Elderly Social Services. These institutions can utilize research results to design more structured and targeted physical rehabilitation programs. Active ROM exercise programs can be integrated into older adults' daily activities in social institutions (Baldelli et al., 2021). This exercise can be done in groups to increase motivation and compliance. In addition, collaboration with medical personnel such as physiotherapists can ensure that active ROM exercises are carried out correctly and safely, especially for older adults with certain health conditions (Sadineni., 2024).

Although this study provided significant results, several limitations need to be noted. The relatively short research time, namely one week, may not be enough to see the long-term impact of active ROM training. Research locations far from campus cause research costs to increase, so the scope of research becomes limited. In addition, this is the first time the researcher has conducted research, so the results obtained are still limited to the researcher's abilities. For future research, it is recommended that the duration of the study be extended to see the long-term effects of active ROM training. Additionally, the study could be expanded to a more extensive and diverse population to increase the generalizability of the results.

Overall, this research proves that active ROM training has a positive influence on increasing muscle strength in the elderly. These results are supported by modern theories that explain the mechanism of action of active ROM training in increasing muscle strength through anatomical and biochemical changes. Despite some limitations, these findings provide an important contribution to the field of physical rehabilitation for the elderly. By implementing a regular active ROM exercise program, older adults can maintain their independence and improve their quality of life. Social service institutions such as the Jombang Elderly Social Services UPT can utilize the results of this research to design more effective and sustainable physical rehabilitation programs.

CONCLUSION

Active ROM training significantly influences increasing muscle strength in the elderly. This shows that intervention in the form of regular active ROM exercises can be an effective solution for improving the physical condition of the elderly, especially in increasing the muscle's ability to resist gravity and external resistance. This research also proves that disease factors such as rheumatoid arthritis, which previously influenced a decrease in muscle strength, are no longer an obstacle after consistent active ROM training. Thus, active ROM exercises can be recommended as part of a physical rehabilitation program for the elderly to maintain their independence and improve their quality of life. This research makes an important contribution to the field of geriatric health by showing the importance of simple but structured physical activity to support the health of the elderly.

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