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Original Article

Effectiveness of Low-Impact Aerobic Exercise to Improve Cardiorespiratory Fitness and Quality of Life in Elderly

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Abstract

Background: Aging is associated with declining physical health and decreased quality of life in the elderly population. In response to the rising challenges faced by the aging demographic, this study aimed to investigate the effects of low-impact aerobic exercise on cardiorespiratory fitness and quality of life in the elderly.

Methods: A quasi-experimental study was employed involving 42 elderly participants who underwent a three-month low-impact aerobic exercise intervention. This study was conducted in the work area of the Surakarta City Health Service, Indonesia from June to August 2023. Cardiorespiratory fitness was measured using the Harvard Step Test, and quality of life was assessed using the World Health Organization Quality of Life Brief Version (WHOQOL-BREF) questionnaire. The effect of low-impact aerobic exercise on cardiorespiratory fitness and quality of life was analyzed using the non-parametric test Wilcoxon Test.

Results: Most respondents were aged 60–65 years (66.7%) and female (71.5%). Significant improvements were observed in both cardiorespiratory fitness (p=0.025) and quality of life (p=0.001) after low-impact aerobic exercise intervention.

Conclusions: Low-impact aerobic exercise is effective on increasing cardiorespiratory fitness and quality of life in the elderly. This finding is expected to be one of the main therapies that can help maintain the health and well-being of the older adults' population.

Keywords: Cardiorespiratory fitness, elderly, low-impact aerobic, older adults, quality of life

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Introduction

Aging is a continuous process that leads to anatomical, physiological, and biochemical changes in the body, affecting the body's overall function and capacity. These changes include a decrease in physical health, which is usually characterized by hearing loss, visual impairment, and reduced muscle strength, which results in slower movements in elderly individuals.[1]

As life expectancy among the elderly, the body naturally experiences cell decline, affecting the function of various systems.[2] In Indonesia, the number of elderly individuals has risen steadily over the years. In 2000, there were approximately 15.1 million elderly people, accounting for 7.2% of the total population, with an average life expectancy of 64.05 years.[3] By 2006, life expectancy had increased to 66 years, and the number of elderly people reached 19 million. It is estimated that by 2020, the number of elderly people will increase to 29 million, representing 11.4% of the population.[4]

Elderly population has continued to increase over time.[4] So the higher the life expectancy, the higher the risk of various types of disease problems in the elderly.[5] Physical fitness is closely related to the body's capacity to perform tasks optimally and efficiently.[6] Physical fitness in humans can be said to be

good if their cardiorespiratory endurance is good.[7] Cardiorespiratory endurance or heart and lung endurance is one of the important elements and is very much needed in human physical fitness. Therefore, physical activity is needed for elderly to stay physically fit and psychologically healthy.[8]

Physical exercise is very important in enhancing the quality of life among older adults. Regular physical exercise can also improve social interaction and is beneficial for physical and mental health. Exercise is essential for maintaining a healthy body in the elderly and reducing the risk of disease.[9] Physical exercise such as walking, running, strength training, weight lifting, and other forms of physical activity are one of the strategies for preventing dangerous diseases.[10] A healthy lifestyle, including regular physical activity aims to prolong life expectancy and improve well-being.[11]

Low-impact aerobic exercise, such as aerobic, is very useful for maintaining and increasing the strength of the heart, lungs, blood circulation, muscles and skeletal structure of the body.[12,13] This type of exercise is particularly suitable for the elderly, as it involves no jumping and focuses on balance exercises that target major muscle groups with light to moderate intensity movements.[9] Aerobic activities are often designed to burn fat and tone muscles, and are typically performed to music that matches the rhythm and movement of the body.[14,15] Low-impact aerobic exercise stimulates the cardiovascular and respiratory systems by engaging the entire body, especially the large muscles groups.[16] It involves continuous, coordinated movement while keeping one or both feet in contact with the ground.[17] Low-impact aerobics has slow, gentle and smooth movements, so it can be done even by elderly with low fitness levels. In particular, aerobic exercise can be done in various forms, making it suitable for use by a large number of elderly people in group exercises.[18]

Aerobic exercise has a positive impact on quality of life and is also effective in maintaining cardiovascular function, especially blood pressure. Therefore, this study aimed to analyze the effectiveness of low-impact aerobic exercise in improving cardiorespiratory fitness and quality of life in the elderly.

Methods

This study was a quantitative research conducted at the Surakarta City Health Office, Indonesia from June to August 2023, using a quasi-experimental research design with a one group pre-test post-test design, meaning that this study only used one experimental group without using a control group. This study has been declared ethically appropriate by the Universitas 'Aisyiyah Surakarta Research Ethics Committee No:111/VI/AUEC/2023.

The population in this study consisted of 90 elderly people. The sampling technique was a purposive sampling with inclusion criteria, namely elderly aged > 60 years, still productive, had cardiorespiratory fitness values, and quality of life below normal. Exclusion criteria were those who had other infectious diseases, had limited mobility and the elderly refused to be research subjects. The total research subject were 42 elderly.

This study examined two variables: the independent variable was low-impact aerobic exercise, while the dependent variables were cardiorespiratory fitness and quality of life. The effectiveness of the intervention was evaluated by comparing participants' post-test scores with their pre-test scores..

Cardiorespiratory fitness was measured using the Harvard Step Test. The results were categorized into five levels based on the scores: poor (≤ 54), less (55–64), enough (65–79), good (80–89), and excellent (≥ 90). Quality of life was assessed using the the World Health Organization Quality of Life Brief Version (WHOQOL-BREF) questionnaire,

Table 1 Characteristics of Respondents

Characteristic	N	%
Age (year)		
60–65	28	66.7
65–70	9	21.4
70–75	5	11.9
Gender		
Male	12	28.5
Female	30	71.5

which evaluates four domains: physical health, psychological well-being, social relationships, and environmental conditions. The physical health domain measured perceptions of energy levels, mobility, pain, and discomfort. The psychological domain addressed mental well-being, including aspects such as positive feelings, self-esteem, body image, spirituality, and cognitive functions. The social relationships domain focused on personal interactions, availability of social support, and sexual activity. Lastly, the environmental domain assessed an individual's perception of their safety, access to healthcare, financial resources, leisure opportunities, and access to information and skills.

Each domain in the WHOQOL-BREF consisted of multiple questions rated on a Likert scale from 1 to 5, where 1 indicated "Very dissatisfied" or "Very poor," and 5 represented "Very satisfied" or "Very good." The total score for each domain was calculated by summing the item scores and transforming the result to a scale ranging from 0 to 100 for ease of interpretation. The overall quality of life score was further categorized into five levels: very poor (0–20), poor (21–40), moderate (41–60), good (61–80), and excellent (81–100).

Data obtained were processed using the SPSS software. The normality of the data was tested using the Shapiro-Wilk test, as the sample size was fewer than 50 participants. If the significance value was greater than 0.05, the data were considered normally distributed. In cases of normal distribution, the Paired Sample t-test was used to assess the effect of the intervention, with a significance level of $p<0.05$. If the data were not normally distributed, the Wilcoxon Signed-Rank Test was employed, also using a significance threshold of $p<0.05$. The results of the analysis were presented in both tabular and narrative formats.

Results

Of the 90 respondents recruited, only 42 were included due to several factors as follows: 12 had cardiorespiratory fitness levels above the normal threshold, 8 had quality of life scores that were not within the required range, 15 had mobility limitations, making them unable to perform low-impact aerobic exercise as required by the study. In addition, 10 others were disqualified after being diagnosed with infectious diseases during the health screening process. Furthermore, 3 participants voluntarily withdrew from the study, citing personal reasons or discomfort with the study protocol. Of the 42 respondents included, most of the respondents were aged 60–65 years (66.7%) and was dominated by female (71.5%) (Table 1).

The results of the Harvard Step Test revealed a significant improvement in cardiorespiratory fitness following the intervention. The number of respondents classified as having a "Good" level of cardiorespiratory fitness increased markedly from 6 individuals (14.3%) before the intervention to 19 individuals (45.2%) after the intervention. Conversely, those in the "Poor" category decreased from 7 individuals (16.7%) to 3 individuals (7.1%). These findings demonstrated a clear enhancement in fitness levels among participants after underwent the low-impact aerobic exercise program.

The majority of respondents achieved a "Good" level of cardiorespiratory fitness after the exercise program, with 19 participants (45.2%) falling into this category (Table 2). In this study, there was a lack of participants reaching the "Excellent" fitness category, although there was improvement (0%).

The changes in cardiorespiratory fitness levels before and after the intervention were statistically significant ($p=0.025$), indicating that the intervention had a meaningful

Table 2 Cardiorespiratory Fitness Levels of Respondents Before and After Low-impact Aerobic Exercise

Cardiorespiratory Fitness Level*	Before		After	
	n	%	n	%
Poor	7	16.7	3	7.1
Fair	9	21	8	19
Moderate	20	47.6	12	28.7
Good	6	14.3	19	45.2
Excellent	0	0	0	0
Total	42	100	42	100

Note: *Harvard Step Test scores: Poor (≤ 54), Fair (55–64), Moderate (65–79), Good (80–89), Excellent (≥ 90)

Table 3 Quality of Life Levels of Respondents by Dimension Before and After Low-impact Aerobic Exercise

Dimension	Before		After	
	n	%	n	%
Physical health				
Very poor	0	0	0	0
Poor	6	14.3	2	4.7
Moderate	20	47.6	14	33.3
Good	10	23.8	18	42.9
Excellent	6	14.3	8	19.1
Psychological				
Very poor	0	0	0	0
Poor	5	11.9	1	2.4
Moderate	26	61.9	17	40.4
Good	5	11.9	12	28.6
Excellent	5	11.9	12	28.6
Social relationship				
Very poor	0	0	0	0
Poor	8	19.1	3	7.1
Moderate	18	42.8	9	21.4
Good	9	21.4	19	45.2
Excellent	7	16.7	11	26.2
Environment				
Very poor	3	7.1	1	2.4
Poor	7	16.7	6	14.3
Moderate	19	45.2	14	33.3
Good	8	19.1	15	35.7
Excellent	5	11.9	6	14.3

Note: Very poor (0–20), poor (21–40), moderate (41–60), good (61–80), and excellent (81–100).

impact on participants' fitness. Following the completion of the low-impact aerobic exercise intervention, participants' quality of life was assessed using the WHOQOL-BREF questionnaire.

The analysis of the physical dimension of quality of life showed a notable improvement following the low-impact aerobic exercise intervention. Prior to the intervention, only 10 respondents (23.8%) reported a "Good" level of physical quality of life, while 6 respondents (14.3%) reported an "Excellent" level. After the intervention, the number of respondents in the "Good" category increased to 18 (42.9%), and those in the "Excellent" category rose to 8 (19.1%). Additionally, the number of participants classified as having a "Poor" physical quality of life decreased from 6 (14.3%) to just 2 (4.7%). These changes were statistically significant (p=0.001), indicating that the low-impact aerobic exercise program had a positive effect on the physical dimension of quality of life.

In terms of quality of life after the intervention, 18 respondents (42.9%) were categorized as having a "Good" level in the physical health dimension. In the psychological dimension, the majority (17 respondents; 40.4%) fell into the "Moderate" category. The social relationships dimension showed the highest improvement, with 19 respondents (45.2%) classified as "Good." Meanwhile, in the environmental dimension, 15 respondents (35.7%) were categorized as having a "Moderate" quality of life (Table 3).

Overall, the statistically significant p-values observed across all domains indicated that low-impact aerobic exercise had a beneficial effect on multiple aspects of quality of life in elderly individuals ($p<0.05$).

Discussion

The distribution of the subjects of this study was dominated by elderly women. A previous study has shown that aerobic exercise has a positive impact on the elderly. Aerobic exercise consisting of rhythmic functional movements helps improve functional movement and quality of life in the elderly women.[19]

This study found that the majority of respondents demonstrated good levels

of cardiorespiratory fitness following the low-impact aerobic exercise intervention, indicating a positive effect on physical health. While the psychological dimension of quality of life remained at a moderate level, improvements were noted in the social dimension, with more respondents classified in the "good" category, suggesting enhanced social well-being. However, the environmental dimension remained moderate, pointing to potential areas for further intervention or exploration.

This study has proven the benefits of physical activity in enhancing physical fitness and overall well-being among older adults. These findings are supported by another study, demonstrating the beneficial effects of low-impact aerobic exercise on both cardiorespiratory fitness and quality of life among elderly individuals.[20] In addition, there was a positive association between exercise and quality of life in the elderly population.[21] Exercise has a positive impact on physical fitness and overall well-being in older adults. The emphasis on low-impact aerobic exercise underscores its suitability for this demographic, minimizing the risk of injury while still providing significant health benefits.[21]

However, the unique contribution of this study lies in its focus on low-impact aerobic exercise specifically, which may offer a safer and more accessible option for older adults with varying levels of mobility or fitness.[5] Additionally, the inclusion of cardiorespiratory fitness as a primary outcome measure adds depth to the understanding of the physiological effects of exercise in this population.[20]

Using a single-group experimental design without a control group, it is possible to assess how well low-impact aerobic exercise improves cardiorespiratory fitness and quality of life in an elderly population. Low-impact aerobic exercise provided to the elderly is part of the intervention, whereas quality of life and cardiorespiratory fitness are the outcome measures.[22] Aerobic exercise on large muscle groups can increase capillary activity in the muscles to facilitate the diffusion of oxygen to smaller muscle units, so that oxygen supply to each muscle unit can be fulfilled. This increase in muscle mass is obtained from increasing the exercise period.[22]

Aerobic exercise can increase VO_2 max in the elderly. The cardiovascular system can fully adapt to this form of exercise at all age. Maintaining good aerobic strength can help elderly stay independent and reduce the risk of developing cardiovascular disease.[17]

The findings of the study showed that participants in low-impact aerobic exercise experience significant improvements in cardiorespiratory fitness. A study using tools like the Gench Test and Skibinsky Index have demonstrated similar improvements in cardiorespiratory function following aerobic exercise interventions.[23] In addition, the result is in line with previous research highlighting the advantages of aerobic exercise for the cardiovascular system.[24]

Low-impact aerobic activity has been shown to be a practical and successful way to improve heart and lung function in the elderly. These exercises are specifically made to be easy on joints and muscles. The improved cardiorespiratory fitness in our study indicates a lower risk of cardiovascular disease and increased endurance, two important aspects of maintaining an active lifestyle into old age.[20]

In this study, there were no respondents who fell into the excellent category in terms of fitness category. A plausible explanation for this finding, despite improvements, may relate to the nature of the exercise intensity. Evidence-based research suggests that while low-impact aerobic exercises are effective in improving overall cardiorespiratory fitness, they may not provide the level of intensity necessary to achieve "Excellent" fitness, particularly among elderly populations. Attaining and maintaining this highest level of fitness often requires higher-intensity workouts, which may be unsuitable for older adults due to potential risks such as injury, chronic health conditions, or reduced physiological resilience.

Beside physical health, improvement were also reported in various aspect of psychological and social well-being. Individuals who engage in low-impact aerobic exercise experience improved mood, a stronger sense of accomplishment, and increased energy levels. These psychological advantages are essential considering the common mental health issues such as anxiety and depression experienced by many older people.[25]

Although the promising findings, this study has several limitations. The small sample size and the reliance on self-reported data to asses quality of life may impact the generalizability and accuracy of the results. Future studies that include larger sample sizes with diverse populations and explore cultural and socioeconomic factors as well as more objective measures of physical fitness and quality of life are recommended. Additionally, long-term studies identifying the optimal

frequency, intensity, and duration of low-impact aerobic exercise are needed to evaluate the sustainability of low-impact aerobic exercise benefits in older adults.

In conclusions, low-impact aerobic exercise has an effect on increasing cardiorespiratory fitness and the quality of life in elderly. Low-impact aerobic exercise is a feasible and effective therapies that can help preserve the health and well-being of the growing older adults population. These findings may be useful the development of future initiatives and regulations targeted at improving quality of life of older adults. Implementing low-impact aerobic exercise in the older adults could potentially make a significant contribution to their overall health and well-being.

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