THE EFFECTIVENESS OF THE BACKWARD WALKING PROGRAM ON CHANGES IN CONTROL POSTURAL, MOVE COORDINATION, AND THE FALL RISK IN THE ELDERLY

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Abstract

The purpose of this study is to find out the effectiveness of backward walking program on chages in control postural, move coordination, and fall risk in elderly. This study used a quasi-experimental design with a two group pretest posttest control group design. Forty respondents were divided into two groups, 20 respondents included in experimental group and 20 respondents included in control group. The experimental group treated with backward walking program and the control group treated with elderly exercise.Tto measure postural control using the berg balance scale, mov coordination using the romberg test, and fall risk using the time up and go test.The results based on the Wilcoxon test analysis showed that there was there is an effect before and after giving the backward walking program to the experimental group in berg balance scale (p=0,000), romberg test (p=0,002), and time up and go test (p=0,000). Furthermore, from the Mann Whitney test, it was found that in berg balance scale the backward walking program was significant difference from elderly exercise (p=0,000), in romberg test there was significant difference from elderly exercise (p=0,001), and in time up and go test there was significant difference from elderly exercise (p=0,000). This study concludes that backward walking program is effective to increase control postural, move coordination, and reduce fall risk in elderly. Backward walking program more effective than elderly exercise to increase control postural, move coordination, and reduce fall risk in elderly.

Keyword :BWP, Control Postural, Move Coordination, Fall Risk

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1. Introduction

The demographic phenomenon that will occur is the growth of the elderly population because the number of people aged 60 years and over is expected to increase from 605 million in 2000 to two billion in 2050. It is estimated that the elderly population in 2030 will increase by 24% (Shishehgar, Kerr ,& Blake, 2018). Due to these demographic changes, health care for the elderly has become even more important. As a result, the need for health research that focuses on the elderly is increasing (Wei-Yao Lim, 2019).

Falling is the second highest cause of death due to traffic accidents in the elderly and is the main cause of death and injury in the elderly (Park, 2018). Where one in three people aged over 65 years has the potential to fall at least once a year (AtefehAboutorabi, 2018). According to the World Health Organization (WHO) 28-35% of the elderly population over 65 years and 32-42% of elderly aged over 70 years show increased risk of falling.

One way to reduce the incidence of falls in the elderly population is by increasing postural control (LaianaSepúlveda de Andrade Mesquita, 2015). Postural control is a complex skill resulting from the interaction of sensory-motor processes and the ability to maintain the center of mass at base support in static or dynamic conditions (Bacha, 2017). Maintaining postural control requires the complex integration of sensory input, the central nervous system, motor coordination, and musculoskeletal functions to perceive external stimuli and body processes to control movement. (Villiers, 2015).

Move coordination is known to be an indicator for good postural control (Salehi, 2020). Move coordination is the harmonious function of body parts that involve movement, including gross motor movements, fine motor movements and motor planning or motor planning (Wijianto, 2017). Decreased sensory-motor function in the elderly results in a slowing of sensory impulse delivery to the brain so that the motor response becomes inadequate and results in impaired coordination. Impaired coordination results in balance disturbances, gait patterns, and an increased risk of falling (Overton & Fort, 2015).

From the description above, an evidence-based exercise program is needed to improve postural control, move coordination, and reduce the risk of falling in the elderly. The backward walking program (BWP) was recently introduced as a means of improving balance and preventing falls. During the BWP one cannot rely on the visual system because they have no view of the road and obstacles that are ahead. According to research (Dorian Rose, 2020) a BWP can improve dynamic balance and walking ability in post stroke patients after 6 weeks of exercise. Improved dynamic balance and walking ability are believed to be important risk factors for reducing the risk of falls.

Research regarding the effectiveness of the BWP on postural control, move coordination and the risk of falling in the elderly is still not widely found. Even though the BWP is an intervention that is easy to implement and more effective than forward walking. For this reason, the researcher is interested in conducting research on "Effectiveness of the BWP on Changes in Postural Control, Move coordination, and the Risk of Falling in the Elderly ".

2. Materials and Methods

The subjects of this study were 40 people in the BataraHatiMulia Social Welfare Institution, Gowa Regency, who met the inclusion criteria and were not included in the exclusion criteria. The inclusion criteria were elderly aged 60-70 years, without neurological, cardiovascular and cognitive disorders. The exclusion criterion was not completing the exercise program. This research was approved by the ethics committee of Hasanuddin University, Makassar, Indonesia with ethical licensenumber2672/UN.14.1/TP.01.02/2023.

The research subjects were divided into 2 groups, the treatment group consisted of 20 people and the control group consisted of 20 people. The treatment group was given BWP exercises 3 times a week for 4 weeks (12 exercises). Meanwhile, the control group was given exercise for the elderly once a week for 4 weeks. This research began on March 11 to April 5, 2023. Before being given the exercises, the respondents were given examinations in the form of vital signs, training zones, berg balance scale (BBS) BBS, Romberg test, and time up and go test TUGT.

BWP is an intervention by walking backwards which aims to improve muscle strength, proprioception, and balance.

The data used is primary data and then a normality test is carried out using the Shapiro Wilk test because it uses a sample less than or equal to 30. The data collected is distributed not normal with a p value< 0.05, so a pre-test and post-test differences are tested using a wilcoxon test. Then to find out the difference in values between the two groups using mannwhitney test. All data is processed using SPSS 25.

3. Result and Discussion

The characteristics of the respondents are shown in table 1. Based on age, most of the respondents were aged 60 to 65 years. In terms of gender, women are the most respondents.

Table 1. Characteristics of the Respondents

Characteristics	BWP		Elderly Exercise		Total
	Total	Percent	Total	Percent	
Age (Years)					
60-65	14	70	12	60	26
66-70	6	30	8	40	14
Total	20	100	20	100	40
Sex					
Male	4	20	7	35	11
Female	16	80	13	65	29
Total	20	100	20	100	40

The normality test is used to determine the choice of using statistical tests in hypothesis testing. The normality test uses the Shapiro-Wilk test because the sample is less than 30 respondents. All groups are distributed not normal because the value of p< 0.05.

To see the differences before and after giving the BWP training on postural control, move coordination and fall risk are presented in table 3. Based on table 3 it was found that there were significant differences before and after giving the BWP training on postural control, move coordination, and risk fall.

To find out the significant differences in the values of the BBS, Romberg test, and TUGT between the treatment group which was given the BWP exercise and the control group which was given elderly gymnastic exercises. Table 4 found a significant difference between giving the BWP exercise and the control group being given elderly gymnastic exercises.

Tabel2. The differences before and after giving the BWP training on postural control, move coordination and fall risk

Group	***BBS***		***Romberg test***		***TUGT***	
	median±(min-max)	P	median±(min-max)	P	media±(min-max)/	P

BWP						
Pre test	10±(5-23)	0,000	1±(1-2)	0,002	16±(9-26)	0,000
Post test	20,50±(12-28)		2±(1-2)		8±(6-13)	
Elderly Exercise	median±(min-max)	P	median±(min-max)	P	mean±SD	P
Pre test	13±(5-28)	0,083	2±(1-2)	0,317	13,4±5,295	0,061
Post Test	12,5±(6-28)		1±(1-2)		12,25±4,229	

Tabel3. The differences in the values of the BBS, Romberg test, and TUGT between the treatment group which was given the BWP exercise and the control group which was given elderly gymnastic exercises

Group	***BBS***		***Romberg test***		***TUGT***	
	median±(min-max)	P	median±(min-max)	P	median±(min-max)	P
BWP	8,50±(2-15)	0,000	0,50±(0-1)	0,001	7,00±2-17	0,000
Elderly Exercise	1±(0-11)		0,00±(-1-1)		2,00±(0-7)	

The results of our study showed that there was an effect of providing backward walking exercise on changes in postural control in the elderly with a p value = 0,000. In the treatment group, there was an increase in the medianBBS value before and after the training, namely 10 and 20,5. BWP is an exercise program by walking backwards. When walking backwards, motor circuits produce muscle movements that are controlled by descending input from the brain and sensory feedback from the feet. Sensory feedback, including external and proprioceptive signals coordinates for walking processes. The sensory input that plays the most role in walking backwards is the moonwalker descending neuron (MDN) which acts as a walking backward command type neuron. The MDN receives input from neurons that convey mechanosensory cues and from visual neurons to walk backwards. The MDN then induces the muscles that control the coxa-transchanter and femurtibia. In addition, MDN also initiated the stance and swing phase during the running phase (Kai Feng, 2020).

During walking backwards there is no heel contact phase at the beginning of the stance phase resulting in a decrease in the force on the knee joint. It is known that increased activation of the lower leg muscles during walking backwards can increase the increase in motor units. Increased motor units can then increase muscle strength. When walking backwards during the loading phase there will be concentric contractions in the quadricep muscles which trigger an increase in quadricep muscle strength. In addition to the quadricep muscles, in previous studies it was found that there was an increase in hamstring muscle strength when walking backwards. In addition to walking forward, walking backward has a longer period of activation in the muscles. With increased muscle strength in the lower limbs it can then contribute to maintaining posture both in dynamic and static positions (Basatiny, 2014).

For the measurement of move coordination using the Romberg test, a value of p = 0.002 was found, which means that there was an effect before and after giving the BWP training. There was an increase in the Romberg test values, namely 1 and 2. There was a change in value from negative to positive which is a sign that there is an improvement in move coordination in the elderly.

Walking backwards has better biomechanical benefits than walking forwards. Backward walking can improve functional balance better than forward walking (Wang, 2019). Walking is known to require a high degree of neuromuscular control integrated with visual, vestibular, and proprioceptive sensors to produce coordinated limb movements. Walking is also known to activate lower leg muscles (Shiu-Ling Chiu, 2013).

When walking backwards there is an increase in sensory feedback that regulates move coordination. With the increase in sensory feedback will increase the motor activation of the lower limbs. In addition, walking backwards can trigger a vestibular response to maintain body position. Stable body position can stimulate lower limb coordination (Skidmore, 2016).

In Trecroci's study (2015) stated that physical exercise in young athletes can improve move coordination and balance. Whereas in Han's research (2016) recommended physical activity to maximize move coordination in children.

In measuring the TUGT to measure the risk of falling, a value of p = 0.000 was found, which means there was a difference before and after giving the BWP training. The TUGT values were 1.90 ± 0.912 and 2.05 ± 0.826. This means that there is a reduced risk of falling in the elderly after the BWP is given.

BWP is known to increase temporal reversal and better muscle activation than walking forward. In addition, electromyogram activity shows a better value than walking forward because it requires more energy. The BWP achieves isometric and concentric muscle activity for the qudriceps, strengthens the knee extensors and strengthens functional balance. In addition, sensory components such as sesomotor, vestibular, and proprioceptive improve during backward walking. By increasing sensory and motor skills so that a person can maintain body balance in both static and dynamic positions so that the risk of falling decreases (Hao, 2011).

In a study conducted by Demark (2019) entitled "Clinical application of backward walking training to improve walking function, balance, and fall-risk in acute stroke: a case series" found that in stroke patients there was an increase in the ability to walk, balance, and reduce the risk of falling by using the BWP intervention. Likewise with research conducted by Edwards (2020) in patients with multiple sclerosis with BWP exercises, there is a reduced risk of falling after undergoing exercise.

In table 3 it was found that there was a significant difference in the measurement of postural control after giving the BWP with a value of p = 0.015. The mean value in the measurement of postural control after the BWP was higher than after the exercise for the elderly. This means that the increase in postural control with the BWP is better than the elderly exercise.

In the BWP there is muscle activation in the lower limbs (Foster, 2016). With increasing lower leg muscle strength it will contribute to an increase in walking speed (Wang, 2018). In addition, when walking backwards, the lack of visual stimulation makes the stride length shorter and the walking speed slower. It is known to be a bigger challenge to maintain posture. Therefore the BWP can improve postural control better than elderly exercise (Foster, 2016).

In the assessment of move coordination using the Romberg test measurement, it was found that the value of p = 0.000, which means there is a significant difference between giving the BWP and elderly exercise. The median value for giving the BWP is 16 while for the elderly gymnastics is 8. This means that the BWP is more effective in improving move coordination than elderly exercise.

The BWP can increase sensory input so that the motor response in the lower limbs also increases. In addition, in the BWP, there is an increase in cerebrum activity. When walking backwards it will increase the concentric activation of the hip extensors and knee flexor muscles during the swing phase, this can then help improve movement patterns and move coordination (Rose, 2018).

In the measurement of the TUGT which assesses the risk of falling, it was found that the value of p = 0.000, which means that there is a significant difference between the BWP and elderly exercise. The median value for giving the BWP is 16, while for the elderly gymnastics it is 8. This means that the BWP is more effective in reducing the risk of falling than elderly exercise.

The lack of visual input during the BWP makes for more sensory input. Increased sensory input such as proprioception makes activation to straighten and maintain posture better. In addition, the vestibular ability to balance the body also increases. Motoric ability in the form of increasing lower leg muscle strength also maintains both dynamic and static balance so that the risk of falling after giving a BWP decreases (Choi, 2021).

4. Conclusion and Recommendation

This study shows that the BWP is effective in increasing postural control, move coordination, and the risk of falling in the elderly.Further research is needed regarding the application of the BWP on changes in move coordination in the elderly who have degenerative diseases such as osteoarthritis.

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