DESCRIPTION OF POSTURAL BALANCE OF THE BODY OF ELDERLY AGE BASED ON AGE CATEGORY 45-90 YEARS

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Abstract

Introduction: Balance is a position to maintain a certain position in both static and dynamic conditions. Low balance performance is caused by age and cognitive function and increases fall risk. **Objective:** To determine the difference between static and dynamic postural balance in the elderly based on age categories of 45-90 years. **Method:** This research used an observational study method with a cross-sectional study approach. There were 220 people involved in this study and conducted by purposive sampling method. Static balance was measured by mCTSIB and dynamic balance used TUG. The cognitive function was measured by the MOCA-Ina questionnaire. The Anova test was conducted to analyse the data. **Results:** There was a significant difference between static and dynamic balance based on age category 45-90 years ($p<0.05$). No significant correlation between cognitive and dynamic balance in those aged 55-64 years, and no significant correlation in static balance in those aged more than 70 years. **Conclusion**: the age group over 70 years has the lowest dynamic balance (TUG) and static balance (MCTSIB).

Keyword: Balance, Elderly, Age category

Introduction

The balance refers to an individual's capacity to maintain a certain position in static and dynamic conditions, or to regulate movement effectively while maintaining a firm stance (13). The balance assessment can be done using a series of tests. Static balance refers to the ability to maintain a stationary or unchanged position, while dynamic balance relates to the ability to regulate the body while moving in a certain space (1). It is important to maintain static balance when walking during the floating or swing phase. To achieve dynamic balance, it is important to maintain a balanced position when carrying out activities by alternating between the right and left feet. There are various methods available to assess balance, including the Modified Clinical Test Sensory Balance (m CTSIB) to measure static balance. This test has been shown to have a sensitivity of 95% and a specificity of 90%. Similarly, the Time Up and Go Test was found to have a sensitivity and specificity of 87%. The risk of losing balance is significantly reduced when the duration is less than 13.5 seconds (2). Balance is the result of the cooperation of various body systems to maintain the position of the centre of gravity (Siddiqi and Masood, 2018). There are two main categories of body balance, namely: static balance and dynamic balance. Static balance refers to the body's ability to maintain a stable center of gravity when in an upright position, such as when standing or sitting. Maintaining balance will reduce the risk of falls, this can support the elderly in maintaining postural control to carry out daily activities. Good daily activities can affect the level of quality of life of the elderly (6).

A previous study by Chu 2020 explained that cognitive function refers to decline or loss of accuracy in a variety of skills, incl language, planning memory (planning), task implementation (executive), attention (attention), and perception (3). Cognitive function plays an important role in the interpretation of balance in the elderly. Elderly people who experience cognitive impairment tend to have a higher risk of falls compared to those who have normal cognitive function. Balance disorders accompanied by decreased cognitive function can result in difficulty in maintaining a stable body position and risk of falling.

Several experts in the field of elderly health, as part of the Ministry of Health (MOH) program and presented in research by Sutikno in 2011, have developed a classification that takes into account various factors. This classification includes the middle age group (45-54 years), the early elderly group (55-64 years), the elderly group (65 years and over), and the high-risk elderly group, which includes individuals aged 70 years and over or those facing situations such as living alone, social isolation, serious illness, or disability. Elderly people tends to have physical activity capacity decreased, that impact to balance disorder. This process occurs due to various factors, particularly in the musculoskeletal and nervous systems. In the musculoskeletal system, myofibril degeneration

leads to a decrease in muscle strength, flexibility, and muscle elasticity. Falls are one of the most common causes of injury in the elderly in Indonesia, accounting for 40.9% of total injuries. The prevalence of falls increases with age, with the incidence reaching 67.1% in the 65-74 year age group and 78.2% in those over 75 years. Elderly people who experience cognitive impairment tend to have a higher risk of falling compared to those who have normal cognitive function. Balance disorders accompanied by decreased cognitive function can result in difficulty in maintaining a stable body position and risk of falling. Therefore, it is very important to improve cognitive function to prevent accidental falls in the elderly. Efforts to improve physical balance while improving cognitive function are important to improve the quality of life and safety of the elderly. This includes implementing balance training and cognitive rehabilitation programs as well as good health care to support the well-being of the elderly (1). One measuring tool for evaluating cognitive function in the elderly is the Montreal Cognitive Assessment (MoCA) for light cognitive and assessing memory, executive function, language abilities. Previous research reported that the Montreal Cognitive Assessment (MoCA) had excellent reliability (ICC=0.81), sensitivity of 90%, and specificity of 87% (7). This research aimed to (1) determine the differences in static and dynamic balance based on age categories and (2) explore the relationship between cognitive function and static and dynamic balance based on age categories.

Methods

This research was carried out based on a research permit and was approved by the ethics commission of Dr Moewardi Hospital with number 682/III/HREC/2024. This research observational study type of research with a Cross-Sectional Study approach. This method is used to look for differences in body postural balance in the elderly based on age categories 45-54 years, 55-64 years, over 65 years and over 70 years. This research was carried out at the Posyandu for the Elderly in elderly community, Sukoharjo, Central Java.

There were 220 elderly joined voluntarily in this study who met inclusion criteria; (1) physically and mentally healthy elderly aged 45-90 years are obtained in the form of an identity card (2) can communicate well and have good cognitive abilities MOCA test (3) Elderly people who use assistive devices or require assistance from others when walking (4) Do not have heart diseasecoroner. While the exclusion criteria was following by (1) Elderly people with controlled disease (2) Elderly people with disorders*musculoskeletal* on below extremities (3) Elderly with impairment vision, hearing loss (4) Elderly during hospital treatment.

The static balance was measured by the Modified Clinical Test Sensory in Balance (mCTSIB). mCTSIB consists of 4 tests where each test is carried out for 30 seconds, including: (1) Test 1 standing patienton the pedestalhard surface (floor/plateform) and hands in front of the chest

with eyes open (2) the patient stands on a hard base (floor/plateform) and hands in front of the chest with eyes closed (3) patient stands on a mattress and hands in front of the chest with eyes open (4) the patient stands on the mat and hands in front of the chest with eyes closed, record all times (in seconds)Foreach test, then add up the results of tests 1-4 in seconds. This test is noted has good validity ($r = 0.625$, $p<0.001$) which was a positive correlation, while the reliability value was tested on elderly people over 65 years. namely ICC = 0.75 (Antoniadou et al., 2020).

The dynamic balance test used the TUG. The procedure of TUG test includes the following steps: first, the elderly are asked to sit in a chair with their backs. Next, they were asked to stand up, then walk 3 meters, turn around and walk back to the chair, and sit back with their backs. The interpretation results of this test indicate that balance function is considered good if the time required to complete the test (TUG) is less than or equal to 13.5 seconds. On the other hand, if the TUG time is more than 13.5 seconds, this indicates that the respondent has an increased risk of falling. This method was proposed by Shumway-Cook in 2000, and has become an important tool in identifying the risk of falling in the elderly (20).

Results

Table 1. Respondent characteristics

Variable	Group 1 Mean +SD	Group 2 Mean +SD	Group 3 Mean +SD	Group 4 Mean + SD
Age	49.33±3.0	59.87±3.1	67.49±1.2	74.93±5.1
Gender				
Women	49 (89.1%)	48(88.9%)	48(87.3%)	50(90.9%)
Men	6(10.9%)	6(11.1%)	7(12.7%)	5(9.1%)
Education				
Elementary School	5(9.1%)	4(7.4%)	3(5.5%)	4(7.3%)
Junior High School	40(72.7%)	8(14.8%)	9(16.4%)	5(9.1%)
Senior High School	10(18.2%)	34(63.0%)	40(72.7)	42(76.4%)
Univ		8(14.8%)	3(5.5%)	4(7.3%)
MOCA-Ina (scores)	27.6 ± 1.3	26.4 ± 2.1	21.9±5.4	23.3±6.4
TUG (secs)	12.9±2.4	13.1±3.0	14.4 ± 2.5	16.3±3.5
mCTSIB (secs)	87.6±29.7	66.1 ± 29.7	67.6 ± 25.6	43.5±23.5

Table 1 shows the characteristics of respondents where the type of female group dominates in all age groups. The level of education shows that in the 45-54 year age group education is dominated by junior high school, the 55-69, 65-69 and over 70 age group is dominated by high school. The cognitive function score was higher in the age group 45-54 years. The age group over 70 years had the lowest dynamic balance (TUG) and static or MCTSIB compared to other age groups.

a. Overview of dynamic and static test results based on age categories

Table 2. Overview of dynamic and static test results based on age categories

Age category	Dynamic(TUG)	Static(mCTSIB)
Ex 1 (45-54 Years)	6.93	23
Ex 2 (55-64 Years)	8,11	15
Ex 3 (65-69 Years)	9.22	12
Ex 4 (>70 Years)	11.41	10

Table 2 shows the results of the dynamic and static balance tests in group 1, aged 45-54 years, who had the lowest TUG test results, namely 6.93, while those in the group aged more than 70 years had the lowest Mctsib test results, along with a graph of the lowest results in each age category.

Table 4 test the differences in static and dynamic balance based on age

Variable	Mean Rank	P Value	Information
TUG	1.03	<0.001	There is a difference
mCTSIB	1.97	<0.001	There is a difference

Table 4 shows the test for differences in static and dynamic postural balance based on age categories using the Friedman test, because the TUG and mCTSIB balance data are not normally distributed. The results of the analysis showed that there was a significant difference between static and dynamic postural balance based on age category ($p<0.05$).

Table 5 correlation test of cognitive function with dynamic balance

Group	Age (years)	Variable	Coefficient	*p*-Value
1	45-54	MOCA TUG	-0.0420	0.001
2	55-60	MOCA TUG	-0.31	0.344
3	61-70	MOCA TUG	-0.349	0.009
4	>70	MOCA TUG	-0.353	0.008

Table 5 describes the correlation of cognitive function with dynamic balance using the Spearman Rho test. The table shows that a decrease in cognitive function has an impact on a decrease in dynamic balance function. Groups 1, 3 and 4 showed a significant relationship between cognitive function and dynamic balance. However, the age group over 70 years old has a stronger correlation between cognitive function and dynamic balance than other age groups. Group 2 states that $p>0.05$, meaning there is no correlation between cognitive function and dynamic balance in the 55-64 year age group.

Table 6 Correlation test of static balance cognitive function

Group	Age (years)	Variable	Coefficient	p-value
1	45-54	MOCA MCTSIB	0.351	0.009
2	55-60	MOCA MCTSIB	0.275	0.044
3	61-70	MOCA MCTSIB	-0.434	0.001
4	>70	MOCA MCTSIB	-0.025	0.854

Table 6 depicts the correlation between cognitive function and static balance in groups 1 to group 3 showing that there is a significant relationship between cognitive function and static balance ($p<0.05$) while in group 4 there is no significant relationship between cognitive function and static balance. Group 3 65-69 years old has the highest correlation (0.434 or moderate correlation) between cognitive function and static balance compared to other age groups.

Discussion

Characteristics of respondents with the average type of female group dominating all age groups for educational level, and for educational characteristics dominated by high school, the age group over 70 years has the lowest dynamic (TUG) and static (MCTSIB) balance compared to the older age group. other. Education influences the knowledge and insight a person has. According to Henniwati (2015), a higher level of education often correlates with increased access to information and deeper understanding. Decreased intellectual function is generally caused by the degeneration process in some brain cells and reduced elasticity of blood vessels. Loss of brain cells that cannot be regenerated results in a decrease in a person's intellectual capacity. The age factor plays an important role in the possibility of balance disorders in the elderly. When entering the elderly stage, humans experience a number of changes and decreases in physical abilities, which can have an impact on balance. Decreased strength and physical ability can be the main factor causing balance disorders in the elderly. In addition, various physiological and neurological changes associated with aging can also affect the body's balance system (15). Population gender is one of the characteristics where of the 220 respondents there are 196 female and 24 male.

The Friedman test shows that there is a significant difference in static and dynamic balance. BalanceThe body is a person's ability to maintain a stable and controlled body position, both when still and when moving. It involves complex integration between the nervous system, musculoskeletal system, and sensory systems to detect changes in body position and respond appropriately (11). Experts reveal that age is a significant factor in reducing the body's balance function. This is also influenced by several factors, such as a decrease in physical function, health function,activity patterns, sensory function, comorbidities(Pramadita et al., 2019). Apart from that, age can

significantly affect body balance due to various factors, including changes in perceptionsensory, muscle strength, joint flexibility, and cognitive function(Princess, 2021).

Static balance of the body is an important concept in the fields of health, sports, and biomechanics. With good balance a person can maintain correct body posture and avoid excessive stress on the joints and muscles, which can cause injuries such as strains or muscle strains and is necessary to maintain a stable posture and optimize performance(Rachmatica et al., 2022). Good static balance of the body is also important for the development of coordination and motor skills (16). This helps a person carry out daily activities such as walking, standing, or lifting objects more efficiently and withoutriskinjury (17).

Dynamic body balance refers to the body's ability to maintain stability or proper position when in movements or activities that involve shifting body weight. It involves complex interactions between the body's nervous, muscular, and sensory systems to regulate and maintain balance during movement. In contrast to static balance, where the body is in a still or stable position, dynamic balance requires more active control over movements and changes in body position. For example, when walking, running, cycling, or doing sports that involve movementcomplicated and heavy (18). Dynamic balance requires coordination between different muscle groups, joints, and sensory systems to adapt to changes in body position and external forces during movement. Dynamic balance is essential for performing daily activities that involve movement, such as walking on uneven terrain, climbing stairs, or performing tasks that require reaching, bending, and twisting (26). Like static balance, dynamic balance also relies on core stability and coordinated muscle activation to maintain stability and control during movement. Strong core muscles help stabilize the spine and pelvis, providing great support for physical movement (17).

Decreased cognitive function in categories 1,3,4, namely aged 45-54 years, over 65 years and over 70 yearsshowrelationship between cognitive function and dynamic balance, but in the age group over 70 years there is a strong correlation between cognitive function and dynamic balance, a decrease in cognitive function causes a decrease in dynamic balance because it is influenced by the somatosensoryin thebody According to research by Putri in 2021, a decrease in cognitive function contributes to a decrease in dynamic balance because both are influenced by the somatosensory system in the body (13). As we age, both cognitive function and body balance tend to decline, which can limit activity and increase the risk of falls. Cognitive function and dynamic balance are closely related in maintaining posture and carrying out daily activities. Disturbances in either of these two aspects can occurinfluencea person's ability to move smoothly and safely(Princess, 2021). In the 55-64 year age group, there was no correlation between cognitive function and dynamic balance. This phenomenon can be caused by the fact that the older a person is, the greater the possibility of impaired cognitive function because aging is a major factor in the occurrence of cognitive

impairment. In other words, the older you get, the higher the risk of cognitive impairment, which in turn can affect dynamic balance. However, in the age range of 55-64 years, cognitive impairment may not have reached a level significant enough to directly affect body balance (1).

The correlation function of static balance in the age group 3 (65-69 years) has the highest correlation of 0.434 moderate or moderate correlation between the function of static balance compared to other age groups, this is because static balance requires more of a role.proprioceptiveas sensory receptors that convey information about muscles and require less role than muscle strengthextremitieslower.

The relationship between cognitive function and postural balance, both static and dynamic, is well known. Cognitive function refers to mental processes such as attention, memory, executive function, and decision making, while postural balance involves the ability to maintain stability and control body position during various activities. The relationships between cognitive function, postural balance, and age are complex and varied. As a person ages, various physiological and cognitive changes occur, affecting cognitive function and postural balance (7). Understanding the complex interactions between cognitive function, postural balance, and age is critical to developing effective interventions to promote healthy aging, reduce the risk of falls, and maintain functional independence in older adults. Interventions that target cognitive and physical aspects of balance control may help reduce the deleterious effects of aging on cognitive function and postural balance(Pramadita et al., 2019)

Conclusion

From the results of the second study of static and dynamic balance tests at the elderly posyandu in Gonilan sub-district which has been described after being sorted from group 1 to group 4, it can be concluded that the group aged over 70 years in group 4 has the lowest dynamic balance (TUG), while the majority for the balance test static (Mctsib) in group 4 has low balance.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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