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Physical activity and the risk of falls in community-dwelling elderly in Central Java in urban and rural areas

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Abstract

Background: In the elderly, there is a deterioration in the physical structure of the muscles. This includes a decrease in muscle strength and contraction, entering old age, the risk of falling will increase due to additional risk factors. This study will examine the effect of physical activity on the risk of falls in the elderly.

Purpose: To understand the differences and impact of physical activity on the risk of falls in the elderly population in Rural and Urban environments.

Method: This study used a cross-sectional design. The research was conducted in Boyolali Regency, Central Java, which represents rural areas, and Gonilan as a representative of urban areas. The research was conducted in August 2023 involving 116 participants in each region.

Results: The Mann-Whitney test results showed a p-value of $0.000 < 0.05$, while the Fisher's Exact test resulted in a p-value of $0.538 > 0.5$. Regression test results showed that the coefficient of determination in urban areas was 0.063 and rural areas was 0.029.

Conclusion: From the results, it is concluded that there is a difference in physical activity between rural and urban neighborhoods. However, there is no significant difference in the risk of falls in the elderly between urban and rural areas. Furthermore, it can be concluded that the physical activity variable has a 63% influence on the risk of falls in urban areas, while the rest is influenced by other factors in each region.

Keywords: Elderly; Fall Risk; Physical Activity.

INTRODUCTION

Ageing is a condition that occurs in human life. The aging process is not a disease. Aging is a process of gradual loss of the ability of body tissues to maintain normal structure and function. This process is characterized by the slow loss of tissue in the nervous system, muscles, and other tissues so that the body dies little by little (Manangkot, Sukawana, & Witarasa, 2016).

The number of elderly people in Indonesia is currently around 27.1 million people or almost 10% of the total population. In 2025, it is projected that the number of elderly people will increase to 33.7 million (11.8%). The increase in the number of elderly people with various health problems is a challenge

for us to prepare healthy and independent elderly people, in order to minimize the burden on society and the state (Ministry of Health of the Republic of Indonesia, 2021).

The Time Up and Go test (TUGT) is one of the measurement instruments used to assess the level of fall risk. TUGT is also used for evaluation to assess and recognize mobility problems and dynamic balance in the elderly (Sari, Motik, & Sudaryanto, 2023).

Elderly people who survive a fall experience significant morbidity. Hospital stays are almost twice as long for elderly patients hospitalized after a fall as for elderly patients admitted for other reasons.

Compared with elderly patients who do not fall, elderly patients who fall experience greater functional decline in activities of daily living and in physical and social activities, and they are at greater risk of institutionalization in later life (Fuller, 2000).

Falls in the elderly have become a major public health problem in many countries. According to World Health Organization estimates, there are nearly 424,000 fatal falls each year. It is estimated that about 30.0% of the population aged 65 years and older have experienced a fall, and about half have recurrent falls. About one-third of people aged 65 and over in the United States experience a fall each year, and about 10.0% of falls result in serious injury. Older people who have had a fall are also more likely to experience serious complications, resulting in death in the same year at 50.0% (Zhang, Ding, Qiu, & Li, 2019).

The importance of physical activity for independent living in older adults is well understood, yet older adults' daily activity levels appear to decline with age. Physical activity has been hypothesized to protect older people from depression, but health-related habits including physical activity change with age, due to illness, social changes and environmental changes. Initiating physical activity in old age may be difficult due to declining physical and mental functioning (Mezhunnath, Santhakumar, & Thunga, 2019).

Lack of physical activity can be a risk factor for chronic diseases and overall is estimated to cause death, but being active and doing physical activity can have an effect on the nervous system that affects neuromuscular, brain function, muscle strength, postural balance, cardiorespiratory fitness, functional independence and quality of life of the elderly (Nur'amalia, Abdullah, Dzakhirah, & Ruhama, 2022).

There is an influence of anxiety about falling on the quality of life of the elderly by 26.8% and there is no influence of depression on the quality of life of the elderly. Anxiety about falling is the dominant factor affecting the quality of life of the elderly (OR=0.971, $p = 0.048$, 95% CI: -1.933--0.009). Anxiety about falling is an important factor affecting the quality of life of older people living in urban areas (Azizah, Komalasari, Naufal, & Supriyadi, 2022).

Elderly people with lower levels of physical activity and belonging to higher age groups have a

higher risk of falls. Strategies should be developed to stimulate increased levels of physical activity and functional mobility in this population, especially among the elderly, reducing the incidence of falls and providing greater autonomy (Andrade daSilva, SáBrandão, Silva, Urbano, Oliveira, Oliveira, & SáBrandão, 2017).

One of the enemies of the aging process is a sedentary lifestyle, a major risk of early morbidity and mortality. Following this concept, the assessment of physical performance receives special attention, as it allows early identification of elderly people at risk of deterioration in health and function, a situation that usually precedes the onset of disability. Moreover, physical performance measures are predictors of functional, psychological, and social health, and in addition, in this complex relationship, they are influenced by several factors, such as environmental conditions (Sampaio, Sampaio, Yamada, Ogita, & Arai, 2012).

After adjusting for age by TUG time and categorization into sex and age groups (30-64 and 65-84 years), the association of TUG performance with physical characteristics and physical activity was confirmed using multiple regression analysis. In men, TUG performance was associated with work and household chores in the 30-64 years age group, whereas TUG performance was only associated with skeletal muscle mass in the over 65 years age group. In women, TUG performance was associated with height and amount of exercise, regardless of age. In conclusion, TUG performance can be maintained by increasing the amount of physical activity for men through work and housework, and increasing the amount of exercise for women, which may prevent the need for long-term care in the future (Uesugi, Maruyama, Saito, Tomooka, Takata, Kawamura, & Naito, 2021).

RESEARCH METHOD

This study has received approval from the Health Research Ethics Committee (KEPK) of Dr. Moewardi Hospital with registration number 1.581/VIII/HREC2023. Using a cross-sectional study design. Observations of the dependent and independent variables were made at the same time.

IPAQ is a physical activity questionnaire, IPAQ is carried out by distributing questionnaires to participants in which there is a willingness to be a

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participant and questions about how long participants do light physical activity, moderate physical activity and heavy activity. For the assessment category of light physical activity if participants do physical activity <10 minutes / day or 600 METs-minutes / week, moderate physical activity if participants do physical activity >20 minutes / day or with a total of at least 600 METs-minutes / week and heavy physical activity if participants do physical activity >30 minutes / day or a total of at least 1500 METs-minutes / week.

TUGT is an assessment of the risk of falling on participants by directly testing participants to perform physical activity walking 3 meters and turning back towards the previous direction, then measuring using a stopwatch from the start of walking to returning to the original position. The measurement category is low risk of falling if <20 seconds and high risk of falling if >20 seconds.

The research was conducted in Boyolali Regency, Central Java, which is represented by rural areas, and Gonilan, which represents urban areas. This research was conducted in August 2023. The population that became the focus of the study involved the elderly in Boyolali Village and the elderly in Gonilan, with a total sample size of 116 in each region.

The measuring instruments in this study involved the International Physical Activity Questionnaire (IPAQ) as an instrument to assess physical activity, and the Time Up and Go Test (TUGT) as a fall risk measurement tool. The data analysis method used involved the Mann-Whitney test to evaluate differences in physical activity levels and fall risk between rural and urban elderly groups. In addition, the Chi-Square test was used to determine high and low fall risk categories between the elderly groups in the two environments, while the Binary Logistic Regression test was used to assess the effect of physical activity on fall risk in the elderly population in rural and urban areas.

The inclusion criteria in this study included elderly people aged ≥ 60 years, both men and women, in good physical and mental health, able to communicate well, and willing to become participants. Meanwhile, the exclusion criteria included elderly who had physical or psychiatric disorders, as well as those who used assistive devices for mobility, elderly who suffered from knee osteoarthritis, elderly who had a history of injury that interfered with walking activities, elderly who had neuromuscular disorders, elderly with cardiovascular or pulmonary disorders, elderly with cerebral ataxia disorders.

RESEARCH RESULTS

Table 1. Characteristic of Participants

Variables	Result	
	Urban (n=116)	Rural (n=116)
Age (Mean \pmSD) (Range)	(66.28 \pm 4.883) (60-80)	(66.30 \pm 4.935) (60-82)
Gender (n/%)		
Male	15/12.9	36/31.0
Female	101/87.1	80/69.0
IPAQ (n/%)		
Light Physical Activity	5/4.3	2/1.7
Moderate Physical Activity	85/73.3	44/38.0
Strenuous Physical Activity	26/22.4	70/60.3
TUGT (n/%)		
Low Fall Risk	44/37.9	37/31.9
High Fall Risk	72/62.1	79/68.1

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Table 1. shows that in urban areas the age of participants with the mean and standard deviation (66.17 ± 4.711) and the range between 60-80 years. Based on gender, the majority are women (87.1%) while men are only (12.9%).

Based on the results of the IPAQ questionnaire that has been answered by participants, the majority of elderly people in urban areas do moderate physical activity, namely as much as (73.3%), while those who do light physical activity (4.3%) and heavy physical activity (22.4%). Based on the TUGT examination that has been carried out on the elderly, the majority of elderly people in urban areas have a high level of risk of falling, namely (62.1%) while the level of risk of falling is low (37.95%).

For the Rural area, the age of participants with mean and standard deviation (66.30 ± 4.935) and the range between 60-82 years. Based on the gender of the participants, the majority were women (69.0%) while men (31.0%).

Based on the results of the IPAQ questionnaire that has been answered by participants, the majority of elderly people in urban areas do heavy physical activity, namely as much as (60.3%), while those who do light physical activity (1.7%) and moderate physical activity (38.0%). Based on the TUGT examination that has been carried out on the elderly, the majority of elderly people in urban areas have a high fall risk level, namely (68.1%) while the low fall risk level (31.9%).

Table 2. Data Normality

Variabel	p-value	Description
Urban		
IPAQ	<0.001	Abnormal
TUGT	<0.001	Abnormal
Rural		
IPAQ	<0.001	Abnormal
TUGT	0.200	Normal

In table 2. explained that in this study, data normality testing was carried out using Kolmogorov-Smirnov. The test results show that one of the variables in the study is not normally distributed, because the p value (significance value) <0.05.

Table 3. Test for differences in physical between Urban and Rural

	Mann-Whitney U	Z	Asymp.sig. (2-tailed)	Description
Physical activity	3425.000	-6.465	.000	There is a significant difference

Based on table 3 of the Mann-Whitney test results on physical activity in Urban and Rural areas, the Asymp. Sig. (2-tailed) value of 0.000, which is smaller than the probability value of 0.05. Thus, the alternative hypothesis (H_a) is accepted. In conclusion, there is a significant difference in physical activity of the elderly between Urban and Rural areas.

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Table 4. Test of Difference Between Urban and Rural Fall Risk

Analysis	p-value	Description
Fall risk	0.538	No Relationship

Based on the Fisher's Exact test results in the table above, the p-value obtained is 0.538, which indicates a probability value greater than 0.05. Thus, it can be concluded that the alternative hypothesis (Ha) is rejected. In conclusion, there is no difference in the risk of elderly falls between Urban and Rural areas.

Table 5. Test of the Effect of Physical Activity on Fall

Variabel	R ²
Urban	0.063
Rural	0.029

Based on the Regression test output in the table above, it is found that the coefficient of determination in urban areas is 0.063 and the Rural area is 0.029.

DISCUSSION

Physical activity is an activity of an individual that involves the movement of skeletal muscles that requires more energy than at rest, where physical activity is a planned activity, continuous, repetitive and aims for fitness (Diani, Maulana, & Isnarawati, 2022).

The number of elderly people in Indonesia continues to increase, especially Central Java Province, which ranks third in Indonesia with a percentage of 10.35% of the 18.55 million elderly people in Indonesia in 2012 and is predicted to continue to increase. This raises important attention to the field of elderly health to improve their quality of life. One of them is the physical activity of the elderly where physical activity is closely related to the physical well-being of the elderly (Baga, Sujana, & Triwibowo, 2017).

Physical inactivity is a modifiable risk factor for cardiovascular disease and many other chronic diseases, including diabetes mellitus, cancer (colon and breast), obesity, hypertension, bone and joint disease (osteoporosis and osteoarthritis), and depression. The prevalence of physical inactivity (among 51% of Canadian adults) is higher than all other modifiable risk factors (Warburton, Nicol, & Bredin, 2006).

Physical condition decreases with age. Physical condition is influenced by the habit of moving or physical activity. Everyone, including the elderly, has

different physical activities in work and other daily activities. It is often found that elderly people in rural areas are able to perform heavier physical activities than elderly people in urban areas. Elderly people in rural areas still do a lot of work that involves muscle loading such as lifting heavy items, walking long distances, and for a long duration (Putra, Kurniasari, & Purnamaswi, 2018).

Hypertension with uncontrolled blood pressure values can cause complications and even death. The cause of uncontrolled blood pressure in people with hypertension is the lack of routine hypertension patients to carry out treatment, and lack of physical activity is one of the factors causing uncontrolled blood pressure values in people with hypertension. The risk of hypertension will be lower if a person, especially in the elderly, if physical activity is carried out regularly (Karyow, Ibnu, & Kusumaningrum, 2022).

Participants' physical activity levels were evaluated using the International Physical Activity Questionnaire (IPAQ) short form. The training group was trained on menopause and its symptoms, and the impact of physical activity on menopausal symptoms. In addition, a preventive physiotherapy program for posture and possible balance problems was taught. The control group continued normal daily activities without any training. The physical activity levels of participants in both groups were evaluated

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with the IPAQ, functional capacity with the 6-minute walk test and the time and test test before and after the 8-week training program. The results showed no significant differences in demographics, physical activity levels and functional capacity between the groups before training (Kurbonboyev, & Kaygisiz, 2019).

Falls are a possible consequence of a loss of balance, which can result in serious injuries such as fractures and spinal damage resulting in limitations in activities (Rahman, Budi, Al Athfal, Hisanah, & Haya, 2022).

The elderly often experience problems caused by the decline in body functions so that it can affect the condition of the body. Balance disorders are the main cause of injury and limitations when doing Activity of Daily Living in the elderly, ADL problems are influenced by several diseases and age changes that will cause functional limitations so that they can affect actual performance. This research aims to see if there is a relationship between dynamic balance and Activity of Daily Living in the elderly (Fikriyah, Naufal, & Wijianto, 2021).

There was a strong and significant negative correlation between TUGT and IPAQ scores ($r = -0.86$; $p < 0.05$). A moderate positive correlation was found between TUG total score and PSQI ($r = 0.63$; $p < 0.05$). We found significant correlations between IPAQ with sleep quality, sleep habit efficiency and daytime dysfunction subgroups and PSQI total score ($p < 0.05$). However, there was no correlation of IPAQ with sleep latency, sleep duration and sleep medication use of PSQI subgroups. ($p > 0.05$) (Ramoglu, Ucgun, Safran, & Gurses, 2018).

Timed up-and-go (TUG) was used to test dynamic balance and a hand grip strength test was used to measure muscle strength. Findings showed that the increase in DHEA levels after 10 weeks of intervention was significantly different between the control and intervention groups ($p < 0.05$). There were no significant group differences in changes over time in anthropometric and body composition measurements, stress scores, cortisol levels, and physical fitness (Ludin, Lau, Sairan, Ahmad, & Farah, 2015).

Sleep quality was taken using a questionnaire containing sleep habits over the past month and physical activity was taken using a questionnaire of daily activity habits over the past seven days and

blood pressure was checked directly at the time of measurement of sleep quality and physical activity. The relationship between sleep quality and systolic blood pressure ($p = 0.020$), the relationship between sleep quality and diastolic blood pressure ($p = 0.014$), the relationship between physical activity and systolic blood pressure ($p = 0.007$), the relationship between physical activity and diastolic blood pressure ($p = 0.025$) which means there is a relationship between sleep quality and physical activity with blood pressure in the elderly (Sari, 2017).

The results of the analysis of the relationship between the level of physical activity with cognitive function of the elderly obtained that participants with high levels of physical activity have normal cognitive function. The statistical test results obtained a value of $p = 0.000$, it can be concluded that there is a relationship between the level of physical activity with cognitive function (Sauliyusta, & Rekawati, E2016).

One hundred healthy women aged 60 years and over answered the IPAQ and Baecke questionnaires and underwent cardiopulmonary exercise tests. The 6-minute walk (6MWT), timed up and go (TUG), and handgrip strength test (HST) were also performed. The mean age and body mass index were 68.5 ± 6.3 years and 27 ± 4.7 kg/m², respectively. No significant correlations were seen between the VO₂max, IPAQ and Baecke questionnaires. IPAQ did not correlate with any functional tests while Baecke correlated weakly with 6MWT and TUG tests. VO₂max was significantly correlated with 6MWT ($r = .38$; $p = .0001$), HST ($r = .34$; $p = .001$), and TUG ($r = -.41$; $p = .0001$). In the multivariate regression model, TUG was the best predictor of VO₂max ($R^2 = .217$; $p = .0001$). In conclusion, the IPAQ and Baecke questionnaires were not significantly associated with VO₂ max in elderly women (Aurora de Fátima, Pinheiro, Castro, De Mello, Tufik, & Szejnfeld, 2018).

CONCLUSION

There is a difference between physical activity that occurs in rural and urban areas. This is triggered by habit and environmental factors. While there is no difference in the risk of falling the elderly between Urban and Rural areas. This is because the incidence of falls in the elderly is usually influenced by various factors, including mobility, risk-taking

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behavior, environmental conditions, intrinsic, and extrinsic factors. Furthermore, it is concluded that the physical activity variable affects the risk of falling in the Urban area by 62.1% where the rest is influenced by other factors in each region.

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