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## Relationship Between Physical Activity and the Risk of Falls in Elderly People With Diabetes Mellitus in the Working Area of the Simpang Tiga Community Health Center, Pekanbaru

Khofifah Aisyah Fitri<sup>1\*</sup>, Ari Rahmat Aziz<sup>2</sup>, Safri<sup>3</sup>

<sup>1,2,3</sup>Riau University

Email : [khofifah.aisyah3719@student.unri.ac.id](mailto:khofifah.aisyah3719@student.unri.ac.id), [arirahmataziz@lecturer.unri.ac.id](mailto:arirahmataziz@lecturer.unri.ac.id), [safri@lecturer.unri.ac.id](mailto:safri@lecturer.unri.ac.id)

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### Abstract

*The physiological decline associated with aging, exacerbated by chronic conditions like diabetes mellitus (DM), significantly increases the risk of falls in the elderly. This study aimed to investigate the relationship between physical activity and the risk of falls in elderly individuals with DM. A quantitative approach with a descriptive correlational design and a cross-sectional method was used. The study population comprised 148 elderly DM patients at the Simpang Tiga Community Health Center in Pekanbaru, and a sample of 108 respondents was selected using purposive sampling. Data were collected using questionnaires for demographics, physical activity, and the Morse Fall Scale (MFS). Bivariate analysis was conducted using the Chi-square test at a significance level of  $\alpha=0.05$ . The findings showed that the majority of respondents had poor physical activity (51.9%) and a high risk of falling (51.8%). A significant relationship was found between physical activity and fall risk ( $p$ -value=0.001). This indicates that poor physical activity is associated with a higher risk of falls. However, a notable proportion of physically active respondents still had a high fall risk, suggesting that physical activity is a crucial but not a singular factor. The conclusion is that while physical activity is essential for fall prevention, a comprehensive, multi-factorial approach is needed to effectively mitigate fall risk in this vulnerable population.*

**Keywords:** Diabetes Mellitus, Elderly, Fall Risk, Physical Activity, Public Health

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## INTRODUCTION

The aging process is a natural and inevitable phase of human life, characterized by a progressive decline in physical, psychological, and cognitive functions (Mujiadi, 2022). This biological degeneration makes the elderly population particularly susceptible to various non-communicable diseases (NCDs), including hypertension, stroke, arthritis, and diabetes mellitus (Harsismanto et al., 2020). The physiological changes associated with aging, such as reduced muscle and bone strength, also increase the risk of physical decline and a higher likelihood of falls (Ratnawati, 2021; Wu et al., 2023). Given that NCDs pose a significant health burden globally and are a major cause of death and disability, understanding and mitigating their impact on the aging population is a critical public health concern (Kuno et al., 2021). Consequently, the interplay between the aging process and the increasing prevalence of chronic diseases highlights the need for targeted interventions to improve the quality of life for older adults (Vella et al., 2024).

Among the most prevalent NCDs affecting the elderly, diabetes mellitus (DM) stands out as a serious chronic condition, placing this demographic at an elevated risk due to their susceptibility to carbohydrate metabolism disorders (World Health Organization, 2016). The International Diabetes Federation (2021) places Indonesia fifth globally in terms of DM prevalence, with 19.5% of its population affected. This prevalence rate peaks between the ages of 55 and 64 and continues to rise with advancing age (Riskesdas, 2018; Kemenkes RI, 2021). Locally, the situation is increasingly concerning. In Riau Province, there were 50,424 reported cases of DM in 2022 (Profil Kesehatan Riau, 2022), with the highest number of elderly DM patients recorded in Pekanbaru City. The Simpang Tiga Community Health Center

(Puskesmas) in Pekanbaru alone registered 1,227 elderly DM patient visits between January and November 2024, confirming a significant local burden (Dinas Kesehatan Kota Pekanbaru, 2024).

The physiological mechanisms of diabetes mellitus create a cascade of health issues that directly contribute to fall risk in the elderly. A deficiency in insulin leads to hyperglycemia, which obstructs the transfer of glucose to muscle tissue. This lack of oxygen and nutrients results in a metabolic deficiency, causing muscle weakness and, in the long term, muscle atrophy. This muscular impairment directly compromises balance, leading to postural instability and a heightened risk of falls and fractures in older adults (Roudhatul Ilmi et al., 2020). Furthermore, a major complication of DM, known as diabetic neuropathy, contributes to this problem by causing nerve damage, which slows nerve conduction and reduces sensitivity. This manifests as numbness, tingling, or pain in the extremities, ultimately leading to impaired kinesthetic and proprioceptive senses that are vital for maintaining posture and stability, and consequently, increasing the risk of falls (Richter et al., 2021). Studies have confirmed that the risk of falls is significantly higher in older adults with DM compared to those without the condition (Daud et al., 2021; Alshammari et al., 2023).

Falls are a critical public health issue among the elderly. The World Health Organization (2023) reports that approximately 28-35% of people aged 65 and over experience a fall annually, with this figure rising to 32-42% for those over 70. This high prevalence is influenced by a combination of intrinsic factors, such as sensory and neurological impairments, and extrinsic factors, including environmental hazards (Devita, 2022). The consequences of falls extend beyond physical injuries, such as fractures, to include pain, reduced mobility, and psychological distress, all of which compromise the quality of life (Ikhsan, 2020). Previous research has consistently shown that a lack of regular physical activity in older adults is strongly associated with a higher risk of falls due to weakened balance and flexibility (Yuliadarwati et al., 2020). Conversely, consistent physical activity can enhance muscle endurance and agility, thereby helping to prevent falls (Ikhsan, 2020). This highlights a crucial gap in current knowledge regarding the specific relationship between different levels of physical activity and the risk of falls among elderly individuals with DM in the local context.

Given the significant health risks posed by the high prevalence of diabetes mellitus and falls among the elderly in Pekanbaru, this study is urgently needed to address a critical local public health issue. The primary objective of this research is to determine the relationship between physical activity and the risk of falls in elderly individuals with diabetes mellitus residing in the working area of the Simpang Tiga Community Health Center in Pekanbaru. While numerous studies have explored the general link between physical activity and fall risk in the elderly, this study's novelty lies in its specific focus on a highly vulnerable population—elderly DM patients—in a particular high-prevalence local setting. By establishing a clear connection, the findings of this research will provide invaluable insights for healthcare providers and policymakers to develop evidence-based and locally tailored intervention programs. The study aims to contribute to both local and international literature by offering a nuanced understanding of how physical activity can be leveraged as a preventive measure against falls in this at-risk group.

## RESEARCH METHODS

### Research Design and Method

This study employs a quantitative approach with a descriptive correlational research design. This design is chosen to investigate the relationship between two variables—physical activity and the risk of falls—in elderly individuals with diabetes mellitus (Sudarma et al., 2021). The descriptive correlational design is suitable for describing existing phenomena and analyzing the association between variables without any intervention or manipulation (Sugiyono, 2022). A cross-sectional approach is utilized to collect data from the target population at a single point in time, enabling the simultaneous analysis of these relationships (Sudaryono, 2021). This design is considered the most appropriate for identifying patterns of relationships among variables that are relevant to the study's objectives and provides an empirical basis for further research (Aurana Zahro et al., 2023).

### Population and Sample

The study's population consists of all elderly patients with diabetes mellitus registered in the working area of the Simpang Tiga Community Health Center in Pekanbaru. Based on the highest number

of patient visits recorded in November 2024, the total population was identified as 148 individuals. A sample, defined as a subset of the population that serves as the primary source of data (Amin et al., 2023), was drawn using a non-probability sampling technique, specifically purposive sampling. This technique was chosen because it allows for the selection of samples based on specific inclusion and exclusion criteria (Suriani et al., 2023; Emzir, 2021). The inclusion criteria for this study were: elderly individuals diagnosed with DM, residing in the Simpang Tiga Community Health Center's working area, capable of effective communication, and willing to participate. The exclusion criteria included individuals with mental disorders, physical disabilities, or cognitive limitations. Based on a population of 148, the sample size was determined using the Slovin formula with a 5% margin of error, yielding a minimum sample size of 108 respondents.

### Instruments and Data Analysis Techniques

Data collection was conducted using a questionnaire divided into three parts. Questionnaire A was used to gather demographic data, including the respondent's age, gender, and duration of diabetes. Questionnaire B, adapted from Nafidah (2014), was used to measure physical activity levels in the elderly. This instrument consists of eight questions using a Likert scale (0-3) to assess leisure and household activities, and its validity and reliability have been established ( $\alpha=0.365$ ;  $r=0.723$ ). The physical activity scores were then categorized as "low" ( $< \text{mean}$ ) or "good" ( $\geq \text{mean}$ ). Questionnaire C, the Morse Fall Scale (MFS), is a standardized and validated instrument (Maryam, 2013; Eka Ediawati, 2012) used to identify the risk of falls. This instrument comprises six questions that categorize fall risk into "no risk" (0-24), "low risk" (25-50), and "high risk" ( $\geq 51$ ).

Data analysis was performed in two stages. First, univariate analysis was conducted to describe the characteristics of each variable through frequency distributions and percentages (Notoatmodjo, 2018). This stage provided a descriptive overview of the demographic information and the study variables (physical activity and fall risk). Second, bivariate analysis was performed to examine the relationship between the independent variable (physical activity) and the dependent variable (fall risk). The Chi-square test was employed for this analysis at a significance level of  $\alpha = 0.05$ . A  $p$ -value  $\leq 0.05$  indicates a statistically significant relationship between the variables, leading to the rejection of the null hypothesis ( $H_0$ ), while a  $p$ -value  $\geq 0.05$  suggests no significant relationship (Notoatmodjo, 2018).

### Research Procedures and Ethics

The research procedures were conducted systematically through three main phases. The preparation phase involved a literature review, obtaining research permits from both the academic institution and relevant government agencies (Fikom, 2017), and conducting a preliminary study to confirm the research phenomenon's existence in the targeted location. The implementation phase commenced after all administrative procedures were completed. The researcher visited the study site, identified potential respondents who met the inclusion criteria, and explained the research purpose, benefits, and potential impacts. Participants who agreed to take part signed an informed consent form, adhering to the principle of *Respect for Persons*. To uphold the fundamental rights of privacy and confidentiality, respondents' identities were protected by using codes instead of their names or addresses (Priadana & Sunarsi, 2021). The final phase involved data processing, report compilation, and the dissemination of the research findings. Throughout the study, the researcher adhered to ethical principles of beneficence and justice, ensuring all participants were treated with fairness and respect, regardless of gender, religion, or ethnicity.

## RESULTS AND DISCUSSION

### Physical Activity

Table 1. Descriptive Analysis of Physical Activity in the Elderly

Physical Activity	Frequencies (n)	Percentage (%)
Not Enough	56	51,9%
Good	52	48,1%

Total	108	100%
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Based on Table 1, which presents a descriptive analysis of physical activity among older adults, it can be seen that of the total respondents, 56 older adults (51.9%) had poor physical activity levels. Meanwhile, 52 older adults (48.1%) had good physical activity levels.

### Fall Risk

**Table 2. Descriptive Analysis of Fall Risk in the Elderly**

Fall Risk	Frequencies (n)	Percentage (%)
Not Risk	18	16,7%
Low Risk	34	31,5%
High Risk	56	51,8%
Total	108	100%

Table 2 presents a descriptive analysis of the risk of falling among older adults. Based on the data, the majority of older adults who participated in the study had a high risk of falling, namely 56 people or 51.8%.

### Bivariate Analysis

**Table 3. Chi-Square Analysis**

Physical Activity	Resiko Jatuh						Total	P value	
	Not Risk		Low Risk		High Risk				
	n	%	N	%	N	%			
Not enough	7	13,2%	9	17%	37	69,8%	53	100%	<b>0,001</b>
Good	11	20%	25	45,5%	19	34,5%	55	100%	
Total	18	16,7%	34	31,5%	56	51,9%	108	100%	

Based on Table 3, in the low physical activity group, the proportion of respondents with a high risk of falling (69.8%) was much greater than that of respondents who were not at risk (13.2%) or at low risk (17%). The statistical test yielded a p-value of 0.001, which is less than  $\alpha = 0.05$ . Therefore, it can be concluded that there is a significant association between physical activity and fall risk.

### Discussion

#### Physical Activity

The study's findings revealed that among the 108 respondents, the majority of the elderly population exhibited a poor level of physical activity, accounting for 56 respondents (51.9%). This result aligns with the findings of Puspitasari and Arianto (2021), whose study also used the Physical Activity Scale for the Elderly questionnaire and reported that the majority of elderly individuals had poor physical activity levels (66%). A lack of physical activity in elderly individuals with diabetes mellitus is not merely an independent risk factor for various health problems; it is also intricately linked to the pathogenesis and management of diabetes itself. Inadequate physical activity can exacerbate insulin resistance, a key pathophysiological condition in type 2 diabetes, which further complicates blood glucose control. Furthermore, a sedentary lifestyle contributes to weight gain, reduced muscle mass (sarcopenia), and decreased muscle strength, all of which are significant risk factors for falls in the elderly population (Cruz

et al., 2019). In elderly patients with diabetes, this process may be accelerated by factors such as peripheral neuropathy and vascular dysfunction, which further worsen muscle weakness, particularly in the lower extremities. This muscle weakness directly impairs balance and postural stability, which are primary risk factors for falls (Lord & Sherrington, 2017). Low physical activity also contributes to a decline in cardiovascular fitness, which can compromise the ability of the elderly to cope with physical stress and maintain balance when faced with environmental challenges.

### **Fall Risk**

The research results indicated that the majority of the 108 respondents had a high risk of falling, with 56 respondents (51.9%) falling into this category. This is consistent with a study conducted by Dady et al. (2020), which found that a majority of elderly individuals (73%) were at risk of falling. A high risk of falls in elderly people with diabetes is a serious health concern as it can lead to physical injuries, a decline in quality of life, increased fear of movement, and even higher mortality rates. Several interacting factors in elderly individuals with diabetes mellitus can contribute to this observed high risk of falls. Chronic complications of diabetes, such as peripheral neuropathy—which causes sensory and motor impairments in the lower extremities—and diabetic retinopathy—which affects vision and depth perception—can directly impact balance and postural stability (American Diabetes Association, 2024). Beyond the direct complications of diabetes, other factors commonly associated with increased fall risk in the general elderly population are also likely to contribute to these findings. These factors include a history of previous falls, polypharmacy, other comorbid medical conditions, and unsafe environmental factors (Rohima et al., 2020). The combination of diabetes complications and these general fall risk factors is most likely the reason why the majority of the elderly participants in this study had a high level of fall risk.

### ***The Relationship between Physical Activity and Fall Risk in the Elderly with Diabetes Mellitus***

The bivariate analysis of the relationship between physical activity and fall risk in 108 elderly respondents with diabetes mellitus from the Simpang Tiga Community Health Center revealed a statistically significant association. The chi-square test yielded a p-value of 0.001, which is less than the significance level of  $\alpha=0.05$ , leading to the conclusion that there is a significant relationship between physical activity and fall risk. This finding indicates that when an elderly individual has poor physical activity, their risk of falling increases. Daily activity is a crucial parameter for assessing an individual's functional status, and in the elderly, this can be observed through their ability to perform daily tasks independently.

The aging process naturally leads to a decline in the ability to perform physical activities, resulting in reduced physical activity levels. This is attributed to the degeneration of muscle function, elasticity, and physical endurance. This observation is supported by Sudiartawan and Wijaya (2020), who state that the greatest risk factors for falls in the elderly are inadequate environmental conditions and balance disorders accompanied by weakness. The structural changes in muscle tissue directly impact muscle function, reducing its capacity to generate strength and contract effectively. Consequently, the elderly often experience a decline in muscle strength, particularly in the lower extremities, which are essential for body support and movement. Muscle and connective tissue elasticity and flexibility also decrease, limiting the range of joint motion and causing stiff movements. Furthermore, reaction speed and the ability to respond quickly to changes in balance are also diminished. This combination of decreased strength, slowed movement, and muscle stiffness impairs stability and balance, making the elderly more susceptible to stumbling, losing their footing, and ultimately falling, even from minor stimuli (Sudiartawan, 2020).

However, based on the findings, even respondents with good physical activity levels still had a high fall risk, with a proportion of 34.5%. This indicates that while good physical activity is important, it does not eliminate the risk of falls in elderly individuals with diabetes mellitus. Several factors may account for this. First, the physical and health conditions of the respondents may affect their fall risk. The sensory and motor functions typically decline with advanced age, such as balance and muscle strength, which increases vulnerability to falls despite good physical activity levels. Second, the type and quality of physical activity performed may not be optimal for fall prevention. Physical activities focused only on general fitness without specific exercises for balance, coordination, and core strength may leave the risk of falls largely unaddressed (Sherrington et al., 2019). Third, environmental factors, such as slippery floors, poor lighting, or physical obstacles, can also contribute to fall risk regardless of an individual's physical activity level. Fourth, other medical conditions, like impaired vision, chronic diseases, or the use of certain medications, can also influence fall risk in physically active individuals. Therefore, while good physical activity plays a crucial role in reducing the risk of falls, a comprehensive fall prevention approach is necessary, encompassing environmental modifications, management of medical conditions, and specific physical training to enhance balance and coordination.

### CONCLUSION

Based on the findings, it is concluded that a significant relationship exists between physical activity and the risk of falls in elderly individuals with diabetes mellitus residing in the working area of the Simpang Tiga Community Health Center, Pekanbaru, as evidenced by a *p*-value of 0.001. The study revealed that a majority of the 108 respondents had poor physical activity levels (51.9%) and, correspondingly, a high risk of falls (51.8%). Despite the significant association, the research highlights a key limitation: a considerable proportion of respondents with good physical activity still had a high fall risk (34.5%). This suggests that while physical activity is a crucial preventive measure, it is not the sole determinant of fall risk in this population. The findings underscore the need for a comprehensive fall prevention strategy that extends beyond general physical activity to include specific training for balance and coordination, alongside environmental modifications and effective management of diabetes complications. For future research, it is recommended to conduct a longitudinal study to better understand the causal relationship between physical activity and fall incidence over time. Additionally, future studies should explore the specific types and intensity of physical activity most effective in mitigating fall risk, and investigate the impact of multi-factorial interventions that combine physical training with environmental and clinical management strategies.

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