FACTORS RELATED TO PHYSICAL ACTIVITY LEVELS AMONG OLDER DIABETIC PATIENTS WITH UNCONTROLLED BLOOD GLUCOSE

Nguyen Thi Thu Huong[1,2,✉], Tran Viet Luc[1,2]
Nguyen Ngoc Tam[1,2], Nguyen Trung Anh[1,2]
[1]Hanoi Medical University
[2]National Geriatric Hospital

This cross-sectional study was conducted to explore factors related to physical acitvity levels of older type 2 diabetic people with uncontrolled blood glucose (HbA1c ≥ 7%). Physical activity (PA) levels was assessed using the International Physical Activity Questionnaire short form. Association existed between the duration of diabetes, chronic complications and HbA1c levels with the extent of PA levels. Prevalence of patients who have been diagnosed with diabetes ≥ 5 years, with at least one chronic diabetes complication or HbA1c level ≥ 8% were significantly higher in lower PA level. Peripheral neuropathy, cerebrovascular, and renal complications, were identified as related factors to the PA levels. Multivariate logistic regression analysis showed independent factors associated with low PA levels were cerebrovascular complications (OR = 7.2), risk of sarcopenia (OR = 5.9), peripheral nerve complication (OR = 4.5), lipid disorder (OR = 4.0), age > 75 years old (OR = 2.5), and an HbA1c ≥ 8% (OR = 2.5). This result highlighted some independent factors were associated with low PA level among older people with uncontrolled type 2 diabetes. However, future studies with larger sample sizes and longitudinal follow-up studies need to be done to understand these issues. Targeted interventions may help mitigate these risks.

Keywords: Physical activity levels, diabetes, older adults, related factor.

1. INTRODUCTION

Diabetes is a chronic metabolic condition with substantial risks of acute and chronic. Over the period from 1997 to 2010, the prevalence of diabetes in older adults has increased by a striking 62%.[1] In Vietnam, the Ministry of Health's survey results from 2021 revealed a significant prevalence of diabetes among adults, estimated at 7.1%. This translates to nearly 5 million individuals living with diabetes in the country. Diabetes has emerged as a common cause of disability and premature death in many countries, posing a substantial burden on healthcare systems.

Numerous scientific studies have provided strong evidence supporting the positive impact of regular physical activity (PA) on various aspects of health. Engaging in PA has been shown to enhance blood glucose control, prevent complications associated with type 2 diabetes mellitus (T2DM), and improve blood pressure, cardiovascular health, mortality rates, and overall quality of life. According to the WHO, older adults should strive to accumulate a minimum of 150 - 300 minutes of moderate-intensity aerobic activity, 75 - 150 minutes of vigorous-intensity aerobic activity, or

Corresponding author: Nguyen Thi Thu Huong
Hanoi Medical University
Email: thuhuonglk@hmu.edu.vn
Received: 12/02/2025
Accepted: 21/03/2025

an equivalent combination of both throughout the week to attain substantial health benefits. In addition, older adults are advised to incorporate muscle-strengthening activities involving all major muscle groups on two or more days per week, as these activities offer further health advantages. Remarkably, this exercise recommendation has been proven effective in individuals living with chronic conditions such as hypertension, T2DM, HIV, and cancer survivors. However, it is disconcerting that global estimates from 2016 reveal that a staggering 1.4 billion adults, accounting for 27.5% of the world's adult population, fail to meet the recommended levels of PA required to enhance and safeguard their health.[2]

The low rate of older people with diabetes achieving blood sugar control goals is a significant public health issue. Poor glycemic control is linked to a range of severe health outcomes, including increased mortality, cardiovascular events, cognitive decline, and functional impairments. Moreover, the healthcare costs associated with diabetes-related complications are substantial and continue to rise. In older adults, several factors contribute to this challenge, including age-related physiological changes, co-existing medical conditions, and the complexity of diabetes management. Among various interventions, PA plays a pivotal role in improving blood sugar control. Through increased insulin sensitivity, improved glucose utilization, weight management, and enhanced cardiovascular health, exercise provides a multifaceted approach to diabetes management.

In Vietnam, only 59.2% of the adults with T2DM met the minimum recommended level of PA (WHO and IDF). After adjusting for potential confounders, participants with T2DM experienced 50.0% significantly lower odds of achieving PA recommendations.[3] These statistics reveal that PA has been and continues to be a weak aspect in achieving glycemic control and plays a crucial role in diabetes management in Vietnam. Therefore, the aim of this study was to explore some factors related to PA levels among older T2D people with uncontrolled blood glucose.

II. MATERIALS AND METHODS

1. Subjects

Older diabetic patients aged 60 years old or over with uncontrolled blood glucose were being examined and treated at the National Geriatric Hospital from March to October 2023.

Included criteria

- Patients who were diagnosed with T2DM by specialist doctors according to the ADA 2022.[4]

- Patients with uncontrolled blood glucose: who had HbA1c ≥ 7%.

- Patients were able to interview and have the physical and cognitive abilities to do a face-to-face interview.

- Patients and the patient's family agreed to participate in the study.

Excluded criteria

Patients with mental disorders, severe dementia, paralysis, other psychotic diseases, or not enough cognitive ability to respond to the interview.

2. Methods

Study design: A cross-sectional study.

- The sample was selected according to the convenience sampling method.

- The sample size is calculated using the formula:

$$n = Z^2_{(1-\alpha/2)} \cdot \frac{p(1-p)}{d^2}$$

p = 0.371 (The prevalence of low PA level among older adults with diabetes[5]).

From the formula, the estimated sample size was 140 patients. In fact, 148 patients participated in this study.

Variables

General information: age, gender, comorbidities.

Physical activity (PA) levels: The International Physical Activity Questionnaire short form (IPAQ-SF) is a self-reported questionnaire used to assess an individual's PA level, collecting information about the frequency and duration of various types of physical activities, including walking, moderate-intensity activities, and vigorous-intensity activities.[6]

Evaluation: Based on the total METs (Metabolic Equivalent of Task) minute per week, classifies the individual's PA level into 3 levels as follows:

Table 1. Classification of the individual's PA level

Total METs minute/week	Physical activity level
≥ 3000 METs	High
600 METs - 2999 METs	Moderate
< 600 METs	Low

T2DM characteristics: diabetes duration (years), fasting blood glucose (mmol/l), HbA1c level (%), chronic complications (peripheral nerve complication, eye complication, cerebrovascular complication. coronary complication, renal complication, foot complication, and peripheral arterial complication).

Geriatric syndromes: Physical function was assessed by Activities of Daily Living (ADL): total ADL score < 6 points was considered as having ADL dependence.[7] Sleep disturbance was assessed using the Pittsburgh Sleep Quality Index (PSQI): a total score ≥ 5 was considered as having sleep disorder.[8] The 21-item fall risk index questionnaire (FRI - 21) was used to evaluate the risk of fall: the cutoff level predicting high fall risk was 10 points or more.[9] The SARC-F is a simple questionnaire was used to screen for sarcopenia with total scores of ≥ 4 points indicating the risk of sarcopenia.[10]

Data collection method

Data were collected by using a research questionnaire through interviews, diagnosis tests, and medical records at National Geriatric Hospital. In person interviews were conducted at the hospital to obtain general and geriatric information by three doctors. Before starting to interview participants, doctors were trained in how to ask for information and the questionnaire in the study.

Data processing and data analysis

The process of data coding, entry into REDCap, and analysis was done by using Statistical Package for Social Science (SPSS) software (version 26.0). Descriptive statistics were adopted to examine characteristic data: frequency, percentage, and mean.

T-test and Chi-square test were performed to compare between low PA level and moderate to high PA level groups. Multivariable regression were performed to evaluate some independent factors related to PA levels among older T2DM patients with uncontrolled blood glucose. Statistical significance was accepted at the 95% of confidence level ($p < 0.05$).

III. RESULTS

1. General information

Among 148 uncontrolled T2DM patients aged 60 years and older, the mean age was

76.0 ± 7.4 years old. Female accounted for 62.2%. Prevalence of low, moderate and high PA levels were 64.2%, 29.7% and 6.1%, respectively.

2. Comparison characteristics of T2DM between PA level groups

Table 2. Comparison characteristics of T2DM between PA level groups

Characteristics		Low PA level (n = 95)		Moderate to high PA level (n = 53)		p-value
		n	%	n	%	
Diabetes duration (year)	< 5	10	10.5	13	24.5	*< 0.05*
	≥ 5	85	89.5	40	75.5	
Chronic complications	Yes	68	71.6	17	32.1	*< 0.001*
	No	27	28.4	36	67.9	
Fasting blood glucose (mmol/l)	< 5	5	5.3	0	0	> 0.05
	5 - 8.3	48	50.5	26	49.1	
	> 8.3	42	44.2	27	50.9	
HbA1c (%)	< 8	36	37.9	31	58.5	*< 0.05*
	≥ 8	59	62.1	22	41.5	
		Mean ± SD				
Diabetes duration (year)		12.7 ± 7.8		10.0 ± 7.0		*< 0.05*

An association existed between the duration of diabetes and HbA1c levels with the extent of PA levels. Patients who have been diagnosed with diabetes ≥ 5 years or HbA1c level ≥ 8% had higher prevalence of lower PA level. Furthermore, those with low level of PA displayed an average diabetes duration of 12.7 ± 7.8 years longer than those with moderate or high PA levels (10.0 ± 7.0 years). Notably, a significant association was identified between chronic diabetes complications and levels of PA ($p < 0.001$).

Table 3. Comparison chronic diabetes complications between PA level groups

Characteristics		Low PA level (n = 95)		Moderate to high PA level (n = 53)		p-value
		n	%	n	%	
Peripheral nerve complication	Yes	32	33.7	8	15.1	*< 0.05*
	No	63	66.3	45	84.9	
Eye complication	Yes	13	13.7	8	15.1	> 0.05
	No	82	86.3	45	84.9	
Cerebrovascular complication	Yes	14	14.7	2	3.8	*< 0.05*
	No	81	85.3	51	96.2	

Characteristics		Low PA level (n = 95)		Moderate to high PA level (n = 53)		p-value
		n	%	n	%	
Coronary complication	Yes	10	10.5	1	1.9	> 0.05
	No	85	89.5	52	98.1%	
Renal complication	Yes	8	8.4	0	0	*< 0.05*
	No	87	91.6	53	100	
Foot complication	Yes	4	4.2	1	1.9	> 0.05
	No	91	95.8	52	98.1	
Peripheral arterial complication	Yes	3	3.2	0	0	> 0.05
	No	92	96.8	53	100	

Chronic diabetes complications, including peripheral neuropathy, cerebrovascular, and renal complications, were identified as related factors to the PA levels in individuals with uncontrolled T2DM.

3. Some independent factors were associated with PA levels

Table 4. Multivariable logistic regression analysis of some related factors with low PA level

Some related factors	Low PA level	
	OR	95% CI
Cerebrovascular complication	*7.2*	*1.1 - 46.3*
Risk of sarcopenia	*5.9*	*1.7 - 20.8*
Peripheral nerve complication	*4.5*	*1.3 - 15.1*
Dyslipidemia	*4.0*	*1.2 - 12.7*
Age > 75 years	*2.5*	*1.0 - 6.5*
HbA1c ≥ 8%	*2.5*	*1.0 - 6.1*
Duration of diagnosis ≥ 5 years	3.0	0.9 - 9.6
Dependence in ADL	1.4	0.4 - 4.8
Sleep disturbance	1.9	0.7 - 4.8
High risk of fall	0.9	0.3 - 2.8

Some independent factors associated with low PA levels were cerebrovascular complications (OR = 7.2), risk of sarcopenia (OR = 5.9), peripheral nerve complication (OR = 4.5), lipid disorder (OR = 4.0), age > 75 years old (OR = 2.5), and an HbA1c level equal to or exceeding 8% (OR = 2.5).

IV. DISCUSSION

Our study showed that various independent

factors associated with low PA level were cerebrovascular complications, risk of sarcopenia, peripheral nerve complication, lipid disorder, age > 75 years old, and an HbA1c level ≥ 8% among older patients with uncontrolled T2DM.

This result observed a correlation between advanced age and PA levels. Patients older than 75 years constituted the majority of individuals exhibiting low PA levels, experiencing 2.5 times increase in the risk of low PA. Indeed, many studies have shown the decline in PA associated with the aging, frequently attributed to diminishing muscle strength in both upper and lower extremities, as well as flexibility, agility, and endurance.[6,11] Related to comorbidities, only dyslipidemia showed a significant relationship with the level of PA (OR = 4.0). Similar results have been found by Fang J et al. (43.1% versus 51.7%) and Churilla J et al. (59.1% versus 68.3%), who have reported that dyslipidemic adults were less likely to regularly engage in PA than those without dyslipidemia.[12,13] While advanced age is typically associated with lower physical activity levels, the relationship is complex and influenced by physical decline, psychological, and social factors. Encouraging older adults to engage in regular physical activity is crucial, as it can greatly improve health outcomes and overall quality of life, even if the level of intensity or frequency is lower than in younger individuals.

A distinct association emerges between the duration of T2DM and PA levels. Notably, patients enduring the condition for five years or more constituted the majority (89.5%) of individuals with low PA. This can be due to complications, fatigue, psychological factors, and other lifestyle challenges. However, with proper management, education, and social support, individuals with diabetes can continue to engage in physical activity, which is crucial for managing the condition and maintaining overall health. However, in the study of Tam NT, there was no correlation between the duration of diabetes and the level of PA.[14] This difference may be related to sample size differences between studies.

An independent association was observed between the HbA1c index and low PA level. Patients with an HbA1c index equal to or exceeding 8% showed a high proportion of low PA level (62.1%), experiencing 2.5 times increase compared to patients with HbA1c levels below 8%. In a study conducted at Hanoi Medical University Hospital, individuals with sufficient PA demonstrated lower HbA1c levels at 7.70 ± 1.24 (%) compared to those with insufficient PA, who exhibited HbA1c levels of 8.73 ± 1.51 (%).[15] Similarly, Beraki Å and colleagues conducted a study in Sweden in 2014, revealing that the average HbA1c level in the group with limited PA was notably higher at 8.8 ± 1.5 (%) compared to the group engaging in abundant PA, which had HbA1c levels of 7.7 ± 1.0 (%) ($p < 0.001$). According to Beraki Å et al., this association held true for both sexes, and regression analysis demonstrated that the relationship remained significant even after adjusting to exclude potential confounders.[16] The findings emphasize that increasing PA stands as the primary and most effective strategy for individuals with T2DM seeking to control glycemia.

This study also highlighted an association between diabetes complications and PA levels, particularly noted in patients with T2DM having chronic complications. Among some prevalent diabetes-related complications, both cerebrovascular complications and peripheral nerve complications demonstrated a substantial

increase in the likelihood of low PA level among participants, with odds ratios of 7.2 and 4.5, respectively ($p < 0.05$). The results were similar to a US study in which adults with diabetes with eye, kidney or nerve complications and those with heart disease were less likely to meet PA guidelines quality compared to people without these complications.[17] The correlation between chronic complications of diabetes and physical activity (PA) levels is a complex and multifaceted relationship. Chronic complications of diabetes can significantly impact a person's ability or willingness to engage in physical activity, either directly or indirectly.

The risk of sarcopenia was significantly associated with the level of PA (OR = 5.9). Sarcopenia often results in reduced strength and endurance, making it more challenging for individuals to engage in physical activities.[18] This correlation was also found in the Park H et al., individuals who walked < 5,300 steps/day and/or spent < 15 min/day at > 3 METs were, respectively, 2.00 - 2.66 and/or 2.03 - 4.55 times more likely to show sarcopenia than those who walked > 7,800 steps/day and/or spent > 23 min/day at > 3 METs.[19] Sarcopenia is the age-related loss of muscle mass and strength, which commonly affects older adults.[20] It is a significant condition that impacts physical function and overall health. Sarcopenia is not only associated with aging but can also be influenced by factors like inactivity, nutrition, chronic disease, and other health conditions. The relationship between sarcopenia and physical activity levels is essential to understand, as physical activity is both a cause and a consequence of sarcopenia.

Our study has some limitations. This is a cross-sectional study with convenience sampling method, so it cannot determine the causal relationship between factors and PA levels. In addition, the study was conducted in a geriatric hospital, so it is not representative of the older diabetic population in Vietnam. Therefore, future studies with larger sample sizes and longitudinal follow-up studies need to be done to understand these issues. Targeted interventions focusing on the above factors should be implemented to improve physical activity levels in this population and thereby improve the quality of management of older diabetic patients.

V. CONCLUSIONS

Cerebrovascular and peripheral nerve complications, risk of sarcopenia, lipid disorder, age > 75 years old and HbA1c level ≥ 8% independently associated with low PA level among older T2DM patients with uncontrolled blood glucose. Targeted interventions may help mitigate these risks.

Acknowledgement

Nguyen Thi Thu Huong was funded by the Master, PhD Scholarship Programme of Vingroup Innovation Foundation (VINIF), code VINIF.2023.TS.047.

REFERENCES

1. Laiteerapong N, Huang ES. Diabetes in Older Adults. In: Cowie CC, Casagrande SS, Menke A, et al., eds. *Diabetes in America*. 3rd ed. Bethesda (MD): National Institute of Diabetes and Digestive and Kidney Diseases (US); August 2018.

2. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*. 2020;54(24):1451-1462. doi:10.1136/bjsports-2020-102955

3. Do VV, Jancey J, Pham NM, et al. Objectively Measured Physical Activity of Vietnamese Adults With Type 2 Diabetes:

Opportunities to Intervene. *J Prev Med Public Health*. 2019;52(2):101-108. doi:10.3961/jpmph.18.213

4. American Diabetes Association Professional Practice Committee. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2022. *Diabetes Care*. 2022;45(Suppl 1):S17-S38. doi:10.2337/dc22-S002

5. Lee J, Kim J, Chow A, et al. Different Levels of Physical Activity, Physical Health, Happiness, and Depression among Older Adults with Diabetes. *Gerontol Geriatr Med*. 2021;7:2333721421995623. Published 2021 Mar 7. doi:10.1177/2333721421995623

6. Milanović Z, Pantelić S, Trajković N, et al. Age-related decrease in physical activity and functional fitness among elderly men and women. *Clin Interv Aging*. 2013;8:549-556. doi:10.2147/CIA.S44112

7. Hartigan I. A comparative review of the Katz ADL and the Barthel Index in assessing the activities of daily living of older people. *Int J Older People Nurs*. 2007;2(3):204-212. doi:10.1111/j.1748-3743.2007.00074.x

8. Le TA, Dang AD, Tran AHT, et al. Factors Associated with Sleep Disorders among Methadone-Maintained Drug Users in Vietnam. *Int J Environ Res Public Health*. 2019;16(22):4315. doi:10.3390/ijerph16224315

9. Wada T, Ishimoto Y, Hirosaki M, et al. Twenty-one-item fall risk index predicts falls in elderly community-dwelling Japanese. *J Am Geriatr Soc*. 2009;57(12):2369-2371. doi:10.1111/j.1532-5415.2009.02591.x

10. Nguyen TN, Nguyen AT, Khuong LQ, et al. Reliability and Validity of SARC-F Questionnaire to Assess Sarcopenia Among Vietnamese Geriatric Patients. *Clin Interv Aging*. 2020;15:879-886. Published 2020 Jun 9. doi:10.2147/CIA.S254397

11. Suryadinata RV, Wirjatmadi B, Adriani M, et al. Effect of age and weight on physical activity. *J Public Health Res*. 2020;9(2):1840. Published 2020 Jul 3. doi:10.4081/jphr.2020.1840

12. Fang J, Keenan NL, Dai S. Fruit/vegetable intake and physical activity among adults with high cholesterol. *Am J Health Behav*. 2011;35(6):689-698. doi:10.5993/ajhb.35.6.5

13. Churilla JR, Johnson TM, Zippel EA. Association of physical activity volume and hypercholesterolemia in US adults. *QJM*. 2013;106(4):333-340. doi:10.1093/qjmed/hcs231

14. Nguyen Thi Tam, Pham Thang, Vu Thi Thanh Huyen. Effect of physical activity among type 2 diabetic outpatients. *Jounal of Medical Research*. 2022;150(2):96-106.

15. Pham Van Hung, Doan Huu Thien, Tran Hong Tram. Characteristics of hba1c in patients with type 2 diabetes at Hanoi Medical University Hospital. *Vietnam Medical Journal*. 2022;512(1). doi:10.51298/vmj.v512i1.2215

16. Beraki Å, Magnuson A, Särnblad S, et al. Increase in physical activity is associated with lower HbA1c levels in children and adolescents with type 1 diabetes: results from a cross-sectional study based on the Swedish pediatric diabetes quality registry (SWEDIABKIDS). *Diabetes Res Clin Pract*. 2014;105(1):119-125. doi:10.1016/j.diabres.2014.01.029

17. Janevic MR, McLaughlin SJ, Connell CM. The association of diabetes complications with physical activity in a representative sample of older adults in the United States. *Chronic Illn*. 2013;9(4):251-257. doi:10.1177/1742395313475461

18. Oliveira JS, Pinheiro MB, Fairhall N, et al. Evidence on Physical Activity and the Prevention of Frailty and Sarcopenia

Among Older People: A Systematic Review to Inform the World Health Organization Physical Activity Guidelines. *J Phys Act Health*. 2020;17(12):1247-1258. Published 2020 Aug 11. doi:10.1123/jpah.2020-0323

19. Park H, Park S, Shephard RJ, et al. Yearlong physical activity and sarcopenia in older adults: the Nakanojo Study. *Eur J Appl Physiol*. 2010;109(5):953-961. doi:10.1007/s00421-010-1424-8

20. Chen LK, Woo J, Assantachai P, et al. Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment. *J Am Med Dir Assoc*. 2020;21(3):300-307.e2. doi:10.1016/j.jamda.2019.12.012