Factors associated with the functional balance among diabetes mellitus patients in Padang, Indonesia

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ABSTRACT

Introduction: One of the common problems in patients with diabetes mellitus is a decrease in balance stability. A decrease in balance stability will result in functional limitations, an increased risk of falling and injury and a decrease in patient productivity. This study aimed to analyse the factors associated with functional balance in diabetes mellitus patients in Padang, Indonesia.

Materials and Methods: This research design is cross-sectional. The number of samples in this study was 132 diabetes mellitus patients. Chi-square test and binary logistic regression were used to examine the factors associated with functional balance in diabates mellitus patients.

Results: Factors associated with functional balance in diabetes mellitus patients were age.

Conclusion: This study highlights that age, gender and degree of neuropathy are significant factors associated with functional balance in diabetes mellitus patients. Nurses must enhance health education about prevention and risk factors that affect functional balance in diabetes mellitus patients.

KEYWORDS:
Diabetes mellitus, functional balance

INTRODUCTION

In 2019, the International Diabetes Federation (IDF) estimates that there will be 436 million people aged 20–70 years in the world suffering from type 2 DM in 2019 or equivalent to 9.3% of the total world population at the same age.[1] The prevalence of type 2 DM in Indonesia in 2020 reached 6.2%, meaning that there are more than 10.8 million people suffering from type 2 DM in 2020.[1]

Increased blood glucose levels (hyperglycaemia) in patients with type 2 DM can cause various problems in patients. Exposure to chronic hyperglycaemia results in ischaemia of the nerves and changes in nerve function, causing functional balance disorder. Functional balance is the body's ability to maintain balance in a certain position or perform movements either statically or dynamically.[2] Balance processes that are regulated by the cooperation of sensory nerves, motor and biomechanical processes experience changes due to hyperglycaemia. The sensory system which consists of the vestibular system, proprioceptive system and visual system has decreased function in DM. Nerve damage in DM patients includes microangiopathy complications.[3] Chronic hyperglycaemia conditions cause vestibular dysfunction in maintaining body balance.[4]

Functional balance disorder in diabetes mellitus patients is one of the causes of the risk of falling in diabetic patients.[5] The results of previous studies showed that many patients with diabetes experienced functional balance disorders. The balance score with the Berg Balance Scale (BBS) in diabetic neuropathy patients was lower, namely 40.5. This means that patients with diabetic neuropathy experience functional balance disorders, because the normal functional balance based on BBS is 46 – 56.[6] The results of Asif and Batool's research 75.5% of DM patients show balance disorder based on the results of the Timed Up and Go (TUG) test. The results of a study by Cordeiro et al in 2009 showed that factors related to functional balance in elderly people with diabetes were age, daily activities, step strategy, and proprioceptive sensitivity.[7] Several research results have explained that balance disorders are more common in patients with diabetes, but are still limited in explaining the factors that influence these functional balance. Based on the existing problems, this study will look further at the factors related to functional balance in DM patients.

MATERIALS AND METHODS

In this cross-sectional, non-interventional study, we enrolled 132 patients previously diagnosed with type 2 diabetes, attending scheduled visits in the Dr. M. Djamil Hospital, Padang, Indonesia. Purposive sampling was used for data collection. At the time of the screening patients, the following were considered exclusion criteria: not ability to provide informed consent, patients with foot edoema, patients with foot ulcers, patients with hearing loss.

The instrument used in this study was a respondent characteristic questionnaire which included age, gender and duration of DM. Blood glucose control is seen based on the HbA1C value. HbA1C <6.5% is defined as controlled blood glucose. The degree of neuropathy is the severity of neuropathy based on the result of a physical examination using MNSI (Michigan Neuropathy Screening Instrument) guidelines. Physical examination consisting of examination of foot appearance, ankle reflexes, vibration perception and

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foot sensitivity. Each physical examination item has a score range of 0 – 1, so the total score range is 0 – 10. The degree of neuropathy is categorized based on total score. The total score >2 – 4.5 is categorized as mild, >4.5 – 7.5 as moderate and >7.5 as severe neuropathy. Functional balance is the body's ability to maintain a position statically or dynamically. Functional balance is assessed with the BBS instrument (Berg Balance Scale). The subject was ordered to make movements and maintain positions according to BBS guidelines. The Berg Balance Scale consists of 14 assessment items an has a score range of 0 to 4 per item. Total score 0 – 56. The total score 46 – 56 is categorized as normal and 0 – 45 as disorder. The study design, protocol and informed consent form were reviewed and approved by the Ethics Committee of Faculty of Nursing, Indonesian University (Number : 0417/UN2.F12.D/HKP.02.04/2016); all patients provided written informed consent prior any study procedure or activity.

Statistical Analysis: IBM SPSS statistics version 26.0 was used to analyse the data. The data were presented descriptively. Chi-square test was used for bivariate analysis. Logistic regression analysis determined the association between the independent variables and identified determinant factors associated with functional balance in diabetes mellitus patients.

RESULTS

A total of 132 diabetes mellitus patients were recruited in this study. The prevalence of functional balance disorder among respondents was 40,90% (54 out 132 respondents). The univariate and bivariate analysis result of this study can be seen in the following table :

The univariate and bivariate analysis in Table I shows that the majority of the respondents with functional balance disorder were aged > 65 years old (51.06%), duration of DM > 5 years (42.85%), female (50.70%), uncontrolled blood glucose (45%), overweight (47.80%) and severe neuropathy degree (76.30%). The majority of the respondents with normal functional balance were aged > 65 years old (48.94%), duration of DM > 5 years (57.14%), male (70.49%), uncontrolled blood glucose (55%), normal BMI (73.60%) and mild neuropathy degree (85.50%).

The multivariate analysis in Table II shows age (OR = 6.89 95% CI = 2.03–23.46, p = 0.002), gender (OR = 2.58 95% CI = 1.02–6.53, p = 0.046) and degree of neuropathy (OR = 4.48 95% CI = 2.47–8.11, p = 0.000) are significant factors associated with functional balance in diabetes mellitus patients.

Table I: Univariate and bivariate analysis of factors associated with the functional balance in patients with diabetes mellitus (N=132)

Factors	Functional balance				*p* value
	Normal		Disorder		
	n	%	n	%	
Age					0.000
< 65 years	32	84.21	6	15.79	
> 65 years	46	48.94	48	51.06	
Duration of DM					0.281
< 5 years	14	70.00	6	30.00	
> 5 years	64	57.14	48	42.85	
Gender					0.014
Male	43	70.49	18	29.51	
Female	35	49.30	36	50.70	
Blood glucose control					0.040
Controlled	18	78.30	5	21.70	
Not controlled	60	55.00	49	45.00	
BMI					0.010
Underweight	4	33.30	8	66.70	
Normal	39	73.60	14	26.40	
Overweight	35	52.20	32	47.80	
Neuropathy degree					0.000
Mild	53	85.50	9	14.50	
Moderate	16	50.00	16	50.00	
Severe	9	23.70	29	76.30	

Table II: Multivariate analysis of factors associated with the functional balance in diabetes mellitus patients (n=132)

Factors	B	Wald	*p* value	OR	95% CI
1	Age	1.93	9.55	0.002	6.89 2.03–23.45
2	Duration of DM	–0.48	0.47	0.492	0.62 0.16–2.41
3	Gender	0.95	3.97	0.046	2.58 1.02–6.53
4	Blood glucose control	0.17	0.05	0.820	1.18 0.28–5.02
5	BMI	0.49	3.29	0.069	1.63 0.96–2.76
6	Neuropathy degree	1.49	24.42	0.000	4.48 2.47–8.11

DISCUSSION

In this study, factors associated with functional balance in diabetes mellitus patients were age, gender, and degree of neuropathy. Nemmers and Miller's research in 2008 showed that age had a significant relationship with the Berg Balance Scale score with a value of r=-0.438 and $p<0.0001$. Increasing age shows a decrease in the Berg Balance Scale score, meaning that increasing age increases functional balance disorders.[8] Increasing age will cause a decrease in the function of the body's systems, including the body's function in controlling balance. The decline in balance ability with age is caused by changes in the sensory, motor and central nervous system. The process of degeneration in the vestibular system will result in balance disorders in the elderly.[9,10]

In this study, it was also found that the percentage of balance disorders was higher in women than men. Theoretically, there is no effect of gender on functional balance disorders. Research by Chaiwanichsiri et al in 2008 showed that gender was not related to balance function and the incidence of falls in the elderly. But if it is associated with changes in bone metabolism in women when they enter menopause, it is found that the decrease in estrogen affects the occurrence of bone fragility. Fragility of the bones in the feet causes an increased risk of injury or falls in postmenopausal women.[11]

The results showed that the degree of neuropathy affects the functional balance of diabetic patients. Palma et al. study in 2012 concerning postural control and functional balance in patients with diabetic neuropathy showed that there was a relationship between the severity of neuropathy and the occurrence of functional balance disorders in diabetic neuropathy patients.[12] The research results of Lim et al. in 2014 regarding a comparison of the ability to maintain balance between type 2 DM patients with neuropathy and without neuropathy in 60 respondents concluded that there was a decrease in dynamic balance stability in DM patients.[13] The process of body balance is regulated by the cooperation of the sensory, motor and biomechanical nervous systems. In neuropathy, the sensory nervous system which consists of the vestibular system, proprioceptive system and visual system experience decreased function. This decrease in the function of the nervous system will lead to a decrease in the ability to regulate balance functions.[2,12]

CONCLUSION

Factors related to functional balance in DM patients are age, gender and degree of neuropathy. The most dominant factor affecting functional balance in DM patients is age. To reduce functional imbalance, patients need to control the complications of neuropathy which can lead to functional imbalance. Nurse must enhance health education about prevention and risk factors that affect functional inbalance.

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CONFLICT OF INTEREST

Conflicts of interest have not been disclosed by any authors.

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