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Research Article

The Effect of Foot Exercise on Daily Activities and Blood Sugar Levels of Elderly in South Bangka, Indonesia

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Abstract

Background: The elderly are a group of people who are at risk of developing diabetes mellitus. Foot exercise is appropriate for elderly people with diabetes to prevent injuries and help improve blood circulation in their feet and also could control blood sugar level. Objective: This study time to determine the effect of foot exercise on daily activities and blood sugar levels among elderly in Tanjung Ketapang Village, Toboali District, South Bangka Regency. Methods: The research employed a quasi-experimental one-group pretest-posttest design. Data were collected using two-part questionnaires: (1) contains the characteristics of the respondents, including age, gender, education, occupation, and (2) contains questions about Activities of Daily Lives and Blood Glucose Level. Data were analyzed using the Statistical Product and Service Solution program with the Independent t-test and then presented in univariate and bivariate analysis. Results: The study found the correlation between Activities of Daily Lives and Blood Glucose Level on foot exercise showed that the Blood Glucose Level before the exercise was 2.28, while after the exercise was 1.86. There is an effect of giving foot exercises to the elderly on Activities of Daily Lives and Blood Glucose Level with a significance p-value of 0.013 and 0.000, respectively. Conclusion: Foot exercise can be used as a standard of nursing care in both hospital and community settings to help and promote the program that has been established to reduce Diabetes Mellitus cases in Bangka Belitung Province.

Keywords: Activity of daily lives, blood glucose level, elderly, foot exercise

INTRODUCTION

The elderly population in developing countries in 2013 was 554 million people out of 7200 million people worldwide. This number will increase by 2050; about 1600 million people from 9600 million people globally.[1,2] Indonesia is included in the top five countries with the largest number of elderly in the world. In 2014, the number of elderly in Indonesia was 18,781 million people, and it is estimated that by 2025 the number will reach 36 million people.[3,4]

According to a 2011 United Nations (UN) report, life expectancy was 66.4 years between 2000 and 2005, with a 7.74 percent elderly population, and is anticipated to climb to 77.6 years between 2045 and 2050, with a 28.68 percent elderly population. According to Statistics Indonesia (BPS), Indonesia's life expectancy is increasing. In 2000, life expectancy in Indonesia was 64.5 years (with a 7.18 percent elderly population), grew to 69.43 years in 2010 (with a 7.56 percent elderly population), and slightly increased to 69.65 years in 2011 (with a 7.58 percent elderly population).[5,6]

According to Statistics Indonesia, Indonesia's senior citizens population was 14,439,967 individuals (7.18%) in 2000 and rose to 23,992,553 people in 2010 (9.77%). By 2020, the number of seniors is expected to reach 28,822,879 (11.34%).[7]

An increase in the population of a country will cause changes in its population structure, which further affects the dependency burden, especially for the elderly population. This change causes the number of elderly dependents to increase. An old-age dependency ratio is a number that shows the level of dependence of the elderly population on the productive age population, and this figure is the ratio between the number of elderly (60 years and over) with the number of productive people (15 -59 years). This ratio shows the magnitude of the productive population's economic burden to finance the elderly population.[8] After reaching old age, most people experience various pathological physical issues, including diminished energy, more wrinkled skin, brittle bones, poor vision, and slow movement. It results in the elderly's dependence, which can enhance dependent and necessitate the assistance of others to do everyday activities.[7–10]

Individually, the elderly will experience a decrease in the ability of daily activities, such as eating, bathing, dressing, changing places, controlling defecation and urination, toileting, mobilizing, climbing and descending stairs. Due to the physical changes experienced by the elderly, they are dependent on needing help from others.[11,12]

Psychologically, individuals who reach old age may undergo changes in their characteristics, such as becoming more rigid in various ways, losing interest, and abandoning formerly held desires or hobbies. Additionally, psychological problems affect the elderly, including loneliness, alienation from their environment, lack of confidence, neglect, especially among the poor elderly, and a lack of support from family members, as well as physical weakness and helplessness, which forces them to rely on others.[13–15]

The Ministry of Health of the Republic of Indonesia stated that the

results of SUSENAS data showed that the dependency ratio of the elderly population in 2014 was 11.90%, which indicates that every 100 people of productive age have to bear around 12 elderly. However, when compared by gender, the dependency ratio of the female elderly population is higher than that of the male elderly population (12.95% versus 10.86%).

Bangka Belitung is likewise experiencing an increase in the number of senior citizens. In 2013, the Province of the Bangka Belitung Islands had a population of 78,809 old persons, which increased to 83,011 and 84,825 in 2014 and 2015, respectively (Department of Statistic Province of Bangka Belitung Islands, 2016). In comparison, the elderly population in South Bangka was 6,265 in 2013. Furthermore, there was an increase of 6,392 individuals in 2014. In 2015, there was another growth of up to 6,426 senior individuals.

Increased reliance on the elderly will raise the strain on families, communities, and the government, particularly for specific services, primary health care for the seniors, which will also result in a significant societal burden as the elderly population continues to expand. Thus, it is critical to measure daily activities in order to identify the old's level of dependence and the level of help required while planning long-term care for the elderly.[16,17]

To maintain the healthy physical condition of the elderly, it is necessary to harmonize physical needs with psychological and social conditions. Therefore, there must definitely be an effort to reduce physically activities. In addition, the elderly must regulate their way of life well, for example, eating, sleeping, resting, and working in a balanced way.[18,19]

Independence in elderly individuals is assessed from their ability to carry out daily activities such as getting up, showering, going to the toilet, light work, sports, dressing neatly, cleaning the room, bed, locking doors and windows, going to the market, sexual potential and other activities, which is normally done in his youth.[20,21]

The elderly are a group of people who are at risk of developing diabetes mellitus. Population risk implies specific segments of the community or society that face physical, social, economic, and lifestyle constraints and life events or experiences resulting in health problems.[22,23]

The aging process in the elderly and other risk factors will cause diabetes mellitus. In the population, risk factors for diabetes mellitus include both modifiable and non-modifiable factors. Overweight, obesity, diabetes, hypertension, inactivity or a sedentary lifestyle, and smoking are all modifiable risk factors. Age, race, ethnicity, gender, and family history are risk factors that cannot be changed. Over 45 years old is an age group at risk of developing diabetes.[24–26] While physical deterioration is a natural part of the aging process and will affect everyone, health care professionals, particularly nurses, must intervene in the development and maintenance of health in the elderly in order to increase and maintain the elderly's independence in meeting their basic needs. Currently, a nursing model dubbed “The Activity of Daily Living” has been developed, which describes the nurse's role as assisting individuals in improving their independence.[27,28]

Limitation of movement is the leading cause of disruption of activities of daily living (ADL) and instrumental ADL (IADL). Similarly, reducing the prevalence of the chronic disease will reduce movement barriers. According to the latest data, ADL and IADL disorders are decreasing in the United States, between 15-20%.[29,30]

Foot exercise is appropriate for people with diabetes or non-diabetics to prevent injuries and help improve blood circulation in their feet. Nurses provide health education and guide DM patients to do foot exercises until patients can do this exercise independently.[31,32]

These foot exercises can help increase blood circulation in their feet, strengthen foot muscles, and facilitate joint movement in their feet. Thus, it is believed that diabetics' feet can be kept in good condition to improve their quality of life.[32]

According to the findings of a preliminary study conducted in Tanjung Ketapang Village on February 3, 2019, on five old, interviews and observations revealed that three elderly (60 percent) were independent and two elderly (40 percent) were dependent on others to perform physical activities. According to the results of interviews with the orphanage's head, some of the elderly have lost their capacity to regularly engage in physical activities due to disease or physical ailments (aging). The orphanage director noted that officers and the elderly had not been exposed to foot exercises.

Thus, this study time to determine the effect of foot exercise on daily activities and blood sugar levels in elderly residents of Tanjung Ketapang Village, Toboali District, South Bangka Regency.

MATERIALS AND METHODS

The research design employed quantitative analytical techniques in conjunction with a quasi-experimental one-group pretest-posttest design. The research was conducted by observation, and direct interviews with samples using ADL sheets with the assistance of three enumerators then provides foot exercises training on the elderly. Previously, the primary researcher described the questionnaire sheet that will be utilized in advance.

The population for this study consisted of all elderly residents of Tanjung Ketapang Village, Toboali District, South Bangka Regency who met the inclusion criteria, namely being willing to participate in the study and being over the age of 50. Purposive sampling was used, with up to 30 elderly residents being sampled because of their particular characteristics. Since these elderly over 50 were as the community members who have the same activity related community health program of elderly.

The data collection process is divided into two steps. Step one, request in writing to obtain permission from the head of Tanjung Ketapang Village, seek permission from the Head of South Bangka District Health Department, and seek permission from the Head of Public Health Centers (PHC). Data collection was started after this research was approved by the Ethical Reviewed Board of the Health Polytechnic of Pangkalpinang, Ministry of Health of the Republic of Indonesia, and permission by the local authority that was granted prior to conducting the study at the selected area. Step two, the data collection was conducted by using direct interviews, filling the ADL questionnaire, Blood Sugar patients examining, and giving education on how to do foot exercise to the participants. The respondents who visited were gathered in the room and given health education and demonstration of diabetes foot exercise. Respondent was given a leaflet on the procedure and steps on performing diabetes foot exercise. Respondents were asked to practice diabetes foot exercise 3 times per week with a duration of exercise 15-30 minutes for 3 weeks in their home regularly. Home visit also performed by researchers and research assistances three times a week to monitor the intervention was performed regularly as scheduled. Further, in the fifth-week blood sugar level and ADL were examined and followed-up.

The data analysis, including screening and cleaning data procedures was checked by the researcher. The data analysis was performed by using the Statistical Product and Service Solution (SPSS) for Windows program version 25. Descriptive statistics such as frequency and percentages were used to describe all variables (demographic factors such as gender, group of ages,

educationallevel, and employment status). Thus, the descriptive statistics were performed to identify frequency and percentages distribution of before and after foot exercise conducted. Further, the data analysis used the statistical test Paired T-Test which is examined the correlation of variables.

RESULT

The majority of respondents (64%) were female, the most common age group was 51-60 years old (42%), the most recent education was high school graduates (48%), and the most common occupation was a housewife (54 %), as shown in Table 1.

Table 1: Frequency distribution of respondents based on their characteristics

Characteristics		n	%
Gender	Male	18	36
	Female	32	64
Age Group	< 50 years old	2	4
	51 – 60 years old	21	42
	61 – 70 years old	13	26
	71 – 80 years old	9	18
	81 – 90 years old	4	8
	>90 years old	1	2
Education	No school	1	2
	Elementary School	9	18
	Junior High School	16	32
	High School	24	48
Occupation	Fisher	8	16
	Daily Laborer	6	12
	Entrepreneur	7	14
	Housewife	27	54
	Unemployed	2	4

ADL status is determined by completing an ADL form, which is divided into two categories: independent and dependent, whereas Diabetes Mellitus status is determined by doing a glucose check, which is divided into three categories: normal, pre-diabetes, and diabetes. ADL and blood sugar levels were determined prior to and following the foot exercise (Table 2 and 3).

Table 2: Frequency Distribution of respondents based on ADL and blood sugar level before foot exercise

Characteristics		n	%
ADL	Independent	40	80
	Dependent	10	20
Blood Sugar Level	Normal	12	24
	Pra Diabetes	12	24
	Diabetes	26	52

Table 3: Frequency Distribution of respondents based on ADL and blood sugar level after foot exercise

Characteristics		n	%
ADL	Independent	46	92
	Dependent	4	8
Blood Sugar Level	Normal	17	34
	Pra Diabetes	23	46
	Diabetes	10	20

Bivariate analysis was used to compare ADL and Blood Sugar Level prior to and following foot exercises and determine the effect on ADL and Blood Sugar Level.

Table 4 shows the decrease in the average value of ADL and Blood Sugar Level in the elderly after doing foot exercises, from 1.20 to 1.08 for ADL, and from 2.28 to 1.86 for Blood Sugar Level. The ADL sig value is 0.000, indicating that there is significance. Similarly, the Blood Sugar Level the sig value is 0.000, meaning that foot exercise has Blood Sugar Level significance

Table 4: Comparison of ADL and blood sugar level of respondents before and after foot exercise

Variable		Mean±SD	p-value
ALD	Pre-test	1.20±0.404	0.000
	Post-test	1.08±0.274	
Blood Sugar Level	Pre-test	2.28±0.834	0.000
	Post-test	1.86±0.729	

Table 5: The effect of foot exercise on ADL and blood sugar level

Variable		Mean±SD	p-value
ALD	Pre-test	0.120±0.328	0.013
	Post-test		
Blood Sugar Level	Pre-test	0.420±0.609	0.000
	Post-test		

Table 5 showed that a value of 0.013 and 0.000, respectively. Therefore, because the value of sig (2-tailed) is less than 0.05, it can be concluded that providing foot exercises to elderly residents in Tanjung Ketapang Village, Toboali District, South Bangka Regency affects their ADL and Blood Sugar Level.

DISCUSION

The effect of foot exercise on ADL in the elderly

Based on the results of the univariate analysis in Table 2 regarding the distribution of the elderly based on ability in ADL before doing foot exercises, there were 40 respondents (80%) still independent, and 10 respondents (20%) experienced dependence in doing ADL. In comparison, 46 respondents (92%) were independent in doing ADL after the foot exercise, and four respondents (8%) were still experiencing dependence in ADL.

Table 4 shows the ADL and blood sugar level sig value is 0.000, indicating that there is significance. Table 5 shows the effect of foot exercise on ADL in the elderly with a sig (2-tailed) value of 0.013 with a sig (2-tailed) less than 0.05. Therefore, it can be concluded that there is an effect of foot exercise on the ADL ability of the elderly.

These results are in line with Darsini on the effect of elderly exercise on ADL independence in the elderly in elderly homes, where the results of the analysis show that there is an influence of elderly exercise therapy on ADL independence (pre-post-test) of 0.58, from the results research proves that elderly exercise can increase ADL independence in the elderly.[33]

These results are also in line with the research of Sitorus et al. on the effect of elderly exercise on daily activities in the elderly at Graha Werdha Maria Joseph Pontianak, where the average score of daily activities before foot exercises is 14.50, and after the exercise is 16.20, which indicates that the respondent is independent in doing some aspects of the activity and requires assistance for several other aspects. Furthermore, the results of the t-test showed a value of p = 0.000 (<0.05); this value indicates that foot exercises can increase the score of daily activities in the elderly. This findings also consistent to the research conducted by Schwenk revealed that foot exercise effects on walking performance and significant improvements the movement in older adult.[1,34]

Foot exercise is a type of activity that patients with diabetes mellitus can do to avoid injury and improve blood circulation in their feet. This foot exercise aims to increase blood circulation to the tissues, strengthen small muscles, calf muscles, and thigh

muscles, and overcome joint motion limitations commonly experienced by people with diabetes mellitus. Thus, it is hoped that the feet of diabetics can be well maintained and can improve the quality of life of diabetic patients.[32]

The World Health Organization guidelines on physical activity, described that in older adults, physical activity also help prevent falls and fall related injuries and decline in bone health and function ability. It is recommended that as for elderly as part of their weekly physical activity, they also should do varied multicomponent physical activity that emphasizes functional balance. The evidence reviewed on physical activity and sedentary behaviour for adults also applied to older adults included adults over the age of 65 years for the common problem in activity related health status.

The physical activity such as foot exercise significant importance for who have physical ability problem including falls, fall-related injuries, physical function, frailty, and osteoporosis. The recent evidence demonstrates an intensive-dose of exercise response to activity and risk of physical functional limitations in older adults. High certainty evidence demonstrates that balance and functional exercises reduce the rate of falls and that can help to improve a wide range of elements of physical function.[35]

Overall, we conclude that foot exercise affects ADL ability for the elderly in Tanjung Ketapang Village, Toboali District, South Bangka Regency.

The effect of foot exercise on blood glucose

Blood glucose is a term that refers to the level of glucose in the blood whose concentration is tightly regulated by the body. Glucose flowing through the blood is the primary source of energy for the body's cells. Generally, the glucose level in the blood stays in the range of 4-8 mmol/L/day (70-150 mg/dl); this level increases after meals and is usually at its lowest level in the morning before people eat food.

Blood glucose levels vary throughout the day, increasing after eating and returning to normal within two hours. Normal blood glucose levels in the morning after fasting the night before are 70-110 mg/dL of blood. However, blood glucose levels are usually less than 120-140 mg/dL 2 hours after eating or drinking fluids containing glucose or other carbohydrates.[36,37]

The results of the univariate analysis in Table 4 show the comparison of the respondents'Blood Sugar Level before and after the foot exercise, where the average value before the foot exercise is 2.28 while after the foot exercise is 1.86. Table 5 shows the correlation between Blood Sugar level and foot exercises of 0.704 with a sig of 0.000, meaning a significant correlation between foot exercises and Blood Sugar Level. Table 6 shows the effect of foot exercise on Blood Sugar Level in the elderly is 0.000 with sig (2-tailed) <0.05, so it can be concluded that there is an effect of giving foot exercises on Blood Sugar Level levels in the elderly.

Studied the effect of foot exercise on differences in blood sugar levels in type 2 Diabetes Mellitus patients in the Enemawira Health Center work area. The paired sample test t-test obtained p-value = 0.000 (α = 0.05), indicating an effect of diabetic foot exercise on changes in blood sugar levels in type 2 Diabetes Mellitus patients.[38]

Investigated the effect of foot exercise on blood sugar levels of Diabetes Mellitus patients at Serang Hospital, Banten Province. The t-test in this study showed an average change in blood sugar levels before and after leg exercise (p=0.001, < 0.05). Studied the effect of leg exercises on blood sugar levels in Diabetes Mellitus patients and showed a decrease in the average blood sugar level after leg exercises in Diabetes Mellitus patients. Explored the effect of leg exercises on blood sugar levels in type 2 Diabetes Mellitus patients in the working area of the Cawas Public Health Center. The results showed that the paired t-test on the average blood sugar level pre-test post-test group got a p-value of 0.000. The results of the Wilcoxon test on the mean pre-post test Blood Sugar levels in the control group obtained a p-value of 0.079. In the independent t-test on the difference in Blood Sugar levels in the pre-post test of the experimental group, there was no difference in the mean Blood Sugar levels of the control group.[39]

After foot exercise, there is a decrease in blood sugar levels but not reaching normal blood sugar levels, due to some factors that can impact in decreasing of blood sugar if it is joined with diabetic foot gymnastics such as, diet and stress settings in diabetics. In addition some studies have highlighted the role of gender to be significant in the hyperglycemia, other factors like diet, lifestyles and age are influence the blood sugar level.[40]

The Effectiveness of Diabetic Foot Exercise to Blood Glucose in Type 2 Diabetes Patients reported by study conducted in Jakarta, Indonesia (2020) revealed that significant difference before and after foot exercise. The findings showed that normal blood sugar level increase from 16.7% to 23.3% after exercise intervention. Patients diagnosed with diabetes should be instructed in a exercise program such as diabetic foot exercise, because it focuses on maintaining and improving range of motion in the ankle and foot. In addition, through the foot exercise, there is an enhancement of blood supply to extremity that also will impact the blood sugar maintaining.[41]

CONCLUSION

This research was conducted in Tanjung Ketapang Village, Toboali District, South Bangka Regency, with 50 elderly respondents. The intervention studied is foot exercise and investigates its effect on dependencies of the elderly in performing daily activities (ADL) and Blood Sugar Level. Before foot exercise, ten elderly (20%) were reliant on others to perform daily activities, and 26 elderly (52%) indicated diabetes. Following the intervention, the dependent elderly decreased to only four people (8%), and the elderly with diabetes decreased to only ten individuals (20%). After performing foot exercises, the average value of ADL decreased from 1.20 to 1.08. Additionally, the average Blood Sugar Level decreased from 2.28 to 1.86 following foot exercise. Overall, based on the findings of this study, it can be concluded that foot exercise has a significant effect on the elderly'slevel of dependence in performing daily activities and reduce Blood Sugar level in Tanjung Ketapang Village, Toboali District, South Bangka Regency.

Foot exercise can be used as a standard of nursing care in both hospital and community settings. However, in future research, it is preferable to include the variable duration of diabetes and to place a greater emphasis on the duration of the study when determining the exact effect of foot exercise. Additionally, the findings of this study are expected to serve as a source of information and references in subsequent research.

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CONFLICT OF INTEREST

The author declared that don't have conflict of interest

ETHICAL CLEARANCE

This study was ethically approved by the e Ethical Reviewed Board of the Health Polytechnic Pangkalpinang Ministry of Health on April 2019 with number 08/EC/KEPK-PKP/IV/2019

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