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The Risk Factors for Diabetic Neuropathy Complications at a Community Health Center in Indonesia

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Abstract: ***Diabetes Mellitus is a non - infectious disease that experiences an increase each year. Uncontrolled Diabetes Mellitus will cause diabetic neuropathy complications. Various researches have explained a different result regarding diabetic neuropathy. The aim of this research is to analyze the relationship between age, gender, period of disease, medication adherence, diet, obesity, physical activities, history of hypertension and history of smoking with the incidence of diabetic neuropathy and analyzing the dominant factors in the incidence of diabetic neuropathy in community health centers in Indonesia. The method of this research was the cross sectional design. As much as 92 respondents participated. The consecutive sampling technique was applied. Independent variables of age, gender, period of disease, medication adherence, diet, obesity, physical activities, history of hypertension and history of smoking were measured by using the Diabetic Neuropathy Symptom (DNS) score. Bivariate analysis with the chi - square correlation test and Fisher's Exact Test were used, and also multivariate analysis with logistic regression test. The results of this research showed that there is a relationship between age (p = 0, 001; OR = 18, 33), period of disease (p = 0, 004; OR = 9, 120), regular medication (p = 0, 004; OR = 8, 296), diet (p = 0, 018; OR = 5, 333), obesity (p = 0, 022; OR = 4, 974), physical activities (p = 0, 006; OR = 7, 2333), and history of hypertension (p = 0, 010; OR = 6, 365) with diabetic neuropathy. The most dominant factor is physical activities (p = 0, 020; OR = 8, 445, 95% CI = 1, 394 < OR < 51, 170). This research concluded that the most influential factors towards diabetic neuropathy were age, period of disease, medication adherence, diet, obesity, physical activities and history of hypertension.***

Keywords: Diabetes mellitus, diabetic neuropathy, age, period of disease, medication adherence, diet, obesity, physical activities, hypertension

1. Background

Diabetes mellitus is a disease that can cause death everywhere in the world. This disease has been the main cause of blindness, heart diseases and kidney failure. The organization International Diabetes Federation (IDF) estimated that around 483 million people in the age range of 20 - 79 in the world, suffer from diabetes in 2019. Equivalent to the prevalence rate of 9, 3% from the total of population of the same age. This prevalence is expected to keep increasing with age becoming 19, 9% or 111, 2 million people in the age of 65 - 79 old. This prediction will keep increasing until 578 million in 2030 and 700 million in 2045. Based on the estimated data from IDF, cases of diabetes in Indonesia in 2019 ranked the 7th highest in the world after China, India, South America, Pakistan, Brazil and Mexico, that is 10, 7 million people and is estimated to exceed 21 million people in the incoming 2025. Indonesian health profile in 2012 showed that DM was ranked 6th out of 10 main diseases in outpatients in the hospital of Indonesia (Kemenkes RI, 2013).

According to Aceh health department's Profiles of Non - Infectious Diseases (PTM), it was recorded that 116, 318 people suffered from Diabetes in 2020 and 8, 569 or 7, 4% were in The District of Aceh Besar. From that amount 65, 1% or 5, 579 people have received standard medication in health centers. Darul Imarah health center received 1, 161 people who suffered from Diabetes or as much as 13, 4% from the total of people who suffered Diabetes that went to the 28 health centers in Aceh Besar.

Adherence is needed in doing medication programs that are given. Introduction towards the disease DM that covers the course of the disease, symptoms, complications, correct implementation procedure, it is absolutely needed so that with good understanding it pushes the person suffering diabetes adhere to the medication program with full consciousness without any forcing. Good understanding gives knowledge towards people suffering about many complications from diabetes (Hartini, 2009). On the average, Diabetes Mellitus sufferers are not conscious or aware of the course of their disease until the individual suffers complications. The complications of this disease can be acute or chronic, macrovascular or microvascular. One of the microvascular complications from DM that are most commonly found and can negatively affect the quality of life is neuropathy (Hartini, 2009).

The higher prevalence of neuropathy can be found in countries in the Middle East for example Egypt (61.3%), Jordan (57.5), and Lebanon (53.9%). The incident rate of neuropathy in Middle Eastern countries are significantly higher than Western countries such as England and South America (15 - 20%) (Janahi&Bakhiet 2015). The prevalence in Asian countries such as Korea which about 10 - 50% DM patients type 2 experience Peripheral Neuropathy (Kodan Cha, 2012). Meanwhile in Indonesia according to the data center and information from Indonesian Hospital Association (PERSI – *Perhimpunan Rumah Sakit Indonesia*) the prevalence of diabetes mellitus sufferers with neuropathy complications is more than 50% of DM sufferers (PERSI, 2011).

Diabetic Neuropathy as a chronic complication of advanced diabetes mellitus ranges from 10% until 60% (Waspadji, 2002). Diabetic neuropathy is any abnormality in the peripheral nervous system which is caused by chronic complications due to diabetes mellitus with complaints of symptoms such as a burning feeling, tingling, numbness and soreness in limbs especially legs (Tjokroprawiro, 2000). A few researches showed that there are many factors that can cause diabetic neuropathy to a patient with diabetes. Research that was done by Sinulingga et al (2015) showed that diabetic neuropathy complications can be influenced by age, gender, the duration of suffering from DM and hyperglycemia. The result of other researches showed that advances in diabetic neuropathy involves environment, lifestyle and genetic factors (Perkins et al, 2015). The amount of sufferers of diabetes in Aceh Besar in 2020 is still categorized as high, which is 8, 564 people and 1, 161 people resided in DarulImarah health center, meanwhile data about diabetic neuropathy complications is still difficult to obtain. The majority of patients that visit hospitals also suffer from ulcers.

2. Method

The design used for the research is analytical observation with a cross sectional approach. There are also dependent variables in this research which is diabetic neuropathy. Meanwhile independent variables are age, gender, period of disease, medication adherence, diet adherence, obesity, physical activities, history of hypertension and history of smoking. The population in this research are patients in non - infectious disease polyclinic with the diagnosis of Diabetes Mellitus that is recorded in the 2020 medical record which was as much as 1160 people. The sample in this research are Diabetes Mellitus patients with complications and without diabetic neuropathy complications. The sampling technique used in this study is consecutive sampling, where all subjects that come and complete the criteria pick is put in the research until the number of subjects is met (Sastroasmoro, 2014). The data analysis is done in a bivariate way through a chi square test and multivariate with logistic regression test. This research has already received ethical approval from the Ethical Committee – Komite Etik Penelitian Kesehatan Fakultas Kedokteran Universitas Syiah Kuala RSUDZA with the number: 161/EA/FK - RSUDZA/20201.

3. Results

In this study, the results and discussion were obtained as follows:

Table 1: Respondent Characteristics

	Incidence of Diabetic Neuropathy				Total	
	Yes		No			
	n	%	n	%	n	%
Age						
> 50 years' old	55	67, 07	1	10, 00	56	60, 90
≤ 50 years old	27	32, 93	9	90, 00	36	39, 10
Gender						
Male	26	31, 70	5	50	31	33, 70
Female	56	68, 30	5	50, 00	61	66, 30
Type of Work						
Farmer	12	14, 63	0	0, 00	12	13, 04
Housewife	30	36, 59	3	30, 00	33	35, 87
Businessman	23	28, 05	2	20, 00	25	27, 17
Civil servant	15	18, 29	1	10, 00	16	17, 40
Not working	2	2, 44	4	40, 00	6	6, 52
Level of Education						
Elementary	15	18, 29	1	10, 00	16	17, 39
Junior High School	42	51, 22	5	5, 00	47	51.09
High School	16	19, 51	2	2, 00	18	19, 56
Academic/PT	9	10, 98	2	2, 00	11	11, 96
Marital Status						
Married	59	71, 95	8	80, 00	67	72, 83
Not Married	3	3, 65	0	0, 00	3	3, 26
Divorced	0	0, 00	0	0, 00	0	0, 00
Death divorce	20	24, 40	2	20, 00	22	23, 91
Total	82	100, 00	10	100	92	100, 00

Respondent characteristics based on group age are divided into 2 age groups which is > 50 years old and ≤ 50 years old. Most of the respondents are in the age group > 50 which is 56 people (60, 90%). Based on gender, most of the respondents are female which is as much as 61 people (66, 33%). Based on job, the respondent's characteristics are divided into 5 types of jobs that is farmer, housewife, businessman, civil servant and not working, where housewife respondents are the majority in this study, which is as much as 33 people (35, 87%). The majority level of education is junior high school which is as much as 47 people (51, 09%). Based on the marital status, the majority of respondents are married which is as much as 67 people (72, 83%).

Table 2: Cross tabulation of the influencing factors of age, gender, period of disease, medication adherence, diet adherence, physical activities, history of hypertension and history of smoking towards the incidence of diabetic neuropathy.

Variable	The Incidence of Diabetic Neuropathy				Total		*P*	OR Vale (95% CI
	Yes		No					
	n	%	n	%	n	%		
Age								
> 50 years' old	55	98, 20	1	1, 80	56	60, 90	0, 001	18, 333 (2, 208 - 152, 234)
≤ 50 years old	27	75, 00	9	25, 00	36	39, 10		
Gender								
Female	56	91, 80	5	8, 20	61	66, 30	0, 296	2, 154 (0, 573 - 8, 095)
Male	26	83, 90	5	16, 10	31	33, 70		
Period of Disease								
>5 Years	57	96, 60	2	3, 40	59	64, 10	0, 004	9, 120 (1, 806 - 46, 050)
≤5 Years	25	75, 80	8	24, 20	33	35, 90		
Medication Adherence								
Not Compliant	64	89, 10	3	10, 90	67	72, 80	0, 004	8, 296 (1, 946 - 35, 371)

Compliant	18	72, 00	7	28, 00	25	27, 20		
Diet Adherence								
Not Compliant	64	94, 10	4	5, 90	68	73, 90	0, 018	5, 333 (1, 357 - 20, 967)
Compliant	18	75, 00	6	25, 00	24	26, 10		
Obesity								
Yes	63	94, 00	4	6, 00	67	72, 80	0, 022	4, 974 (1, 270 - 19.479)
No	19	76, 00	6	24, 00	25	27, 20		
Physical Activities								
Not Routinely	62	95, 40	3	4, 60	65	70, 70	0, 006	7, 233 (1, 708 - 30, 633)
Routinely	20	74, 10	7	25, 90	27	29, 30		
History of Hypertension								
Yes	60	95, 20	3	4, 80	63	68, 50	0, 010	6, 364 (1, 511 - 26, 806)
No	22	75, 90	7	24, 10	29	31, 50		
History of Smoking								
Yes	26	92, 90	2	7, 10	28	30, 40	0, 718	1, 857 (0, 368 - 9, 364)
No	56	87, 50	8	12, 50	64	69, 60		

Table 2 shows that the age group >50 years old that there were as much as 55 samples (98, 2%) that experience neuropathy and 1 sample experienced no neuropathy (1, 8%). In the age group of ≤50 years' old with 36 samples, 27 experienced neuropathies (75, 0%) and 9 samples (25, 0%) did not experience neuropathy. Based on the results of the Fisher test, it was found that the p - Value was 0, 001 < 0, 05 so that the null hypothesis (Ho) is rejected which means that there was a meaningful relationship between the age of sufferers and the incidence of diabetic neuropathy in the DarulImarah health center. The OR value is 18, 333 meaning that the age group over 50 years old have a higher risk of 18, 333 of experiencing diabetic neuropathy compared to the age group younger than 50 years old.

Table 2 shows that females as much as 56 people (91, 8%) experience neuropathy and 5 people did not experience neuropathy (8, 2%).26 males experienced neuropathy (83, 9%) and 5 (16, 1%) people did not experience neuropathy. Based on the Fisher test it was found that the p - Vale was 0, 296 > 0, 05 so that the null hypothesis (Ho) was accepted which means that there was no meaningful relationship between the gender of patients and the incidence of diabetic neuropathy in the DarulImarah health center.

Table 2 also shows samples with the period of disease of >5 years which were as much as 57 samples (96, 6%) who experienced neuropathy and 2 (3, 4%) samples did not experience neuropathy. Patients with the period of disease being ≤5 years had 25 samples (75, 8%) experienced neuropathy and 8 (24, 2%) samples did not experience neuropathy. Based on the results of the Fisher test, it was found that the p - Vale was 0, 004 < 0, 05 so that the null hypothesis (Ho) is rejected which means that there was a meaningful relationship between the period of disease and the incidence of diabetic neuropathy in the DarulImarah health center. The OR vale was 9, 120 meaning that patients with the period of disease being >5 years had a higher risk of 9, 120 more times to experience diabetic neuropathy compared to the period of disease being ≤5 years.

The variable of medication adherence, Table 2, shows that more than 18 (72, 0%) samples that adhered drinking their medication experienced neuropathy and 7 (28, 0%) samples did not experience neuropathy. Sufferers that did not adhere to drinking their medication from 67 samples, 64 (89, 1%) samples experienced neuropathy and 3 (10, 9%) samples did not experience neuropathy. Based on the results of the Fisher test, it was found that the p - Value was 0, 004 < 0, 05 so that the null hypothesis (Ho) is rejected which means that there was a meaningful relationship between the adherence of drinking medication and the incidence of diabetic neuropathy in the DarulImarah health center. The OR value was 8, 296 meaning the patients that did not adhere to drinking their medication have a higher risk of 9, 296 times more of experiencing diabetic neuropathy compared to the patients who adhered to drinking their medication.

Table 2 also shows that the patients that adhered to the diet were as much as 18 (75, 0%) samples that experienced neuropathy and 8 (25, 0%) samples did not experience neuropathy. Furthermore, from 68 samples that did not adhere to the diet, 64 samples (94, 1%) experienced neuropathy and 2 (5, 9%) sample did not experience neuropathy. Based on the results of the Fisher test, it was found that the p - Value was 0, 018 < 0, 05 so that the null hypothesis (Ho) is rejected which means that there was a meaningful relationship between the adherence of dieting and the incidence of diabetic neuropathy in the DarulImarah health center. The OR value was 5, 333 meaning patients that did not adhere to the diet had a higher risk of 5, 333 times more to experience diabetic neuropathy compared to those who adhered to the diet.

Table 2 shows that from 67 people who experienced obesity, 63 (94, 0%) experienced neuropathy and 4 (6, 0%) did not experience neuropathy. Based on the results of the Fisher test, it was found that the p - Value was 0, 022 < 0, 05 so that the null hypothesis (Ho) is rejected which means that there was a meaningful relationship between obesity and the incidence of diabetic neuropathy in the DarulImarah health center. The OR value was 4, 974 meaning that patients who experienced obesity had a higher risk of 4, 974 times more to experience diabetic neuropathy compared to the patients that did not experience obesity.

Table 2 also shows that 65 samples that did not routinely do physical activities, as much as 62 (95, 4%) experienced diabetic neuropathy and 3 (4, 6%) did not experience diabetic neuropathy. Furthermore, from 27 samples that routinely did physical activities, 20 (74, 1%) samples experienced neuropathy and 7 (35, 9%) did not experience neuropathy. Based on the results of the Fisher test, it was found that the p - Value was 0, 006 < 0, 05 so that the null

hypothesis (Ho) is rejected which means that there was a meaningful relationship between physical activities and the incidence of diabetic neuropathy in the DarulImarah health center. The OR value was 7, 232 meaning that the patients that did not routinely do physical activities had a higher risk of 7, 232 times more to experience diabetic neuropathy compared to the patients that routinely did physical activities.

On the history of hypertension variable, table 2 showed that 63 samples with history of hypertension, 60 (95, 2%) samples experienced neuropathy and 3 (4, 8%) samples did not experience neuropathy. Patients that did not have a history of hypertension which was 29 samples, 22 samples (75, 9%) experienced neuropathy and 7 (24, 1%) samples did not experience neuropathy. Based on the results of the Fisher test, it was found that the p - Value was 0, 010 < 0, 05 so that the null hypothesis (Ho) is rejected which means that there was a meaningful relationship between history of hypertension and the incidence of diabetic neuropathy in the DarulImarah health center. The OR value was 6, 364 meaning that the patients with history of hypertension had a higher risk of 6, 364 times more to experience diabetic neuropathy compared to sufferers that did not have a history of hypertension.

Table 2 also showed that sufferers with a history of smoking which was as much as 28 samples, 26 (92, 9%) samples experienced neuropathy and 2 (7, 1%) samples did not experience neuropathy. Sufferers that did not have a history of smoking which were 64 samples, 56 samples (87, 5%) experienced neuropathy and 8 (12, 5%) samples did not experience neuropathy. Based on the results of the Fisher test, it was found that the p - Value was 0, 718 < 0, 05 so that the null hypothesis (Ho) was accepted which means that there was no meaningful relationship between the history of smoking and the incidence of diabetic neuropathy in the DarulImarah health center.

Table 3: Logistic regression is the dominant factor of diabetic neuropathy in DM patients.

Variable	B Value	Wald	P - Value	OR	95 % CI	
					Lower	Upper
Age	- 0, 936	0, 369	0, 544	0, 392	0, 019	8, 057
Period of Disease	- 2, 189	2, 009	0, 156	0, 112	0, 005	2, 312
Drinking Medication	- 1, 584	0, 621	0, 431	0, 205	0, 004	10, 561
Diet	3, 171	2, 779	0, 096	23, 839	0, 573	992, 519
Obesity	0, 894	0, 531	0, 466	2, 445	0, 221	27, 090
Physical Activities	3, 296	5, 943	0, 015	27, 007	1, 908	382, 285
History of Hypertension	- 1, 051	0, 366	0, 545	0, 350	0, 012	10, 537

The gender and history of smoking variable in this bivariate selection has a p - vale of >0, 25, so that it was not put into the logistic regression test. With that said the age, period of disease, drinking medication, diet, obesity, physical activities and history of hypertension variables filled in the conditions and was continued in the logistic regression test to be assess its contribution towards the incidence of diabetic neuropathy in the DarulImarah health center in 2021. Physical Activities had contributions with the incidence of diabetic neuropathy due to the P Vale being < 0, 05. Based on the OR value, physical activities have a chance as big as 27, 007 times to advance the incidence of diabetic neuropathy in DarulImarah health center.

4. Discussion

The result of this study shows that it was found that there was a meaningful relationship between the age of the patient with the incidence of diabetic neuropathy. The age group > 50 has a high risk of 18, 33 times more to experience diabetic neuropathy compared to the age group ≤ 50. This research is in line with the research that was done by (Mildawati, 2019) that states that it was found that there was a meaningful relationship between age and the incidence of diabetic neuropathy in a positive direction, which means that the more the person gets older, the higher the risk to contact diabetic neuropathy. Other studies in another health facilities with over 97 respondents, with a cross sectional design that researches the history of family, age, obesity, physical activities, dietary habit and the period of suffering from DM states that there is a meaningful relationship between age and diabetic neuropathy (Hidayat et al, 2020).

This study shows that the older you grow; the risk of contracting neuropathy becomes higher. However, this does not rule out the occurrence of diabetic neuropathy to happen to younger people (Bansal et al, 2014). Diabetes Mellitus complications with neuropathy can be contracted by diabetes patients from varying ages (Betteng et al, 2014). The age of someone after more than 30 will go through physiological that can negatively affect the functioning body of some (Smeltzer et al, 2010).

This study shows that there was no relationship found between gender and the incidence of diabetic neuropathy. This is not in line with the research that was done by (Mildawati, 2019) who stated that it was found that there was a relationship found between gender and the incidence of diabetic neuropathy, with the P Value being 0, 043 which if someone is a female, the higher the risk is for contracting diabetic neuropathy. Other studies by (Windasari, 2015) states that 28 (68, 3%) females suffer more from neuropathy than males which was 13 people (31, 7%). The result of other studies also states that neuropathic complications on diabetic patients are majorly female (63%) than males (37%) (Al - Rubeaan, 2015).

This study concludes that there is a meaningful relationship between the period of disease and diabetic neuropathy. The period of disease being more than 5 years have a higher risk of 21, 750 times more to experience diabetic neuropathy compared to the period of disease being less than 5 years in the DarulImarah health center. This study is in line with the research that was done by (Mildawati, 2019) who states that there was a relationship between the duration of suffering from DM with the incidence of diabetic neuropathy in a positive direction, which means that the longer someone suffers from DM, the higher the risk of experiencing diabetic neuropathy.

This study shows that the average patient that suffers DM in the group neuropathy was as much as 6, 46 years and other groups with no neuropathy were as much as 2, 41 years (Putra, 2011). The result of this study is also supported with a research that obtained the results that complications appeared after the disease has already coursed for 10 - 15 years due to the duration of patients that suffer DM that caused the glucose in their blood to build up continuously until complications appeared (Permana, 2009).

Adherence is defined by following the instructions that were ordered. The adherence of drinking medicine is the behavior to comply with the advice from doctors that was previously proceeded with the consultation process between the patient and doctor as a health care provider. Some of the things that are measured for this adherence are the suitability of the prescription, type of drug, dose, method and time recommended by the doctor after communication between the two parties. Researches modify the Morisky Medication Adherence Scale (2005) measurement method in a language that is easily understood by the respondents. From the results of the analysis, it can be concluded that it was found that there was a relationship between the adherence of drinking medication and the incidence of diabetic neuropathy. The result of the study was in line with the research conducted by Rahmawati (2018) that showed that there was a link between the adherence of drinking medicine and the incidence of diabetic neuropathy. This is also in line with the research conducted by Lestari (2016) that shows that there was a relationship between therapy and the incidence of diabetic neuropathy.

Sticking to the diet means compliant in controlling dietary habit. Keeping to the diet is very important to diabetic patients, due to increased blood sugar levels in the disease it will cause many chances of complications. Dietary habits must be maintained well. In addition to the type with low fat content and high fiber, the amount and scheduled food should follow the dietary habit that is recommended by the International Nutritional Organization (Sami et al, 2017). This study is in line with the research conducted by Semana et al (2013) that states that there is a link between dietary habits with the incidence of complications of diabetes mellitus patients type 2.

This study shows that it was found that there was a relationship between obesity and the incidence of diabetic neuropathy. This is in line with the research conducted by Musyafirah (2016) that states that obesity is a factor that has a relationship with the incidence of diabetic neuropathy complications. This study is also in line with previous research (Yuliani et al, 2015) with the results showing that it was found that there was a meaningful relationship between IMT/obesity with the incidence of coronary heart disease. Theoretically, obesity can increase the risk of cardiovascular disease because it is associated with metabolic syndrome consisting of insulin resistance, dyslipidemia, diabetes mellitus, fibrinolysis disorders, hypertension, hyperuricemia, and hyperfibrogenemia. In the end it will eventually lead to diabetic neuropathy with wound terminal on the leg or diabetic ulcer (Tanenberg & Donofrio 2008).

This study also proved that it was found that there was a relationship between physical activities with the incidence of diabetic neuropathy. This result is in accordance with the research done by Nurayati&Adriani (2017) that states that it was found that there was a relationship between physical activities with diabetic neuropathy complications. Physical activities can lower blood sugar levels fast and prevent complications. The muscles inside the body will react with the glucose that is stored inside the body so that it will lower the storage of glucose inside the body. Glucose inside blood will lower so that the blood sugar levels inside the body can be controlled. This is in line with the research conducted by Wanjaya (2019) that states that it was found that there was a meaningful relationship between physical activities and periphal diabetic neuropathy.30 minutes of moderate - intensity physical activity a day and a healthy diet can drastically reduce the risk of developing type 2 diabetes (WHO, 2016). Physical activities are an important part in controlling blood glucose levels and guard the body so it will keep staying healthy. Being active physically has a lot of benefits for our health, like lowering blood glucose levels, lowering blood pressure, increase blood flow, burn excess calories (keep weight healthy) and increase in mood (NIDDK, 2016).

This study states that there is a relationship between history of hypertension and diabetic neuropathy. This result is in line with other studies that states that there is a relationship between hypertension and the incidence of diabetes mellitus type 2 complications (Stanifer, et al 2016). Hypertension can cause the thickening of arterial walls that can cause narrow blood vessel diameter. Narrowing can affect the transport of metabolism in blood, so that blood glucose levels in blood will be disturbed. The incidence rate of diabetes mellitus is higher than patients with hypertension so that hypertension is also one of the factors of risks to diabetic neuropathy (Fadilah et al, 2016). This study states that the duration of suffering from diabetes, hypertension, dyslipidemia and HbA1c level can influence the incidence of neuropathy (Tarigan et al, 2015).

The result of the analysis uses the chi - square test to show that the behavior of smoking is not one of the factors that has a relationship with the incidence of diabetic neuropathy complications. According to research, this is due to the fact that there are more women than men. Although the number of females smoking is increasing, smoking is still considered taboo in Aceh. This study is in line with previous research that was done by Tanharjo et al (2016) who states that, smoking is not one of the factors that has a relationship with diabetic neuropathy because the chi - square test analysis results shows that $p = 0.73 > 0.05$. This is also in accordance with the research that was done in Makassar that also states that there is no relationship between smoking with the incidence of diabetic neuropathy (Musyafirah, 2016) with the p - value 0, 938, Other studies that were done in Surakarta also states that there is no relationship between smoking with the incidence of peripheral neuropathy on diabetes mellitus type 2 patients (Rahman, 2017). According to theory, history of smoking affects blood vessels because it can cause atherosclerosis in blood vessels. As a result of the atherosclerosis will increase systolic pressure which has an

impact on the value of the Ankle Brachial Index (Jung et al, 2011).

The result of the multivariate logistic regression analysis shows that the most dominant variable towards the incidence of diabetic neuropathy is physical activitis. With a P Value = 0, 015 and the value OR = 27, 007, which means someone that does not do physical activities routinely has a risk of suffering diabetic neuropathy complications as much as 27, 007 times more in DarulImarah health center. Physical activity is one of the steps in diabetes management. Before 2009,
neuropathy is a contraindication to physical activity that causes the feet to bear weight, such as walking. American Diabetes Association (ADA) advised that neuropathy patients to do physical activities such as swimming, bicycling and upper body exercise. After multiple studies, the ADA states that moderate - intensity physical activity that makes the feet hold weight such as walking does not increase the incidence of ulcers; on the condition that the patient always wears footwear and there is no severe foot deformity found.

Physical activities are needed because pharmacological therapy is not enough to decrease and delay the development of diabetic neuropathy. The combination of physical activities includes aerobic, tai chi, walking, toga, reducing sedentary behavior and diet consultation can increase balance, reduce soreness and fatigue and also fix cutaneous innervation in neuropathy (Kluding et al, 2017). Flexibility training and strengthening foot - ankle for a year on peripheral diabetic neuropathy patients shows the increase in speed of walking and level of activities day - to - day, as well as the increase in the quality of life, foot strength, leg function, physical mobility and biomechanical abilities during walking (Monteiro et al, 2018). Aerobic exercise is a type of physical activity that can fix and reduce diabetic neuropathy. Balance training shows high positive effects in the improvement of motor and sensory symptoms in peripheral neuropathy. Balance training is a type of physical activity that is most effective on peripheral diabetic neuropathy patients (Streckman et al, 2014).

5. Conclusion

Based on the results of the study and the discussion that has been described, it can be concluded that there is a relationship between age, adherence with medication, diet, obesity, history of hypertension, duration of disease, as well as physical activities with diabetic neuropathy complications in DarulImarah health center. In other side, there is no relationship between gender andhistory of smoking with diabetic neuropathy complications. The most dominant factor that affected towards the incidence of diabetic neuropathy complications in health center under study is the physical activities. The study further confirmed upon physical activities as a type of therapy that is worthy, promising and safe to improve condition of diabetic neuropathy patients.

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