Original article

Biological Factors Related to Distress of Patients with Diabetes Type-2

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Abstract:

Objective: The purpose of this study was to analyze the relationship between biological factors with distress of diabetes type 2. ***Material and Methods:*** The research method is quantitative correlation. Samples were taken by accidental sampling method for 3 months (November 2017-January 2018) in 44 patients who were treated at PKU Muhammadiyah Yogyakarta Hospital and PKU Muhammadiyah Bantul Hospital in Yogyakarta, Indonesia. The instruments of the study were medical records, diabetes distress scale (DDS17) questionnaire, sphygmomanometer, scales, and microtoise. Data analysis used was ordinal logistic regression. ***Result and Discussion:*** The results of the study showed 70.5% respondents were hyperglycemic; 79.5% respondents had normal total cholesterol; 45.5% respondents had normal HDL cholesterol; 52.3% respondents had normal LDL cholesterol; 63.6% respondents had normal triglycerides; 68.2% respondents had a normal BMI; 63.6% respondents had comorbidities; 50.0% respondents had complications; 72.7% respondents suffer from hypertension; and 68.2% respondents suffer from DM> 5 years. The result also showed 50.0% respondents had mild distress; 43.2% respondents had moderate distress; and 6.8% had severe distress. ***Conclusion:*** It was concluded that biological factors related to distress were comorbidities, complications, BMI and total cholesterol.

Keywords: diabetes, distress, biological factors, cholesterol, BMI, hypertension

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Introduction

The prevalence of diabetes in the world is increasing. The International Diabetes Foundation (IDF) estimates that the number of people with DM in 2040 will increase around 54.7% compared to 2015. Diabetes Type-2 is the most common form of diabetes. The prevalence of patients with DM type 2 is about 91% of the total number of people with diabetes. Indonesia is the seventh ranked country with the highest prevalence of DM in the world[1].

DM is often associated as a cause of psychological stress for its patients[2]. This is due to changes in lifestyle, physical weakness, vision problems, and potentially death. About 69.2% of type-2 diabetics experienced stress[3].

Unhealthy, negative and destructive response to stress is called distress. Emotional pressure that triggers distress in diabetes is caused by anxiety feelings related to the disease and management of the disease[4]. The chance of diabetes distress (DD) is higher in patients with DM who have experienced complications both micro and macrovascular. This is due to their concerns on higher medical costs after complications, and negative views about theirselvesin the future[5].

The facts showed that around two-thirds of the mental health problems of diabetic patients were not diagnosed and not treated. This is due to the failure of medical staff to recognize the psychological condition of DM patients since they focus more on their poor health condition. One factor that complicates this problem is that the symptoms of mental disorders often overlap with physical signs of diabetes, for example anxiety symptoms are similar to hypoglycemic disorders in DM patients[6].

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Excessive diabetes distress can decrease consciousness and increase the risk of death. The increased of cortisol hormone due to stress will inhibit the work of the insulin hormone, so that blood sugar becomes increasingly high. Another negative consequences of stress conditions is the presence of sympathetic nerve stimulation which results in vascular vasoconstriction. Thus, it will increase the resistance of peripheral resistance. This condition will increase of blood pressure, make the heart work heavier, and reduce of peripheral tissue perfusion[7].

Diabetes distress is influenced by biological factors such as glucose levels, lipid profile, body mass index (BMI), duration of illness, number of comorbidities suffered, and the number of complications that exist[4]. If biological factors that contribute to distress can be controlled, the life expectancy of diabetic patients can be increased. The purpose of this study was to analyze the biological factors that contribute to the distress of patient with DM type-2.

Materials and Methods

This was a quantitative correlation research study with a cross-sectional design using blood sugar levels during fasting, lipid profiles, and body mass index as primary data; and medical records to determine the duration of diabetes, the number of comorbidities, and the number of complications as secondary data. The population in this study was all DM type 2 inpatients who were treated at PKU Muhammadiyah Yogyakarta Hospital and PKU Muhammadiyah Bantul Hospital in Yogyakarta, Indonesia. The inclusion criteria were patients' age range was ≥20 years old; patients can communicate well; and patients did not experience amputation on both legs. The sampling method was accidental sampling during the study (three months), started in November 2017 until January 2018. The samples of the study were 44 respondents.

The instruments used in this study were the results of medical records of laboratory tests during hospitalization, scales, microtoise, and Diabetes Distress Scale 17 questionnaire in Indonesian version. This research has received permission from the Ethics Commission of Universitas'Aisyiyah Yogyakarta, Indonesia. The statistical analysis of correlation used was chi square test and spearman rank, while multivariate analysis test used was ordinal logistic regression test.

Results

Table 1. Frequency Distribution of Respondents' Sociodemographic Characteristics

No.	Characteristics	Number (n=44)	Percentage (%)
1.	Age Range		
	=30 years old	1	2.3
	31-40 years old	2	4.5
	41-50 years old	8	18.2
	51-60 years old	14	31.8
	>60 years old	19	43.2
2.	Sex		
	Male	17	38.6
	Female	27	61.4
3.	Education Level		
	Never attend any school	1	2.3
	Elementary school	14	31.8
	High School	25	56.8
	College	4	9.1
4.	Marital Status		
	Single/Not Married	2	4.5
	Married	37	84.1
	Widow	5	11.4

Table 2. Frequency Distribution of Assessment Related to Diabetes Type-2

No.	Research Data	Number (n=44)	Percentage (%)
1.	Duration of having Diabetes		
	=5 years	14	31.8
	>5 years	30	68.2
2.	Family Diabetes History		
	No history	19	43.2
	History exist	25	56.8
3.	Commorbidities		
	No Commorbidities	16	36.4
	Commobidities exist	28	63.6
4.	Hipertension History		
	No hipertension history	12	27.3
	Hipertension exist	32	72.7
5.	Complication		
	No complication	22	50.0
	Complication exist	22	50.0
	• Neuropathy	5	11.4
	• Retinopathy	3	6.8
	• Nefropathy	9	20.5
	• Neuropathy & Retinopathy	3	6.8
	• Neuropathy. Retinopathy & Nefropathy	2	4.5

Table 3. Frequency Distribution of Respondents' Physical and Laboratory Assessments

No.	Data	Number (n=44)	Percentage (%)
1.	Body Mass Indext		
	Thin (<18.5)	2	4.5
	Normal (18.5 – 24.9)	30	68.2
	Overweight (25 – 29.9)	9	20.5
	Obesity (>29.9)	3	6.8
2.	Fasting Blood Sugar Level		
	Normal (=125 mg/dL)	13	29.5
	Hyperglycemia (>125 mg/dL)	31	70.5
3.	Total Cholesterol Level		
	Normal (<200 mg/dL)	35	79.5
	Pre-hypercholesterolemia (201 – 239 mg/dL)	6	13.6
	Hypercholesterolemia (=240 mg/dL)	3	6.8
4.	*High Density Lipid* (HDL) Level		
	Low (<40 mg/dL)	18	40.9
	Normal (40 – 60 mg/dL)	20	45.5
	High (>60 mg/dL)	6	13.6
5.	*Low Density Lipid* (LDL) Level		
	Ideal (<100 mg/dL)	23	52.3
	Borderline (100 – 159 mg/dL)	17	38.6
	High (160 – 189 mg/dL)	3	6.8
	Very High (>190 mg/dL)	1	2.3
6.	Triglycerides Level		
	Normal (<150 mg/dL)	28	63.6
	Borderline (150 – 199 mg/dL)	9	20.5
	Hypertriglyceride (>199 mg/dL)	7	15.9

Table 4. The Mean Value of Respondents' Laboratory Examination

No.	Examination Component	Mean ± SEM	SD	Min	Max
1.	Fasting Blood Sugar	155.96 ± 12.085	80.163	69	520
2.	Total Cholesterol	176.77 ± 6.931	45.973	108	340
3.	HDL	44.63 ± 2.380	15.790	13	105
4.	LDL	103.63 ± 6.708	44.449	40	293
5.	Triglycerides	144.14 ± 12.495	82.884	48	417

Table 5. Distress Diabetes Scale in Respondents

Diabetes Distress Scale	Mild or No Distres (<2)	Moderate Distres (2-2.9)	Severe Distres (>2.9)
Diabetes Distress in General	22 (50.0%)	19 (43.2%)	3 (6.8%)
Emotional Domain Burden	15 (34.1%)	23 (52.3%)	6 (13.6%)
Interpersonal Domain Distress	21 (47.7%)	21 (47.7%)	2 (4.5%)
Physician Domain Distress	20 (45.5%)	19 (43.2%)	5 (11.4%)
Regiment Domain Distress	19 (43.2%)	20 (45.5%)	5 (11.4%)

Table 6. Cross Tabulation of Sociodemographic Characteristics with Distress Occurrence in Respondents

Variable	Mild Distress (n=22)	Moderate Distress (n=19)	Severe Distress (n=3)
Age			
=30 years old	1	0	0
31-40 years old	1	1	0
41-50 years old	0	6	2
51-60 years old	7	7	0
>60 years old	13	5	1
Sex			
Male	7	8	2
Female	15	11	1
Education Level			
Never attend any school	0	1	0
Elementary school	7	7	0
High School	11	11	3
College	4	0	0
Marital Status			
Single/Not Married	1	1	0
Married	17	17	3
Widow	4	1	0

Table 7. Cross Tabulation Assessment of Disease History with Respondent Distress Incidence

Variable	Mild Distress (n=22)	Moderate Distress (n=19)	Severe Distress (n=3)
Duration suffering from Diabetes			
=5 years	10	4	1
>5 years	13	15	2
Diabetes History on family			
None	11	6	2
There was diabetes history	11	13	1
Comorbidity			
None	4	11	1
There was comorbidity	18	8	2
Hypertension History			
None	7	3	2
There was hypertension history	15	16	1
Complication			
none	16	5	1
There was complication	6	14	2
Neuropathy	0	3	2
Retinopathy	3	0	0
Nefropathy	2	7	0
Neuropathy & Retinopathy	1	2	0
Neuropathy. Retinopathy & Nefropathy	0	2	0

Table 8. Cross Tabulation of Laboratory Assessment with Distress Incidence in Respondents

Laboratory Assessment Data	Mild Distress (n=22)	Moderate Distress (n=19)	Severe Distress (n=3)
BodyMass Index			
Thin (<18.5)	0	2	0
Normal (18.5 – 24.9)	12	16	2
Overweight (25 – 29.9)	8	0	1
Obese (>29.9)	2	1	0
Fasting Blood Glucose Levels			
Normal (=125 mg/dL)	3	10	0
Hyperglycemia (>125 mg/dL)	19	9	3
Total cholesterol levels			
Normal (<200 mg/dL)	18	16	1
Pre-hypercholesterol (201 – 239 mg/dL)	4	2	0
Hypercholesterol (=240 mg/dL)	0	1	2
High Density Lipid (HDL) level			
Low (<40 mg/dL)	9	7	2
Normal (40 – 60 mg/dL)	12	7	1
High (>60 mg/dL)	1	5	0
Low Density Lipid (LDL) level			
Ideal (<100 mg/dL)	10	13	0
Borderline (100 – 159 mg/dL)	10	5	2
High (160 – 189 mg/dL)	2	1	0
Very high (>190 mg/dL)	0	0	1
Triglyceride level			
Normal (<150 mg/dL)	13	13	2
Borderline (150 – 199 mg/dL)	6	3	0
Hypertriglyceride(>199 mg/dL)	3	3	1

Table 9. Test of Chi Square Analysis and Spearman Rank between Lab Check and Type 2 Diabetes Patient Distress

Statistical Test	Variables of Biological Factors Associated with Diabetes Distress		P value	Correlation coefficient	Interpretation
Chi Square test	Type-2 Diabetes Distress	Comorbidity	0.031	0.370	There is correlation, moderate correlation
		Complication	0.010	0.415	There is correlation, moderate correlation
		Hypertension	0.147	0.283	There is no correlation
		The duration of suffering form diabetes	0.395	0.201	There is no correlation
Spearman Rank test		BMI	0.013	-0.373	There is correlation, moderate correlation
		FBG	0.073	-0.273	There is no correlation
		Total cholesterol	0.274	0.169	There is no correlation
		HDL	0.727	0.054	There is no correlation
		LDL	0.865	-0.026	There is no correlation
		Triglycerides	0.748	-0.050	There is no correlation

Table 10. Ordinal Logistic Regression Biological Factors with Type-2 Diabetes Distress

Variable	Wald	Significance	Pseudo R-square
Comorbidity	0.596	0.440	
Complication	6.094	0.014	
Hypertension	1.075	0.300	
The duration of suffering form diabetes	0.186	0.666	Cox and Snell 0.464
BMI	1.105	0.293	Nagelkerke 0.557
FBG	1.661	0.197	McFadden 0.349
Total cholesterol	6.104	0.013	
HDL	0.023	0.881	
LDL	0.765	0.382	
Triglycerides	2.887	0.089	

Discussion and Conclusion

Table 1 shows that 43.2% of type 2 diabetes respondents were elderly. Along with the aging process, more elderly people are at risk for DM disease. The emergence of insulin resistance in the elderly can be caused by four factors, namely: (1) less muscle mass and more fat tissue; (2) decreased physical activity resulting in a decrease

in the number of insulin receptors that were ready to bind to insulin; (3) dietary changes, namely eating more carbohydrates due to reduced number of teeth; (4) neurohormonal changes especially plasma insulin-like growth factor-1 (IGF-1) and dehidroepiandosterone (DHEAS), which result in a decrease in glucose uptake due to decreased insulin receptor sensitivity and insulin action[8].

Table 1 shows that 61.4% of diabetes respondents were women. Several studies has been conducted to analyze the risk of type-2 diabetes based on sex. Young women are more dominant in type-2 diabetes because of the effects of gestational diabetes on mothers and infants. This condition will increase the risk of type-2 diabetes later in life[9]. During pregnancy, insulin sensitivity decreases. Increased estrogen, lactogen, and progesterone hormones during pregnancy and lactation increase appetite, thereby it will increase the fat tissue in the elderly[10].

The increased prevalence of diabetes in elderly women is precisely due to a greater life expectancy, so that the risk of diabetes complications such as blindness, ischemic heart disease is higher[9]. The risk of women getting diabetes is 2.777 times greater than in men[11].

A study conducted in Germany states that the quality of control of diabetes in middle-aged women is worse than that of men. This is because women have complex obligations in family care compared to men, which results in often being negligent in dealing with diabetes. In addition, the male masculine attitude as the head of the family influences the taking of an active attitude to resolve the problem, so that it will encourage men to recover quickly from their illness[12].

Most of the respondents in this study (56.8%) had high school education level. Some studies show that low education status is associated with negative effects on glycemic control, although the closeness of the correlation between the two variables is very small.

Education level is not a good predictor of type-2 diabetes. Education levels place more emphasis on adherence to the overall therapeutic regimen, namely: diet and exercise that are beneficial in glycemic control rather than drug adherence itself[13].

Based on marital status (table 1), the majority of respondents were married (84.1%). Poor quality of marriage is often associated with various indicators of poor health, including immunological and metabolic responses associated with the occurrence of type-2 diabetes. Some studies show that there is no significant difference in the prevalence of type-2 diabetes based on marital status, but several findings indicate that single status, divorce, widows/widowers are significantly associated with DM[14].

Married people can share environments that support better physical and mental health than those who are not married[15]. Widows or widowers have higher risks of diabetes due to relatively higher stress levels. The level of stress experienced will change lifestyle behavior and fat storage in the body (central obesity)[16].

Table 2.shows that the majority of respondents (68.2%) had diabetes for more than 5 years. The duration of diabetes indicates how long the patient has suffered from diabetes since the diagnosis was made. The long duration of suffering from diabetes is often associated with the risk of complications that arise afterwards[17].

56.8% of respondents had a family history of diabetes mellitus (table 2). A person will be more quickly affected by DM if they have a lineage from the mother, and tend to suffer from diabetes more easily if he or she had a history of diabetes lineage from the father + mother. This is possible because of the combination of DM-carrying genes from the father and mother so that the age diagnosed with DM becomes faster. The study found that if one parent has diabetes, the risk of developing DM was 15%, if both parents had diabetes, the risk of developing DM increased to 75%. Other studies also found that someone who has one or more family members, whether parents, siblings, or children with diabetes, was 2-6 times more likely to suffer from diabetes than people who do not have a family member who have diabetes[18].

The risk of getting DM from a mother is 10-30% greater than a father with DM. This is due to a decrease in genes when in the womb the mother is greater than the father. In female, the composition of estradiol will activate the expression of the β (ERβ) estrogen receptor gene. This gene will be responsible for insulin sensitivity and increased glucose uptake. Along with age, estrogen levels in the female body will decrease. Decreasing estrogen will reduce activation of ER gene expression so that insulin sensitivity and glucose uptake will also decrease[19].

In addition to ERβ genes associated with type-2 diabetes, including TCF7L2 which plays a role in insulin secretion, ABCC8 plays a role in helping insulin regulation, CAPN10 which is associated

with the incidence of type-2 diabetes in America and Mexico, GLUT2 which assists glucose uptake in the pancreas, GCGR along with glucagon hormone play their roles in glucose regulation. These genes can experience genetic mutations caused by environmental factors that cause type-2 diabetes[20].

63.6% of respondents had comorbidities other than diabetes. Chronic conditions in diabetes provided a risk of other diseases that occurred (comorbidity). Based on the research, it was found that diabetes patients had at least one comorbid chronic disease, such as hypertension; and as many as 40% of patients had at least 3 comorbidities. The increasing prevalence of multimorbidity in elderly diabetes patients is a result of the poor quality of diabetes care. It is necessary to conduct more regular testing of HbA_1C and administration of drug regimens such as ACE inhibitors and aspirin. Comorbidity also has a profound effect on the patient's ability to manage their self-care. Comorbidity can weaken the financial resources of diabetics by increasing additional costs for medical care[21].

Most of the respondents had hypertension (72.7%). Diabetes and hypertension often occur simultaneously. This is because both of these diseases have the same main risk factors, namely: poor diet, lack of physical activity, smoking and drinking alcohol. The bad lifestyle causes the blood vessels to narrow and the heart to work extra hard to pump blood. The other result is the chaos of the production of body hormones and enzymes, including insulin production. In fact, insulin has an important role to regulate blood pressure[22].

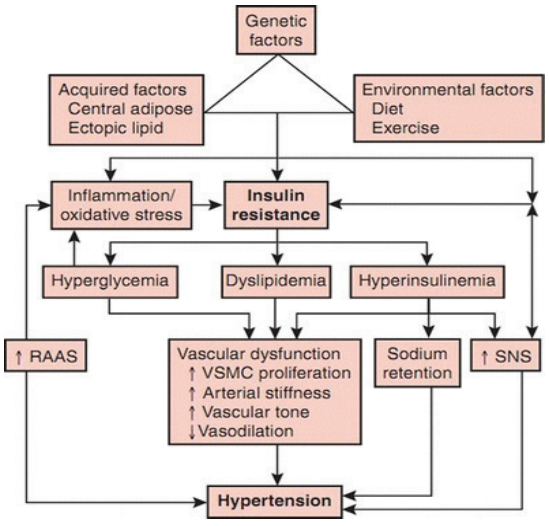

Figure 1. Mechanism of development of hypertension in diabetes mellitus[23]

Diabetes and hypertension have the same pathway. These pathways react between each other and can even cause a vicious circle. Hypertension and diabetes, both of which are the end result of metabolic syndrome. Central obesity is the cause of the metabolic syndrome. Lifestyle optimization remains the foundation in the prevention and treatment of diabetes and hypertension[24].

Some of the respondents (50.0%) had complications with the biggest type of complication was nephropathy (20.5%). Diabetes is very closely related to complications both micro and macrovascular. Diabetes will induce changes in microvasculature, cause extracellular matrix protein synthesis and capillary basal thickening which is a pathogenic feature of diabetic microangiopathy. These changes are closely related to advanced glycation end-products (AGE), oxidative stress, inflammation and neovascularization. The most common microvascular complications are nephropathy, retinopathy, and diabetic neuropathy[24].

Table 3 shows that the majority of respondents (68.2%) had a normal body mass index, which was in the range of 18.5-24.9. People who have a normal BMI have a two times greater risk of developing DM compared to people with a thin BMI. Research found that people who have a fat BMI are about three times more likely to develop DM than those with a thin BMI[25].

This is in line with the theory of Guyton that obesity is a predisposing factor for the rise of blood sugar levels. This is due to several things, including: (1) the beta cells of theLangerhans become less sensitive to stimuli or due to rising sugar levels; and (2) obesity will also reduce the number of insulin receptors in cells throughout the body One of the negative effects of excess weight is insulin resistance, namely the inability of insulin to produce normal biological functions (decreased insulin sensitivity), characterized by an increase in the amount of fasting insulin then it will cause an increase in blood glucose levels[26].

Most respondents (70.5%) had high fasting blood glucose levels (hyperglycemia), which was> 125 mg/dL. The results of this study are in accordance with PERKENI (2011), which states that 66,6% diabetics are on treatment, only 33,3% of which are in their glucose levels[27]. If blood glucose levels increase, it will cause an increase in AGE products that trigger the appearance of malondialdehyde - which is a biomarker of oxidative stress. If the level of malondialdehyde is high it will increase

the risk of complications in type 2 diabetes[28].

Total cholesterol levels in most respondents (79.5%) were normal, in the range of <200 mg / dL. As many as 45.5% of respondents had normal HDL levels, which were in the range 40 - 60 mg/ dL. LDL levels in most respondents (52.3%) were ideal, which was less than 100 mg/dL. Most of the respondents (63.6%) had normal triglyceride levels of <150 mg/dL.

The data obtained in table 3 shows that the lipid profile of most respondents was in good or controlled condition. Diabetics do not always have a bad lipid profile, this is because fasting blood glucose levels do not have a direct relationship with total cholesterol levels, HDL levels, LDL, and triglycerides[27].

The mean LDL level of respondents in this study was 103.63 mg/dL which was borderline or cautious, while the mean cholesterol, HDL, and triglyceride levels were still in the normal range (Table 4). In general, LDL cholesterol levels in diabetics are no higher than individuals without diabetes. Low LDL cholesterol levels can reduce cardiovascular risk in diabetes. If higher LDL levels than normal can trigger atherosclerosis or cause increased vascular smooth muscle cell apoptosis[29].

Increased cholesterol levels in the blood will be closely related to oxidative stress in the body. Oxidative stress is harmful to the health of the body because it induces damage to DNA, cells, and enzymes. In addition, the presence of free radicals can also oxidize LDL which triggers plaque buildup and atherosclerosis[28,48].

Table 5 shows that some respondents (50.0%) had mild distress. Diabetic distress is difficult to distinguish because it often overlaps with several conditions related to depression, anxiety, and stress. Diabetic distress is a condition in which a person experiences a unique emotional problem that is directly related to the burden and worries of life due to diabetes that he suffered. According to Fonda, a researcher at the Diabetes Institute, distress conditions are characterized by worries, frustration, and a little fatigue[30].

Diabetes distress is a rational emotional response to the threat of disease that can change one's life. Distress is different from depression. Distress comes from the demands of diabetes management and is a product of emotional adjustment[31]. Patients tend to worry when there are many demands for lifestyle changes; they feel failed to manage diabetes when their fasting blood glucose is high; worry about the risk of complications; and frustrated because patients cannot control diabetes every day[32].

Diabetic distress can be measured by a patent questionnaire, namely the Diabetic Distress Scale which consists of four domains: (1) emotional disturbances; (2) interpersonal disturbances; (3) distress of health personnel; and (4) therapeutic distress regimen.

The first domain of diabetic scale distress (DSS) is the domain of emotional burden. The results of the research presented in table 5 show that the majority of respondents experienced moderate distress (52.3%) in the domain of emotional distress. Emotional burden describes the distress associated with personal emotions in patients suffering from DM, including fear of possible complications caused by DM. Personal reactions such as feeling afraid, angry or feeling that diabetes changes the pattern of life[4], and feelings of anger because diabetes makes the activity limited. Emotional burden is considered the most important domain in steaming diabetic distress[14].

The second domain in DSS is distress caused by health workers, most respondents (45.5%) experienced mild distress or no distress (Table 5). Distress caused by health workers is a feeling of worry that the treating doctor does not understand enough about diabetes care and does not understand the patient's concerns about the disease. Another concern is the feeling of not having the right doctor for counseling for diabetes that he suffered[15].

Most respondents (45.5%) experienced moderate distress in the problem of therapeutic regimens in diabetes (Table 5). The third domain in DSS describes the distress felt by patients caused by the need for adherence to therapeutic management plans, namely distress caused by too many drugs and needles and distrust of one's ability to treat diabetes. The results of this study are in accordance with previous studies which found distress in this domain included in the medium category with an average score of 2.23.

Based on the interpersonal distress domain, respondents who experienced mild distress and moderate distress were as much as 47.7% (Table 5). The results of this study are in line with previous studies which found an average score in this domain of 2.06 or included in the medium level distress category[33]. Interpersonal distress domain is a feeling of worry that arises because the family does not support the self-care effort

that is done, the feeling of being ignored for their efforts to survive with the diabetes they suffer, and the feeling of not being given the emotional support they desire[15].

Diabetic distress does not always require doctor care. Occasionally experiencing distress is normal. Steps needed to overcome distress include: (1) making lifestyle changes that are slow but continuous, such as increasing physical activity, paying attention to diet, and diligently monitoring blood glucose. (2) Improve coping strategies by accepting the fact that humans cannot control everything. The reception process will create a feeling of being more relaxed and able to reduce stress levels. (3) Increasing faith and family support[30].Furthermore, recognizing the factors of cost-of-illness will help both patients and health care providers to improve the management plan and cost control and hence, to have better quality of life47.

Table 9 shows that the comorbidity variables (p = 0.031), complications (p = 0.010) and BMI (p = 0.013) were associated with the incidence of distress in type-2 diabetes patients due to the value of p <0.05. The closeness of the correlation of biological variables was moderate because the correlation coefficient was in the range of 0.30-0.49.

The bio-psychosocial determinant of type-2 diabetes patients consists of three factors, namely: (1) biological determinants consisting of BMI, age, genetic history, and comorbidity; (2) social determinants, namely income, education and employment; and (3) psychological determinants, namely depression. Comorbidity is a diabetes disease that is measured by analyzing the medical record. Some studies show that disease that is closely related to the incidence of type-2 diabetes is hypertension[34]. The prevalence of hypertension relates to type-2 diabetes is 59.6%.

The presence of comorbidity can also affect the life quality of patients with type-2 diabetes. One dimension of life quality is the physical health dimension, which includes activities carried out by daily patients, patient dependence on drug use, patient mobility, pain and feeling of comfort. All of these are related to the life quality of the patient, therefore if there is a concomitant disease other than diabetes, it will certainly affect the quality of life of the patient itself[35].

Patients without comorbidities have a better quality of life 4.7 times compared to patients who have comorbid hypertension. The number of comorbidities that the patient has affects the quality of life of the patient. Patients with one comorbidity have a quality of life 3.8 times better than patients who have more than one number of comorbidities[36].

Complications in diabetes consist of micro and macrovascular. If the condition of diabetes is not handled properly, it will cause several complications such as heart disease, kidney disease, blindness, limb amputation, erectile dysfunction, and persistent infection. If an individual is able to make appropriate lifestyle changes and pay attention to blood glucose control, then this can substantially reduce the risk of complications[28].

The result of the study in table 9 shows that the p-value for diabetes distress and complications was 0.010 (p0.05). The Wald parameter test result which was a multivariate test with ordinal logistic regression (table 10) shows that the variable complication was (p = 0.014). Someone who had complications has the opportunity to experience distress 6,094 times.

Complications due to diabetes caused psychological changes, such as distress or depression. Research shows that the number of complications was also related to psychological changes. Diabetic patients with one complication had depression symptoms of 6.9%, two complications 42.4%, three complications 88.8%, and four complications 60.0%[37].

Complications and distress in diabetes are interrelated. Research suggested that distress can activate the hypothalamic pituitary axis, stimulate the sympathetic nervous system, increase platelet aggregation and inflammatory responses, and contribute to poor glycemic control, increasing the risk of diabetes complications[38]. Distress can also interfere with glycemic control through negative effects on behavior such as adherence to diet, exercise, checking blood sugar and taking prescription drugs.

Type 2 diabetes patients are also at high risk of experiencing depressive symptoms, for example patients with diabetes complications such as nephropathy need hemodialysis, or patients with retinopathy experience visual impairments that can end up being blind, causing significant changes in their daily lives. Stresses that are faced every day can be extraordinary which in turn can trigger distress that increases to depression[37].

Table 9 shows that the BMI variable (p = 0.013) was associated with the incidence of distress in type 2 diabetes patients due to the value of p <0.05. The

closeness of the correlation of biological variables was moderate because the correlation coefficient was in the range of 0.30-0.49.

The result of this study supports the research which states that BMI is associated with serious psychological pressure in DM patients. In general, there is a trade-off between depression and weight. Younger people are at risk of depression if they experience weight loss, while older people are at risk of depression if they are obese[39].

Diabetes is a chronic disease associated with suffering and early death. The emergence of diabetic distress is often associated with poor quality of life, low levels of knowledge of diabetes which allows for adverse effects on self-management and glycemic control. Poor self-management will increase the risk of complications. One indicator of poor self-care management is excessive or even obese BMI[40].

The correlation between distress and BMI incidence is a relationship that affects each other. Increased BMI can affect distress events, and vice versa, the incidence of distress can affect BMI. The research suggested that psychological distress can affect BMI and central obesity. Psychological factors such as depression, anxiety, fatigue, and psychological trauma are risk factors for obsession. The results revealed that psychological stress was positively associated with BMI in women. Stress in individuals with BMI <22 kg/m^2 at the beginning would result in weight loss, however the stress suffered by individuals with BMI> 27 kg/m^2 at the beginning would actually increase body weight[41].

Women have a higher level of anxiety than men. Stressors complained by women include: lack of environmental and family support, work problems, and anxiety about diabetes[41].

According to the American Psychological Association, sedentary life behaviors such as watching television, drinking alcohol, smoking, playing games, and surfing the internet, have serious implications for increasing body weight. The lack of physical activity results in slow metabolism of the body, so much fat is stored in adipocyte cells[42].

Some people might use food as a means of overcoming their difficulties. Those who have high stress levels can change their food choices from healthy eating low fat, to unhealthy foods (eg high hydrogenated fats) and can also increase their food consumption[43].

The biological mechanism that explains why stress can affect BMI is an increase in cortisol products. Cortisol is a hormone secreted by the adrenal gland and is responsible for maintaining homoeostasis. Chronic psychological stress will increase cortisol levels, which result in hyperglycemia, hypertension, reduced heart rate variability, increased central obesity, and metabolic syndrome[44].

Gu, et al. reported that someone who experiences stress usually chooses foods with high fat and sugar content[41]. Hence, they eat when they are not even hungry. it can be concluded that brain tissue during stress will stimulate a person's eating behavior so that it can cause obesity. In a study it was reported that a person who has post-traumatic stress has a high level of salivary cortisol. Cortisol dysregulation is also seen in men who have metabolic syndrome[46].

Table 9 shows that total cholesterol levels were not related to distress events, because p = 0.274 (p> 0.05). On the other hand in the multivariate statistical test (table 10) the value of the total cholesterol was significant, p = 0.013 (p≤0.05) meaning that cholesterol levels had a significant influence on the incidence of distress of type-2 diabetes patients with an incidence of 6,104 times. The combination of stress and high cholesterol in individuals will increase the risk of heart disease. During stressful situations, the hypothalamus triggers the release of two hormones, namely adrenaline and cortisol, which have the effect of accelerating the heart rate, stimulating the release of energy, and increasing blood flow to the brain. This response is called fight and flight response[45]. Adrenaline and cortisol hormone can trigger cholesterol production. This cholesterol will be used as energy and repair damaged cells. However, if the energy is not used, it will accumulate slowly in the body as fat tissue. Cortisol has the additional effect of producing more sugar – whichis a short-term source of energy for the body. During repeated stressful situations, sugar is repeatedly not used and will eventually be converted into triglycerides or other fatty acids. Research shows that these fat deposits tend to end up in the stomach, which causes a higher risk of macrovascular complications in diabetic patients[45].

Cholesterol levels of diabetics that are more than normal can indicate failure of diabetic management self-care. Diabetics will be more anxious when they know their lipid profile is in the borderline or even very high. The most feared threat is a complication due to diabetes, especially

heart disease, because it will further increase mortality opportunities.

Table 9 shows that the duration of suffering from diabetes (p = 0.395) was not related to the incidence of distress in diabetes. The result of this study is different from the research conducted by Permana (2017) which states that the duration of diabetes is closely related to the incidence of distress. The longer the patient has diabetes, the lighter the distress he suffers[33].

The length of illness experienced by patients will result in patients being able to understand conditions both in terms of physical, psychological, social, and environmental relationships. The patient's understanding of his illness will encourage patients to be better able to anticipate emergence of a situation or something that might happen to the patient. The duration of a person's illness has an impact on the ability of people to understand their condition and control themselves about their state of health[33].

The absence of a relationship between the duration of illness and the incidence of distress was due to the patient's anxiety remains high due to fear of complications, or the biological condition of him even though the patient has long suffered from diabetes. Another theory reveals that the more patients understand the disease, then it will lead to higher anxiety about the disease[4].

Table 9 shows that fasting blood glucose (FBG) levels (p=0.073), HDL cholesterol levels (p=0.727), LDL cholesterol levels (p=0.865), and triglyceride levels (p=0.748) were not associated with diabetic distress. The result of the study in table 4 shows that the average FBG level was 155.96 gr/dL (hyperglycemia), the mean total cholesterol was 176.77 mg/dL, the mean HDL was 44.63 mg/dL, the mean LDL was 103.63 mg/dL, and average triglyceride level of 144.14 mg/dL. The mean lipid profile in this study shows in the normal range, so it can be concluded that the average respondent did not experience dyslipidemia.

When an individual is diagnosed with diabetes, patients will be informed to change their lifestyle significantly so that diabetes can be controlled. Patients will be informed that the prognosis of the disease will be very dependent on perseverance and compliance in carrying out a therapeutic regimen, such as modification of diet, taking medication, diligently controlling blood glucose levels and even learning to inject insulin if needed. Patients are also asked to increase physical activity regularly. If the patient has carried out diabetes self-care well, but it turns out that the lab results are not in line with their expectations, it will give rise to feelings of despair which then results in treatment non-compliance. Breach of diet begins to be made which will further worsen the blood sugar level and the lipid profile of the patient[46].

Conclusion

Biological factors related to distress were comorbidity, complications, and BMI; while the biological factors that were not related to distress are hypertension, duration of diabetes, FBG, total cholesterol, HDL, LDL, and triglycerides. The most influential biological factors in diabetes distress were complications and total cholesterol.

Recommendations

The health care providers must be handling distress diabetic problems as an effort to anticipate before the stress occurs in diabetic patients.

Ethical Approval Issue:

Equitable distribution of benefits and burdens in the selection of individuals of participants in research.

Conflict of interest : None.

Author's Contribution :

Data gathering and idea owner of this study: Diyah Candra Anita.

Study design: Diyah Candra Anita.

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