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by Adiba Hasna Hanifah

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Correlation between Physical Activity Level and Therapeutic Success on Patients with Type 2 Diabetes Mellitus in Dr. Soetomo General Hospital Surabaya

Adiba Hasna Hanifah¹, Soebagijo Adi Soelistijo², Bambang Purwanto³

¹Bachelor Student, Faculty of Medicine University of Airlangga, Surabaya, Indonesia, ²Head of Internal Medicine Department, Dr. Soetomo General Hospital Surabaya, Indonesia, ³Head of Physiology Department, Faculty of Medicine University of Airlangga, Surabaya, Indonesia

Abstract

Background: Diabetes mellitus is a group of metabolic diseases characterized by high blood sugar levels that occur due to abnormal working/secretion of insulin. Meanwhile, physical activity plays a significant role in regulating blood sugar levels in type 2 diabetes mellitus (T2DM) patients. During physical activity, insulin resistance decreases because when muscles contract, membrane permeability increases, and glucose can enter the cells. **Objectives:** The study aimed to determine the correlation between physical activity level and the therapeutic success of T2DM patients. **Method:** This cross-sectional study sample was all T2DM patients in Dr. Soetomo General Hospital internal polyclinic with a sample size of 87 people taken by consecutive sampling. Data was collected by direct interviews using the IPAQ questionnaire. The study variables were the therapeutic success and physical activity level of T2DM patients. **Results:** At a low level of physical activity, 69.8% of respondents had not met the therapeutic success criteria, at a moderate level, 56.0% have met the criteria, at a high level, 66.7% have not met the criteria. **Conclusion:** There is no correlation between physical activity level and the therapeutic success of T2DM patients at RSUD Dr. Soetomo Surabaya ($p = 0.086$).

Keywords: Cross-sectional Analysis, Diabetes Mellitus, IPAQ, Physical Activity, Therapeutic Success

Introduction

Diabetes mellitus is a group of metabolic diseases characterized by high blood sugar levels (hyperglycemia). This can occur due to abnormal working insulin, abnormalities in insulin secretion, or a combination of both¹. Indonesia is one of the 10 countries with the highest number of diabetic patients at the age of 20-79 years, ranked 6th in 2017. 80% of patients with type 2 diabetes mellitus (T2DM) are in middle or low-income

countries with an age range of 40-59 years². Surabaya is the largest city in East Java and ranked sixth in the case of diabetes mellitus in 2018 with a total of around 4,5 million patients³. This study aims to determine the correlation between physical activity level and the therapeutic success of T2DM patients by looking at the percentage of patients who achieved the criteria for therapeutic success with their level of physical activity.

Material & Methods

This analytical, observational, and cross-sectional study has a population of all patients with T2DM in the internal polyclinic diabetic division who entered Dr. Soetomo General Hospital from August-December 2019. The minimum sample size in this study was 79 people with an added 10% for anticipation so that the study sample was 87 respondents. The study used consecutive sampling as a sampling technique where all subjects

Corresponding Author:

Dr. Soebagijo Adi S,
dr., Sp.PD-KEMD, FINASIM
Address : Department of Internal Medicine Dr.
Soetomo General Hospital. Jl. Mayjen Prof. Dr.
Moestopo No. 6-8, Gubeng, Surabaya, Indonesia 60286
E-mail : soebagijo@yahoo.com
Telephone number : +62(812)3531065

who came and met the selection criteria were included in the study until the required number of subjects were met. The subjects must be a diabetic polyclinic patient in Dr. Soetomo General Hospital, has T2DM, aged between 15-65 years old, complete medical record, not having a high physical activity (builders, construction workers and laborers), not having disabilities that cause immobilization or unable to do physical activity, and not having a cardiorespiratory disease (Stroke, COPD, Cardiac decompensation) which cause a decrease of physical activity intensity or duration.

The variables studied were 2 hours post-prandial blood sugar <180 mg / dL, fasting blood sugar <130 mg /dL (bounded variables), and physical activity level of patients with type 2 diabetes (free variables). Data was collected by having a direct interview using IPAQ-SF (International Physical Activity Questionnaire-Short Form) and seeing patients' laboratory results. The collected data were analyzed through Cramer's V and Chi-Square methods. In statistics, Cramer's V is used to see the correlation between nominal data. Meanwhile, Chi-Square is used to see the correlation between 2 categorical variables

Results & Discussion

Table 1 Gender Distribution

Gender	Frequency	%
Male	40	46
Female	47	54
Total	87	100

Table 2 Age Distribution

Age (years old)	Frequency	%	Mean	Standard Deviation
20-35	4	4,6	53,71	8,589
36-50	22	25,3		
51-65	61	70,1		
Total	87	100		

Table 3 Physical Activity Level and Therapeutic Success

Physical Activity Level	Therapeutic Success		Total	p value
	Not achieved	Achieved		
Low	37 (69,8%)	16 (30,2%)	53 (100,0%)	0,086
Moderate	11 (44,0%)	14 (56,0%)	25 (100,0%)	
High	6 (66,7%)	3 (33,3%)	9 (100,0%)	
Total	54 (62,1%)	33 (37,9%)	87 (100,0%)	

According to table 1, from 87 respondents, there were more female patients than male.

According to table 2, out of 87 respondents, the most age group was in 51-65 years old, and the least was in 20-35 years old.

According to table 3, most patients with low and high physical activity level have not met the therapeutic success criteria, and most patients with moderate physical activity level have met the therapeutic success criteria.

The p-value of Cramer's V and Chi-Square test was 0,086. It can be concluded that H_0 is accepted and H_a is rejected ($p > 0,05$). Thus it can be interpreted that there is no correlation between physical activity level and therapeutic success of T2DM patients in Dr. Soetomo General Hospital Surabaya. This also means that the physical activity level of T2DM patients does not determine therapeutic success. Several things might contribute to this result. First, there may be some patients who failed to find the equivalent activities based on the intensity despite the existing examples. Secondly, there may be some patients who miscalculated the duration of their physical activities because this questionnaire only relied on estimation and recalls. Third, there may be some confounding and more dominant factors that can influence the results of the study even though they had been eliminated such as medication adherence, counseling, family supports, knowledge and education, stress level, diet and eating patterns, food selection, and sleep quality.

The Non-Correlation between Physical Activity Level and Therapeutic Success

This study establishes that there is no significant correlation between physical activity level and therapeutic success. This indicates that physical activity level is not directly proportional to the therapeutic success of patients with T2DM. High physical activity level cannot guarantee the therapeutic success of patients with T2DM. This finding is supported by a few studies which suggested that this might be caused by most of the respondents who were elderly patients who were unable to do heavy intensity activities. Besides, many respondents are housewives and related to light activities that can be interspersed with rest. This is consistent with

the theory that when resting for an extended period after doing physical activity, the physical activity undertaken will not have much influence on blood sugar levels. Besides intensity, the duration of activity also influences the therapeutic success in patients with T2DM⁴. It was also stated that there was no acute effect in different intensity of physical activity on post-prandial blood sugar levels in the respondents and no blood sugar decreases either being indoors or outdoors after doing submaximal physical activity⁵. The role of physical activity interventions in controlling blood sugar in T2DM was also considered less significant because, in the groups that had performed physical activity interventions, there were no significant controlled blood sugar results ($p = 0.549$)⁶. People with moderate physical activity had the possibility of controlled blood sugar by 0,367 times compared to people with low physical activity. However, moderate physical activity level category did not have a significant relationship with blood sugar levels ($p = 0,061$)⁷. There may be some confounding and more dominant factors that can influence the results of the study even though they had been eliminated such as medication adherence, counseling, family supports, knowledge and education, stress level, diet and eating patterns, food selection, and sleep quality.

Medication Adherence

There is an association between anti-diabetic medication adherence with the regulation of blood sugar levels in diabetic patients. Respondents who are not compliant in taking anti-diabetic drugs will have 14 times greater risk of experiencing poor blood sugar regulation compared with respondents who are compliant in taking anti-diabetic drugs ($p = 0.015$, OR = 14)⁸. Blood sugar level (controlled) has a significant correlation with the level of adherence to consume high category anti-diabetic drugs ($p = 0.002$). Respondents who consumed high category anti-diabetes drugs were 0.143 times more likely to be compliant in regulating blood sugar levels compared to respondents who consumed low anti-diabetes drugs. If the patient is not compliant in taking anti-diabetic drugs, his blood sugar level will be difficult to control. If the patient is obedient, the opposite will happen. It can be concluded that blood sugar levels are associated with adherence to consuming high category anti-diabetic drugs ($p = 0.002$). In contrast, blood sugar levels are not associated with adherence to consuming

low and moderate category anti-diabetic drugs ($p = 0.066$)⁷. Medication adherence is also related to the number of drugs given⁷. In the linear regression test results found that there is a significant influence between the number of drug items to the adherence score of Morisky Medication Adherence Scale-8 (MMAS-8) in patients with T2DM ($p = 0.012$)⁹. The adherence level influences the therapeutic regimen factor for the amount of drug the patient receives. If the number of drug items increases, the value of adherence scores in patients with T2DM will decrease. According to this, increasing the number of pills ingested in a day can reduce the level of adherence¹⁰.

Many factors affect the non-adherence of taking medication; 4 categories are from the patients (age, education, occupation, partner), disease factors, therapeutic regimen factors, and interaction factors with practitioners²². The adherence level will be lower the more they age. It can be caused due to the physiological decline caused by aging¹⁰. In this study, medication adherence was not scrutinized so that the role of medication adherence could not be excluded from the therapeutic success

Counseling

A decrease in blood glucose levels 2 hours post-prandial after counseling shows that counseling affects the knowledge and attitudes of patients to act adherently to the management of diabetes mellitus which includes diet, exercise, and treatment⁶. In this study, education/knowledge was not scrutinized so that the role of counseling could not be excluded from the therapeutic success.

Family Support

Psychosocial factors (e.g. family support) play an essential role in glycemic control too. A family is a social group that plays a vital role in diabetics behavior because family is an influential factor in fostering patient compliance in undergoing therapy¹¹. In this study, family support was not scrutinized so that the role of family support could not be excluded from the therapeutic success.

Knowledge and Education

Educational material can include maintenance/

care of feet, research and the latest technology about diabetes mellitus, education of special conditions faced (pregnant, fasting/sick days), plans for special activities (sports/achievements), management during suffering from other diseases, and introduction and prevention of complications¹². Improving the knowledge of patients can be done via family. Therefore, to have a controlled blood sugar levels, family involvement in every routine control in health care is necessary because some patients are elderly who had experienced some deterioration of physiological organs such as memory, hearing, and vision¹³. In this study, education/knowledge was not scrutinized so that the role of education/knowledge could not be excluded from the therapeutic success.

Stress Level

Sympathetic nervous system secretion is the first reaction of the stress response then followed by sympathetic-medullary secretion. The hypothalamus-pituitary system will be activated when stress persists. The hypothalamus secretes corticotropin-releasing factor which stimulates the anterior pituitary to produce adrenocorticotrophic hormone (ACTH). Increased blood glucose levels are influenced by the production of cortisol that is stimulated by ACTH¹⁴. Blood sugar levels will be in normal limits if the stress level is within the normal range and vice versa¹⁵. In this study, the stress level was not scrutinized so that the role of stress level could not be excluded from the therapeutic success

Diet Adherence and Eating Patterns

Diabetes mellitus patients need to be stressed about the importance of the type and calorie content in the regular eating schedule, especially in those who undergo insulin therapy or use drugs that increase insulin secretion itself¹². The higher the education, the higher the awareness and knowledge of the importance of diabetes mellitus diet in maintaining blood sugar levels. A good level of education makes the respondent had a good motivation to recover faster from illness¹⁶. Dietary factors give ± 11 times influence on increasing blood glucose levels in patients with T2DM¹⁷. Elderlies who had an eating hobby are 5 times more likely to develop diabetes mellitus compared to older adults who had enough eating habits ($p = 0.001$, OR = 5,067)¹⁸. In this study diet/eating pattern was not scrutinized so that the role of diet/eating pattern could not be excluded from the

therapeutic success.

Food Selection

Salty, fatty, and sweet food diet is significantly related to diabetes mellitus. Consumption of fatty and sweet foods had a lower risk of developing diabetes mellitus. While the consumption of salty foods is at risk for diabetes mellitus by 2.62 times¹⁹. This is different from previous studies that the habit of consuming sweet foods has a doubled risk of developing diabetes mellitus²⁰. In this study, the food selection was not scrutinized so that the role of the food selection pattern could not be excluded from the therapeutic success.

Sleep Quality

Sleep quality can also affect the therapeutic success. Decreased sleep quality is caused by sleep disturbances that cause a decrease in the body's response to insulin, insulin resistance, and abnormal glucose tolerance²¹. In this study sleep quality was not scrutinized so that the role of sleep quality could not be excluded from the therapeutic success

Conclusion & Acknowledgement

Based on this study results, the following conclusions can be drawn:

1. 81 T2DM patients in Dr. Soetomo General Hospital, who were the respondents, had a proportion of 46% male and 54% female with the most age group at 51-65 years old (70.1%) with the average age 53.71 years old

2. Low physical activity level is the most undertaken by most respondents (60.9%)

3. Most therapeutic success criteria of the respondents are "not achieved" (62.1%)

4. At the low physical activity level, most respondents have not met the therapeutic success criteria (69.8%), at the moderate physical activity level, most respondents have met the therapeutic success criteria (56.0%), and at the high physical activity level, the most respondents have not met the therapeutic success criteria (66.7%)

5. The most therapeutic success criteria "achieved" are owned by respondents with low physical activity

level (48.5%) and the therapeutic success criteria "not achieved" are most owned by respondents with low physical activity level (68.5%)

6. There is no correlation between physical activity level and therapeutic success on patients with T2DM in Dr. Soetomo General Hospital Surabaya ($p = 0.086$)

Conflict of Interest: There was no conflict of interest in this study

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