The Roles of Medical Doctor and Family on Patient Health Behavior in Controlling HbA1C Level Among Patients with Type 2 Diabetes Mellitus at Dr. Moewardi Hospital

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ABSTRACT

Background: Diabetes Mellitus is one of non-communicable diseases with high prevalence of complication and mortality at productive age. Patients with type 2 DM need to control their blood glucose level to attain optimal blood glucose. Thereby, it is expected to prevent or minimize the incidence of complication. This study aimed to examine the roles of medical doctor and family on patient health behavior in controlling HbA1C level among patients with type 2 diabetes mellitus at Dr. Moewardi Hospital, Surakarta.

Subjects and Methods: This was an analytic observational study with case control design. This study was conducted at Dr. Moewardi Hospital, Surakarta, from April to May, 2017. A sample of 50 patients with type 2 Diabetes Mellitus and 100 control group were selected by fixed disease sampling. The dependent variable was HbA1C blood level. The independent variables were roles of medical doctor, roles of family, treatment compliance, physical activity, diet, and duration of illness. HbA1C blood level was measured by clinical laboratory test. The independent variable was measured by a set of questionnaire. The data were analyzed by path analysis.

Results: HbA1C blood level was affected by duration of illness (b= 0.04; SE= 0.01; p<0.001), diet (b=0.18; SE=0.09; p=0.044), and physical activity (b=0.16; SE=0.07; p=0.024). Diet was affected by the role of medical doctor (b= 0.02; SE= 0.07; p= 0.766), the role of family (b= 0.13; SE=0.07; p=0.082), duration of illness (b=0.01; SE=0.01; p=0.063), and treatment compliance (b=0.32; SE=0.11; p=0.002). Physical activity was affected by the role of medical doctor (b=0.17; SE=0.08; p=0.025), the role of family (b=0.21; SE=0.09; p=0.017), diet (b=0.27; SE=0.10; p=0.005) and duration of illness (b= 0.03; SE= 0.01; p< 0.001). Treatment compliance was affected by the role of medical doctor (b= 0.18; SE= 0.05; p<0.001) and the role of family (b=0.24; SE= 0.05; p< 0.001).

Conclusion: HbA1C blood level was directly affected by duration of illness, diet, and physical activity. HbA1C blood level was indirectly affected by the role of medical doctor, the role of family, duration of illness, and treatment compliance, and diet.

Keywords: HbA1C level, diabetes mellitus, healthy behavior

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BACKGROUND

Non-communicable disease is one of the health problems that becomes both national and global priority. Non-communicable disease is not merely a health problem, since if it is not properly, correctly and continually managed, it can inflict national economy defense (Kemenkes RI, 2012).

Non-communicable disease causes 38 million deaths and three-quarter of them occur in low income and poor countries (WHO, 2015). Indonesia is facing triple burden diseases, since in addition to outbreaks of certain communicable diseases that often occur, there are also the emergence of new and old communicable

diseases and the incidence of non communicable diseases that indicates to be increasing (Kemenkes RI, 2012).

Diabetes is one of non-communicable diseases that may lead to complication and increase the risk of death at productive age. Even since 2012, diabetes has become a direct cause of 1.5 million deaths globally (WHO, 2016). Global report on diabetes *WHO* (2016) shows that the number of grownups who live with diabetes escalating to almost four times since 1980 become 422 million people. The significant growth is mostly caused by the growth of type 2 diabetes and diabetes prevalence is keep on growing for the last few decades (WHO, 2016).

Indonesia is one of 10 countries with the most diabetes patients. In 1995 Indonesia was in the 7th place and in 2025, it is predicted to raise to the 5th, with the estimation of 12.4 million people with diabetes (Arisman, 2011). International Diabetes Federation (2014), predicted that there was an increasing number of people with Diabetes Melitus (DM) in Indonesia from 9.1 million in 2014 becoming 14 mil-lion in 2035. Diabetes came as the second in the main priority of non-communicable diseases control which was 18.33% (Dinas Kesehatan Provinsi Jawa Tengah, 2015).

Dr. Moewardi Hospital in the city of Surakarta, Central Java is a type A referral hospital. It was obtained from the patients visit datathat there were 1,893 patients ofDiabetes Melitus (DM) type 2 during 2015 (Dinas Kesehatan Kota Surakarta, 2015).

Diabetes is a serious and chronic disease that occurs either because pancreas produces insufficient amount of insulin (hormone that control blood sugar, or glucose), or when body uses insulin ineffectively (WHO, 2016). Diabetes is a major public health problem, one of the

four priorities of non-communicable disease targeted by leaders of the world. If diabetes is not well managed it will lead to advanced non-communicable diseases such as heart disease, stroke, and renal failure. Managing non-communicable diseases can be conducted by doing appropriate interventions to each target or certain population group so that the number of new cases of non-communicable diseases can be reduced. DM greatly influence the quality of human resources and it gives impact to the increasing amount of healthcare cost which is quite significant. All parties, both society and government should be actively involved in the prevention effort of Diabetes Mellitus (PERKENI, 2015).

Diabetes Mellitus is a chronic disease which is carried for a life time. The management of the disease requires the participation of doctors, nurses, nutritionists, and other medical professionals. Patients and the family also play important roles, therefore they should be educated to have an understanding about the course of the disease, the prevention, the complications, and the management. Good understanding will help improving family's participation in DM management effort (PERKENI, 2015).

Blood glucose regulation level is the level of controlled blood glucose. In this term is by using HbA1C test which is considered as the best method to know whether or not blood glucose is still within controlled limit (Florkowski, 2013). HbA1C is a hemoglobin molecule which is bound with glucose. Red blood cells may live for 90 up to 120 days, it is equal to HbA1C that is also increasing along with blood glucose level during the last 120 days. Measuring the level of HbA1C by laboratory test is able to identify blood glucose level in average for the last 2-3 months (Braatvedt et al., 2012). It is important for patients of Type 2 DM to maintain their blood regulation by using

optimal glycemic control, thus it can help the case early detection, prevention, minimizing complications and improving patients' life (WHO, 2016).

Mayberry dan Osborn (2012) states that family support and roles give positive impact toward patients of Type 2 DM in conducting diet, physical activity, treatment compliance as the effort to control blood glucose level. The role of doctors as health practitioners also greatly affects toward the behavior of Type 2 DM patients in perform treatment compliance, diet, and physical exercise or sport. Therapy and counseling intervention given by doctors can give attention, problem solving, as well as social support for patients (Alam et al., 2009).

According tostudy by Kassahun et al., (2016) treatment compliance of diabetes patients in Ethiopia helps the case early detection, prevention, and minimizing complication, therefore it is effective to control glycemic index. DM patients with high level of treatment compliance have good glycemic control, whereas patients with low level of treatment compliance have poor glycemic control.

Kusnetsov et al., (2015) conveys that regular physical activity on patients Type 2 DM can reduce the level of HbA1C and improve the quality of life. A study conducted by Yates et al., (2015) proves that physical activity is one of determinant factors of the most important life style that contributes in the prevention and management of DM. Physical activity that is conducted for at least 150 minutes in each weak influence the reduction of HbA1C level in Type 2 DM patients (Umpierre et al., 2011).

Diet in Type 2 DM patients affects blood glucose level control to prevent or slow down the occurrence of complication (Astuti dan Setiarini, 2013). Gannon dan Nuttall (2006) states that to control blood

glucose in patients of Type 2 DM, it needs diet with the emphasis on food composition that is consistently conducted.

A study by Kusnetsov et al., (2015) on patients who are newly diagnosed with Type 2 DM compare to patients who have been diagnosed for quite sometimes found that it greatly influence the quality of life. Patients who are newly diagnosed with Type 2 DM are likely to be more compliant toward medication accordingly it reduce the level of HbA1C, meanwhile patient who have been diagnosed for quite sometimes tend to be less compliant and the level of HbA1C tend to be increasing, therefore the duration of the disease on patients of Type 2 DM affects the increasing of HbA1C level post the diagnosis.

Researcher limited the factors associated with the roles of doctors, among others were the roles in treatment compliance, diet, physical activity, and information. Factors associated with the roles of family among others were emotional, financial, instrumental and informational roles. Based on those factors, the researcher was concerned to conduct a study about the role of doctors and family toward health behavior of patients such as treatment compliance, diet, and physical activity associated with HbA1C level of blood of diabetes mellitus type patients in Dr. Moewardi Hospital, Surakarta.

SUBJECTS AND METHOD

1. Design of the Study
The method used in the study was analytic observational study with case control approach. The study was conducted during April-May 2017 Dr. Moewardi Hospital, Surakarta, Central Java.

2. Population and Sample
Population of the study was patients of Type 2 DM who resided in Central Java and underwent medication in Dr. Moewardi

Hospital, Surakarta. The subjects of the study were selected by considering inclusion criteria. The inclusion criteria of the study were Type 2 DM patient who had been diagnosed by doctor ≥6 months, patient's age≥18 years old, underwent medication in Dr. Moewardi Hospital, conducted regular HbA1C test once every three months. Exclusion criteria of the study were DM type patient who were not undergoing blood transfusion or did not have any blood transfusion history at least in the last 2-3 months, was not anemic/ hemoglobinopat, nor with weak physical condition.

Sample collection technique used was fixed disease sampling, which is a scheme of selection based on subjects' disease status, namely with or without the disease being studied, meanwhile the subjects' exposure status are varied in accordance with the subjects' disease status (Murti, 2013). *Fixed disease sampling* ensures sufficient number of study subjects within group with the disease (case group) and group without the disease (control group). Subjects of the study were patients who had been diagnosed with Type 2 DM. Case group consisted of 50 patients of Type 2 DM with HbA1C level <6.5%. Control group consisted of 100 patients of Type 2 DMwith HbA1C level ≥6.5%.

3. Variables of the Study
Dependent variable of the study was the HbA1C blood level. Independent variables were the role of medical doctor, family, treatment compliance, diet, physical activety, and duration of the illness

4. Operational Definitions
Operational definition of HbA1C blood level was the result of laboratory investigation on the patients of Type 2 DM toward the level of glycated hemoglobin that becomes the standard of their health status and conducted regularly once every three months.

The role of medical doctor was statement of study subjects about the support given by medical doctors as medical practitioners in providing suggestions and motivation to perform health behavior in attaining glycemic control on DM patients.

The role of family was statement of study subjects about family support in giving social support that consists of emotional, informational, and financial support to perform health behavior in self care management for the patients of Type 2 DM patients.

Treatment compliance was statement of study subjects about the behavior in receiving treatment therapy given by health care service provider including the obstacles related to the drug, obstacles on health care system, obstacles that are either intentionally or unintentionally conducted by the subjects of the study.

Diet was statement of study subjects on behavior/ action in undergoing nutrition therapy by medical professionals that is appropriate with types, number, and schedule of meal which are suggested in the self care management of DM patients.

Physical activity was statement of the study subjects on behavior in conducting activities or physical exercises that consisted of the time spent to walk outdoor, physical exercise, and contribution in doing house chores. Duration of illness was statement of study subjects for duration/ the length of time of the illness since the patients were diagnosed by doctors until

5. Instruments of the Study
The data were collected by using questionnaires. The questionnaires consisted of favorable questions (question items that contained positive and supportive matters for the occurrence of health behaviors in controlling HbA1C blood level) and unfavo-

rable questions (question items that contained negative and unsupportive matters for the occurrence of health behavior in controlling HbA1C blood level). The questionnaires used as the instruments of the study had been tested for its validity and reliability. The result of reliability test was presented in Table 1.

Table 1. The result of reliability and validity test on role of medical doctors, role of family, treatment compliance, diet, and physical activity

Variables	*Item-Total Correlation* (r)	Alpha Cronbach
Role of medical doctor	≥ 0.37	0.93
Role of family	≥ 0.32	0.93
Treatment compliance	≥ 0.22	0.89
Diet	≥ 0.37	0.91
Physical activity	≥ 0.21	0.90

Based on Table 1 the result reliability test on item-total correlation, it was found that on measuring variables the role of doctors, the role family, treatment compliance, diet and physical activity r count>0.20, and Cronbach's Alpha ≥0.70. All question items are stated as reliable.

6. Data Analysis

Data analysis used in the study was path analysis. Path analysis is the applied form of multi regression analysis. The analysis uses complex path diagram therefore it is able to calculate the direct effect of each independent variable toward dependent variable. The effect on the variable can be observed as path coefficient which is actually already standardized regression coefficient (Kerlinger, 2003).

Steps in conducting data analysis by using path analysis were model specification, model identification, model fit, model estimation, and model respecification

RESULT

A. Univariate Analysis

Characteristics dimension of study subjects, the patients of Type 2 DM were among others age, sex categories, level of education, and occupation. Tables showed that out of 150 study subjects most of them were female both in case group (with controlled HbA1C blood level) and control group (with uncontrolled HbA1C blood level), they were 68% in case group and 64% in control group. Most subjects were ≥50 years of age, they were 70% in case group and 66% in control group. The last education of most subjects was High School, they were 38% in case group and 36% in control group. For occupation, 28% subjects in case group worked as private employees, 36% of control group was unemployed.

The result of descriptive statistic data continuous on the role of doctors, the role of family, treatment compliance, diet physical activities, and duration of illness could be observed in Table 3. Table 3 showed that each variable had relatively small data variation. Mean represented the average value. Standard deviation (SD) represented how varied the data were. The small SD indicated that the data were representative.

B. Bivariate Analysis

Table 4 showed that the role of medical doctors (r=0.10; p=0.020) and the role of family (r=0.06; p=0.051) which were increasing would improve the health behavior to control HbA1Cblood level.

Treatment compliance (r=-0.03; p= 0.070), diet (r=-0.27; p<0.001), physical activity (r=-0.35; p<0.001) which were increasing would reduce HbA1C blood level, and the longer duration of illness (r=0.51; p<0.001) would be increasing HbA1C blood level.

Table 2. Characteristics of subjects of the study

Characteristics of subjects of the study	Status					
	Controlled HbA1C Level		Uncontrolled HbA1C Level		Total	
	N=50	%	N=100	%	N=150	%
Age						
< 30 years	4	8.0	3	3.0	7	4.7
31-50 years	11	22.0	31	31.0	42	28.0
≥ 50 years	35	70.0	66	66.0	101	67.3
Sex Categories						
Male	16	32.0	36	36.0	52	34.7
Female	34	68.0	64	64.0	98	65.3
Level of Education						
Primary School	9	18.0	21	21.0	30	20.0
Secondary School	5	10.0	8	8.0	13	8.7
High School	19	38.0	36	36.0	55	36.7
Associate Degree	5	10.0	17	17.0	22	14.7
Bachelor Degree	10	20.0	17	17.0	27	18.0
MasterDegree	2	4.0	1	1.0	3	2.0
Occupation						
Merchant	10	20.0	15	15.0	25	16.7
Farmer	2	4.0	8	8.0	10	6.7
Teacher	6	12.0	7	7.0	13	8.7
Housewife	7	14.0	13	13.0	20	13.3
Private employee	14	28.0	19	19.0	33	22.0
Civil Servant	2	4.0	2	2.0	4	2.7
Unemployed	9	18.0	36	36.0	45	30.0

Table 3. Univariate Analysis on Variables of the Study

| Variables	n	Mean	SD	Min.	Max.
Role of medical doctors	150	28.23	2.32	18	36
Role of family	150	27.78	2.22	24	36
Treatment compliance	150	20.61	1.62	15	26
Diet	150	26.02	2.03	22	32
Physical activity	150	23.97	2.60	15	31
Duration of illness	150	63.00	28.10	6	120
HbA1C blood level	150	8.19	2.48	4.9	17.2

Table 4. Bivariate analysis on the effect of role of medical doctors, role of family, treatment compliance, diet, physical activity, and duration of illness variables toward HbA1C blood level

Independent Variables	r	p
Role of medical doctors	0.10	0.020
Role of family	0.06	0.051
Treatment compliance	- 0.03	0.070
Diet	- 0.27	< 0.001
Physical Activity	- 0.35	< 0.001
Duration of illness	0.51	< 0.001

C. Path Analysis

Figure 1 showed structural model after an estimation by using IBM SPSS AMOS 20 was conducted, thusit obtained values presented in the Picture 1.
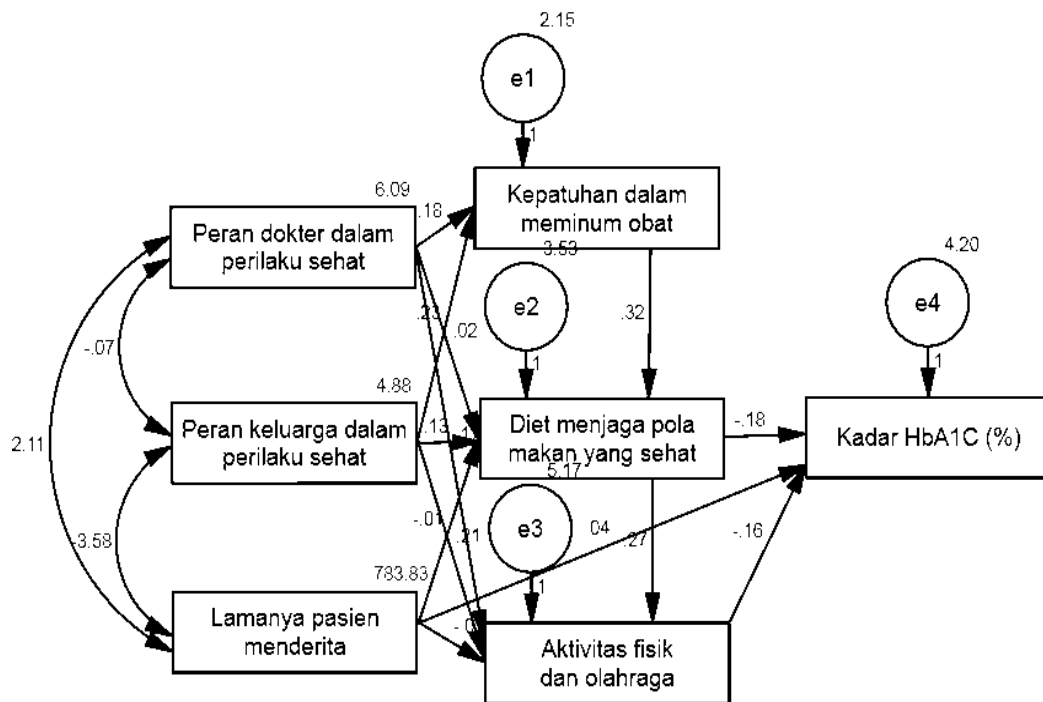
Picture 1. Structural model with unstandardized solution

Indicators that showed model fit of path analysis in Table 5 also showed goodness of fit measurethat it obtained the result of CMINfit indexas big as 6.44; p=0.210 (>0.05); GFI 0.99 (>0.90); NFI 0.95 (≥0.90); CFI 0.98 (≥0.90); RMSEA 0.05 (≤0.08) it meant the empirical model met the determined criteria and stated as in accordance with empirical data

Table 5 showed that HbA1C blood level was affected by duration of illness, diet, and physical activity. Every year increase of duration of illness would increase HbA1C blood level by 0.04 unit (b= 0.04; SE= 0.01; p<0.001). Every increase of diet compliance would reduce HbA1C blood level by 0.18 unit (b= 0.18; SE= 0.09; p=0.044). Every increase of physical activity would reduce HbA1C blood level by 0.16 unit (b= 0.16; SE=0.07; p= 0.024).

Diet was affected by role of doctors, role of family, duration of illness, and treatment compliance. Doctors with strong role would increase the diet score by 0.02 higher compared to weak doctor's role (b=0.02, SE=0.07, p= 0.766). Family with strong role would increase the diet score by 0.13 higher compared to weak family's role (b=0.13, SE=0.07, p=0.082). Every year increase of duration of illness would reduce the diet score by 0.01 unit (b=0.01, SE= 0.01; p=0.063). Every increase of treatment compliance would increase the diet score by 0.32 (b= 0.32; SE= 0.11, p= 0.002).

Physical activity was affected by role of doctor, role of family, diet, and duration of illness. Doctor with strong role would increase the score of physical activity by 0.17 hour higher compared to weak doctor's role (b=0.17; SE=0.08; p=0.025). Family with strong role would increase the score of physical activity by 0.21 hour higher than

weak family's role (b= 0.21, SE= 0.09, p= 0.017). Every increase of diet compliance would increase physical activity by 0.27 hour (b= 0.27; SE= 0.10; p= 0.005). Every year increase of duration of illness would decrease physical activity by 0.03 unit (b=0.03; SE= 0.01; p<0.001).

Treatment compliance was affected by role of doctors and role of family. Doctors with strong role would increase the score of treatment compliance by 0.18 higher than weak doctor's role (b=0.18; SE=0.05; p<0.001). Family with strong role would increase the score of treatment compliance by 0.24 higher than weak family's role (b= 0.24; SE= 0.05; p< 0.001).

Table 5. The result path analysis on role of doctors and role of family toward health behavior of patients in controlling HbA1C blood level of type 2 DM

Endogenous Variables		Exogenous Variables	b*	SE	p	β**
Direct Effect						
HbA$_1$C level (%)	←	Duration of illness (year)	0.04	0.01	< 0.001	0.43
HbA$_1$C level (%)	←	Diet	- 0.18	0.09	0.044	- 0.14
HbA$_1$C level (%)	←	Physical activity (hour)	- 0.16	0.07	0.024	- 0.17
Indirect Effect						
Diet	←	Role of doctors	0.02	0.07	0.766	0.02
Diet	←	Role of family	0.13	0.07	0.082	0.14
Diet	←	Duration of illness	- 0.01	0.01	0.063	- 0.14
Diet	←	Treatment compliance	0.32	0.11	0.002	0.26
Physical Activity (hour)	←	Role of Doctors	0.17	0.08	0.025	0.16
Physical Activity (hour)	←	Role of family	0.21	0.09	0.017	0.18
Physical Activity (hour)	←	Diet	0.27	0.10	0.005	0.21
Physical Activity (hour)	←	Duration of illness (year)	- 0.03	0.01	< 0.001	- 0.28
Treatment Compliance	←	Role of doctors	0.18	0.05	< 0.001	0.27
Treatment Compliance	←	Role of family	0.24	0.05	< 0.001	0.32
Model Fit						
p = 0. 210 (> 0.05)						
CMIN = 6.44						
GFI = 0.99 (> 0.90) CFI = 0.98 (≥ 0.90)						
NFI = 0.95 (≥ 0.90) RMSEA = 0.05 (≤ 0.08)						
*= unstandardized path coefficient**=standardized path coefficient						

DISCUSSION

1. The effect of diet toward HbA1C blood level on patients of Type 2 DM

The study showed that there was a direct effect of healthy diet toward HbA1C blood level. The study is supported by a study conducted by Astuti and Setiarini (2013) that shows diet compliance to maintain healthy dietary habit (carbohydrate, protein, fat, and fiber) on patients of Type 2 DM is able to control fasting blood glucose level. Patients of Type 2 DM who do not perform healthy diet have poor prepandial blood glucose level.

Angamo et al., (2013) presents an evidence that disobedience of patient of Type 2 DM in performing diet leads to poor glycemic control. Maintaining good glycemic control on DM patients primarily aims to prevent the damage of micro vascular organs and complication on macro vascular organs.

The effect of diet compliance toward patients of Type 2 DM greatly influences HbA1C blood level in achieving good glycemic control. Patients who do not comply with the diet neither maintain daily food intake pattern, do not eat in accordance to the schedule may lead to poor

glycemic level. Diet with more vegetables and fruits in daily menu is one of the excellent approaches in improving glycemic control on DM patients.

2. The effect of physical activity toward HbA1C blood level on patients of Type 2 DM

The study showed that there was a direct effect of physical activity toward HbA1C blood level. The result of the study is supported by a study by Umpierre et al., (2011) which shows that consistent physical activity or exercise can significantly lower down HbA1C blood level on patients of Type 2 DM. Patients of Type 2 DM who inconsistently perform physical activity or exercise have HbA1C blood level that is likely to be increasing. Al-Kaabi et al., (2009) conveys that physical activity of patients of Type 2 DM that is in accordance to what is advised may maintain decent glycemic control toward HbA1C blood level. Patients who do not performed the suggested physical activity have indecent glycemic control.

Physical activity that can be conducted by DM patients among others are going to gym, special exercise for DM patients such as aerobic or doing daily house chores. The activities consistently conducted can be beneficial in maintaining decent glycemic control toward HbA1C blood level. DM patients who do not perform regular and consistent physical activity will find it difficult to maintain good glycemic control, consequently it will increase HbA1C blood level (Yates et al., 2015).

3. The effect of duration of illness toward HbA1C blood level on patients of Type 2 DM

The study showed that there was a direct effect of duration of illness toward HbA1C blood level. The study supports the developing evidence that the longer duration of illness on patients of type 2 DM can increase the level of fasting blood glucose and HbA1C. Patients with duration of illness <5 years are likely to be able to maintain the level of blood glucose than patients who have been diagnosed with type 2 DM ≥5 years (Kusnetsov et al., 2015; Kassahun et al., 2016).

A study conducted by Ali et al., (2012) also supports the result of the study, that duration of illness on patients of type 2 DM, that ranges from 1-5 years, give impact toward the controlled HbA1C level. The description indicates that the longer patients are diagnosed with type 2 DM especially those with duration of illness ≥5 years, the more they feel fed up with the treatment and have low compliance with the treatment, with diet to maintain healthy dietary pattern, and with physical activities. Therefore the intention to perform health behavior is getting low.

Patients who are newly diagnosed by doctors have good health behavior implementation and good glycemic control on HbA1C level. According to Jiang et al., (2012) patients with duration of illness<5 years have good glycemic control and there is no complication on macro vascular organs.

4. The effect of role of medical doctors toward HbA1C blood level on patients of Type 2 DM

The result of the study indicated that there was no effect of role of medical doctors toward diet to maintain healthy dietary pattern on patients on DM type 2. It turns into an evaluation for the doctors since in diabetes management, the role of medical doctors is not only as medical practitioners, instead they should be actively involved in new development of diabetes management. Medical doctors provide attention to patients in a form of approach of giving advice to make collective decisions with

patients in organizing and monitoring diet until patients achieving better result toward HbA1C blood level (Marrero et al., 2013).

The study is also supported by Ciecha-nowski et al., (2001), who states that patients who feel less satisfied with doctors' service in giving counseling and advice to perform diet compliance will have low diet compliance to maintain healthy dietary pattern.

5. The effect of role of medical doctors toward physical activity of patients of Type 2 DM

The result of the study gave an evidence which is supported by Walker et al., (2015) who states that self care management on type 2 DM patients toward control over HbA1C is significantly influenced by social support in this case is the role of medical doctor that is important in giving advice, evaluation, and monitoring on physical activity recommended to the patients. Intervention for patients in term of physical activity is given by medical doctors through strategy such as aerobic or sports designed in particular for patients of type 2 DM which are provided in local health care service centers. Therefore patients are aware of therapy and social support which are beneficial to achieve better health condition.

Alam et al., (2009) also states that there was a significant effectiveness of intervention by health practitioners (role of medical doctors) toward patients of type 2 DM in improving glycemic control. Therapy and counseling given by medical doctors through physical activity are able to give comfort, problem solving as well as social support for patients. Patients who are aware of support from doctors and local health care service will be more enthusias-tic in performing physical activity in order to achieve better health condition thus complication on tyoe 2 DM can be avoided.

6. The effect of family role toward diet to maintain healthy dietary pattern on patients of type 2 DM

The result of the study indicated that there was an effect of role of family toward diet in maintaining healthy dietary pattern on patients of type 2 DM. the result of the study is supported by Astuti and Setiarini (2013) that show the role of family in motivating patients of type 2 DM to comply with the diet to maintain healthy dietary pattern (carbohydrate, protein, fat, and fiber) is significantly able to control the level of fasting blood glucose. Patients whose family does not understand their important role in motivating type 2 DM patients to perform healthy diet, will have poor fasting blood glucose level.

Positive role offamily toward patients of type 2 DM who perform diet is associated with the control over blood glucose level, meanwhile negative support or role of family is not associated with the control over blood glucose level (May-berry dan Osborn, 2012). It is in accordance with the behavioral change theory by Riley et al., (2016) that social cognitive theory becomes the foundation in developing intervention to observe that health behavior on type 2 DM patients is the result of dynamic inte-raction between the effect of individuals, behavior, and social environment.

Decent self care through diet compliance in maintaining healthy dietary pattern is positively associated with great role of family (social support). Patients who are aware of family support in performing and reminding about healthy diet will have good diet compliance, consequently the glycemic level will be controlled well. The role of family can be conducted for example by providing healthy menu that contain a large amount of fiber and vitamin such as fruits and vegetables in daily menu, pre-venting patients from consuming fatty food

and reminding patients to have meals 3 times a day in accordance with the diet schedule. It takes good collaboration between family and patients to avoid the occurrence of complications on type 2 DM.

7. The effect of family role toward physical activity on patients of Type 2 DM

The result of the study indicated that there was an effect of family role toward physical activity of type 2 DM patients. The result of the study is supported by Astuti and Setiarini (2013) who indicate that the positive role of family in the management of type 2 DM patients to perform physical activity (physical exercise and sport) is significantly able to control fasting blood glucose level. In contrast, patients whose family does not understand their important role in the management of type 2 DM patients to perform physical activity (physical exercise and sport), will have poor fasting blood glucose level.

Role of family is able to help lowering HbA1C level through family members participation in supporting patients of type 2 DM to perform physical activity (McElfish et al., 2015). Physical activity is recognized as a means to reduce weight up to normal level, and also for DM patients who actively perform physical activity will have better glycemic control than patients who do not actively perform physical activity. Al-Kaabi (2009) mentions that the role of family members who give positive support toward physical activity is able to maintain the glycemic control of type 2 DM patients on HbA1C level.

The role of family who give positive support to patients by reminding, suggesting, and accompanying during morning walk in daily basis can give positive effect toward patients' behavior consequently they can control the level of HbA1C better. Osborn dan Egede (2010) state that family

support directly affects patients' behavior to perform physical activity and indirectly affects glycemic control of type 2 DM patients toward better course.

8. The effect of treatment compliance toward diet to maintain healthy dietary pattern on patients of Type 2 DM

There was an effect of treatment compliance toward diet to maintain healthy dietary pattern on patients of type 2 DM. The association between treatment compliance and HbA1C blood level on the result of analysis was recognized to be indirectly affecting through intervening variable diet.

The result of the study is supported by Kassahun et al., (2016) who state that there is an effect of high treatment compliance on type 2 DM patients toward good control on fasting blood glucose id it is accompanied by self care behavior by means of diet maintaining healthy dietary pattern. Patients of type 2 DM with low treatment compliance and poor diet will not be able to control the level of fasting blood glucose.

Patients of type 2 DM with low treatment compliance such as patients who do not comply with drug application instruction as it is prescribed by medical doctors, sometimes patients forget the application schedule and have poor diet compliance. Patients often eat ill-timed, it is also used as the reason not to take medicine prescribed by medical doctors in accordance with the dosage. The least compliance in treatment and diet leads to uncontrolled HbA1C blood level. Patients with high compliance in treatment and diet will have good glycemic control (Kassahun et al., 2016)

9. The effect of diet toward physical activity on patients of type 2 DM

There was an effect of diet maintaining healthy dietary pattern toward physical activity of type 2 DM patients. The result of the study is supported by the evidence that

self care on DM management by means of diet maintaining healthy dietary pattern and suggested physical activity, signify-cantly affects HbA1C blood level (Walker et al., 2015). Variable physical activity plays a significant role toward the accomplishment of diet maintaining healthy dietary pattern to achieve good glycemic control. Patients of type 2 DM who perform only diet but do not regularly perform physical exercise or sport will find it difficult to achieve controlled HbA1Clevel, in contrast healthy diet accompanied by physical exercise or sport can consistently achieve controlled HbA1C level (Kassahun et al., 2016).

Imbalanced diet on patients of type 2 DM that is related to inconsistent physical activity, significantly leads to uncontrolled HbA1C blood level (Yates et al., 2012). The result of the study is expected to be input to establish health policy about intervention on healthy life style for patients of type 2 DM and early prevention of diabetes mellitus.

10. The effect of duration of illness toward diet maintaining healthy dietary pattern on patients of type 2 DM

There was an effect of duration of illness toward diet maintaining healthy dietary pattern on patients of type 2 DM. The result of analysis found that there was an effect of the duration of the illness toward HbA1C blood. The effect was indirect through intervening variable diet,

The result of the study is supported by Kassahun et al., (2016) that there is an affect of duration of illness on type 2 DM patients. Patients with duration of illness ≤ 5 years have good self care level by means of diet maintaining healthy dietary pattern. Patients of type 2 DM with duration of illness 5-10 years and ≥10 years have poor level of self care in term of diet compliance as the consequence they have poor glycemic control. Patients' behavior to be healthy is

getting low in term of the compliance with diet maintaining dietary pattern. It needs an improvement on how to increase patients' awareness to be more enthusiastic in achieving good glycemic control by maintaining the intake of food that consists of large amount of fruits and vegetables in daily menu.

Patients who have been diagnosed with type 2 DM by doctors for longer duration will feel fed up in implementing healthy dietary pattern, consequently, their glycemic level is worsening. Jiang et al., (2012) states that patients with duration of illness <5 have good diet compliance and glycemic control, in addition, they do not have complications on macro vascular organs

11. The effect of duration of illness toward physical activity on patients of type 2 DM

The result of the study indicated that there wasan effect of the duration of illness toward physical activity on patients type 2 DM. The result of the study is supported by a study conducted by Kusnetsov et al., (2015) which reveals that there is an effect of duration of illness toward HbA1C blood level.

Patients of type 2 DM with duration of illness <5 tahun have good self care level through physical activity and sport conse-quently HbA1C blood level is in control. Patients of type 2 DM with increasing du-ration of illness will give negative impact to health status and poor control over HbA1C blood level since patients are already fed up to perform physical activity and sports.

Duration of illness that ranges from 1-5 years on patients of type 2 DM have indirect effect toward HbA1C blood level through physical activity. Patients who have been diagnosed with type 2 DM for ≥5 years have been fed up to perform physical activity therefore the intention to conduct

healthy behavior is also decreasing (Ali et al., 2012). Patients who are newly diagnosed with type 2 DM have strong intention to conduct healthy behavior by doing physical activity therefore glycemic HbA1C blood level is well controlled.

Based on the result of the study it can be concluded that HbA1C blood level which is under control is affected by diet, physical activity, and duration of illness. Diet is affected by role of medical doctors, role of family, duration of illness and treatment compliance. Physical activity is affected by role of medical doctors, role of family, diet and duration of illness. Treatment compliance is affected by role of doctors and role of family.

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