DETERMINING THE NUTRIENTS CHANGES AFTER UNDERGOING NUTRITIONAL COUNSELING AND COOKING ASSISTANCE AMONG T2DM OUTPATIENTS IN MALANG CITY, INDONESIA

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ABSTRACT

Background: Nutrition and diets are critical factors for T2DM patients to maintain health. Nutrition education are considered less effective because most patients have not implemented them. This research tries to develop program innovation by combining nutrition counseling and cooking assistance for T2DM outpatients. This study aimed to know the risk factors for T2DM and determine the effectiveness of programmed nutrition education (NEP) on changes in nutrient intake in patients with T2DM.

Methods: A total of 70 participants registered as T2DM outpatients at Kedung Kandang primary healthcare center in Malang city. Subjects were recruited using a 'quota sampling' technique. The design of this study is a quasi-experiment study using a comparison of the control (n=32)-treatment group (n=38). This research was conducted from September to November 2018. Fifty minutes of intensive individual counseling and cooking assistance were provided to T2DM patients and families. The data were analyzed using independent sample t-test, Wilcoxon Mann Whitney U-test, and logistic regression. The patients' 4-d dietary records of 3 normal days and 1 holiday/weekend were assessed after 24 hours.

Results: From this study it can be seen that intake of amino acid lysine was significantly higher in the treatment group than the control group (p = 0.04). The intake of fiber, MUFA, and PUFA was greater in the intervention group, while sodium intake was lower in the intervention group. The risk factors of T2DM incidence were age (p = 0.036), education (p = 0.043), waist circumference (p = 0.015), and carbohydrate intake (p = 0.033).

Conclusion: T2DM patients treated with individual nutrition counseling and cooking assistance gained a higher intake of fiber, amino acid lysine, and unsaturated fatty acids. The most influential risk factors of T2DM incidence are age, education, waist circumference, and carbohydrate intake.

Keywords: nutrition counseling, cooking assistance, nutritional intake, T2DM.

BACKGROUND

Diabetes is the new plague of the 21st century developing throughout the world both in developing and developed countries with the most dramatic increase occuring in type 2 diabetes (T2DM), whose increase is mainly associated with an increase in the prevalence of sedentary lifestyle and obesity. T2DM is a metabolic disorder characterized by insulin resistance, dysfunction of β-cells, and increased risk of vascular diseases which can be caused and influenced by genetic, behavioral, and environmental factors[1,2]. More specifically, factors of age, lifestyle, and diet are causative to T2DM [3]. Certain types of food intake are associated with higher or lower insulin resistance and insulin secretion, which can increase the risks of diabetes and insulin resistance-related diseases [4].

Nutritional recommendations for T2DM patients set by the American Diabetes Association (ADA) include limiting energy intake to achieve or maintain ideal body weight; limiting total and saturated fat, cholesterol, and sodium; consuming adequate amounts of carbohydrates from nutrient-dense foods such as vegetables, fruits, whole grains, and legumes; and consuming enough fiber. Nutritional recommendations for

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people with diabetes aim to prevent or slow down diabetes complications by achieving as close as possible to normal blood glucose levels and lipid profiles to reduce the risk of cardiovascular disease and blood pressure [5]. Although these nutritional recommendations are useful, the vast majority of people with diabetes do not achieve them and are at risk for dyslipidemia, hypertension, poor blood glucose control, and being overweight [5].

People with diabetes often find recommendations for healthy eating confusing and difficult to implement[6,7]. Barriers include a lack of understanding of dietary recommendations, lack of family support, limited budget, food choices, and cooking habits [8]. There is something dangerous about consuming excessive sugar. Excessive sugar intake is a major factor in the development of T2DM. People living with T2DM need a combination of medical care and a healthy lifestyle to maintain their condition and prevent complications.

The global prevalence of diabetes in 2015 was 415 million and is likely to grow to 642 million by 2040, with the most dramatic increase of 90 percent in T2DM following socio-cultural change [9]. The prevalence of T2DM in the aged fifteen population in Indonesia based on doctors' diagnosis data according to Indonesia Basic Health Research is 2% presently, with the highest average of 2.6% occurring in East Java [10].

Considering the mentioned nutritional problems, this study attempted to innovate nutrition programs through intensive nutrition counseling and cooking assistance for T2DM outpatients. The program was expected to give a positive impact on T2DM patients, especially in changes in nutrient-related intake. This study aimed to determine the change in nutritional intake of fiber, lysine, and unsaturated fatty acids after undergoing nutrition counseling and cooking assistance among T2DM outpatients in Malang city, Indonesia.

MATERIALS AND METHODS
Study Design and Participants

The study applied a quasi-experimental design with a control and treatment group. The control group was only given leaflets about the DM diet by a trained nutritionist, while the treatment group was given the same as the control group plus 1×50 minutes of intensive nutrition counseling (including booklet and slide presentations) and cooking assistance for one set of DM menu at lunchtime by expert nutritionist. The research was conducted from September to November 2018 at the primary healthcare center Puskesmas Kedungkandang of Malang City, Indonesia.

As many as 72 T2DM high-risk adults registered at the healthcare center voluntarily participated in the research, but 2 dropped out prematurely. Subjects were recruited voluntarily using a 'quota sampling' technique, out of the 70 participants, 32 were put in the control group while 38 were in the treatment. The participants were included in the study under certain criteria: literate, diagnosed with T2DM by the doctor at the Kedungkandang Healthcare Center, having classic symptoms of DM (polyuria, polydipsia, polyphagia, unexplained weight loss), Fasting Blood Glucose level (GDP) more than 126 mg /dL, plasma glucose level 2-hours Postprandial after Oral Glucose Tolerance Test (OGTT) more than 200 mg/dL, having a history of using Anti-Diabetic Drugs, and having complications of hypertension. Participants would be excluded under certain criteria: incomplete 4d-food records, worsening prognosis, using insulin therapy, and having infectious disease complications. Participant recruitment was voluntary. All subjects signed informed consent before participating in the study. The research protocol had been approved by the ethics test at the Health Research Ethics Commission of Politeknik Kesehatan Kementerian Kesehatan Malang with Reg. No.468/KEPK-POLKESMA/2018.

The study used research instruments of explanatory texts, informed consent, social demographic questionnaires to probe the participants' age, ethnicity, sex, educational level, occupation, and income per year. For anthropometric measuring instruments, stamped scales and Medline tape were used to measure body weight, height, and waist circumference. During the study, the control group was only given leaflets about the DM Diet, while the treatment group was given the same as the control group plus 1x50 minutes of intensive nutritional counseling and cooking assistance for 1 DM menu at one meal. The study used instruments of booklet and presentation slides containing counseling materials and recipes, a 4 days times 24 hours-food record form to evaluate nutrients intake and cooking ingredients. The data from the control group were collected by trained nutritionist enumerators (graduated from three years diploma program), while expert nutritionists (graduated from four years undergraduate program) handled the intervention group.

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Data Analysis

The nutrient intakes data of each group were processed with the Nutrisurvey application and to be compared with the recommendations from the ADA. Data processing was carried out using descriptive statistical analysis and an independent sample t-test (if the data were not normally distributed, the Wilcoxon Mann Whitney U-test would be used) to compare the differences between the control and intervention. Logistic regression was performed to obtain Odds ratios (OR) to determine the association between nutritional intake and risk factor variables with T2DM and their interactions. The statistical test used the latest version of SPSS software at a 95% confidence level.

RESULTS

Socio-Demographic and Anthropometric Characteristics

The socio-demographic and anthropometric analysis results in Table 1 showed that the characteristics of the participants were female in the majority, married, Javanese ethnic, elementary school graduated, unemployed, under minimum wage income, abnormal waist circumference, and obese.

Tabel 1. Characteristic of Social Demographic and Anthropometric

Characteristics	Total (n=72)	Control (n=32) n (%)	Intervention (n=38) n (%)
Sex			
Female	55 (76.4)	24 (75)	29 (76.3)
Male	17 (23.6)	8 (25)	9 (23.7)
Marital Status			
Married	55 (76.4)	29 (90.6)	26 (68.4)
Widower	17 (23.6)	3 (9.4)	12 (31.6)
Tribe			
Java	60 (83.3)	30 (93.7)	30 (78.9)
Madura	11 (15.3)	2 (6.3)	7 (18.4)
Pendalungan	1 (1.4)	0	1 (2.7)
Educational Level			
Not in school	5 (6.9)	1 (3.1)	3 (7.9)
Elementary school	44 (61.1)	16 (50)	27 (71.1)
Junior high school	11 (15.3)	8 (25)	3 (7.9)
Senior high school	11 (15.3)	7 (21.9)	4 (10.5)
Diploma/Bachelor	1 (1.4)	0	1 (2.6)
Occupation			
Not working	32 (44.4)	14 (43.75)	16 (42.1)
Labor	4 (5.6)	3 (9.4)	1 (2.6)
Trader	16 (22.2)	5 (15.6)	11 (28.9)
Self-employed	5 (6.9)	1 (3.1)	4 (10.5)
Teacher	1 (1.4)	1 (3.1)	0
Tailor	4 (5.6)	3 (9.4)	1 (2.6)
Retiree	2 (2.8)	2 (6.3)	0
Masseur	1 (1.4)	0	1 (2.6)
Driver	1 (1.4)	1 (3.1)	0
Singers	1 (1.4)	0	1 (2.6)
Others	5 (6.9)	2 (6.25)	3 (7.9)
Monthly income			
Below the minimum wage	61 (84.7)	24 (75)	35 (92.1)
Equal to/Above the minimum wage	11 (15.3)	8 (25)	3 (7.9)
Waist circumference, cm			
Normal (P≤80, L≤90)	15 (20.8)	8 (25)	6 (15.8)
Abnormal (P>80, L>90)	57 (79.2)	24 (75)	32 (84.2)
Body mass index, kg/m²	25.3±4.2	25±4.6	25.6 ± 4
Normal (18.5-22.9)	21 (29.2)	12 (37.5)	9 (23.7)
Overweight (23-24.9)	20 (27.8)	7 (21.9)	11 (28.9)
Obese (≥25)	31 (43.1)	13 (40.6)	18 (47.4)

Energy and Nutrient Intake

As seen in Table 2, there were significant differences in amino acids (lysine and glutamine) intake. Lysine intake in the intervention group was higher than in the control group. However, glutamine intake was lower in the intervention group. In addition, the intake of energy, fat, SAFA (Saturated Fatty Acids), protein,

and carbohydrates tended to be higher in the intervention group, although not significantly different. The intervention group had a higher intake of fiber, MUFA, and PUFA but a lower sodium intake.

Tabel 2. Energy and nutrient intakes in T2DM patients (n=70)

Intake	Control (n=32) Mean (SD)	Intervention (n=38) Mean (SD)	p-value
Energy (kkal)	1054 (322)	1158.9 (403.7)	0.24
Carbohydrate (g)	157.2 (58)	175.2 (75.2)	0.25
Fiber (g)	7.9 (3.3)	8.7 (3.5)	0.31
Fat (g)	32.6 (12.9)	35.1 (13.7)	0.36
SAFA (g)	15.1 (7.9)	15.8 (7.2)	0.68
MUFA (g)	7 (3.2)	7.1 (4.3)	0.89
PUFA (g)	7.3 (3)	7.9 (4.6)	0.93
Protein (g)	35.3 (11.8)	40.6 (14)	0.09*
AA glutamine (g)	0.15 (0.78)	0.04 (0.05)	<0.01*
AA lysine (g)	1.9 (0.6)	2.3 (0.8)	0.04†
Sodium (mg)	344.9 (320)	306.9 (306.7)	0.51

*Independent t-test and with significant p-value set at < 0.05.

†Wilcoxon Mann Whitney U-test with significant p-value set at < 0.05.

The Association Between T2DM and Risk Factors

Table 3. The association between T2DM and other factors and interaction

Predictor Variables	B	Sig.	OR
Age	2.434	.036*	11.407
Education	.765	.043*	2.149
Occupation	-.624	.092	.536
Waist Circumference by Sex	-.910	.015*	.403
Carbohydate Intake	.016	.033*	1.016
Constant	-.769	.696	.464

Based on table 3, on the age variable, it can be interpreted that persons aged 60 and above have 11.407 times greater chance of being diagnosed with diabetes and T2DM than those who are younger. On the education variable (the multinomial categorical independent variable), based on the OR value, it can be interpreted that people with a lower level of education have 2.149 times greater chance of being diagnosed with T2DM than those whose education was one level above. On the carbohydrate intake variable (continuous variable), it can be interpreted that for every 1 unit increase in intake given or occurs to a person gives the person 1.106 times greater risk of being diagnosed with T2DM. On the waist circumference variable, a female person with an abnormal waist circumference (>80 cm) has a 0.403 times greater chance of being diagnosed with T2DM.

DISCUSSION

The results showed that the majority of T2DM patients were obese with an average BMI > 25 kg/m². This is supported by previous research which states that the incidence of T2DM is increasing in general throughout the world, mainly due to an increase in the prevalence of a sedentary lifestyle and obesity. T2DM is influenced by genetic, behavioral, and environmental factors [1]. T2DM is increasingly common, mainly due to the increasing prevalence of sedentary lifestyles and obesity. Whether T2DM can be prevented by interventions that affect the lifestyle of subjects at high risk for the disease is unknown [11].

The patient's overeating behavior should be evaluated through a diet journal to establish a weight measurement that favors eating behavior. Behavioral improvement through motivational measures routine is considered effective in maintaining the desired behavioral change [12]. All patients should receive counseling and be encouraged to show greater adherence to nutritional therapy and treatment of T2DM [13]. Ramlan and Margawati (2016) said that providing intensive counseling can affect positive changes in a person's behavior [14].

Dietary intake, diet, and food quality have an important role in T2DM patients, by understanding the different characteristics of an individual can be used to develop and facilitate clinical practice to assist

diabetic patients in controlling their glucose [15]. Behavioral therapy that can reduce body weight and achieve effective glycemic control in T2DM patients is a modification to achieve and maintain long-term weight loss in obese T2DM patients [16].

Dietary recommendations for T2DM patients set by the ADA include limiting energy intake to achieve or maintain ideal body weight; limiting total and saturated fat, cholesterol, and sodium; consuming adequate amounts of carbohydrates from nutrient-dense foods such as vegetables, fruits, whole grains, and legumes; and consume enough fiber. In addition, a study conducted by Yuliani et al., (2020) showed that choosing functional foods such as yogurt containing probiotics is currently also an alternative for preventing secondary complications of T2DM that started much research [17]. Nutritional recommendations for people with diabetes aim to prevent or slow down diabetes complications by achieving as close as possible to normal blood glucose levels and lipid profiles to reduce the risk of cardiovascular disease; and blood pressure [5].

Although these nutritional recommendations are useful, the vast majority of people with diabetes do not achieve them and are at risk for dyslipidemia, hypertension, poor blood sugar control, and being overweight [5]. People with diabetes often find recommendations for healthy eating confusing and difficult to implement [6,7]. Barriers include a lack of understanding of dietary recommendations, lack of family support, limited budget, food selection, and cooking habits [8]. There is something dangerous about consuming too much sugar. Intake of too much sugar is a major key factor in the development of T2DM. People living with T2DM need a combination of medical care and a healthy lifestyle to maintain their condition and prevent complications [18].

Despite the recognition that diabetes and nutrition education is at the core of diabetes management, and that lifestyle education substantially proves a risk factor and delays the onset of diabetes in high-risk people, 6-8 Aboriginal people access diabetes and undernutrition education more than Australians [19]. A small study aimed at identifying effective nutritional interventions in Aboriginal communities [20]. The cooking program for diabetics aims to promote healthy eating by improving nutritional knowledge and cooking skills. A focus on healthy cooking techniques and the use of familiar and affordable foods is likely to increase its effectiveness [21].

Analysis of dietary records in patients with T2DM showed higher carbohydrate consumption in the intervention group than in the control group, this happened because respondents in the intervention group liked to consume simple carbohydrates such as sugar, syrup and sweet cakes. Types of simple carbohydrates (sugar, syrup, and sweet cakes) if consumed too much tend to cause overweight and obesity. In addition, carbohydrate food sources tend to be affordable for low-income groups, resulting in excess carbohydrate intake in the intervention group. Seligman et al., (2010) on their research said that to preserve caloric intake, food-insecure adults frequently shift their diets towards energy-dense, nutritionally-terrible foods (which include subtle carbohydrates, delivered sugars, and delivered fats), which diabetic sufferers are cautioned to keep away from to optimize their glycemic control. Such foods are less expensive than equicaloric portions of fruits, vegetables, and dairy products [22].

The advantage of this study was that it showed higher fiber (vegetable and fruit), amino acid lysine intake (wheat, eggs, fish, cheese and milk), MUFA and PUFA (omega 3 (mackerel and sardines) and omega 6 (cooking oil and nuts such as soybeans, almonds and cashews) sources of food) results in the intervention group than in the control. According to previous studies, the increase in lysine can increase the activity of GLUT4, which plays a role in the transport of glucose into glycogen. Sources of foodstuffs containing the amino acid lysine in wheat products, eggs, fish, cheese, and milk [23].

The increase in fiber also indicated that the participants consumed more vegetables and fruit. Meanwhile, the increase in MUFA and PUFA showed that the participants consumed more omega-3 and 6 sources of food. In addition, the sodium intake was lower in the intervention group. Sodium in patients with T2DM needs to be controlled regarding the development of the disease towards hypertension. The study showed that excessive sodium intake is independently associated with the risk of hypertension among a representative sample of Inner Mongolia residents [24].

Obesity is one of the main risk factors for T2DM [25], although increasing protein intake also has the potential to prevent T2DM. The optimal amount and quality of protein to prevent T2DM are controversial [26]. Although short-term interventions comparing low-protein diets have shown beneficial effects on weight loss, body composition, and several metabolic markers, the outcomes of long-term interventions are generally modest [27]. Furthermore, several prospective studies have raised concerns that even moderately high protein intake may increase the risk of T2DM [28], although associations have also been reported [29]. Several Similä et al. (2012) epidemiological studies have also suggested that replacing

protein with carbohydrates can reduce the risk of T2DM [30]. Contrary to short-term interventions, prospective studies indicate that high protein intake with a higher risk of T2DM is partly mediated through the effect of higher protein intake on obesity [28]. Relatively high protein intake was not independently associated with T2DM risk, but protein and carbohydrate quality modified risk when protein was consumed as a carbohydrate substitute. Supporting protein from plant sources and eggs from other animal sources may be beneficial in the prevention of T2DM [31].

The result of lower glutamine amino acid intake in the intervention group was also not expected. Sources of food containing the amino acid glutamine are animal dishes. This showed that the intake of these foods in the intervention group tended to be lower. The monthly income in the majority intervention group was below the minimum wage and the status of the unemployed was higher. It was possible because the intervention group could not afford to buy food ingredients as sources of the amino acid glutamine. Previous studies have shown that GLN supplementation can increase EPC mobilization and promote vascular endothelial repair in diabetic rats with limb ischemia [2].

Four-day food records were used to estimate food intake. In the week before each testing session, participants recorded all food and beverages, including portion sizes, consumed over three weekdays and one weekend day [32]. The Nutrition Data System for Research diet analysis software (Nutrition Coordinating Center, Minneapolis, MN, USA) was used to analyze food records to estimate mean daily intake of total energy (kcal/day), carbohydrates (g/day;%), protein (g/day;%), fat (g/day;%), fiber (g/day) and food groups [33]. 4-d food logs provide detailed information on diet and are not prone to memory errors, it may not be the best method for capturing occasionally consumed foods. The long follow-up time may have weakened the association between dietary protein and T2DM. However, the associations did not differ significantly in analysis with shorter follow-up times [31].

This study showed that there were some variables related to the risk of T2DM such as age, education level, carbohydrate intake, and waist circumference (female). The results of this study are in line with research conducted by Nayak et al. (2014) which states age to be the most influential risk factor of T2DM in Trinidad [34]. Increasing age can increase the risk of being diagnosed with DMT2. Previous research found the same result that T2DM in patients aged >45 years had a risk of 18.143 times compared to patients aged >45 years [35].

This study also found that a low level of education had correlation with incidence of T2DM. In a previous study, A person with a low educational level has risk of 2.53 times greater chance of being diagnosed with T2DM compared with a person with a high educational level [36]. Varying levels of SEP might contribute to the different vulnerabilities of diabetes through different pathways, including education, which affect the clustering of diabetes through health literacy [37]. The knowledge and skills attained through education may help people to reach a higher level of health consciousness, which, in turn, influence a person's choice of healthy food and healthy behaviors [38].

In this study, for every one-unit increase in intake given or occurs to a person, that person would be at 1.106 times greater risk of being diagnosed with diabetes mellitus and hypertension. The previous finding showed the same result, that higher dietary Glycemic Load (GL), Glycemic Index (GI), and carbohydrate, and lower dietary fiber increased the risk of T2DM in 37.846 Dutch adults aged 20–70 [39]. As recommended by the ADA in 1994, the priority in the planning of food intake and/or meals should be given to the total amount of carbohydrates consumed rather than the source of the carbohydrate. The previous study assumed that carbohydrate intake is the primary determinant of the postmeal glycemic response, and the response is similar if the carbohydrate is eaten separately or as part of a mixed meal [40]. High-GI diets can rapidly increase postprandial glucose levels, thereby increasing insulin demand. This may lead to pancreatic exhaustion. In addition, high-GI diets can increase postprandial free fatty acid release, directly increasing insulin resistance [41].

The other finding of this study was that waist circumference was correlated with T2DM and hypertension, especially in females. In previous research, waist circumference can diagnose T2DM higher than other indicators in women. This can be seen from the visceral deposition of fat and distribution of regional adipose tissue, changes in body fat distribution during menopause, postmenopausal accumulation of abdominal fat becomes more pronounced. Therefore, the relationship between female waist circumference and risk factors for T2DM is stronger [42]. The same result was also found by Jeon [43], that those who had high-increasing waist circumference levels over time had a higher risk of T2DM by 5–7 times. Zhang et al. (2017) study on sex differences in abdominal fat distribution on insight found that women have much more

hepatocellular lipids than men [44]. It is well-known that visceral adipose tissue is related to increased cytokine production and insulin resistance (IR) [45].

The limitation of this study was the unexpected result for energy, carbohydrate, protein, fat, and SAFA intakes which were greater in the intervention group. The other limitation of this study is there was no monitoring of food intake by enumerators in the control group; it could be that the control group consumed foods high in glutamine during the research process. In addition, there was no assessment of food intake before and after treatment in the control or intervention group. Further research is needed regarding outpatient T2DM intake by adding research variables such as biochemical data on blood sugar and HbA1c and increasing the number of subjects.

CONCLUSION

Combined nutritional counseling and cooking assistance program brings about a change in knowledge, attitudes, and nutritional intake in T2DM patients indicated by the results of four days of dietary records for 3 normal days and 1 day off/weekend for 24 hours. Such treatment can increase significantly the intake of fiber, amino acid lysine, and non-fatty acids among T2DM outpatients. Counseling and cooking assistance can also increase saturation. In addition, such intervention can reduce the sodium intake of T2DM outpatients, which means counseling and cooking assistance affect the nutritional intake of T2DM outpatients. Counseling and cooking assistance may not be able to increase glutamine amino acid intake, and unexpectedly not able to decrease carbohydrate intake, which means that there is no effect of counseling and cooking assistance on the nutritional intake of DM outpatients. The influential factors of T2DM are age, education, waist size by gender, and carbohydrate intake. Whereas age is the biggest risk variable, elderly people are at risk of T2DM.

ACKNOWLEDGEMENTS

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