

Chromium and Zinc Level of Patients with Type 2 Diabetes and Non-Diabetes

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Abstract

Type 2 diabetes mellitus and its complications have become a serious public health problem and an important cause of morbidity, mortality and disability in worldwide. Type 2 diabetes caused by insulin resistance together with insulin deficiency, occurs in adulthood. Micro mineral that contribute to the occurrence of diabetes mellitus are chromium and zinc. This study aimed to determine differences level of chromium and zinc between patients with type 2 diabetes and non-diabetic in Hajj General Hospital, Surabaya.

This research is an observational study with cross sectional approach. The study was conducted in internal disease poly of Hajj General Hospital, Surabaya on June to July 2014 using simple random sampling as sampling method. Sample sizes are 30 people, consisting of 15 patients with type 2 diabetes and 15 non-diabetic patients. Blood tests performed in the laboratory and interview was conducted using a questionnaire. Bivariate analysis using Independent Sample T-test.

The results showed no significant difference of chromium (p<0.201) and zinc level (p<0.431) between type 2 diabetes group with non-diabetic. Average level of chromium and zinc in type 2 diabetic patients is lower than the non-diabetic.

Keywords: Type 2 diabetes; Chromium level; Zinc level

Introduction

Diabetes mellitus and its complications have been becoming a serious public health problem and an important cause of morbidity, mortality and disability in the whole world. Data from a global study showed that the number of diabetics mellitus in 2011 around the world have reaching 366 million people. Data International Diabetes Federation [1] revealed, diabetes mellitus worldwide in 2012 reached 371 million people. Whereas in 2013, the number of diabetes mellitus patients were 382 million people. If no action done, this number expected to increase to 592 million people by the 2035. One of ten adults exposed diabetes, and it is estimated that there are three new cases every ten seconds or almost ten million per year [2].

The main types of diabetes are type 1 diabetes and type 2 diabetes. Type 1 diabetes occurs in puberty whereas type 2 diabetes occurs in adulthood. Type 2 diabetes is caused by insulin resistance together with insulin deficiency, occurs in adulthood. Insulin is a hormone which produced by pancreatic beta cells. One of the main functions of insulin is to facilitate the uptake of glucose into the cell. Therefore, cells can undergo functional impairment if there is an interruption in the production and/or resistance to insulin [3].

Micro minerals that have a role to the occurrence of diabetes mellitus are chromium and zinc. Chromium as a cofactor can improve glucose metabolism by improving insulin action in moving glucose into the cells. Besides, chromium also increases number of insulin receptors and insulin sensitivity at the cellular level. The safe and adequate daily intake of chromium in adult was considered to be in the range 50-200 μ g.

Zinc is an essential micronutrient which has an important role in the functioning of hundreds of enzymes, in insulin metabolism and acts as an efficient antioxidant. Zinc has close links in the pathogenesis of glucose intolerance and diabetes complications [4]. Zinc is an important structural component of insulin biosynthesis and necessary for structural and biosynthetic role in β -pancreatic cells which is a place to production insulin. The recommended adequacy rate of zinc is 13 mg for men and 10 mg in women [5]. In Hajj General Hospital of Surabaya, patients with diabetes mellitus dominate every year in that hospital. As the data in 2013, which was taken from the hospital medical record, patients with diabetes mellitus get the first rank of the 20 types of disease diagnosis that identified.

Until now, research on chromium and zinc level in patients with type 2 diabetes is still rarely done. Chromium and zinc deficiency in food consumption may play an important role in the etiology of diabetes. Therefore researchers interested in conducting research about chromium and zinc levels, and to know nutrients consumption that effect on both levels in type 2 diabetes patients compared with nondiabetics patients.

The purpose of this study is to determine differences of chromium and zinc levels of type 2 diabetes patients who newly diagnosed with diabetic and non-diabetic patients at Hajj General Hospital, Surabaya.

Methods

Study design and population

This is an observational analytical study with cross sectional design. The study was conducted in Hajj General Hospital, Surabaya on June to July 2014. The population in this study is patients who aged more than 40 years that visited and got treatment in Hajj General Hospital, Surabaya. The sampling technique was conducted using simple random sampling with 30 people consisting of 15 persons with type 2 diabetics and 15 non-diabetes.

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Informed consent and ethical clearance

This study has obtained ethical clearance from the ethical committee of Public Health Faculty of Airlangga University. Any patients who are the subject of this study has been agreed to be the subject of study by completing a written informed consent form.

Data collection

Primary data including patient characteristics, consumption level, activity/exercise and Body Mass Index obtained by interview using a questionnaire.

Anthropometric assessment

Weight and height of patients identified through anthropometric measurements using weight measuring tool and microtoise. Weight and height of patients used to calculate Body Mass Index (BMI).

Dietetic assessment

Information of dietary intake identified using food frequency and 24-hours recall method. To assist the subject in quantifying the food portion consumed, food models and utensils were used.

Biochemistry assessment

Blood samples were collected in the laboratory and analyze with AAS (atomic absorption spectrophotometer) method by medical analyst to know chromium and zinc levels in the blood of patients.

Statistical analysis

Processing and data analysis conducted using SPSS version 16. Statistical tests used is Mann- Whitney, Chi-Square and Independent Sample T-test with α = 0.05. A p-value <0.05 was considered statistically significant.

Result

Characteristics of respondents

Here is the data distribution of respondents based on characteristics.

Age: In this study, the number of respondents who aged over 40 years in Hajj General Hospital, Surabaya is 30 respondents and majority (46.6%) aged between 50-59 years old. Mann-Whitney test results showed that there was no difference of age between type 2 diabetes and non-diabetes group (p<0.465) (Table 1).

Sex: Sex of 18 respondents (60.0%) was women, but who have type 2 diabetes are only 5 respondents. Respondents with type 2 diabetes majority are male with 10 out of 30 people. From Chi- Square test results showed that there was a differences of sex between groups of type 2 diabetes and non-diabetes (p<0.030) (Table 1).

Education level: From education level, majority of respondents are graduated from senior high school/equivalent (12 respondents). Chi-Square test results showed that there was no significant difference in education level between type 2 diabetes and non-diabetes group (p<0.478) (Table 1).

Income level: Respondents' income levels, both type 2 diabetes patients and non-diabetic patients are mostly above the minimum wage (UMR) of Surabaya, as many as 24 respondents (80.0%). Chi-Square test results obtained that there was no difference of income level between type 2 diabetes and non-diabetes group (p<0.169) (Table 1).

Family history of disease: Reviewed from family disease history,

majority of respondents (15 respondents) who suffer from type 2 diabetes have a history of diabetes in the family (50.0%). In the non-diabetic group 6 respondents (20.0%) have family history of diabetes too. Chi-Square test results showed that there was no difference in family history of disease between both group (p<0.121) (Table 1).

Differences in physical activity and body mass index (BMI) of respondents

Here is the data distribution of respondents based on physical activity and BMI.

Physical activity: Results of Chi-square test indicates that there was no significant difference of physical activity between type 2 diabetes and non-diabetes group (p<0.651) (Table 2). Majority respondents in both groups have low physical activity.

Body Mass Index (BMI): Based on the data, it is known that majority of respondents either from type 2 diabetes group and non-diabetes group are overweight. Chi-Square test results showed that there was no difference of Body Mass Index between both group (p<1.000) (Table 2).

	Category						
Characteristics	Type 2 DM		Non-DM		Total		p-value
	n	%	n	%	n	%	1
Age (year)							
40 – 49	4	26.7	4	26.7	8	26.7	0.465
50 – 59	9	60	5	33.3	14	46.6	
≥ 60	2	13.3	6	40.4	8	26.7	
Sex							
Man	10	66.7	2	13.3	12	40	0.03
Woman	5	33.3	13	86.7	18	60	
Education Level							
Never attended school	0	0	0	0	0	0	0.478
Primary school	1	6.7	0	0	1	6.7	
Junior high school	3	20	5	33.3	8	26.7	
Senior high school	6	40	6	40	12	40	
Academy/University	5	33.3	4	26.7	9	26.7	
Income Level							
< UMR	4	26.7	2	13.3	6	20	0.169
> UMR	11	73.3	13	86.7	24	80	
Family history of disease							
Yes	9	60	6	20	15	50	0.121
No	6	40	9	80	15	50	

 Table 1: Data distribution characteristics of respondents in Hajj General Hospital, Surabaya.

Variable	Туре	2 DM	Nor	P-value	
	n	%	n	%	-
Physical Activity					
High	4	26.7	2	13.3	0.651
Low	11	73.3	13	86.7	
Body Mass Index (BMI)					
Underweight	0	0	0	0	1
Normal	6	40	5	33.3	
Overweight	8	53.4	10	66.7	
Obese	1	6.7	0	0	

 Table 2: Data distribution based on physical activity and BMI of respondents in Hajj
 General Hospital, Surabaya.

Nutrition consumption rate and level of chromium and zinc

Here is the data distribution of respondents based on nutrition consumption and level of chromium and zinc.

Chromium: The average of chromium consumption rate in type 2 diabetes group was higher than in non-diabetes group. The result of differences test using Independent Sample T-test showed that there are no differences of chromium intake between type 2 diabetes group and non-diabetes group (p<0.511) (Table 3).

Zinc: The average of zinc consumption rate in type 2 diabetes group was lower than in non-diabetes group. Independent Sample T-test result indicated that there are no differences of zinc intake between both group (p<0.309) (Table 3).

Protein: The average of protein consumption rate in type 2 diabetes group was lower than in non- diabetes group. The result of differences test indicates that there are differences of protein consumption rate between type 2 diabetes group and non-diabetes group (p<0.034) (Table 3).

Vitamin C: Independent Sample T-test result showed that there are no differences of vitamin C intake between both group (p<0.727) (Table 3). Based on the data, it is known that the average of vitamin C consumption rate in type 2 diabetes group was lower than in non-diabetes group.

Fiber: The average of fiber consumption rate in type 2 diabetes group was higher than in non-diabetes group. Independent Sample T-test result showed that there are no differences of fiber intake between groups of type 2 diabetes and non-diabetes (p<0.735) (Table 3).

Serum chromium level: The result of differences test using Independent Sample T-test result indicated that there are no differences of serum chromium level between type 2 diabetes and non-diabetes group (p<0.201) (Table 4). Based on the data, it is known that generally the average serum chromium level in type 2 diabetes group was lower than in non-diabetes group.

Serum zinc level: Generally the average serum zinc level in type 2 diabetes groups was lower than in non-diabetes group. Independent Sample T-test result showed that there are no differences of zinc serum level between groups of type 2 diabetes and non-diabetes (p<0.431) (Table 4).

	Cate			
Consumption Rate	Type 2 DM	Non-DM	p-value	
	n = 15	n = 15		
Chromium (µg)	10.21± 4.05	9.30 ± 3.07	0.511	
Zinc (µg)	6.06 ± 1.20	6.30 ± 0.70	0.309	
Protein (g)	48.50 ± 7.80	55.80 ± 9.90	0.034	
Vitamin C (mg)	70.00 ± 2.20	81.50 ± 8.00	0.727	
Fiber (g)	8.40 ± 2.90	7.70 ± 2.60	0.735	

Table 3: Data distribution based on nutrition consumption rate in Hajj GeneralHospital, Surabaya.

	Cate		
Serum level	Type 2 DM	Non-DM	p-value
	n = 15	n = 15	
Chromium (µg/dl)	0.17 ± 0.10	0.21 ± 0.08	0.201
Zinc (µg/dl)	373.00 ± 110.00	404.00 ± 92.30	0.431

 Table 4: Data distribution based on chromium and zinc level of respondents in Hajj
 General Hospital, Surabaya.

Discussion

Characteristics of Respondents

Age: The majority of respondents in type 2 diabetes group were 50 to 59 years old (Table 1). This is in line with Ngaisyah [6] research result which indicates that 70.9% of diabetic patients aged over 50 years. Result of Riskesdas in 2013 [7] shows that the number of people with diabetes increases with age.

Sex: According to Soegondo [8], the main risk factors that affect occurrence of diabetes are due to unhealthy diet, where they tend to continue consume carbohydrates and food sources of excessive glucose, plus due to lack of physical activity. Men's risk for developing type 2 diabetes is greater because greater risk of obesity is owned by men. Type 2 diabetes occurs because of too much glucose in blood as a result of the body's ability to regulate sugar levels in several organs disturbed. This condition is associated with excess fat in some organs such as liver and muscle [1].

Education level: Majority of respondents are graduated from senior high school (Table 1). This were in line with Krisma et al. [9] research which showed similar results, i.e. mostly respondent education level are high school graduate/equivalent. The higher the education level, person's knowledge in preventing diseases including diabetes will be better although education is not included as one of the factors that influence the occurrence of diabetes mellitus.

Income level: Increased of income also increased chances to buy food with better quality and quantity. However, high levels of income without coupled with sufficient level of knowledge about the selection of good food, will have an impact on the incidence of health problems, including diabetes mellitus type 2.

Family history of disease: John et al. [10] showed that 60.0% patients with diabetes mellitus have a family history of diabetes mellitus. In the non-diabetic group, 20.0% of respondents have a family history of diabetes (Table 2). This means that the respondent also has the risk for developing diabetes. According to the ADA [11], a person's risk for developing type 2 diabetes will be greater if the person has a parent with diabetes.

Differences in physical activity and body mass index (BMI)

Physical activity: Based on the data, it is known that majority of respondents either from type 2 diabetes group and non-diabetes group have low physical activity (Table 2). This is in line with Ngaisyah [6] research result, where the majority of the respondents (70.15%) patients with diabetes mellitus have low physical activity. Physical activities as recommended tend as a protective factor against diabetes, although not statistically significant.

Body Mass Index (BMI): The results of this study indicate that among the group of respondents with a normal Body Mass Index and overweight/obese have the same risk of developing diabetes mellitus. Several studies have shown a close relationship between BMI with risk factors. Therefore, focus of achieving a normal weight is one of the efforts to reduce other risk factors such as blood pressure, dyslipidemia and blood sugar.

Nutrition consumption rate

Chromium: Research results showed that there was no difference of chromium consumption rate between both groups. This is in line with Wulandari [12] research result, which indicates that, the average chromium consumption rate of respondents under RDA standard. Based on RDA, chromium in men aged less than 50 years are 35 mg/ day and aged \geq 50 years are 30 mg/day.

Whereas in women aged less than 50 years is 25 mg/day and \geq 50 years are 20 mg/day. Data about chromium in Indonesia still very limited, as well as the list of food composition which contains chromium in it. These causes the researchers could not calculate chromium consumption rate in all foods which consumed by respondents, thus causing chromium consumption rate calculation results mostly less than adequacy.

Zinc: Research results showed that there was no difference of zinc consumption rate between type 2 diabetes and non-diabetes group. This is in line with Marie et al. [13] research result. In her research showed that only 3.45% respondents of her research who suffer from type 2 diabetes have zinc consumption rate that meets the RDA standard. As we know that animal protein is the main source of zinc. Generally, these foods are expensive, so its consumption rate tends to be limited compared to vegetable protein.

Protein: The results of calculations on protein consumption rate of the respondents indicated that protein consumption rate of nondiabetic group tends to be higher or better than type 2 diabetes group (Table 3). This research does not differentiate between animal protein and vegetable proteins, because based on interviews about the pattern of consumption, vegetable protein such as tofu and tempeh is a source of protein that is often consumed by respondents because it price affordable.

Vitamin C: Most of vitamin C consumption rate of the respondents still less than RDA standard. This is in line with Ngaisyah [6] result research, where in patients with type 2 diabetes and non-diabetes, 73.9% respondents have less vitamin C consumption rate, still below RDA standard. The main sources of vitamin C are fruits and vegetables. These results reflect that fruit and vegetable consumption among respondents is still low.

Fiber: Recommendation of fiber intake for peoples with type 2 diabetes same as for a normal person i.e. 20-35 g/day with emphasis on water soluble fiber. Fiber consumption rate of respondents in this study majority (53.3%) still in deficit category (Table 4). As well as vitamin C, foodstuffs that contain lots of fiber are fruits and vegetables, which in this study have not been much consumed by respondents.

Serum level of chromium and zinc

Serum chromium level: In patients with type 2 diabetes who newly diagnosed diabetes, their chromium levels in the blood tend to decrease compared with those without diabetes, although not statistically significant. Total chromium levels in the body diminish with age, decreased approximately 25% to 40% [11]. Increasing of age, reduction of chromium in the body is more susceptible compared younger age groups. As it is known that in this study majority of respondents aged over 40 years.

Serum zinc level: In people with diabetes, zinc levels in the blood start to decline, it is because many zinc in the body excreted through urine. As it is known that one of the symptoms of diabetes are urination frequently, so it is possible that a lot of zinc wasted from the body through urine.

Conclusion

1. Based on characteristic, average age of the respondents are 54.2 \pm 7.7 years old, female (60.0%), completed high school

education/equivalent (53.3%), the level of income above the minimum wage (80.0%) and with a family history of disease diabetes mellitus (60.0%)

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- Physical activity of respondents mostly in lower categories (80.0%) and majority Body Mass Index of respondents are overweight (50.0%)
- 3. There are no significant difference in chromium, zinc, vitamin C and fiber consumption rate between type 2 diabetes and nondiabetes group
- 4. There is a significant differences of protein consumption rate between type 2 diabetes and non- diabetes group
- 5. There are no difference of physical activity and Body Mass Index (BMI) between both group
- 6. There are no significant difference of chromium and zinc serum between type 2 diabetes and non- diabetes group, but the average of chromium and zinc serum in type 2 diabetes group is lower than non-diabetic group

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