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The Relationship between Smoking as a Modifiable Risk Factor and Chronic Complications on Elderly with Type 2 Diabetes Mellitus

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Abstract

Smoking is known as a variable that can be changed through a specific intervention activity. Recently in Indonesia, research related to chronic complication among elderly with type 2 Diabetes Mellitus (DM) was not available. This research has objective in exploring the risk of smoking towards chronic complication among elderly with type 2 DM. This research was using *Riset Kesehatan Dasar (Riskesdas)* in 2007. *Riskesdas* is a representative Indonesia Health Survey. 1,565 elderly (aged 60++ years) with type 2 DM have selected by random. 70-80% of the elderly have Chronic Complications and 32.11% of the sample is smokers. The elderly who smoke more than 24 cigarettes per day have risk 2.5 (95% CI, 1.54-3.97), smoker 1-12 cigarettes per day, and smoker 13-24 cigarettes per day have risk 1.3 and 1.6 respectively to get chronic complication compared with those who do not smoke, controlled by age, obesity, and physical activity. The proportion of smokers among elderly with type 2 DM is high, most of them are low education, low socioeconomic status, lack of access to the health services, low of physical activity, and low consume vegetables and fruit. Smoking increases the risk of chronic complication of type 2 DM.

Abstrak

Hubungan antara Merokok sebagai Faktor Risiko yang dapat Dimodifikasi dari berbagai Komplikasi Kronis pada Lansia dengan Diabetes Mellitus Tipe 2. Merokok dikenal sebagai variabel yang dapat diubah melalui aktifitas intervensi yang spesifik. Saat ini di Indonesia belum terdapat penelitian mengenai komplikasi kronis di antara para lansia penderita Diabetes Mellitus (DM) tipe 2. Penelitian ini bertujuan untuk mempelajari risiko dari aktifitas merokok terhadap komplikasi kronis di antara para lansia penderita DM tipe 2. Penelitian ini menggunakan Riset Kesehatan Dasar (Riskedas) 2007. Sebanyak 1.565 lansia (usia 60++ tahun) penderita DM tipe 2 dipilih secara acak. Sebanyak 70-80% dari para lansia tersebut memiliki komplikasi kronis, dan 32,11% sampel penelitian adalah perokok. Para lansia yang merokok lebih dari 24 batang per hari memiliki risiko 2,5 (95% CI, 1,54-3,97), sementara itu lansia yang merokok 1-12 batang per hari, dan yang merokok 13-24 batang per hari memiliki risiko masing-masing setinggi 1,3 dan 1,6 untuk terserang komplikasi kronis dibandingkan mereka tidak merokok, terkontrol secara usia, tingkat obesitas, dan aktifitas fisik. Persentase perokok di antara para lansia penderita DM tipe 2 cukup tinggi. Sebagian besar dari mereka memiliki tingkat pendidikan, tingkat status sosioekonomi, aktifitas fisik, serta tingkat konsumsi buah dan sayur yang rendah. Mereka pun kurang memiliki akses terhadap layanan kesehatan. Merokok meningkatkan risiko komplikasi kronis DM tipe 2.

Keywords: diabetes chronic complications, diabetes mellitus tipe 2, elderly, indonesia, smoking

Introduction

Many researchers discovered that smoking can cause a type 2 diabetes mellitus since it causes insulin resistance.[1,2] Moreover, smoking is also causing death for type 2 diabetes mellitus patients.[3,4] The effect of smoking is significant towards the diabetes mellitus type 2's patients. The risk for diabetes mellitus type 2 increases 28% for smoker patients.[5] This risk will reduce simultaneously as the patients quit smoking. The risk of type 2 diabetes mellitus smokers are depend on the number of cigarettes smoked, for 1-14 cigarettes perday, the risk that possess is 1.39 (1.17 to 1.64), and for >25 cigarettes per day, the risk that possess is 1.98 (1.57 to 2.36) compare with non smokers.[6]

Smoking is not only increasing the chance of people to be affected by type 2 diabetes mellitus, but also chronic complication of diabetes that are very dangerous.[7,8] Smoking is a bad habit that will affect the deposition of

fat in the arteries, which will damage the blood vessels. Therefore, smoking will also cause a hypertension and stroke.[7] Due to this situation, the complication of diabetes mellitus that often time happened is hypertension. Hypertension will also increase the risk of heart attack. The proportion of smoker in Indonesia continues to increase. According to social economic survey in 1995, the proportion of smokers in Indonesia was 27% and in 2007 it reached 34.2%. Moreover According to Riskesdas in 2007, the proportion of smoker above 60 years old was approximately 36%.

In 2003, According to *Badan Pusat Statistik Indonesia's* report, the total of type 2 diabetes mellitus patients was 13.7 million people and estimated to be 20.1 million in 2030 with prevalence rate of 14.7% in urban and 7.2% in rural. The risk of type 2 diabetes mellitus was higher for elderly. DM type 2 is one of the chronic diseases that can elevate prevalence of the chronic complication for elderly.[9] This chronic complication disease considered serious since it closely relates with others chronic diseases such as hypertension, heart attack, stroke, blindness due to retinopathy, glaucoma, cataracts, kidney failure, impotencein men, and disabilitydue towounds that hard to be healed.[9,10]

Chronic complications of diabetes mellitus type 2 are largely caused by genetic factors, poor behavior or lifestyle to maintain health, poor social environment and lack of utilization of health services. Chronic complications defined as the presence of two or more diseases or chronic conditions, in which the one is not always more significant than others diseases.[11,12] Chronic complications can affect the quality of life, ability to work, disability and death.[9] Data of chronic complications for the elderly in Bangladesh, as a developing country, reached 53.8%, most of them are women and people in the lower socioeconomic groups.[13,14] Chronic complications are a challenge for preventive and curative services health provider in Indonesia.[15] This kind of conditions can trigger the multi use of prescription or polypharmacy. The uses of a number of drugs also have risks such as increased drug reactions, increased incidence of undesirable drug effects. The condition was more damning in elderly patients since the decrease of capacity for drug metabolism in the body would increase the risk of toxic reactions.[13]

Indonesia is trying to provide healthy, happy, productive and independent life for elderly.[16] However, currently, there are only few data and research related to smoking, and chronic complications in elderly patients with type 2 diabetes mellitus in Indonesia. Moreover, the data and the research arenecessary to describe the strategic program that requiredin reducing the problems that arise, such as: Improving health care systems, economic burden and quality of life for elderly in Indonesia. Therefore, this study aims to determine the prevalence of chronic complications of type 2 diabetes, combination pattern chronic complications of type 2 diabetes mellitus, and relationship of smoking as modifiable risk towards chronic complications of type 2 diabetes mellitus. The results of this result should produce strategic suggestions to reduce the likelihood of chronic complications in elderly patients with type 2 diabetes mellitus.

Methods

This research was using the Baseline Health Research Survey (BHRS/Riskesdas) 2007 with a cross-sectional design. Riskesdas 2007 is a community-based research that using households and household members samples that can represent the population in the district or city. Riskesdas 2007 provides basic health information including biomedical measurements. The population that used in this study was all the elderly residents (with age of 60 years old and above) in Indonesia. Samples in the study are the respondents that were selected in the survey Riskesdas 2007 and met the inclusion and exclusion criteria. Inclusion criteria for the study are the respondents that have type 2 diabetes mellitus that diagnosed by health work force. Exclusion criteria for the study are the situation where the elderly have BMI (Body Mass Index) below 18.5 and with incomplete data. Total of 1,565 samples were obtained as samples. Data analysis was performed using the software Statistical Package for Social Science (SPSS) version 16.0 license Universitas Indonesia. Analysis that conducted includes descriptive and multivariate complex survey analysis.

Type 2 diabetes mellitus measurement. The measurement of type 2 diabetes mellitus are based from the diagnosis that being enforced by a doctor. Respondents were also interviewed for other chronic diseases that diagnosed by the doctor. In the Riskesdas survey (chronic diseases have some of the limitation such as, hypertension, heart, and stroke). In this research, the analysis of the risk of chronic complications of type 2 diabetes mellitus with the relationship of smoking and 10 other independent variables such as age group, sex, marriage status, socioeconomic status, formal education, body mass index, fat consumption, fruit, and vegetable consumption, physical activity, and utilization of health services had been conducted.

Dependent variable. The operational definition of chronic complications of type 2 diabetes is when the respondents suffered from diabetes and at least one other chronic diseases. On the other hand, the respondents who only have type 2 diabetes without other chronic diseases complications were not considered aschronic complications. Complications and non complications (reference).

Independent variables. The behavior as smoker were categorized by smoker status (whether if they smoked daily or occasionally), and not smokeas there ference.

Potential confounders. 1) Age, divided into two categories:60-74 years (reference), 75+years; 2) Gender, divided into two categories: male (reference) and female; 3) Formal education; below high school and graduate or above high school (reference); 4) Marital status; single, married (reference) and divorce; 5) Socioeconomic status was grouped based from expenditure of per capita (expenditure status for groceries and not groceries for 1 month divided by the number of household members). Socioeconomic status considered high if spending per capita was equal to or greater than the median (reference) and socioeconomic status consider low when spending per capita was less than the median; 6) Nutrition status consist of good nutrients/normal (18.5-24.9) as reference and excess nutrients/obesity (>25); 7) Fruit and vegetable consumption were categorized as 'enough' fruit and vegetable consumption when the consumptionof vegetables and/or fruit at least 5 servings per day for 7 days a week (reference). It categorized as 'not enough' fruit and vegetable consumption when fruit and vegetable consumption is less than the requirements mentioned above; 8) Physical activity, it categorized as 'enough' when the activity was performed cumulatively 150 minutes for five days a week (reference) and ‘not enough‘ if it performed less than the above conditions; 9) Fat consumption considered as “often” when the respondent consumed this food once or more every day and considered “seldom” if the consumption was not every day (reference); 10) Health service utilization categorized as'good' if the respondents had been utilized at leastone of health services, such as neighborhood health center, village health post, postdrug, or adrug shop in the last 3 months (reference). This considered as 'not good' if they under utilized the health services in the last3 months.

Statistical Analysis. Complex survey analysis was conducted using chi-square and logistic regression models with an alpha of 5%. Stratum: urban and rural, PSU: Enumeration area (group of 20 RT), Weight (Individual). Data collection was conducted in compliance with the standards or ethics when done taking the survey.

Results and Discussion

This research has several of limitation such as the classification of chronic complication type 2 Diabetes Melitus status. Because not all of chronic complications diseases, such as renal failure, glaucoma, retinopathy, impotence, gangrene and tuberculosis, were being analyzed. Therefore, the precentage of respondent that experiencing the complication might be obscured from the actual condition. On the other hand, the occurrence of bias recall when the data collectors asked for the history of respondend regarding the particular disease based from diagnosis by health professionals was also limiting this research. Another limitation was the absence of the question regarding how long the respondend had stopped smoking, thus the bias effects of smoking in the blood for ex-smokers were not appropriately measured.

Another bias threat was selection bias. According to Riskesdas’s data, the number of samples that met the inclusion criteria that been diagnosed by health professionals for age ≥60 years and have type 2 diabetes, were 1,924 samples. However, according to inclusion and exclusion criteria that have been established, samples that used in this study were 1,565 samples of appropriate. The rest of the samples, 359 samples, were excluded from the list because the respondents surveyed had incomplete data of on important variables required and about 1% had BMI below 18.5. The 359 samples excluded have characteristics as follows: 52.5% are female, 62.5% are married, 20% are smokers, mean age was 68 years old, and 28.6% are obese (incomplete data) and 1% of them have a BMI below 18.5.

Based on Table 1, the chronic complications status are very high in the five groups of smoker, which was about (70-82%). Percentage of the group that has the highest complication was the 'Ex-Smokers' with almost 82%. The lowest percentages among the groups are 'No Smoking' and 'smoker 1-12 cigarettes per day'groups. The average age of the five groups was 67 years. Approximately 70% of men catagorized as 'Ex-Smokers';' smoker 1-12 cigarettes per day 'and' Smokers over 24 cigarettes per day, while the women (about 65%) catagorized as ' No Smoking 'and groups' Smoker 13-24 cigarettes per day. Two of three research’s samples are from low education in all groups. Low education mentioned considered as formal education from junior high school to below. From the total elderly above 50% of them are categorized as of low socioeconomic and most of them (over 70%) were still married. The percentages of the respondend that have low education and socioeconomic were in line with low access in utilizng health services (over 55%). On the other hand, there were only a few who conducting regular exercise per week, for only about (1.7-5.7%) who do regular exercise per week, the former smoker was highest group who performing regular exercise per week. Nutrition status of elderly in the research was almost 30-40% catagorized as overweight and obesity with a very low vegetables, and low fat food consumption.

Table 2 shown that 67.07% of chronic complications were the complication of diabetes and hypertension. The

other description of chronic complications were as follows: 12.8% was a complication of diabetes, heart and hypertension; 8.9% was complication of diabetes, stroke and hypertension; 7.44% combination from diabetes and heart diseases; 2.68% was complication of diabetes, heart, stroke and hypertension; 0.85% complications diabetes and stroke; and the rest was the diabetes, heart and stroke (0.24%). Broadly speaking, hypertension is the most chronic complication that occured on patients with type 2 diabetes, which about 92%. Elderly people with type 2 diabetes mellitus prone to have chronic complications, the results of a study reported that 73.1% from 1,565 of the elderly have chronic complications. In the group of age over 60 years old, due to aging, changes in the pancreatic beta cells caused changes in glucose metabolism in old age. In addition, aging was also associated with obesity, disease, drug use and reduction of physical activity.[17-20]

The most common complications in this study were hypertension (35.1%), the same result was also reported by Meeuwisse-Pasterkamp,[21] which revealed that more than 70% of diabetics' patients were also suffer from high blood pressure as well. Type 2 diabetes along with hypertension would increase the risk of microvascular and macrovascular complications. The increase of 10 mmHg in systolic was associated with the increase of 12% on each diabetes complications, 15% of deaths that related with diabetes, increase of 11% in the occurrence of myocardial infarction and increase of 13% in microvascular complications of type 2 diabetes. deaths from heart disease were 2 to 4 times higher in diabetics than non-diabetics. Diabetics are 2 to 4 times as well, would develop into a stroke.[10,20] Therefore, people with diabetes with hypertension need to extremly maintain their health to avoid other chronic disease caused by this conditions,monitoring the salt intake is required.[21,22]

Table 1. Characteristics and Behavior

	Non Smoker	Former Smoker	Smoker with 1-12 cigarettes/day	Smokerwith 13-24 cigarettes/day	Smoker with >24 cigarettes/day
N	989	223	45	28	280
Age (Rerata) (year)	67.89	68.4	68.06	68.13	67.67
Gender (%)					
Female	67	27.9	29.2	62.7	25.9
Male	33	72.1	70.8	37.3	74.1
Formal education (%)					
Low	77.1	67	64.5	70.8	32.8
High	22.9	33	35.5	29.2	67.2
Socioeconomic (%)					
Low	54.5	54	69.7	58.4	47
High	45.5	46	30.3	41.6	53
Marital status (%)					
Married	61.4	77.6	77.2	71	76.3
Divorced/Death	38.6	22.4	22.8	29	23.7
Health service utilization (%)					
Not Good	57.2	56.8	54.2	48	62.3
Good	42.8	43.2	45.8	52	37.7
Physical activity (%)					
Enough	1.7	5.7	4.6	0	2.6
Not enough	98.3	94.3	95.4	100	97.4
Nutrition status (%)					
Good	68.0	62.2	74.2	63.1	70.8
Excess	13.3	17.5	17.5	25.5	14.2
Obesity	18.7	20.3	8.3	11.4	15
Fruit and vegetable consumption (%)					
Enough	0.8	0	0	0	0.4
Not enough	99.2	100	100	100	99.6
Fat consumption (%)					
Seldom	92.4	90.5	97.1	81.3	92.8
Often	7.6	9.5	2.9	18.7	7.2
Complication status (%)					
Non complication	29.7	18.2	29.4	20.6	24.2
Complication	70.3	81.8	70.6	79.4	75.8

Based on Table 3, the combination distribution of the chronic complications in elderly people with type 2 diabetes mellitus, which is smoker, has a greater proportion in experiencing chronic complications than those who never smoked. Moreover, those who never smoked, the proportion in experiencing chronic complications of the disease was only 40.99%, while 51.99% for smokers (the ratio of the proportion for smokers who experience chronic complications of a disease than nonsmokers was 1.26). For two complications of chronic disease, the proportion of non-smokers were at 10.32% and 17.67% for smokers (the ratio of smokers who experience chronic complications of the two diseases than non smokers was 1.71). For the proportion of smokers who have complications from three diseases had the ratio 6 times greater than non smokers. These conditions did not differ in other pattern of chronic complications, except for the combination of diabetes and hypertension. In this pattern the proportion of non smokers is greater than the proportion of smokers.

To obtain the final model (Table 4), logistic regression was included on the analysis. The table showed that 'Smokers who smoke more than 24 cigarettesper day' had 2.35 times grater risk in getting chronic complications from type 2 diabetes compared to the 'No Smoker' (95% CI OR; 1.5 to 3.7). 'Smoker with 1-12 days per cigarettes and 'Smoker with 13-24 cigarettes per day had risk of getting chronic complications of type 2 diabetes by 1.32 and 1.64 times (respectively) compared to the 'No Smoker'. Even 'Former Smokers' was still obtained the risk for getting type 2 diabetes chronic complications 1.66 times compared to the 'Non Smoker'. The size of risk in getting type 2 diabetes chronic complications had already been controlled by several variables, such as: age, sex, not exercise, and nutrition status.

Based on Table 4, it had been proved in this study that smoking had a 2.5 times greater risk in getting for the complications of type 2 diabetes mellitus compared to those who did not smoke (OR 95% CI, 1.54 to 3.97) and can be associated with a high mortality rate for people with diabetes.[2-4] The effects of smoking, even though towards the ex-smokers had big influence for occurance of type 2 diabetes. Risk of incident type 2 diabetes mellitus increased by 28% among all smokers. The risk decreased by the length of time the person quitting smoking.[5]

Table 2. Chronic Complication Combination towards Elderly with Type 2 Diabetes

The Pattern of Diabetes Melitus Complication	Personates
Diabetes and hypertension	67.07%
Diabetes, heart, and hypertension	12.80%
Diabetes, stroke, and hypertension	8.90%
Diabetes and heart	7.44%
Diabetes, heart, stroke, and hypertension	2.68%
Diabetes and stroke	0.85%
Diabetes, hypertension, and stroke	0.24%
Total	100.00%

Table 3. The Distribution of Chronic Complication Combination and Smoking Behavior

The Pattern of Diabetes Melitus Chronic Complication	Non Smoker N (%)	Smoker and Former Smoker N (%)
Non complication	474 (47.97)	153 (26.51)
Complication	514 (52.03)	424 (73.49)
The status of diabetes melitus chronic complication		
Non complication	474 (47.97)	153 (26.51)
One disease	405 (40.99)	300 (51.99)
Two diseases	102 (10.32)	104 (17.67)
Three diseases	6 (0.60)	20 (3.63)
The pattern of diabetes melitus chronic complication		
Diabetes and hypertension	401 (78.02)	276 (65.09)
Diabetes, heart, and hypertension	27 (5.25)	38 (8.96)
Diabetes, stroke, and hypertension	41 (7.98)	42 (9.91)
Diabetes and heart	33 (6.42)	46 (10.85)
Diabetes, heart, stroke, and hypertension	7 (1.36)	20 (4.72)
Diabetes and stroke	1 (0.19)	2 (0.47)
Diabetes, hypertension, and stroke	4 (0.78)	0 (0.00)

Table 4. Multivariat Analysis

Variables	B	ρ value	OR	Confidence Interval 95% OR	
				Lower	Upper
(Intercept)	-0.178	0.523	0.837	0.480	1.459
Age	0.495	0.011	1.640	1.127	2.388
Gender	0.529	0.003	1.697	1.215	2.370
Absent of exercise	0.555	0.001	1.742	1.256	2.415
Former smoker	0.512	0.146	1.668	0.832	3.343
Smoker with 1-12 cigarettes/day	0.272	0.570	1.312	0.505	3.407
Smoker with 13-24 cigarettes/day	0.495	0.221	1.640	0.735	3.659
Smoker with >24 cigarettes/day	0.857	0.000	2.357	1.501	3.701
Nutrition status	0.246	0.021	1.279	1.039	1.575

Smoking was not only increased the person's risk of type 2 diabetes but also the risk of dangerous complication of chronic diabetes.[7,8]

Smoking was a risk factor for hypertension, heart disease and stroke. According to American Diabetic Assosiations, cigarette smoke can cause a reduction of oxygen levels on the tissue, it also increases cholesterol levels and blood pressure, and blood sugar levels.[7,8] The research, on the last 10 years, had proved the existence of macrovascular complications in patients with type 2 diabetes who smoking. Smoking is heightens the risk of macrovascular complications such as hypertension heart disease, stroke, and peripheral vascular disease.This was all because smoking made the atherosclerosis. Atherosclerosis is the thickening the inner walls of the arteries due to plaque deposits. Thus, it can inhibit and block the blood supply to the muscle cells. Thickening of the artery, due to fat deposition in the arteries walls, would then damage the walls of blood vessels, ongoing Atherosclerosis chronic might cause many diseases. Therefore the most common complication of diabetes mellitus is high blood pressure. High blood pressure would also increase the risk of heart disease.[25]

Patients with type 2 diabetes dan chronic complications frequently would causing polypharmacy, this will lead to the duration of the elderly treatment, and it even could cause death.[26-28] Therefore the integrated health care system is required to monitoring the elderly treatment.[28,29]

Conclusions

Characteristics and behavior of elderly people with type 2 diabetes mellitus among the five groups of studies were as follows: the 'No Smoking'; 'Ex-Smokers';' smoker 1-12 cigarettes/day;' Smokers 13-24 cigarettes/day and smoker above 24 cigarettes/day. Approximately 70% of men that catagorised as 'Ex-Smokers'; 'smoker 1-12 cigarettes/day' and 'Smokers over 24 cigarettes/day' had an average age that quite similar one to the other. The proportion of gender was different among the five groups. Women (about 65%) were in a 'No Smoking' and 'Smoker with 13-24 cigarettes/day' groups, the remaining groups were men (for about 70%). Two-thirds of the elderly, in this study, were in the lower educated and socioeconomic groups on all cigarettes's categories. 55% of them were lack in utilizing health services. 30-40% of these elderly had the nutritional status that categorised as overweight and obesity, although the their intake towards fat were low. The vegetables that consumed by elderly were very low, and they were also lack of regular activity (exercise).

The results of multivariate analysis showed that the smoker who smoked more than 24 cigarettes per day had bigger risk in getting chronic complications of type 2 diabetes of 2.35 times compared with non-smokers (95% CI OR; 1.5 to 3.7) and smokers who only smoked 1-12 cigarettes per days; smoker who smoked 13-24 cigarettes per day smokers had greater risk in getting chronic complications of type 2 diabetes by 1.32 and 1.64 times (respectively) compared with non-smokers. As former smokers remain, they still had higher risk in getting type 2 diabetes chronic complications of 1.66 times compared with non-smokers.

Promotive effort, such as providing precautions information regarding the elderly with type 2 diabetes might be necessary. There are somc actions that need to be enforced for instance periodically check the health condition (such as weight, waist circumference, blood pressure, and blood sugar levels), reduce the cigarette smoke, perform physical activity regularly, calorie balanced with healthy diet, have plenty of rest, and control the stress. Educational objectives fromthese actions are the elderly and their families, with understandable delivery. Elderly with type 2 diabetes complications should control their weight, have light exercise regularly, and avoid smoking.

Therefore, the government needs to provide special policy that can enhance the elderly or pre elderly patients with type 2 diabetes in particular, thus the number of chronic complications can be reduced, which

of course, it would also reduce the economic, mental and social burden for the elderly as well as for the families, neighborhoods and government. The high rate of elderly with type 2 diabetes complications, poor access for elderly to utilize health facilities and treatment received by the elderly that can lead to excessive drug consumption, developing an integrated treatment system between physicians, prescribers, pharmacy, health facilities nearby as well as patient and family can be one of the strategic interventions for this issues.

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