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# CONTRIBUTION OF LIFESTYLE AND OBESITY TO THE INCIDENCE OF PRE-DIABETES

Abstrak :

*Impaired glucose tolerance (IGT) is defined as an early phase of Diabetic Type-2 process. IGT shows an occurrence of early phase of Diabetic and asymptomatic. The prevalence is increased in accordance to poor or unhealthy lifestyle such as over consuming of carbohydrate and lack of physical exercises. The aim of the study was to analyze the correlation between lifestyle and individual with obesity, obesity and pre-diabetic, and lifestyle with pre-diabetic. The study was conducted at the Kassi-Kassi Community Health Center in Makassar from May to July 2009. The study was a case control study. The number of samples was 54 people selected by purposive sampling. The samples were divided into 27 pre-diabetic individuals and 27 individuals with normal blood glucose. The data were collected through structured interview and questionnaire. The measurement of height, weight, waist circumference, blood pressure, and blood samples was done twice after fasting 12 hours for fasting blood glucose and oral glucose tolerance test. The data were analyzed by using univariate, bivariate with chi square, and independent t-test and Mann-Whitney test. The result of the study indicate that there is a correlation between lifestyle and obesity in which p = 0,018, obesity and pre-diabetic in which p = 0,003. Lifestyle has a role in the incident of pre-diabetic in which p = 0,021. In conclusion, lifestyle has been proved affecting pre-diabetic event through obesity. This research shows a correlation between lifestyle and obesity, and also connection between obesity and pre-diabetic incident.*

Keyword :

*lifestyle, obesity, pre-diabetes*

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# CONTRIBUTION OF LIFESTYLE AND OBESITY TO THE INCIDENCE OF PRE-DIABETES

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## ABSTRACT

*Impaired glucose tolerance (IGT) is defined as an early phase of Diabetic Type-2 process. IGT shows an occurrence of early phase of Diabetic and asymptomatic. The prevalence is increased in accordance to poor or unhealthy lifestyle such as over consuming of carbohydrate and lack of physical exercises. The aim of the study was to analyze the correlation between lifestyle and individual with obesity, obesity and pre-diabetic, and lifestyle with pre-diabetic. The study was conducted at the Kassi-Kassi Community Health Center in Makassar from May to July 2009. The study was a case control study. The number of samples was 54 people selected by purposive sampling. The samples were divided into 27 pre-diabetic individuals and 27 individuals with normal blood glucose. The data were collected through structured interview and questionnaire. The measurement of height, weight, waist circumference, blood pressure, and blood samples was done twice after fasting 12 hours for fasting blood glucose and oral glucose tolerance test. The data were analyzed by using univariate, bivariate with chi square, and independent t-test and Mann-Whitney test. The result of the study indicate that there is a correlation between lifestyle and obesity in which p = 0,018, obesity and pre-diabetic in which p = 0,003. Lifestyle has a role in the incident of pre-diabetic in which p = 0,021. In conclusion, lifestyle has been proved affecting pre-diabetic event through obesity. This research shows a correlation between lifestyle and obesity, and also connection between obesity and pre-diabetic incident.*

*Keywords: lifestyle, obesity, pre-diabetes*

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## INTRODUCTION

Changes in lifestyle (lifestyle) people now because of urbanization, westernization, modernization as a risk factor for diabetes (Tandra 2008, Arifin 1995). Diabetes is not felt by the patient at an early stage so it is not known earlier and was diagnosed after complications arise (Alberti 1996, ADA 1998). These complications will decrease the quality of life and productivity of a person who experienced it (Tjokroprawiro 2001). Disturbed Glucose Tolerance (IGT) are pre-diabetic stage, which is a phase in the course of type-2 diabetes. Basic and clinical research has been published indicate that the phenotypic diabetes can be described as a state that resembles the "iceberg phenomenon" (Lawrence et al. 2004). This is evident in developing countries the diagnosis of DM was found only one patient out of 5 people who should have DM (Darmono 1996). The prevalence of diabetes is increased if there is an increasing environmental risk, such as the lifestyle of excessive carbohydrate consumption habits and less physical exercise, so that experienced excessive weight gain, sedentary life (life relaxed), smoking and alcohol. And the risk of diabetes will increase if age over 40 years. (Irawan 2004, Tandra 2008). Obesity and physical inactivity was found as a major risk factor for type 2 diabetes, and 80 to 90% of diabetics are those who are overweight or obese. In people who have a genetic predisposition, the possibility/probability of getting type 2 diabetes would be very high if combined with lifestyle factors (Lindstrom 2006).

Type 2 diabetes that usually develops slowly and gradually to be identified. When genetic factors support the individual or someone gets insulin resistance relate to environmental factors such as obesity and inactivity, they may be exposed to post-prandial Hyperglycemia or commonly referred to as impaired glucose tolerance (IGT/IGT). IGT is a pre-diabetic stage. Finally, the capacity of beta cells is insufficient for insulin resistance to compensate happened, worsening hyperglycemia and diabetes will occur. It has been estimated that at the time of clinical diagnosis of type 2 DM, only about 50 to 60% of capacity remaining pancreatic beta cells, associated with a fact that the disease process has been around for more than 10 years. Therefore, the optimal strategy to reduce the impact of type 2 diabetes is primary prevention, namely to avoid increasing glucose intolerance before the adverse effects of hyperglycemia become permanent. The main facts for the prevention of type 2 diabetes is supported at the same time preventing or delaying the occurrence of

complications of type 2 diabetes include cardiovascular disease. Based on studies that showed that diabetes increased the risk of death occurs at age 65-74 years (Lindstrom 2006).

The prevalence of DM in the world has increased so that it can be considered as a plague epidemic, which in 2000 predicted a world population of 150 million people suffer from diabetes in 2020 and is estimated to 300 million people. Which greatly increased the prevalence rate is estimated in developing countries such as China, India, including Indonesia (Adam 1998). The prevalence of diabetes worldwide was 7.5%, while prevalence in Southeast Asia show a figure of 13.2% with an estimated prevalence of patients who are in IGT status was approximately 17.1% - 25.8% or about 93 million people (Lawrence et al. 2004).

Recent clinical study reported that changes in lifestyle and/or approach to pharmacotherapy in individuals with IGT can reduce the risk of incident diabetes (Lawrence et al. 2004). Intervention lifestyle changes such as low-calorie foods, low fat and aerobic exercise to lose weight and improve insulin sensitivity and reduce the risk of diabetes (Warnken et al. 2005, Mercola 2005). Research shows that the benefits of exercise in people with diabetes can lower blood glucose, insulin sensitivity alter or enhance the ability of cells to respond to insulin, strengthens the heart, increase muscle and reduce fat and prevent the effects of diabetes (Mercola 2005, Mirkin 2007). Regular exercise is very important and helps a person to control blood glucose levels and increasing HDL and cholesterol. Less exercise, poor diet, smoking and alcohol users are intimately associated with an increased risk of diabetes (Hu et al. 2001). This study aims to analyze the relationship of individual lifestyle and obesity; analyze the relationship between obesity and the incidence of pre-diabetes, and analyze the role of lifestyle on the incidence of pre-diabetes.

**MATERIALS AND METHODS**

Subjects were individually pre-diabetes mellitus and normal blood sugar levels are selected by purposive sampling method of selecting samples that meet the inclusion criteria with a sample of 54 people. The sample is divided into 27 individual pre-diabetes and 27 individuals with normal blood sugar. Patients willing and fill out the informed consent, sex men aged 30-65 years, subjects were excluded if it does not follow all procedures for laboratory examination and measurement of BB, TB, TD and LP, individuals who are using steroids, an individual who is experiencing problems kidney function, liver function, patients with asthma and

diabetes mellitus. This study was approved by the Ethics Committee of the Medical Faculty of Hasanuddin University, and all subjects requested approval to participate in the research.

Completion of questionnaire by direct interview, conducted by a team that had previously been trained about personal biographical data, lifestyle. Previous questionnaires had been tested for validity and reliability. All the selected samples were measured by trained teams of 5 persons including measurement of BB, TB, TD. Measurement of body weight using digital scales and measuring microtoise height, BMI with the formula weight/(TB) 2, TDS and TDD using the mercury sphygmomanometer, with a tape measure waist circumference.

For blood sampling laboratory tests performed by officers subject Prodia laboratory. Previously, individuals were told to fast for 12 hours from 20:00 to 08:00 hours local time. Blood sampling in the folds of the elbow (median cubital) 2 times. First taken 6 cc for checking fasting blood sugar (GDP) in the next two 3cc for blood sugar 2 hours after drinking the sugar water (glucose) 75 grams dissolved in a glass of water (250cc). Criteria for obesity by calculating BMI according to the Asia namely Obesity: $\geq 25.0$, abnormal waist circumference for men $\geq 90$ cm. TD High:? 130/85 mmHg. Pre-diabetes is an early stage of diabetes mellitus is the condition of the individual with the results obtained GDPT: 100-125 mg/dl and/or IGT: 144-179 mg/dl.

Statistical analysis using SPSS for Windows version 14.0, with significance level (significance) which used p <0.05. General descriptive univariate analysis method to calculate the minimum, maximum, mean or median and standard deviation, and frequency. Analysis of the relationship of individual lifestyle and obesity are used chi-square test. Based on the results of chi-square test, as one of the conditions to the merger of the cell. The difference between the role of lifestyle and obesity on the incidence of pre-parametric test was used to diabetes independent t-test for normally distributed parameters, whereas the normal distribution is not used non-parametric test Mann-Whitney test.

**RESULTS**

Research subjects numbered 54 people comprising 27 individual pre-diabetes and 27 individuals with normal blood sugar. A mean age of respondents in pre-diabetes group was 45 years (SD = 30-65). Of the 39 respondents with BMI in obese category, 29 (74.4%) of respondents have a lifestyle with a category quite well and there

were 10 (25.6%) of respondents have a lifestyle with excellent category. And of the 15 respondents with normal BMI, there were 6 (40%) of respondents have a pretty good lifestyle by category and there are 9 (60%) of respondents have a lifestyle with excellent category (Table 1). Based on this, there is significant correlation between the Lifestyle with Body Mass Index (BMI) with the significant value of 0.018 and OR = 4.35 which means that respondents with the lifestyle is good enough to have the possibility of 4.35 times for obese compared with respondents who have a lifestyle very good.

Table 1. Correlation between lifestyle and obesity

| | Body Mass Index (BMI) | | | | | |
| | Obesity | | Normal | | p | OR |
| | n | % | n | % | | |
| Lifestyle | | | | | | |
| Good enough | 29 | 74.4 | 6 | 40 | | |
| Very good | 10 | 25.6 | 9 | 60 | 0.018 | 4.35 |
| Total | 39 | 100 | 15 | 100 | | |

Source: primary data, 2009

In the group of pre-diabetes is a lifestyle with the highest frequency category that is good enough 20 (74.1%) and in the highest frequency of normal blood sugar is pretty good lifestyle by categories namely 14 (51.9%). While based on the parameters of BMI with the incidence of pre-diabetes are at the highest frequency of pre-diabetes are obese BMI category of 15 (55.6%) and in normal blood sugar group frequency is the most obese BMI category of 12 (44.4% ) (Table 2).

Table 2. Cross-tabulation on the role of lifestyle in pre-diabetic incidence.

| | Pre-Diabetic Incidence | | | |
| | Pre-diabetic | | Normal | |
| | n | % | n | % |
| Lifestyle | | | | |
| Less | 1 | 3.7 | 0 | 0 |
| Enough | 20 | 74.1 | 14 | 51.9 |
| Very Good | 5 | 18.5 | 13 | 48.1 |
| Perfect | 1 | 3.7 | 0 | 0 |
| Body Mass Index (BMI) | | | | |
| Obesity | 15 | 55.6 | 12 | 44.4 |
| Pre-obesity | 7 | 25.9 | 5 | 18.5 |
| Normal | 4 | 14 | 7 | 25.9 |
| BMI less | 1 | 3.7 | 3 | 11.1 |
| Total | 27 | 100 | 27 | 100 |

Source: primary data, 2009

Of the 25 respondents with pre-diabetes, 20 (80%) of respondents have a pretty good lifestyle by category and

there were 5 (20%) of respondents have a lifestyle with very good categories. And of the 27 respondents with normal blood sugar, there were 14 (51.9%) of respondents have a pretty good lifestyle by category and there were 13 (48.1%) of respondents have a lifestyle with excellent category (Table 3).

Table 3. Correlation between lifestyle and obesity with pre-diabetic incidence

| | Pre-Diabetic Incidence | | | | | |
| | Pre-diabetic | | Normal | | p | OR |
| | n | % | n | % | | |
| Lifestyle | | | | | | |
| Enough | 20 | 80 | 14 | 51.9 | | |
| Very Good | 5 | 20 | 13 | 48.1 | 0.033 | 3.714 |
| Total | 25 | 100 | 27 | 100 | | |
| BMI | | | | | | |
| Obesity | 22 | 81.5 | 17 | 63 | | |
| Normal | 5 | 18.5 | 10 | 37 | | |
| Total | 27 | 100 | 27 | 100 | | |

Source: primary data, 2009

Based on this, there is significant correlation between the incidence of lifestyle with pre-diabetes with significant value of 0.033 and OR = 3.714, which means the respondent with the lifestyle is good enough to have 3.71 times likely to have pre-diabetes as compared with respondents who have a very good lifestyle. Meanwhile, out of 27 respondents with pre-diabetes, 22 (81.5%) of respondents have a BMI with obesity and there is a category 5 (18.5%) of respondents have a normal BMI category. And of the 27 respondents with normal blood sugar, there were 17 (63%) of respondents have a BMI with obesity category and there were 10 (37%) of respondents have a normal BMI category.

Table 4. The role of lifestyle on the incidence of pre-diabetes

| Parameters | Pre-diabetes (n = 27) | Normal blood glucose (n=27) | p |
| | Mean ± SD | Mean ± SD | |
| Lifestyle | 49.78 ± 12.98 | 42.7± 12.59 | 0.021 |
| Body mass index | 25.91 ± 3.23 | 23.89 ± 3.55 | 0.033 |

Source: primary data, 2009

The mean of lifestyle in pre-diabetic group was 49.78 ± 12.98 and the average lifestyle in the normal blood sugar group was 42.7 ± 12.59. While the mean BMI in pre-diabetic group was 25.91 ± 3.23 and the mean BMI in the normal blood sugar group was 23.89 ± 3.55 (Table 4). Based on this, found significant value p = 0.021 and p = 0.033 on the parameters of lifestyle and body mass index (BMI), which means that there are

differences in lifestyle and body mass index (BMI) was significant between groups of pre-diabetes with normal blood sugar group.

## DISCUSSION

Statistical analysis showed that there was a significant correlation between lifestyle and obesity, with a significance value of $p = 0.018$. There are 29 individuals (74.4%) pre-diabetes with lifestyle quite well but there were obesity, researchers assume this is related to lifestyle modernization or Westernization. They are less aware of the impact of poor lifestyle habits including factor "eat" (diet) who still loves to eat fried *coto* and coupled with a lack of physical activity as much as 8 people (29.6%) did not work on pre-diabetic individuals. This will lead to obesity, and travel along the same pre-diabetes occurs without symptoms. This is in line with the results of research that there are some experiments that have shown the effects of lifestyle westernization/modernization of the increase in obesity and type 2 diabetes. A group of residents/community in Arizona has a 5-fold prevalence of type 2 diabetes than those who live in mountainous areas of Mexico (Lindstrom 2006).

Lifestyle or life style is the behavior and habits in one's life, which can affect one's health level (Nieman 1993). Lifestyle bad, one of them is a lack of physical activity, "overeating" excessive diet "that will eventually lead to obesity. This is consistent with the result that the researchers obtain a mean BMI $25.91 \pm SB \pm 3.23$ which indicates that the average individual has undergone obesity, and as many as 15 people (55.6%) occurred in group pre-diabetes. The result of the data showed that individuals with lifestyle pretty well have the possibility of 4.35 times for obese compared with respondents who have a very good lifestyle.

Research by Vyhnankova (2009) showed that after undergoing the process of weight loss through diet and physical activity involvement showed changes in glucose and lipid metabolism, diabetic patients are obese. In addition, age also influences the occurrence of pre-diabetes that begins with obesity, according to research, researchers in an average age of individuals who have pre-diabetes is the age of 45 years. This fits the theory that the process of pre-diabetes screening begins at age 30 years and more are at risk with a family history of heart disease, stroke or diabetes. Age 45 years is also a risk factor for pre-diabetes occurs as well as diabetes (Arora 2007). These results are supported also by the results of research in 1992 with a population-based sample of 2087 people aged 45-64 years in three geographic areas in Finland with the oral glucose

tolerance using WHO standard. As a result, the total prevalence of diabetes is approximately 10.2% of men and 7.4%, and female. In addition, 44% from the previous prevalence of diabetes cases are undiagnosed. In studies in 2004-2005 at three hospitals in Finland, the prevalence of diabetes were identified in men aged 45-74 by 7.4% and 4.3% in women, and the prevalence of undiagnosed DM 8.8% male men and 6.9% of women on the basis of WHO criteria in 1999 (Lindstrom 2006).

Based on the results of bivariate analysis that the lifestyle associated with obesity, researchers assume that not only one of the factors like physical activity or diet alone that play a role in the incidence of pre-diabetes through obesity is still there However the other lifestyle factors such as smoking, alcohol, lack of rest, impaired psychological, eating snacks, drinking coffee may affect lifestyle. If these factors are not balanced among the causes that trigger the occurrence of bad lifestyle that will be at risk of becoming obese pre-diabetic individuals. This is supported by previous studies, the average American sweetened with high fructose syrup and high consumption of soft drinks can cause an artificial fructose intake in high amounts, which can lead to disruption of fat and glucose metabolism. Fructose can increase the risk of DM, also indirectly via increased body weight (Lindstrom 2006). This is in line with the results of research Bray (2009) that if the consumption of fructose sweetener found in soft drinks is increasing, while their milk consumption reduced, it will cause obesity.

Statistical test results also show that there is a link obesity with the incidence of pre-diabetes. Obesity in pre-diabetic group were 22 persons (81.5%) with average BMI indicator 25.91. This proves that obesity occurs because of an unhealthy lifestyle performed on the individual and can cause individuals to become pre-diabetic. Results showed individuals with lifestyle enough to have the possibility of 4.35 times for obese compared with individuals who have a very good lifestyle.

BMI was associated with the occurrence of pre-diabetes is supported by previous research. Type 2 diabetes mellitus have the highest prevalence among populations with high rates of obesity. In a study conducted by a group of nurses, the risk for women diagnosed with diabetes during follow-up of 14 years was 5-fold in BMI 24.0-24.9 kg/m2, 40-fold in BMI 31.0-32.9 kg/m2 and 93-fold in BMI above 35 kg/m2 compared with the group below 22.0 kg/m2 BMI. The amount of waist circumference was found more have a close relationship with insulin resistance and cardiovascular risk factors compared with BMI. In epidemiologic prospective study has been conducted by several researchers, waist

circumference is one independent predictor of the risk of type 2 diabetes mellitus (Lindstrom 2006).

Researchers assume that the result of sedentary lifestyle that is relaxed lifestyle lead to central obesity according to the researchers that the results obtained are not normal waist circumference> 90 cm in as many as 16 people (59.3%) in pre-diabetic individuals. Jaana Lindström (2006) states that the factors predisposing to the occurrence of abdominal fat accumulation is influenced by genetic factors, but lifestyle factors are also very influential. Smoking was found to increase the accumulation of fat, as well as high alcohol consumption and low consumption of fiber.

Statistical analysis showed that there is a relationship role of lifestyle on the incidence of pre-diabetes, with p = 0,021. In pre-diabetes group there are 20 individual lifestyle enough, because their lifestyle is less healthy, which is still lack of exercise, is still eating at midnight, like snacks, fried foods, coffee, smoking. This is in line with the results of the study by Breslow (UCLA, USA), on the famous study of 6000 people at the beach area of San Francisco, found a very dramatic difference to the average death rate among those who follow the seven healthy habits (no smoking, consumption alcohol a little, eat breakfast every day, do not eat a snack, 7-8 hours of sleep per night, exercise/exercise routine, and maintaining ideal body weight) and those who do not. People who follow all the seven healthy habits have on average a lower death rate than people with no more than three healthy habits. Dr. Breslow has estimated that people who follow all the seven habits of healthy living with an average of 9 years longer than did not (Nieman 1993).

Research conducted by Tuomiletho, et al (2001) conducted a study of 522 adults was found that the intervention group (which apply a good lifestyle) cumulative incidence of diabetes is lower than the group not intervened, he got it after doing the study for 4 years ahead and see how much influence the lifestyle in preventing the occurrence of DM. During the intervention we found a decreased risk of DM by 58% in the intervention group (p <0.01). In addition, to the intervention group, found the occurrence of weight loss. There was significant and linear relationship between the decrease in the incidence of diabetes with lifestyle application.

Frank, et al (2001) studied 84,941 female nurses for 16 years to identify the influence of lifestyle on the incidence of DM. He then getting around 3300 cases of type 2 diabetes and found those who have diabetes have a bad lifestyle, excess weight, lack of physical exercise, poor diet and use of cigarettes and alcohol, 91% of new cases of diabetes experienced by the sample who have a habit and poor lifestyle. Research conducted by Kazue and Toshiro (2005) prove the influence of lifestyle education to the decrease of plasma glucose 2 hours, which serves lower the risk of type 2 diabetes. This research was conducted during one year, and researchers gain a decrease of plasma glucose in the sample who have a good lifestyle compared with the control group which he researched. Epidemiological studies show that type 2 diabetes arise from the interaction between genetic predisposition and lifestyle factors. This is supported by Bazzano (2002) which states that some factors affecting sensitivity and insulin resistance include obesity, lifestyle, diet and genetics.

In a study conducted by O'dea, he tried to change the lifestyle group of Australian aborigines to hunt lifestyle and as a result, hyperglycemia can be prevented and reduced. Therefore, based on various studies above, it can be assumed that lifestyle changes can prevent the development of DM (Lindstrom 2006). Research conducted by Paul et al (2007) of a sample of over 25 years to get evidence that there is influence of lifestyle in reducing new cases of Diabetes Mellitus, in those who have a good lifestyle, the incidence of the DM less appeal in a distinguished group who have a bad lifestyle.

In accordance with the theory that the condition of obesity are intimately associated with insulin resistance. In obese adipocytes will experience dysfunction, inflammation, or known as "sick fat cells". Tues adipocytes are cells that actively remove various components such as leptin, adiponectin, free fatty acid (FFA), various cytokines and other lipoproteins, TNF?, IL-6, CRP (C reactive protein) as a marker of inflammation in the liver and stimulates the occurrence of resistance insulin. ALB concentrations increased in the circulation caused by increased lipolysis process. The process is strongly influenced by the presence of the enzyme Hormone Sensitive Lipase (HSL) in adipose cells. Currently it is known that ALB is a pathogenic factor for the development of type 2 diabetes. Increased FFA can cause insulin resistance in skeletal muscle, liver and endothelial cells (Boden 2004). ALB is decreased and the state of insulin resistance will improve the process of lipolysis. Increased FFA in the long term is one of the causes of insulin resistance. It is proved that with the decrease in FFA levels can increase insulin sensitivity in obese subjects with diabetes (Boden 2004, Evans et al. 2004, Khaterine et al. 2004).

Increased FFA in muscle and liver would interfere with insulin signaling that may lead to intake (uptake) impaired glucose. As a result of increased FFA will cause an increase Fatty Acid CoA in muscle and liver

cells, which in turn increases the activity of protein kinase C (PKC) through increased diacylglycerol (DAG). Increased PKC activity increases the phosphorylation of serine and tyrosine phosphorylation reduces the Insulin Receptor Substrate-1 (IRS-1). The situation is the background of insulin resistance in muscle and liver (Boden 2004, Evans et al. 2004, Khaterine et al. 2004, Kadowaki et al. 2003). The decrease in insulin sensitivity can also be an increase in insulin secretion of pancreatic beta cells that causes the pancreas becomes exhausted and unable to produce insulin, eventually going destruction of pancreatic ß cells, which is a journey into pre-diabetes and diabetes (Guyton 2007). Alcohol intake seems to have a protective effect when consumed in portions, but may increase the risk of diabetes when the high consumption. High intake of meat products, it was found to have a relationship with a high risk of DM (Lindstrom 2006).

Research by Hanoten, K.A. et al (2009) found the relationship between coffee consumption and increased risk of DM. In addition, the postprandial study found that caffeine may damage the glucose tolerance. However, coffee is only a little effect on glucose and insulin resistance. In some studies, have shown a change from traditional diet to a Western diet has resulted in increased incidence of type 2 diabetes mellitus (Lindstrom 2006). Physical activity is less risky to the occurrence of pre-diabetes or type 2 diabetes. This is in line with previous research, observational study of 1467 men and women with normal conditions and have impaired glucose tolerance/DM indicate lifestyle-related physical activity is clearly related to the existence of insulin sensitivity. The study further states that a person walking over 10,000 steps each day, blood sugar levels within normal limits and the obese will lose weight if followed by heavy exercise. Magnetic resonance imaging (MRI) showed that people who walked 45 minutes every day will burn 20% more fat, improve the ability of muscle to store glucose (Kahn 2008).

Bell (2002) in his article proves the effectiveness of aerobic exercise in preventing cases of diabetes mellitus type 2, by running the program "First Step Program" is a sample daily aerobic exercise by walking every day and the number of steps is calculated by using a pedometer. Every day, the samples do 10,000 steps. The result is approximately 58% of the sample who do aerobic exercise the incidence of diabetes was lower than other groups. Various evidences have been found that type 2 diabetes can be prevented with lifestyle modification. Not only that, also found that weight loss is also one factor predictors of decreased risk of type 2 diabetes mellitus. The existence of preventive programs through increased physical activity and physical exercise aimed

at weight loss, this has been applied in America and proved as a program that is far more cost effective (cost effective) (Marrero 2009).

Various studies have shown the strong influence of physical activity levels with the incidence of Diabetes Mellitus. Cardiovascular fitness level is one predictor of excess mortality due to diabetes type 2 (Bell 2002). Physical exercise may increase tissue sensitivity to insulin. Based on cohort studies, found that those who perform regular physical exercise have a lower risk of about 35% get type 2 diabetes disease compared their low activity level (Bazzano 2004). Based on retrospective studies (case control) done Kriska (1993) against an entire community of Indians, found that those who are affected by diabetes, having traced proved to have low levels of physical activity.

Various studies suggest aerobic exercise as a type of activity to prevent diabetes. Aerobic exercise is a type of exercise that requires greater muscle work, such as walking, running, and riding a bike. For the purpose of improving insulin sensitivity and glucose intolerance, several studies have advocated high-intensity exercise than low intensity, because it has more influence on changes in body metabolism (Kriska 1993). Clinical trial of diet and exercise can reduce adverse events in people with type 2 diabetes with Impaired Glucose Tolerance (IGT) (Lawrence et al. 2004).

Regular physical activity will increase life expectancy by reducing the effects of heart disease, obesity and diabetes. Healthy habits are very clearly identified as factors that affect the very strong against life expectancy and quality of life during old age (Nieman 1993). In addition, the risk factors that can cause type 2 diabetes is the consumption of vitamin D and calcium or dairy consumption, according to research by Pittas (2009) showed that the relationship between the state of vitamin D levels, low calcium intake or dairy consumption is less with the incidence of DM type 2.

Thus, lifestyle contribute to the occurrence of pre-diabetes, so that every individual should make healthy living habits such as not smoking, no alcohol consumption, breakfast every day, do not eat snacks, reduce the consumption of soft drinks and fruit drinks, consumption of vitamin D, milk consumption or calcium, enough (7-8 hours of sleep per day), training/exercise routine, and maintaining an ideal weight so as to prevent the occurrence of pre-diabetes or diabetes mellitus which can increase life expectancy and quality of life. Routine activity can provide the following benefits: lower blood glucose levels, lower basal insulin levels, improve insulin sensitivity, lower

HbA1c, increasing energy use, increase strength and body flexibility.

## CONCLUSION

Lifestyle is shown to play a role on the incidence of pre-diabetes through obesity. This study shows that there is a relationship with obesity and lifestyle. There is also a relationship of obesity with the incidence of pre-diabetes.

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