THESIS

THE DETERMINANTS OF THE DEVELOPING TYPE 2 DIABETES MELLITUS AND THE PREVENTION MODEL IN SURABAYA

BY:

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UNIVERSITAS AIRLANGGA
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PROGRAM MAGISTER
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THESIS

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SUMMARY

This study is observational analysis study by using a case control approach for identifying, and analysis the potential association between the determinant factors of developing of type 2 diabetes mellitus diseases among Surabaya population. Surabaya is capital city of East Java province, and also is the second largest city in Indonesia, after Jakarta. The study was conducted in the primary health care centers in 2016. Type 2 is the commonest form of diabetes affecting more than 90% of the diabetic population worldwide. Type 2 diabetes mellitus is one of the largest global health emergencies of the 21st century worldwide and major public health problems particularly in Asia, Specifically in Indonesia and east java furthermore in Surabaya, Each year more and more people live with this condition which can result in life changing complications. Diabetes was appeared at all ages and in all ethnic groups and has been found in virtually all parts of the region from East, West, North, South, and also in the Center of Surabaya. The objectives of this study was to analysis the potential association between the determinant factors that may be occurred developed type 2 diabetes mellitus diseases among the Surabaya population, such as the socio demographics, genetic (family history of DM), biological, behavioral and diet factors attempting to enhance the prevention efforts to reduce the burden of type 2 diabetes complications in this city. The study included 100 participants 50 cases randomly selected among patients with T2DM diseases and 50 controls randomly selected among patients without T2DM diseases from recruited from the patient

attendants at 5th PHCs randomly selected from the whole PHCs of Surabaya (5th PHCs out of 62 PHCs), which includes; wonokosumu, lontar, jagir, peneleh, and pacar keeling. A questionnaire that contained sociodemographic characteristics and risk factors was used for data collection, medical report also used to identify the biological factors. Chi square was performed to find the significance. Simple binary logistic regression and multiple binary logistic regression were performed to find the correlations, using odds ratio (OR) and 80% confidence interval (CI) was calculated to find the significance of the observed OR. A p value <0.05 was considered statistically significant. Matched between age and gender were performed before started collected the data. Study results showed that, 64% females and 36% males in both cases and controls subjects participated in this study. The majority (70%) of study subjects among cases and controls group were elders. The majority 76.0% of cases subjects (n=38) and 64.0% of controls (n=32) of cases belonged to Surabaya they were born there, 92% of cases were more likely to be having low education, 70% of them had low annually income. High statistically association between T2DM and education OR=8.817, 80%CI, 2.803-27.738, (p<0.01), family history of diabetes mellitus OR=4.893, 80%CI, 1.792-13.359(p<0.043), physical inactivity OR=13.722, 80%CI, 4.793-39.288 (p<0.00), BMI OR=6.687, 80%CI, 2.525-17.708 (p<0.012). So education, family history of DM, body mass index, waist circumference, triglyceride, physical inactivity and the carbohydrates intakes were the significance of this finding in this study and it will help greatly in planning the screening, active health education programs and preventive measures in type 2

diabetes mellitus among the Surabaya population. Significant of this finding will help greatly in planning the screening, active health education programs and preventive measures in type 2 diabetes mellitus among the Surabaya population. The screening should preferably be undertaken before 45 years of age and early intervention should start at an earlier age in this region with regarded to increase concerning about the physical activates programs, dietary patterns. A recommendation to the Surabaya people is regular physical activity as well as eating a diet high in fiber to promote a healthy body weight and reduced risk factors for type 2 diabetes mellitus. Adequate physical activity and a healthy diet have a positive effect an individual's BMI.

ABSTRACT

The Determinants of the Developing type 2 Diabetes Mellitus and the Prevention Model in Surabaya

Introduction: Diabetes mellitus is characterized by high levels of blood glucose, late onset of disease and associated with serious complications. Genetic and environmental risk factors are known to exist and the importance of educidating these risk factors in different populations.

Objectives: The aim of this study was to assess the impact of determinant factors that may be developed the type 2 diabetes mellitus such as, family history of DM, (BMI), physical inactivity, diet, educational, urbanization and smoking.

Methodology: A case control study included 50 cases with newly diagnosed type 2 diabetes and 50 non diabetic controls from 5th health care centers in Surabaya, cluster random sample technique used. A specifically designed questionnaire used to collect information on possible risk factors of type 2 diabetes mellitus. BMI was calculated from these measurements. The odds ratios (OR), and 80% confidence interval (80% CI) for type 2 diabetes mellitus will be calculate by a conditional logistic regression.

Results: The result shown that 92% of cases were more likely to be having low education, 70% of them had low annually income. High statistically association between T2DM and education OR=8.817, 80%CI, 2.803-27.738,($p<0.01$), family history of diabetes mellitus OR=4.893, 80%CI, 1.792-13.359($p<0.043$), physical inactivity OR=13.722, 80%CI, 4.793-39.288 ($p<0.00$), BMI OR=6.687, 80%CI, 2.525-17.708 ($p<0.012$), but no any association between the smoking and the disease.

Conclusion:: The results of the present study will be of use in planning primordial, primary and secondary measures of prevention at the community level.

Keyword: Type 2 diabetes mellitus, Determinant factors, case control study, Surabaya

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figures
Pages

LIST OF APPENDIX

Appendix
Pages

ABBREVAIATION LIST

DM : Diabetes mellitus
B-cell : Beta cell
NCDs : Non communicable diseases
USD : United state dollars
PHCs : Primary health care centers
T2DM : Type 2 diabetes mellitus
IDDM : Insulin dependent diabetes mellitus
NIDDM : Non Insulin dependent diabetes mellitus
MRDM : Malnutrition related diabetes mellitus
DNA : Deoxyribonucleic acid
IGT : Impaired glucose tolerance
IR : Insulin resistance
GDM : Gestational diabetes mellitus
OGTT : Oral glucose tolerance
IRS : Insulin receptor substance
UCP : Uncoupling portion
FPG : Fasting plasma glucose
BMI : Body mass index
HDL : High density lipoprotein
LDL : Low density lipoprotein
HTN : Hypertension
NLD : Necrobiosis lipodica diabeticorum
DKA : Diabetes ketoacidosis
MODY : Maturity onset of diabetes of the young

INTRODUCTION

1.1 Background

Surabaya is capital city of East Java province, and also is the second largest city in Indonesia, after Jakarta. The majority population in Surabaya is Javanese people, but also there is some ethnic group live in Surabaya such as, Madura, Sundanese, Malay, Arab, and some others are the expatriates. Surabaya has become the Metropolis city with numbers of diversities among the people, cultures, habits and way of living. Moreover, Surabaya nowadays is already become the center of business activities commerce, industry, and education in eastern of Indonesia, and surrounding area. The city has attracted migrants; a large influx of manpower coming from the surrounding areas to work in Surabaya. Most of the population is engaged in services, industry, hotel, restaurant, and trade. The city's annual population growth rate is 0.65 percent, and much of the city's center is densely populated (Haryono, 2007).

People have meals every day, either at home or away from home. As food is a primary need for human beings. In Surabaya, where dining out has increasingly become the metropolitan life style for people spending their leisure time. They are so eager to dine out and try new exciting restaurants in town. As a result, new restaurants are opening regularly. Indeed, in recent years, small and medium food service operators dominate the restaurant business. The rapid growth of food service

establishments in Surabaya attracts people to dining out, although there are many dishes with town names attached to them, (Sienny et al., 2010).

Cuisine in Surabaya is diversity vary greatly by socioeconomic class, tribes, season, and ecological conditions. The famous cuisine in Surabaya includes Javanese, and Madura cuisine; Javanese cuisine is more indigenously developed and noted for its simplicity. Some Indonesians perceive Javanese cuisine as rather sweet compared to other Indonesian dishes, because generous amount of gula jawa (palm sugar) or kecap manis (sweet soy sauce) are ingredients favored by the Javanese. The East Java cuisine is largely influenced by Madurese cuisine too, Madura being a major producer of salt, hence the omission of sugar in many dishes. Many of the East Javanese dishes are also typically Madurese, such as Soto Madura and Sate Madura, usually sold by Madurese settlers (Avian et al., 2011).

Rice is a staple element in most regional cooking and the center of general east java and Surabaya, and is served with every meal .Side dishes of meat, fish, eggs, and vegetables and a variety of condiments and sauces using, chili peppers and other spices accompany rice. Rice can be processed into lontong or ketupat, or cooked in coconut milk, or colored with turmeric as (yellow rice). Other sources of carbohydrate such as tahu telur, rawon, sate ayam Madura, nasi goreng, rindang padang, and consumed by some people in Surabaya. Sweet potato is consumed as snacks in between meals with beverages such as sweet tea or coconut. Also noodles and potatoes are often served as accompaniments to rice. Potatoes are often fried and mashed to be rounded, spiced and fried again coated with battered eggs as perkedel.

Wheat noodles, bihun (rice vermicelli) and kwetiau are influences of Chinese cuisine (Bondan et al., 2016).

The transformation of diets as economic development proceeds, rapid urbanization, migration, changes in the countries and household demographic structure, improvements in education, transportation, communication and marketing infrastructure; could play a role in influencing dietary patterns. Acculturation has also caused family members to increasingly desire fasten food, which is dramatically different than the traditional diet. There have been health problems related to this change in diet, such as, developing type 2 diabetes mellitus. Income can play a big role in most people's diet. In cases of low income, some families turn to food shelters which contain food that is highly processed, cheap prices, and different than the traditional diet such as noodles (Allan, 2007).

People have immigrated to places different from their homeland. This drastic change in environment has forced them to learn how to survive in these new places on what is available to them. Immigration has caused a change in traditional diet, roles in the family, and ways of gaining education. This change in culture has come with consequences such as in the erosion of cultural and dietary traditions; the change in their traditional way of living to an industrialized society may have contributed to increased risk of developing type 2 diabetes mellitus (Haryono, 2007).

The American Diabetes Association Guide to Diabetes Medical Nutrition Therapy and Education listed the major risk factors for type 2 diabetes mellitus as: age >45 years, ethnicity, family history, habitual physical inactivity, overweight (BMI >25

kg/m^2), hypertension (140/90 mm Hg in adults), previously diagnosed impaired fasting glucose or impaired glucose tolerance, HDL cholesterol (< 35mg/dL) and/or triglyceride level (> 250 mg/ dL), polycystic ovary syndrome, and history of vascular disease (Ross, 2014).

Diabetes is a complex group of diseases with variety of causes. People with diabetes have high blood glucose, this diabetes also called high blood sugar or hyperglycemia. The term "diabetes mellitus" describes a metabolic disorder of multiple etiologies; which are environmental and genetic. diabetes mellitus characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defect in insulin secretion, insulin action, or both, a hormone that controls glucose, fat and amino acid metabolism. The effects of diabetes mellitus include long term diseases with variable clinical manifestation and progression. Diabetes is associated with a range of serious complications which result in reduced quality of life and premature mortality. Early detection and treatment is one strategy for reducing this burden (William et al, 2014).

Type 2 Diabetes is defined as chronic hyperglycemia resulting from either decreased insulin secretion, impaired insulin action or both in the absence of autoimmune destruction of the pancreatic beta cell. Classically, type 2 diabetes occurs in the older, obese patients in the setting of strong family histories of diabetes and in association with other components of the metabolic syndrome. The T2DM is characterized by insufficient synthesis of insulin and its secretion, secondary to insulin resistance. It is normally diagnosed after the fourth decade of life, and

accounts for approximately 90% of all diabetes worldwide. The incidence and prevalence of T2DM are found to increase with age. T2DM is divided into two subgroups, diabetes with obesity and without obesity. The obese T2DM patients usually develop resistance to endogenous insulin due to alterations in cell receptors, and this is associated with distribution of abdominal fat. In non obese T2DM there is some insulin resistance at the post receptor levels in addition to a deficiency in insulin production and release since obesity and aberration of metabolic factors are central to the incidence of T2DM, the notable changes in diet and lifestyle in developing countries support the highest prevalence of diabetes occurring in these countries (Kriti et al, 2012).

Type 2 diabetes mellitus is lead to micro vascular diseases, blindness, heart disease, stroke, nerve damage arthrosclerosis, renal complications, amputation of toes, feet or legs, and premature mortality, and medical expenditures, while they reduce employment, productivity, and quality of life, and its typically gradual in onset and occurs mainly in the middle aged and elderly, frequency mild, slow to ketosis and is comparable with long survival is given adequate treatment. Its clinical picture is usually complicated by the pancreas of other diseases processes (Amod et al, 2012).

Type 2 diabetes complex requiring continuous medical care with multi factorial risk reduction, strategies beyond glycemic control. Ongoing patient is critical to preventing acute complications and reducing the risk of long term complications In accordance to World Health Organization (WHO) and the International Diabetes

Federation (IDF) 2003, People with diabetes require at least 2-3 times the health care resources of people who do not have diabetes, and diabetes care accounts for up to 15% of national healthcare budgets. The link between urbanization, sedentary lifestyles, unhealthy eating and rising levels of obesity and type 2 diabetes has been demonstrated universally, and effective prevention of obesity and type 2 diabetes requires a paradigm shift from a patient centered approach to a "whole of government" and a "whole of society" approach. Hence, together with nongovernmental organizations, need to join forces in preventing and combating diabetes. Collaborating partners must effectively work together at all levels of service delivery (Gatineau, 2014).

1.2 Magnitude of the Problem

The burden of type 2 diabetes is increasing globally, particularly in Asia. The international diabetes federation (IDFs) and World Health Organization in 2015 estimates indicate that diabetes now affects 415 million people world-wide, and the number of people with the diseases will increase by the year 2040 to 642 million, yet, with 193 million of cases currently undiagnosed, a vast amount of people with diabetes are progressing towards complication unawares. Moreover, with 80% of the total number affected living in low and middle income countries. The top ten countries/ territories for number of adults with diabetes mellitus worldwide are includes; China (109.6) million, India (69.2) million, United state of America (29.3) million, Brazil (14.3) million, Russian federation (12.1) million, Mexico (11.5) million, Indonesia (10.0) million, Egypt (7.8) million, Japan (7.2) million, and

Bangladesh (7.1) million. The majority of the 415 million people with diabetes are aged between 20 and 79, while the number of people with diabetes and living in urban environment are 269.7 million, and 145.1 million cases are living in rural environment. Furthermore, there are 318 million adults that are estimated to have impaired glucose tolerance, which puts them at high risk of developing the disease by the end of this year. All types of diabetes are on increase; in particular the number of people with type 2 diabetes will increase to (David et al, 2015).

According to international diabetes federation (2015), approximately 35.4 million people, or 9.1% of adults aged 20-79, are living with diabetes in the Middle East and North Africa Region in 2015. Over 40.6% of these are undiagnosed. Although 54.9% of all adults in the region live in urban areas, 67.0% of people with diabetes live in urban environments. The vast majority (83.9%) of the people with diabetes in the region are living in low or middle income countries. The countries with high diabetes prevalence include Saudi Arabia 17.6% and Kuwait 14.3%. The countries also with the largest number of adults with diabetes are Egypt 7.8 million, Pakistan 7.0 million, and Iran 4.6 million. A further, 30.2 million people in the region or 7.8% of the adult population, are estimated to have impaired glucose tolerance and are therefore at high risk of developing diabetes. It is estimated that the number of people with diabetes in the region will double to 72.1 million by 2040 (David et al, 2015).

According to world journal of diabetes, about the prevalence of diabetes in Asia countries, the prevalence estimates of diabetes mellitus , and impair glucose

tolerance (IGT) are high for all Asian countries and are expected to increase further in the next two decades. The present trend indicates that more than 60% of the world's diabetic population will be in Asia. Additionally, Asian countries have undergone rapid economic development, urbanization, and transitions in nutritional status, which may further increase the type 2 DM prevalence. Most DM patients in this area have type 2 DM (90%). The direct economic burden due to type 2 DM among these patients include expenses due to hospitalization, medications, treatment of diabetes complications; the indirect economic burden include decline in social productivity, income loss, disability, transportation expenses for medical care. Of the Asian type 2 DM patients, 30% are estimated to have retinopathy (Ambady et al, 2012).

Diabetes was responsible for 342,000 deaths in 2015. Over half (51.3%) of all deaths from diabetes in the region occurred in people under 60. These early deaths may be the result of a combination of factors: the rapidly changing environments and lifestyles in the region, late diagnoses and health systems that are not equipped to provide optimal management to the increasing numbers of people with diabetes (David et al, 2015).

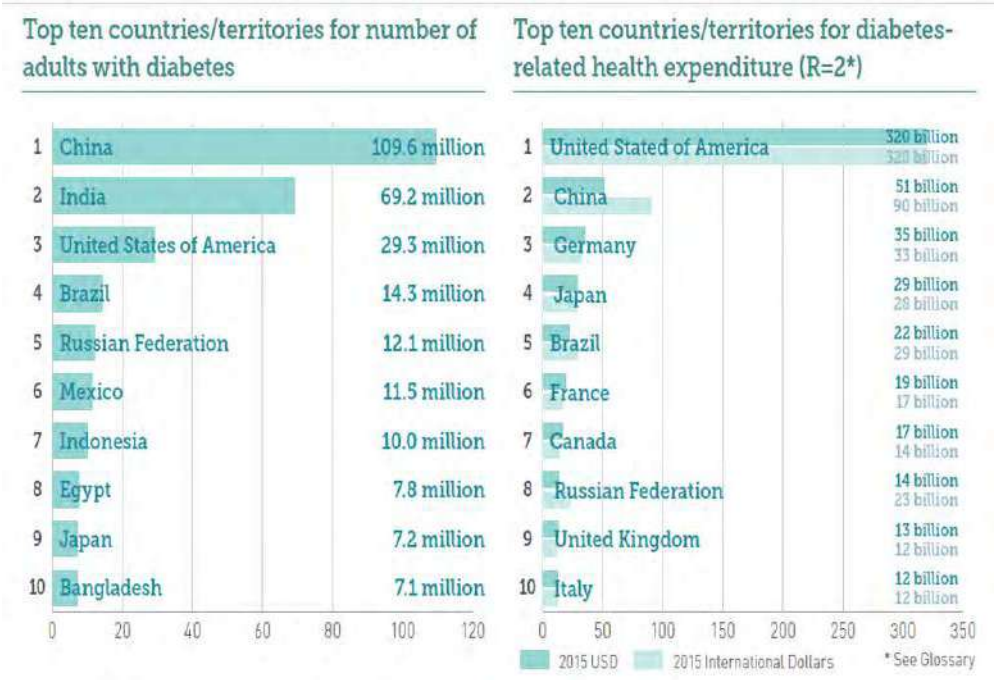
Despite the high estimates of diabetes prevalence throughout the region, a total of only USD17.1 billion to USD27.7 billion was spent on diabetes healthcare in 2015. This is equivalent to approximately 15% of the total health budget. Health expenditure on diabetes in the region accounts for just 2.5% of global spending on the disease. This is expected to almost double by 2040 but will likely not be enough to

adequately treat all people with the disease. The cost of diabetes care is high and increasing worldwide (Elizabeth, 2015).

The young age at onset not only increases the health care burden of treating large numbers of people with type 2 diabetes mellitus, but also increases the morbidity and premature mortality due to diabetic complications. The rate of complications increases proportionally with the duration of diabetes. The economic burden is very high, especially in developing countries, and more so in the lower economic groups, who spend 25%-34% of their income on diabetes care .The cost of care increases substantially when complications occur or when admission to hospital, surgery or insulin treatment is needed (Ambady et al, 2012).

Indonesia is one of the 21 countries and territories of the IDF Western Pacific region and also it is member country of IDF since 1994. While Indonesia is the fourth most populated country with 255,993,674 peoples in 2015, also Indonesia is seventh country with highest number of estimated cases of diabetes in according to international diabetes federation 2015, furthermore There are 10 million people in Indonesia are living with diabetes and this number of people will be top 11.8 million by 2030, while another 12.6 million have pre diabetes. Furthermore there are 5,286.2 of cases of diabetes undiagnosed among the adult population (1000s) in Indonesia. The Prevalence of diabetes in adults population (1000s) (20-79 years) are increase from 5.8 % in 2014 to 6.2% in 2015. The number of deaths in adults due to diabetes are increased also from 175,936 in 2014 to 184,985 in 2015, while the total costs of diagnosed diabetes per person have risen to (USD) 174.7 (David et al,2015).

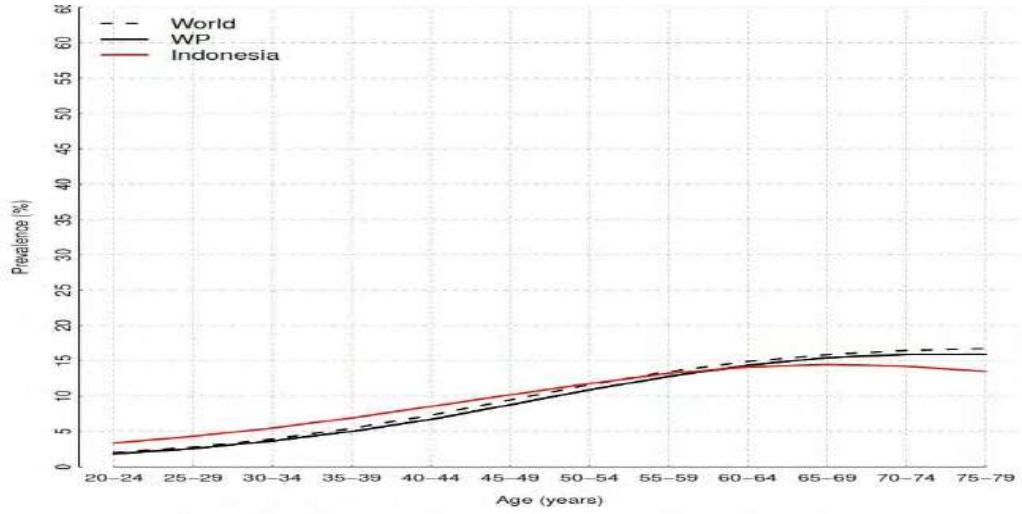
Moreover, fewer than half of those with diabetes are aware of their condition, and the vast majority of those who are aware receive treatment, only less than 1% are achieves treatment targets. Those who remain in rural areas will have the greatest need for high quality treatment from a healthcare system strained by demand for resources and know how. Increasing diabetes rates are often related to an improvement in living standards. As people leave the countryside to perform jobs in the cities, the key diabetes risk factors such as lack of exercise and dietary habits are generally exacerbated. Unfortunately, the disability, loss of life and productivity resulting from the complications from undertreated diabetes may negatively affect the Indonesian economic progress (Leonor, 2013).



Source: (David et al, 2015)

Figure (1.1) The top ten worldwide countries with number of adults affected by diabetes mellitus

Figure (1.1) describes the top ten countries with high level of diabetes mellitus among the adult worldwide; Indonesia is the seventh countries with largest number of adults with diabetes mellitus worldwide in accordance to international diabetes federation 2015.



Source: (David et al, 2015)

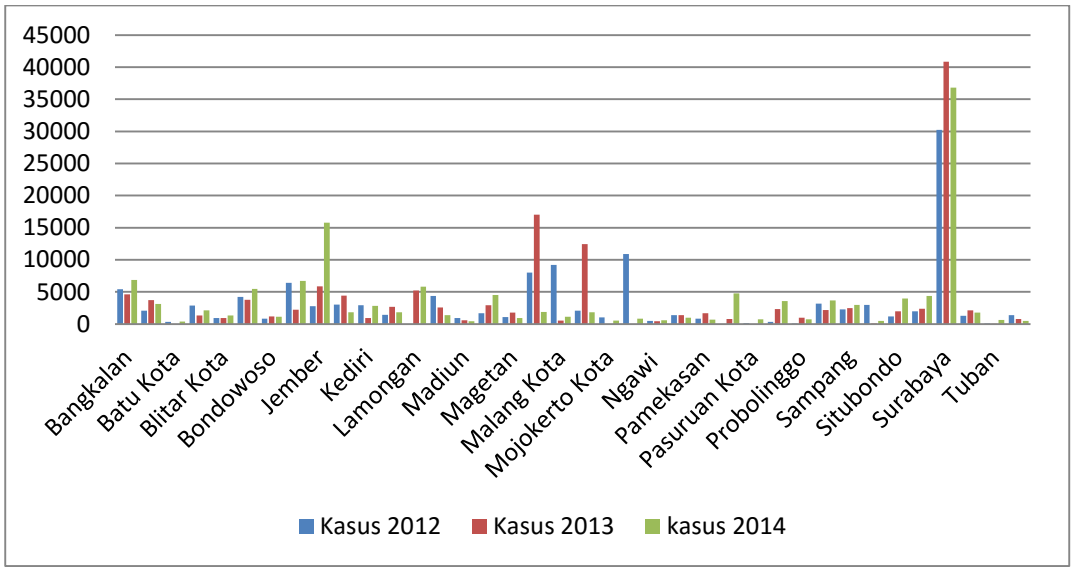
Figure (1.2) The prevalence of type 2 diabetes mellitus among the adults in Indonesia

The figure (1.2) describes the prevalence of diabetes mellitus in which age groups in the population have the highest proportions of diabetes mellitus in Indonesia The prevalence of diabetes mellitus is(3-14)% among (25-59) age group, 17% in(65-79)age group while 7% - 13% among(40-59) age group according to international diabetes federation 2015 (David et al, 2015).

According to ministry of health profile of east java province in (2013), diabetes mellitus is second diseases lead people to treat in the hospital every year; with high hospitalization in the government hospital type A, B and C with. In according to data

of health care centers in east java 2013; East Java province is one of the areas with highest prevalence of DM in Indonesia. The cities with highest number of diabetes in East Java are includes; Surabaya with number of (30219) cases, Nganjuk (10878) cases, Malang city (9196) cases, Malang (5399) cases in 2012(Surabaya Health Department, 2014).

Furthermore Surabaya also recorded as largest city of diabetes mellitus in 2013 with (40843) cases, besides Malang city (17019) cases, Mojokerto (12426) cases, Jember (5883) cases, Lamongan (5209) cases and Bangkalan (4599). In 2014, the recorded recognized that the cities with highest number of diabetets mellitus in wohle East Java are includes; Surabaya with (36801) cases , Jember (15803) cases, Bangkalan with (6852) cases, and Gresik (6723) cases . According to department of health in city of Surabaya, type 2 diabetes mellitus is the top ten diseases that recorded in primary health care in Surabaya in several years, moreover type 2 diabetes mellitus without complication is number 5th with (16,661) cases in December 2014, while non insulin dependent diabetes mellitus with coma become number 10 with 5,970 cases (Surabaya Health Department, 2014).



Source: Ministry of health Surabaya 2014.

Figures 1.3 the distribution of diabetes mellitus in PHCs in East Java (2012 – 2014)

The figure above describes the trend of diabetes mellitus in east java, Surabaya is top city with largest number of cases of diabetes in east java with (30219) cases in 2012, (40843) cases in 2013, and (36801) cases in 2014 according to the ministry of health of Surabaya 2014.

1.3 Formulation of the Problem

Type 2 Diabetes is one of the largest global health emergencies of the 21st century worldwide and Specifically in Indonesia and east java furthermore in Surabaya, Each year more and more people live with this condition which can result in life changing complications. Diabetes was appeared at all ages and in all ethnic groups and has been found in virtually all parts of the region from East, West, North, South, and also in the Center of Surabaya. While diabetes can cause devastating

personal suffering, it is also an economic burden for every people around the region and require continuously healthcare to decrease the complications and mortality in Surabaya. Diabetes killing more people each year than all other causes combined diabetes appears to be increasing rapidly, every six seconds a person dies from diabetes.

1.4 Research Questions

1. What is the association between the determinant factors that may be developed the diabetes mellitus type 2 in Surabaya?
2. How can we enhance diabetes prevention efforts to reduce the burden of diabetes complications in Surabaya?

1.5 Research Objectives

1.5.1 General Objective

To analysis the association between the determinant factors that may be developed the type 2 diabetes mellitus diseases attempting to enhance the prevention efforts to reduce the burden of type 2 diabetes complications in Surabaya.

1.5.2 Specific Objectives

1. To analyze the socio-demographics factors that may be associated with developing type 2 diabetes mellitus in Surabaya.
2. To analyze the genetic factor (family history of diabetes mellitus) that may be associated with developing type 2 diabetes mellitus in Surabaya
3. To analyze the biological factors that may be associated with developing type 2 diabetes mellitus in Surabaya.

4. To analyze the Behavioral factors that may be associated with developing type 2 diabetes mellitus in Surabaya.
5. To analyze the diet factors that may be associated with developing type 2 diabetes mellitus in Surabaya.
6. To explore the suitable prevention model to reduce the burden of type 2 diabetes mellitus complication.

1.6 Research Benefits

The results of this study are expected to provide the institution, researcher and society by new information about the prevalence of diabetes mellitus type 2 in Surabaya, also it may provide them by suitable information related with the study, and it can use as basic research, input for the public health field and may increase student knowledge about the risk of diabetes mellitus and how can manage it in the future. This study may supply of skill, knowledge of recent scientific research. The skills needed to ways, and may help to solve complex problems, also may encourage student for more exploring about the diseases.

Studies about type 2 diabetes mellitus are required to provide a more accurate picture of the prevalence of diabetes; further research will serve as a catalyst for governments and organizations to act with more haste and greater effectiveness to put in place early interventions, improved screening and timely management to reduce the impact of diabetes on the individual and society.

CHAPTER II

LITREATURE REVIEW

2.1 Definition of Diabetes Mellitus

According to international diabetes federation (2015) Diabetes is a chronic condition that occurs when the body cannot produce enough insulin or cannot use insulin, and is diagnosed by observing raised levels of glucose in the blood. Insulin is a hormone produced in the pancreas; it is required to transport glucose from the bloodstream into the body's cells where it is used as energy. The lack, or ineffectiveness, of insulin in a person with diabetes means that glucose remains circulating in the blood. There are three main types of diabetes; type 1 and type 2, and gestational diabetes. Over time, poorly managed of diabetes mellitus, resulting high levels of glucose in the blood (known as hyperglycemia), and it can be causes damage to many tissues in the body, leading to development of disabling and life threatening health complications and early death (David et al., 2015).

The definition of diabetes mellitus that described by American diabetes association 2015 is diabetes refers to disorder of metabolism; the way the body uses digested food for energy. The digestive tract breaks down carbohydrate; sugar and starch found in many foods into glucose, a form of sugar that enters the bloodstream. With the help of hormone insulin, cell throughout the body absorb glucose and use it for energy (William et al., 2015).

Diabetes develops when the body doesn't make enough insulin or is not able to use insulin effectively, or both. Insulin is made in the pancreas, an organ located behind the stomach. The pancreas contain cluster of cells called islets. Beta cells with the islets make insulin and release in to the blood. If beta cells don't produce enough insulin, or the body doesn't respond to the insulin that is present, glucose builds up in the blood instead of being absorbed by cells in the body leading to pre diabetes or diabetes (Albert et al., 2014).

The cause of diabetes mellitus is poorly understood by many people. Changes in diet and life style due to rapid economic development are fore most among the principle drives of diabetes in developing and developed countries. Barring the environmental impact, genetic component plays a vital role for the development of diabetes (Mohan, 2004).

Several pathogenic processes are involved in the development of diabetes. These include processes that impair or destroy the function of the pancreatic beta cells, with consequent insulin deficiency, and others that result in resistance to insulin action (insulin resistance/insulin insensitivity). Abnormalities of carbohydrate, fat and protein metabolism are due to the deficient action of insulin on target tissues, resulting from insensitivity to or lack of insulin, or both. Over time high blood glucose damages nerves and blood vessels, leading to complications such as heart diseases, stroke, kidney diseases, blindness dental diseases and amputations. Other complications of diabetes may include increased susceptibility to other diseases, loss of mobility with aging, depression, and pregnancy problems. No one is certain what

start the processes that causes diabetes, but scientists believe genes and environmental factors interact to cause diabetes in most causes (Ozougwu, 2013).

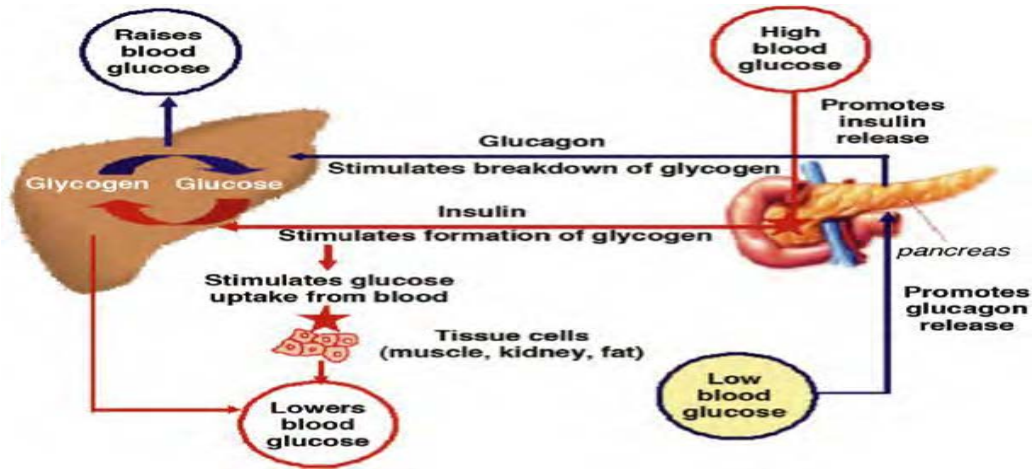
According to international diabetes federation 2015, NIDDM is much more common type of diabetes than IDDM. It is often discover by chance and It is usually occurs in adults, but is increasingly seen in children and adolescents. In type 2 diabetes, the body is able to produce insulin but becomes resistant so that the insulin is ineffective. Over time, insulin levels may subsequently become insufficient. Both the insulin resistance and deficiency lead to high blood glucose levels. Type 2 diabetes mellitus is a complex metabolic disease, primarily characterized by insulin resistance, relative insulin deficiency and hyperglycemia and leading to micro vascular diseases, blindness, nerve damage arthrosclerosis and renal complications. Type 2 diabetes mellitus typically gradual in onset and occurs mainly in the middle aged and elderly, frequency mild, slow to ketosis and is comparable with long survival is given adequate treatment. Its clinical picture is usually complicated by the pancreas of other diseases processes (Maureen et al., 2012).

In adult type 2 diabetes account for about 90% to 95% of all diagnosed case of diabetes. Type 2 diabetes usually begins with insulin resistance, a disorder in which the cells primarily within the muscles, liver and fat tissue do not use insulin properly as the need for insulin rises. The beta cell in the pancreas gradually loses the ability to produce sufficient quantities of the hormones (Albert et al., 2014).

T2DM is divided into two subgroups, diabetes with obesity and without obesity. The obese T2DM patients usually develop resistance to endogenous insulin

due to alterations in cell receptors, and this is associated with distribution of abdominal fat. In non obese T2DM there is some insulin resistance at the post receptor levels in addition to a deficiency in insulin production and release. Since obesity and aberration of metabolic factors are central to the incidence of T2DM, the notable changes in diet and lifestyle in developing countries support the highest prevalence of diabetes occurring in these countries (Kriti et al., 2012).

The risk of developing type 2 diabetes is associated with older age, obesity, family history of gestational diabetes, impaired glucose metabolism, physical inactivity and race /ethnicity. African American Hispanics/Latinos, American Indian, some Asian, and native Hawaiians or other pacific islanders are at particularly high risk for type 2 diabetes and its complication. Type 2 diabetes in children, and adolescents, although uncommon, is being diagnosed more frequently among American Indian, African Americans, Hispanics/Latinos, Asian, and Pacific Islander (Edward et al., 2015).



Source: (Kriti et al, 2012).

Figure (2.1) The glucose homeostasis

Figure (2.1) described the glucose homeostasis. When the blood glucose levels are raised, insulin is released from the beta cells and stimulates the liver and most other body cells to absorb glucose. The glucose is converted to glycogen, triglycerides and protein. If the glucose levels are decreased, the secretion of glucagon from the alpha cells stimulates the liver to release glucose from the liver. The glucose is released from the breakdown of glycogen and the conversion of amino acids and fatty acids into glucose. Dysfunction in glucose metabolism results from deficiency in insulin (T1DM) and resistance to insulin action (T2DM) by target tissue (Kriti et al., 2012).

2.2 Impair Glucose Tolerance (IGT)

Impaired glucose tolerance (IGT) is also known as pre-diabetes. This occurs when the glucose (sugar) in your blood is become higher than normal, but not high enough to be called diabetes. Pre-diabetes can often lead to diabetes although changing the amount and type of food that you eat and increasing your physical activity may prevent the development of diabetes. Your body produces insulin, which is needed to transport glucose from your blood stream to your muscle, liver and fat cells, where it is used for energy. Pre-diabetes means the insulin is not working properly. Excess body fat contributes to this problem by causing resistance to insulin. People with pre-diabetes have a higher chance of getting type 2 diabetes mellitus and heart disease (Albert et al., 2014).

Impaired insulin secretion is generally progressive, and its progression involves glucose toxicity and lipotoxicity. The progression of the impairment of pancreatic beta cell function greatly affects the long-term control of blood glucose. While patients in early stages after disease onset chiefly show an increase in postprandial blood glucose as a result of increased insulin resistance and decreased early phase secretion, the progression of the deterioration of pancreatic beta cell function subsequently causes permanent elevation of blood glucose (William et al., 2015).

2.3 Insulin Resistance

According to international institution of diabetes and digestive and kidney disease (2009) Insulin resistance is a condition in which the body produces insulin but does not use it effectively. When people have insulin resistance, glucose builds up in the blood instead of being absorbed by the cells, leading to type 2diabetes or pre diabetes. Most people with insulin resistance don't know they have it for many years until they develop type 2 diabetes that a serious, lifelong disease (Albert et al., 2009).

Insulin resistance can lead to a variety of serious health disorders. In insulin resistance, muscle, fat, and liver cells do not respond properly to insulin and thus cannot easily absorb glucose from the bloodstream. As a result, the body needs higher levels of insulin to help glucose enter cells. The beta cells in the pancreas try to keep up with this increased demand for insulin by producing more. As long as the beta cells are able to produce enough insulin to overcome the insulin resistance, blood glucose levels stay in the healthy range. Over time, insulin resistance can lead to type 2 diabetes and pre diabetes because the beta cells fail to keep up with the body's

increased need for insulin. Although the exact causes of insulin resistance are not completely understood, scientists think the major contributors to insulin resistance are excess weight and physical inactivity (Sheri et al., 2006). Table (2.1) the classification of type 2 diabetes mellitus (Maureen, 2013)

Classification of the Types of Diabetes	
Class name	**Characteristics**

Insulin-dependent diabetes mellitus (IDDM)	1.Low or absent levels of circulating endogenous insulin and dependent on injected insulin to prevent ketosis and sustain life 2.Onset predominantly in youth but can occur at any age 3.Associated with certain HLA and GAD antigens 4.Abnormal immune response and islet cell antibodies are frequently present at diagnosis 5.Etiology probably only partially genetic, as only ~35% of monozygotic twins are concordant for IDDM/
Non-insulin dependent diabetes mellitus (NIDDM)	1) Insulin levels may be normal, elevated, or depressed; hyperinsulinemia and insulin resistance characterize most patients; insulinopenia may develop as the disease progresses. 2)Not insulin-dependent or ketosis-prone under normal circumstances, but may use insulin for treatment of hyperglycemia. 3) Onset predominantly after age 40 years but can occur at any age 4)Approximately 50% of men and 70% of women are obese 5)Etiology probably strongly genetic as 60%-90% of monozygotic twins are concordant for NIDDM
Gestational diabetes (GDM)	1.Glucose intolerance that has its onset or recognition during pregnancy 2. Associated with older age, obesity, family history of diabetes 3.Conveys increased risk for the woman for subsequent progression to NIDDM 4. Associated with increased risk of macrosomi.
Other types of diabetes, including diabetes secondary to or associated with: Pancreatic disease hormonal disease drug or chemical exposure Insulin receptor abnormalities Certain genetic syndromes	1. In addition to the presence of the specific condition, hyperglycemia at a level diagnostic of diabetes is also present 2.Causes of hyperglycemia are known for some conditions, e.g., pancreatic disease; in other cases an etiologic relationship between diabetes and the other condition is suspected

2.4 Natural History of Type 2 Diabetes Mellitus

Impaired insulin secretion and increased insulin resistance, the main pathophysiological features of type 2 diabetes, jointly contribute to the development

of this disease. Recently, it has become widely recognized that the functional pancreatic /3 cell mass decreases over time and type 2 diabetes mellitus is a progressive disease. Type 2 diabetes mellitus is caused by a combination of genetic factors related to impaired insulin secretion and insulin resistance and environmental factors such as obesity, overeating, lack of exercise, and stress, as well as aging. It is typically a multifactorial disease involving multiple genes and environmental factors to varying extents (Kohei, 2010).

Type 2 diabetes results from an imbalance between insulin sensitivity and insulin secretion. Both longitudinal and cross sectional studies have demonstrated that the earliest detectable abnormality in type 2 diabetes is an impairment of the body's ability to respond to insulin. Impaired insulin action is observed in several tissues e.g., skeletal muscle, adipose tissue and the liver. It leads to increased insulin secretion from the pancreas to overcome impaired insulin action. Compensatory hyperinsulinemia maintains glucose level within normal range, but in individual at high risk of developing diabetes, beta cells function eventually declines and leads to the development of impaired glucose tolerance and eventually overt diabetes mellitus (Josepha, 2010).

The Etiology of diabetes is divided into three main groups; agent, environment and host factor as the follows;

2.4.1 Agent

The agent factor is genetic susceptibility; Type 2 diabetes mellitus caused by a combination of genetic factors related to impaired insulin secretion and insulin resistance and environmental factors such as obesity overeating, and lack of exercise. It is typically a multi factorial disease involving multiple genes and environmental factors to varying extents. The underlying cause of diabetes is insulin deficiency. This may be due to a wide variety of mechanisms such as; pancreatic disorder inflammatory, and other disorders such as cystic fibrosis. Also due to that defect in the formation of insulin, the destruction of beta cells by viral infection and chemical agents, disorder may be due to the decrease of insulin sensitivity, decrease numbers of a dipocyte and monocyte insulin receptors, Genetic defect, is the last mechanisms is considered agent factor (Kohi, 2010).

The development of type 2 diabetes is clearly associated with a family history of diabetes. Significantly higher concordance rate between monozygotic twins than between dizygotic twins suggests the considerable involvement of genetic factors. The pathogenesis has been assumed to involve genetic abnormality in the molecules related to the regulatory system of glucose metabolism (Park, 2005).

Evidence is accumulating that the insulin response to glucose is genetically controlled. The overall effect of these mechanisms is reducing utilization of glucose which leads to hyperglycemia accompanied by glucosuria. Prevalence of T2D is high among Asian populations, particularly in Asian Indians, by virtue of a high genetic susceptibility and enhanced interaction with environmental triggers. Exposure to a high fat diet and lower levels of physical activity are the common factors which

trigger the gene-environmental interaction. Both the thrifty genotype and thrifty phenotype hypotheses appear to have etiological roles in development of diabetes in Asian populations. While the thrifty genotype hypothesis points to a mismatch between the ancestral genes and modern environment, the thrifty phenotype hypothesis postulates a mismatch between intrauterine and adult life environments. The selective presence of "thrifty genotypes" has been considered to be advantageous in certain populations during evolutionary selection by repeated famine and feast cycles. However, these genes have rendered them highly predisposed to obesity and diabetes during the modern of era of continuous feasting. The "thrift phenotype" hypothesis postulates that intrauterine malnutrition leads to metabolic and structural changes in the beta cells that are beneficial for early survival, but increases the risk of T2D and other chronic disorders in adulthood. Rapid weight gain occurring in childhood due to a nutritionally rich environment enhances the risk of these adult diseases (Ambady et al., 2012).

2.4.2 **Host Factors**

Aging, obesity, insufficient energy consumption, alcohol drinking, smoking, etc; are independent risk factors of pathogenesis. Obesity (particularly visceral fat obesity) due to a lack of exercise is accompanied by a decrease in muscle mass, induces insulin resistance, and is closely associated with the rapid increase in the number of middle and high-aged patients. The changes in dietary energy sources, particularly the increase in fat intake, the decrease in starch intake, the increase in the consumption of simple sugars, and the

decrease in dietary fiber intake, contribute to obesity and cause deterioration of glucose tolerance. Even mild obesity (BMI<25) causes a 4-to5 fold increase in the risk of developing type 2 diabetes mellitus, if accompanied by the increase in visceral fat mass. The Japanese are prone to visceral (Kohei et al., 2010). The host factor of type 2 diabetes mellitus can be divided as the following;

1. Age

Although diabetes may occur at any age surveys indicate that Ageing is a key demographic transition indicator, has been reported to be a significant risk factor for T2DM. The prevalence rises steeply with age. NIDDM usually comes to light in the middle years of life and thereafter begins to rise in frequency. Malnutrition related diabetes affect large number of young people. The prognosis is worse in younger diabetics who tend to develop complication earlier than older diabetics (Park, 2005).

Asian populations develop diabetes at a younger age than Western populations. However, racial variations within Asia are evident in the age specific prevalence of diabetes. In the Asian Indian population, prevalence of diabetes peaks at 60-69 years of age, whereas in the Chinese population it peaks at 79-89 years. Indians also have a higher prevalence of IGT at a younger age than the Chinese population. The findings from Pakistan and Sri Lanka are similar to the results from India. The ethnic differences in the prevalence of diabetes and impaired glucose regulation may not be completely explained by the living environment and geographical locations, sug-gesting a major role for genetic factors as well. It may also be related to interplay of higher rates of central obesity, insulin resistance, genetic predisposition and/ or

influence of adverse intrauterine influences present among the Asian Indian population (Ambady et al., 2012).

The prevalence of diabetes increases, the proportion of young people with diabetes also increases. The rapidly increasing prevalence of T2DM in the youth is highlighted by studies in the Asian populations in native lands and in migrant countries. Asian people with young onset of diabetes have substantial phenotypic heterogeneity, many with a positive family history, impaired beta cell function, no islet cell auto antibodies and with clustering of cardio metabolic disorders. The major cause for the increasing prevalence of T2D in Asian children is the increasing rate of obesity and decreasing rate of physical activity, leading to insulin resistance. Most of the Asian countries are largely rural; hence a sudden change in the lifestyle of the rural people would increase the number of people affected by metabolic disorders (Kohei et al., 2010).

2. Sex

In some countries the overall male- female ratio is about equal. In South - East Asia, an excess of male diabetics have been observed, but this is open to question. It's a troubling fact: Women with diabetes have it worse, on average, than men with diabetes. This shocking inequality was revealed in a 2007 study that found that, between 1971 and 2000, death rates fell for men with diabetes, while rates for women with the disease didn't budge. Plus, while men with diabetes live 7.5 years less on average than those who don't have the disease, among women the difference is even greater: 8.2 years. It's most likely a combination of factors, according to the 2007

study in Annals of Internal Medicine. For starters, the bodies of men and women are of course not the same, so differences in physiology are almost certainly involved. In addition, research has suggested that, as a group, doctors treat men and women differently. That gap in care leads to poorer outcomes for women and can even be downright deadly (Ambady et al., 2010).

In the general population, women live longer than men, largely because of their lower rates of heart disease. Yet, when women get diabetes, something happens that strips them of this advantage. "The risk for heart disease is six times higher for women with diabetes than those without," says Marianne Legato, MD, FACP, director of the Partnership for Gender-Specific Medicine at Columbia University. With men, diabetes increases the risk for heart disease two- to threefold. Data also show that women with diabetes are more likely than men with the disease to have poor blood glucose control, be obese, and have high blood pressure and unhealthy cholesterol levels (Erika, 2011).

3. **Genetic factors**

The genetic nature of diabetics is undisputed, Twin studies shown that in identical twins that develop NIDDM, concordance was approximately 90%, thus demonstrating a strong genetic component. The development of type 2 diabetes is clearly associated with a family history of diabetes. The significantly higher concordance rate between monozygotic twins than between dizygotic twins suggests the considerable involvement of genetic factors. The pathogenesis has been assumed to involve genetic abnormality in the molecules related to the regulatory system of

glucose metabolism. The analyses of candidate genes targeted at glucose-stimulated insulin secretion of pancreatic beta cells and the molecules comprising the molecular mechanism for insulin action have identified genetic abnormalities that can be independent causes of pathogenesis, including those in glucokinase genes, mitochondrial genes, and insulin receptor genes. Recently, a genome wide association Study (GWAS) has identified the mutation in the KCNQ1 gene related to insulin secretion abnormality as an important disease-susceptible gene associated with the pathogenesis of diabetes in Asian ethnic groups. The genetic abnormalities reported so far, all combined, explain about 30% of the genetic factors for diabetes, and our understanding of genetic factors is expected to be practically complete in the near future. According to the current classification of disease types, diabetic cases with identified genetic abnormality are classified under “those due to other specific mechanisms or diseases (Kohei, 2010).

4. **Immune mechanisms**

There is some evidence of both cell mediated and of hormonal activity against islet cell. Some people appear to have defective immunological mechanisms, and under the influence of some environmental “trigger” attack their own insulin producing cell (David et al., 2015).

5. BMI & Waist circumference

BMI (Body Mass Index) is defined by Lee and Nieman (2003) as "weight in kilograms divided by height in meters squared (kg/m2). The most widely used weight height or power-type index". Many longitudinal studies have reported that increased

BMI is a strong risk factor for type 2 diabetes. A strong positive association between obesity and type 2 diabetes mellitus is found both in men, and women. Obesity is associated with increased risk of developing insulin resistance and type 2 diabetes mellitus. In obese individuals adipose tissue releases increased amounts of none esterifies fatty acids, glycerol, hormones, pro inflammatory cytokines and other factors involved in the development of insulin resistance, When insulin resistance is accompanied by dysfunction of the beta cells, the following fall in insulin secretion results in failure to control blood glucose level leading to type 2 diabetes mellitus. Many genes interact with the environment leading to obesity and in some also to diabetes. Many genes have been shown to be involved in determining the whole range of BMI in a population, with each gene only explaining a few hundred grams difference in body weight. Genes responsible for obesity and insulin resistance interact with environmental factors such as increased fat, calorie intake and decreased physical activity resulting in the development of obesity and insulin resistance followed ultimately by the development of type 2 diabetes mellitus (Gatineau et al., 2014).

Obesity due to a lack of exercise is accompanied by a decrease in muscle mass, induces insulin resistance, and is closely associated with the rapid increase in the number of middle and high-aged patients. Obesity particularly central adiposity has long been accepted as a risk factor for NIDDM and the risk is related to both the duration and degree of obesity. The association has been repeatedly demonstrated in longitudinal studied in different populations, with a striking gradient of risk apparent

with increasing level of BMI. Adult weight gain, waist circumference or waist to hip ratio, indeed waist circumference or waist to hip ratio (reflecting abdominal or visceral adiposity) are more powerful determinant of subsequent risk of type 2 diabetes than BMI. Central Obesity is also an important determinant of insulin resistance, the underlying abnormality in most cases of type 2 diabetes. In some instance obesity reduce the number of insulin receptors on target cells. Voluntary weight loss improves insulin sensitivity and in several randomized controlled trails has been shown to reduce the risk of progression from impaired glucose tolerance to type 2 diabetes mellitus. However many obese subjects are not diabetic. BMI ranges for weight classification in adults are includes; <18.5 for Underweight,18.5–24.9for Healthy weight range, 25.0–29.9for Overweight, 30.0–34.9 for Obesity type I, 35.0–39.9 for Obesity type II, and ≥ 40.0 for Obesity type III (Amit et al., 2010).

Waist circumference is considered a good estimate of the body fat; the dangerous internal fat which coats the organs especially the internal fat deposits of developing weight related to diseases, it is more accurate predictor of cardiovascular risk, type 2 diabetes mellitus, and metabolic syndrome. Health professionals often use BMI and waist circumference together to assess overweight and obesity and assessing risk of diseases. Waist circumference thresholds which indicate increased risk of disease are includes; the ranges as follows;

- For women: The risk is increased at ≥ 80 cm, and it becomes high at ≥ 88 cm.
- For men: The risk is increased at ≥ 94 cm, and it becomes high at ≥ 102 cm (Gatineau et al., 2014).

2.4.3 Environment Factors

The susceptibility of diabetes mellitus appears to be unmasked by number of environmental factors acting on genetically susceptible individuals. They are includes the follows;

1. Sedentary life style

Sedentary life style appears to be an important risk factor for the development of type 2 diabetes mellitus (NIDDM).lack of exercise may alter the interaction between insulin and its receptors and subsequently lead to NIDDM (Park, 2005)

2. Diet

Diet is one of the major factors now linked to a wide range of diseases including type 2 diabetes mellitus. The amount and type of food consumed is a fundamental determinant of human health. Diet is individualized depending on age, weight, gender, health condition, and occupation etc. Fruits constitute a commercially important and nutritionally indispensable food commodity. Being a part of a balanced diet, fruits play a vital role in human nutrition by supplying the necessary growth regulating factors essential for maintaining normal health. Fruits and vegetables are good source of vitamins, minerals and several types of dietary fibers. The fruits and vegetables not only prevent malnutrition but also help in maintaining optimum health through a host of chemical components that are still being identified, tested, and measured. They prevent various chronic diseases like stroke, hypertension, birth defects, cataracts, diabetes, heart disease, cancers, diverticulosis, obstructive pulmonary disease (asthma and bronchitis), and obesity etc(Esposito et al., 2009).

Soft drinks are the beverage of choice for millions of people worldwide, but sugary drinks increase the risk of type 2 diabetes, heart disease, and other chronic conditions. People who consume sugary drinks regularly 1 to 2 cans a day or more have a 26% greater risk of developing type 2 diabetes than people who rarely have such drinks. A study that followed 40,000 men for two decades found that those who averaged one can of a sugary beverage per day had a 20% higher risk of having a heart attack or dying from a heart attack than men who rarely consumed sugary drinks. Strong evidence indicates that sugar-sweetened soft drinks contribute to the development of diabetes. The Nurses' Health Study explored this connection by following the health of more than 90,000 women for eight years. The nurses who said they had one or more servings a day of a sugar-sweetened soft drink or fruit punch were twice as likely to have developed type 2 diabetes during the study than those who rarely had these beverages (Asif, 2014).

Frying is a common cooking method in Western countries, especially outside of the home where French fries and fried chicken products make up a substantial percentage of the items sold at fast-food restaurants. Through the processes of oxidation, polymerization, and hydrogenation, frying modifies both the composition of foods and their frying medium. With repeated use, oils deteriorate, which leads to a change in the fatty acid composition and absorption of other oil-degradation products into fried foods (Choe et al., 2007). In cross sectional studies, fried food consumption has been positively associated with several cardiometabolic risk factors including hypertension, low serum HDL cholesterol, and obesity. In prospective

studies, the Western-style dietary pattern includes fried foods as a major component and is generally positively associated with increased risk of type 2 diabetes; however, to our knowledge, no prospective research has specifically quantified the association between fried food consumption and T2DM (Leah et al., 2014).

The changes in dietary energy sources, particularly the high saturated fat intake has been associated with a higher risk of impaired glucose tolerance, and higher fasting glucose and insulin levels. A high proportion of saturated fatty acids in serum lipid or muscle phospholipids have been associated with higher fasting insulin, lower insulin sensitivity and a higher risk of type 2 diabetes mellitus. An unfavorable blood lipid has been reported as a risk factor for type 2 diabetes by several prospective studies (Kohi et al., 2010).

Some prospective studies found low HDL cholesterol to be a stronger risk factor for type 2 diabetes mellitus in women only. Only one previous study measured non-fasting triglycerides found an independent risk of type 2 diabetes connected to elevated triglyceride levels. High plasma triglycerides and low plasma HDL cholesterol levels are both seen in the insulin resistance syndrome, which is a prediabetic state. The mechanisms suggested are increased circulating levels of free fatty acids due to increased insulin levels and increased Chylomicron assembly and secretion in the gut, the latter process being a result of localized insulin resistance in the intestine. Cross sectional studies have shown that high BMI is associated with a higher level of total cholesterol and unfavorable lipids pattern, with low concentrations of HDL cholesterol and high triglycerides concentrations.

Longitudinal studies have shown BMI change over time to be positively associated with changes in total cholesterol, triglycerides, and low density lipoprotein (LDL) cholesterol and negatively associated with HDL cholesterol change. Apart from triglycerides, all these lipids have been shown to convey diabetes risk independently of BMI, but how they interact have been little studied (Klein et al., 2013).

Higher unsaturated fatty acids form vegetables sources and polyunsaturated fatty acids have been associated with reduce risk of type 2 diabetes. Higher proportions of long chain polyunsaturated fatty acid in skeletal muscle phospholipids have been associated with increased of insulin sensitivity. In human intervention studies, replacement of saturated by unsaturated fatty acids leads to improved glucose tolerance and enhanced insulin sensitivity (Ramal, 2011).

The American Heart Association recommends all adults age 20 or older have their cholesterol to check their blood cholesterol every four to six years. The measure of cholesterol levels in milligrams per deciliter of blood (mg/dL). To determine how your cholesterol levels affect your risk of heart disease need also to account other risk factors such as age, family history, smoking and high blood pressure. The total cholesterol score is calculated using the following equation:
HDL + LDL + 20 percent of your triglyceride level (David et al., 2015).

1. HDL cholesterol

With HDL cholesterol, higher levels are better. Low HDL cholesterol puts the patient at higher risk for heart disease. People with high blood triglycerides usually also have lower HDL cholesterol. Genetic factors, type 2 diabetes, smoking, being overweight and being sedentary can all result in lower HDL cholesterol (David et al., 2015).

2. LDL cholesterol

A low LDL cholesterol level is considered good for the heart health. However, LDL number should no longer be the main factor in guiding treatment to prevent heart attack and stroke, according to new guidelines from the American Heart Association. For patients taking statins, the guidelines say they no longer need to get LDL cholesterol levels down to a specific target number. A diet high in saturated and Tran's fats raises LDL cholesterol (Klein et al., 2013).

3. Triglycerides

Triglyceride is the most common type of fat in the body. Normal triglyceride levels vary by age and sex. A high triglyceride level combined with low HDL cholesterol or high LDL cholesterol is associated with atherosclerosis, the buildup of fatty deposits in artery walls that increases the risk for heart attack and stroke (Josepha, 2010).

3. Urbanization Transition

The escalating prevalence of diabetes seen in the last two to three decades can be attributed mostly to the change in lifestyle as a result of rapid socioeconomic growth. The rise in prevalence, therefore, is a result of environmental and behavioral

changes and cannot be attributed to altered gene frequencies since the increase has occurred within a few decades. It is estimated that the substantial increase in urbanization will occur in most Asian countries, including, although the rates are variable among these countries. The highest rates of urbanization (50%) have been in Indonesia, Singapore, Korea, Malaysia, Philippines and China, Pakistan, and India. The increase in urban population and aging are the main determinants of the global rise in prevalence of diabetes type 2. Urbanization and internal rural to urban migration result in several adverse impacts; physical activity decreases, diet habits shift towards high energy foods and body mass index (BMI) and upper body adiposity increase considerably (Josepha, 2010).

4. Socioeconomic transition

Socioeconomic progress, occurring even in the rural areas of countries such as Indonesia, India and China, have adversely affected the proportion of people affected with lifestyle disorders such as obesity, diabetes, hypertension (HTN) and cardiovascular diseases (CVD). As shown in the recent studies in India and China considerable changes have occurred in the living pattern of the rural population, leading to an increase in total prevalence of over weightiness and diabetes in these countries (David et al., 2015).

5. Low Education

In high and low income countries, low socio economic status (SES) has been linked to higher incidence of mortality from different chronic diseases, such as some types of the group of chronic diseases in which the relationship with socio economic

status is the most evident, share a number of etiological factors with type 2 diabetes mellitus (T2DM). Several studies showed a strong inverse relationship, particularly in women, between T2DM prevalence and SES as determined by educational level, income and deprivation score. The most recent research, focused mainly on the relationship between SES and T2DM incidence, has been carried out in North America and Europe, including a number of large-scale studies and a recent meta-analysis. SES refers to an individual's social position relative to other members of a society, and cannot be measured directly. Instead, different proxies for SES are used, and often include educational level, income or occupation. These three indicators are strongly related and complementary, but are not interchangeable. The major advantage of using educational level as a proxy for SES is its simplicity and universality. Nevertheless, the relationship between educational level and health is complex, as it is mediated by anthropometric factors, lifestyle, behavior, access to health services and knowledge of health promotion. Furthermore, improving national educational levels could be a feasible public health goal for worldwide countries, and would make the study of the association between educational level and risk of disease a basis of observation that could readily be translated into public health measures (Carlotta et al., 2012).

Previous prospective studies have examined the association between educational attainment and the incidence of diabetes and found that low education is significant predictor of type 2 diabetes. In a cross sectional study of National Population Health Survey found that people with less than high school diploma were

almost twice as likely to report having diabetes as those with a bachelor degree or more. Another cross sectional study from the National Health Interview Survey found that women with low education had a higher prevalence of diabetes than the better educated. Furthermore, the association varied by race, ethnicity and gender, with Whites, Hispanics and women exhibiting a stronger association between education and diabetes than blacks and men. A recent cross sectional study found that type 2 diabetes risks was higher in the least educated who were obese and inactive compared to the more educated. These studies suggest that educational attainment promote an interest in own health and acquisition of knowledge that strongly influence people's ability to reduce risk by successfully adopting a healthier life style (Emily, 2013).

6. Dietary fiber

An important life style factor associated with the development of type 2 diabetes is dietary habits. Positive associations have been reported between the risk of type 2 diabetes and different patterns of food intake. Higher dietary glycemic index has been consistently associated with elevated risk of type 2 diabetes in prospective cohort studies (Josepha, 2010). A prospective study found that regular consumption of white rice is associated with an increased risk of type 2 diabetes whereas replacement of white rice by brown rice or other whole grains was associated with a lower risk. A review which included 19 studies, "On diet and risk of type 2 diabetes: the role of fat and carbohydrate" concluded that a higher intake of polyunsaturated fat and long chain of fatty acid is beneficial, where as higher intake of saturated fat and trans fat adversely affects glucose metabolism and insulin resistance (David et al.,

2015). Another prospective study found higher consumption of butter, potatoes and whole milk to be associated with increased risk of type 2 diabetes. Higher consumption of fruits and vegetable was associated with reduced risk of type 2 diabetes. The possible mechanisms suggested are that insoluble fiber intake was consistently associated with improved insulin sensitivity and decreases risk of type 2 diabetes. Furthermore large observational studies have suggested an association between low vitamin D status or low vitamin D intake and increased incidence of type 2 diabetes mellitus. The suggested mechanisms are that vitamin D deficiency may contribute to beta cell dysfunction, insulin resistance and inflammation that may result in type 2 diabetes. The effect of dietary habits has in all these studies been shown to be independent of BMI change (Ramal, 2011).

In many controlled experimental study, high intakes of dietary fiber have been shown to result in reduce blood glucose and insulin levels in people with type 2 diabetes mellitus and impair glucose tolerance, more over an increase intake of wholegrain, cereal, vegetable and fruit were a feature of diet in randomized control trail. Thus the evidence for a potential protective effect of dietary fiber appears strong. A minimum daily intake of 20 grams of dietary fiber is recommended (Josepha, 2010)

7. Malnutrition

Malnutrition is infancy and childhood may result in partial failure of beta cell function. Damage to beta cell may well explain the associated impair carbohydrate tolerance in kwashiorkor (Kriti et al., 2010).

8. Smoking

Several prospective studies reported that current smoking is a risk factor for developing type 2 diabetes mellitus. Recently, a Meta analysis including 25 prospective studies showed that current smoking was associated with a 44% increased risk of type 2 diabetes mellitus. The association between smoking and type 2 diabetes was stronger for heavy smokers? 20 cigarettes/ day compared with light smokers or former smokers. In addition some studies found an increased risk of type 2 diabetes the first 2 -3 years after smoking cessation, with a risk in the smokers first after 12 years. Smoking leads to insulin resistance and inadequate compensatory insulin secretion response. This could be due to a direct effect of nicotinic or other components of cigarette smoke on beta cells of the pancreas as suggested by the association of cigarette smoking with chronic pancreatitis and pancreatic cancer. Also, some studies suggest that heavy smokers with evidence of increased systemic inflammation, who gain substantial in weight after quitting, are at high risk of developing type 2 diabetes mellitus. However over longer follow up, smoking cessation is associated with a reduction in risk of developing type 2 diabetes mellitus (Josepha, 2010).

9. Alcohol

Excessive intake of alcohol can increase the risk of diabetes by damaging the pancreas and liver and by promoting obesity. Viral infections among the viruses that have been implicated are rubella mumps and human koxsacki virus B4. Viral

infections may trigger in immunogenetically susceptible people a sequence of events resulting in beta cell destruction (park, 2005).

10. Chemical agents

There are number of chemical agents are known to be toxic to beta cell such as alloxan, streptozotocin, the rodenticide VALCOR ,etc. a high intake of cyanide producing food e.g. cassava and certain beans may also have toxic effects in beta cell (Kriti et al., 2010).

11. Physical Inactivity

Physical activity is defined as any bodily movement produced by skeletal a muscle that requires energy expenditure. Physical inactivity has been identified as the fourth leading risk factor for global mortality causing an estimated 3.2 million deaths globally. Physical activity is important in maintaining a healthy weight and reducing the risk of many chronic diseases. Therefore, 30 minutes of moderate intensity physical activity is recommended most days of the week but preferred all days of the week. Regular moderate intensity physical activity such as walking, cycling, or participating in sports has significant benefits for health. For instance, it can reduce the risk of cardiovascular diseases, diabetes, colon and breast cancer, and depression. Moreover adequate levels of physical activity will decrease the risk of a hip or vertebral fracture and help control weight (William et al, 2015).

Longitudinal studies have found that physical inactivity to be a strong risk factors for type 2 diabetes. Prolonged television watching as a surrogate marker of

sedentary life style was reported to be positively associated with diabetes risk in both men and women. Moderate and vigorous physical activity was associated with a lower risk of type 2 diabetes. Evidence from clinical trials which included physical activity as integral part of life style interventions suggested that onset of type 2 diabetes can be prevented or delayed as a result of successful lifestyle interventions that included physical activity as a part of these interventions (Josepha, 2010). Physical activity plays an important role in delaying or prevention of development of type 2 diabetes mellitus in those at risk both directly by improving insulin sensitivity and reducing insulin resistance, and indirectly by beneficial changes in body mass and body composition (Josepha, 2010). Physical inactivity has long been identified as a risk factor of T2DM independently of its effects on body size, and dietary patterns. Physical activity of moderate to vigorous intensity and duration decreases the risk of conversion of impaired glucose tolerance into diabetes even in the absence of significant weight loss, and independently of other risk factors. Regular strenuous exercise is needed to reduce the risk of type 2 diabetes among adults which works in a dose response manner (Alberti et al., 2010).

12. Stress

Stress is factor associated with developing type 2 diabetes mellitus. Stress is related factors with overeating, especially excessive intake of simple sugars, smoking, increase in alcohol intake, disorders of nervous and endocrine systems, increase in cortisol, abnormality in sex hormone secretion (Kohei, 2010).

13. High Blood Pressure

Many reports shown that people with diabetes having high blood pressure (Hypertension). Blood pressure is the force of blood flow inside your blood vessels. The doctor records the blood pressure as two numbers, such as 120/80, which as "120 over 80." Both numbers are important. The first number is the pressure as your heart beats and pushes blood through the blood vessels. Health care providers call this the "systolic" pressure. The second number is the pressure when the vessels relax between heartbeats. It's called the "diastolic" pressure. The healthy blood pressure is below 120/80, Early high blood pressure are between 120/80 and 140/90, and the high blood pressure are 140/90 or higher. The lower blood pressure is the better chances of delaying or preventing a heart attack or a stroke. When the blood moves through your vessels with too much force, people have high blood pressure or hypertension (William et al., 2015).

The heart has to work harder when blood pressure is high, and the risk for heart disease and diabetes goes up. High blood pressure raises the risk for heart attack, stroke, eye problems and kidney disease. High blood pressure is a problem that needs treatment and changes diet and lifestyle (Josepha, 2010).

14. Occupation

From an Occupational Health focus, much has been done to clarify the causal relations between exposure in the work environment and cancer Nevertheless, studies that analyze factors that can predispose workers to the appearance of metabolic disorders, such as type 2 diabetes mellitus 2, can be considered

incipient. Also, their analysis remains restricted to the identification of risk factors in the study groups, however, without establishing correlations between the work process and the appearance of T2DM. Diabetes mellitus is not considered a professional illness, nor is it seen as specific to health workers. The lifestyle these workers adopt, however, can enhance the appearance of the disease. In many cases, workers assume long workdays, multiple jobs, shift work, entailing difficulties to adopt healthy life habits, without mentioning that the nature itself of health work confronts its workers with stress and anxiety on a daily base. These have been evidenced as harmful to people's health, making them susceptible to chronic health problems as T2DM (Vitoria et al., 2011). Inactivity or a low quantity of physical activity can be a work associated factor when considering that some professions or occupations, due to its own characteristics, limit professionals' physical activity. For a physical activity to have protective health effects, however, it should take place continuously, regularly and at adequate intensity levels. The sedentary condition of the study subjects becomes even more important when considering that, besides constituting a risk factor for T2DM, sedentariness surpasses the other risk factors that were presented, such as overweight and abdominal obesity, enhancing their effects and, thus, considerably increasing the chances that these subjects will become diabetics. As for smoking, previous study has demonstrated that smoking is negatively associated with the qualification of professional occupations in terms of specialization level (Victoria, 2011).

2.5 Clinical Diagnosis of Type 2 Diabetes

In selecting the criteria for the diagnosis of diabetes mellitus and other disorders of glycaemia, the most important point is how to identify person at risk of diabetes specific complication early and accurately. The body usually is able to keep glucose concentrations stable. The normal fasting blood sugar is usually between 3.5-6.7mmol/l. After a meal it would rarely exceed 8mmol/l. Normally there is no glucose in urine since the normal threshold above which glucose would appear in the urine would be 10mmol/l. Below a concentration of 10mmol/l the kidneys reabsorbs glucose back into the blood stream and so glucose does not appear in the urine unless the blood concentration of glucose is high. Dip sticking urine for the presence of glucose is therefore often used as a screening test for diabetes mellitus. The commonest approach to diabetes screening was a preliminary, semi quantitive test for glucose in a urine sample, followed by an oral glucose tolerance examination for those early detection and effective control of hyperglycemia in asymptomatic (Park, 2005).

1. Urine Examination

Urine test for glucose, 2 hour after a meal, is commonly used in medical practice for detecting cases of diabetes. All those with glucosuria are considered diabetic unless otherwise proved by a standard oral glucose tolerance test. Most studies now confirm that although glucose is found in urine in most severe cases of diabetes. It is often absent in milder forms of the disease, and such cases are likely to be missed by urine test. This is known as lack of “sensitivity”.

The lack of sensitivity of the test means that many diabetics would have been missed if this had been the only test; that is, the test yield too many of false negative. Further, glycosuria may be found in perfectly normal people; this gives rise to false positives. Since the specificity of the test is over 90 per cent, the yield of false positive is not very high .or these reasons, urine test is not considered an appropriate tool for case finding or epidemiological survey of the population to be more precise use blood glucose test (David et al., 2005).

2. **Blood Sugar Test**

Because of the inadequacies of Urine examination, "standard oral glucose test" remains the cornerstone of diagnosis of diabetes. Mass screening programmes have used glucose measurements of fasting, random blood sample. The measurement of glucose level in random blood sample is considered unsatisfactory for epidemiological use, at the most it can give only a crude estimate of the frequency of diabetes in a population .the fasting value alone is considered less reliable since true fasting cannot be assured and spurious diagnosis of diabetes may more readily occur. Therefore, for epidemiological purpose the 2 hour value after 75 gram oral glucose may use either alone or with the fasting value (Nam et al., 2013).

3. Diagnosis Values for the Oral Glucose Tolerance

The various criteria and cut points used for the diagnosis of diabetes and the categories of intermediate hyperglycaemia are mentioned in the table For clinical purposes, the diagnosis of diabetes should always be confirmed by repeating the test on another day (preferably the same test), unless there is unequivocal hyperglycaemia

with acute metabolic de compensation or obvious symptoms. The diagnosis of diabetes should be based on formal laboratory testing and not point-of-care or bedside instruments. For glucose-based diagnosis, laboratory venous plasma glucose is preferred, while For capillary blood glucose measurements, the plasma glucose value will need to be derived using the following conversion factor: Plasma glucose (mmol/l) = 0.102 + 1.066 x capillary blood glucose (Josepha, 2010).

4. WHO and ADA Criteria

According to international diabetes federation (2015) World Health Organization recommendations for the diagnostic criteria for diabetes and intermediate hyperglycaemia are;

- Diabetes should be diagnosed if one or more of the following criteria are met:

Fasting plasma glucose ≥ 7.0 mmol/L (126 mg/ dl).

Two-hour plasma glucose ≥ 11.1 mmol/L (200 mg/dl) following a 75g oral glucose load

- Impaired Glucose Tolerance (IGT) should be diagnosed if both of the following criteria are met:

Fasting plasma glucose < 7.0 mmol/L (126 mg/ dl)

Two-hour plasma glucose 7.8-11.1 mmol/L (140 -200 mg/dl) following a 75g oral glucose load

- Impaired Fasting Glucose (IFG) should be diagnosed if both of the following criteria are met:

Fasting plasma glucose 6.1-6.9 mmol/L (110-125 mg/ dl)

Two-hour plasma glucose< 7.8 mmol/L (140) following a 75g oral glucose load.

National Diabetes Data Group and World Health Organization have issued

diagnostic criteria for DM based on the following premises; (1) the spectrum of fasting plasma glucose (FPG) and the response to an oral glucose load (OGTT-oral glucose tolerance test) varies among normal individuals, and (2) DM is defined as the level of glycemia at which diabetes-specific complications occur rather than on deviations from a population based mean (David et al 2015).

Table (2.2) describes the criteria of diagnosis of diabetes mellitus

Criteria for the Diagnosis of Diabetes Mellitus
Symptoms of diabetes plus random blood glucose concentration >11.1 mmol/L (200 mg/dL) or Fasting plasma glucose >7.0 mmol/L (126 mg/dL) Two-hour plasma glucose >11.1 mmol/L (200 mg/dL) during an oral glucose tolerance test.

A Random is defined as without regard to time since the last meal

B Fasting is defined as no caloric intake for at least 8 hours

The test should be performed using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water; not recommended for routine clinical use (William et al., 2007).

5. ADA criteria for diagnosis diabetes

Diabetes also diagnosed based on A1C criteria or plasma glucose criteria, either the fasting plasma glucose (FPG) or the 2-h plasma glucose (2-h PG) value after a 75-g oral glucose tolerance test (OGTT).

The same tests are used to both screen for and diagnose diabetes. Diabetes may be identified anywhere along the spectrum of clinical scenarios: in seemingly low-risk individuals who happen to have glucose testing, in symptomatic patients, and in higher-risk individuals whom the provider tests because of a suspicion of diabetes. The same tests will also detect individuals with pre diabetes (William et al., 2015).

The A1C test should be performed using a method that is certified by the NGSP and standardized or traceable to the Diabetes Control and Complications Trial (DCCT) reference assay. Although point-of-care (POC) A1C assays may be NGSP certified, proficiency testing is not mandated for performing the test, so use of POC assays for diagnostic purposes may be problematic and is not recommended.

The A1C has several advantages to the FPG and OGTT, including greater convenience (fasting not required), greater preanalytical stability, and less day-to-day perturbations during stress and illness. These advantages must be balanced bygreater cost, the limited availability of A1C testing in certain regions of the developing world, and the incomplete correlation between A1C and average glucose in certain individuals. It is important to take age, race/ ethnicity, and anemia/ hemoglobinopathies into consideration when using the A1C to diagnose diabetes (William et al., 2015).

Table (2.3) American Diabetes Association criteria for the diagnosis diabetes (William, 2015)

A1C 6.5%. The test should be performed in a laboratory using a method that is NGSP certified and standardized to the DCCT assay.
OR

FPG 126 mg/dL (7.0 mmol/L). Fasting is defined as no caloric intake for at least 8 h. OR
2-h PG 200 mg/dL (11.1 mmol/L) during an OGTT. The test should be performed as described by the WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water. OR
In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose 200 mg/dL (11.1 mmol/L). In the absence of unequivocal hyperglycemia, results should be confirmed by repeat testing.

2.6 Prevention of Type 2 Diabetes Mellitus

Studies have shown that many complications of diabetes can be prevented or delayed through effective management. This includes lifestyle measures such as a healthy diet, physical activity, the avoidance of overweight and obesity, and not smoking. Preventative care need not involve costly treatment or medication. Education in good foot care as well as regular inspection is a good example of a low cost method of prevention Diabetes therapy is not only about lowering glucose, but also about the overall reduction in the risk factors for diabetic complications, which includes the control of blood pressure and blood lipids. This requires lifelong care and management (Josepha, 2010).

Diabetes education plays a key role in empowering people with the knowledge and skills to manage their own condition effectively. In order to prevent or delay complications, people with diabetes may have to modify their lifestyle. People with type 2 diabetes often require oral drugs, and sometimes insulin to control their blood

glucose levels. Studies have shown that many complications of diabetes can be prevented or delayed through effective management. This includes lifestyle measures such as a healthy diet, physical activity, the avoidance of overweight and obesity, and not smoking. Preventative care need not involve costly treatment or medication. Education in good foot care as well as regular inspection is a good example of a low cost method of prevention (David et al., 2015).

Diabetes therapy is not only about lowering glucose, but also about the overall reduction in the risk factors for diabetic complications; which includes the control of blood pressure and blood lipids. This requires lifelong care and management. Health systems that are able to deliver optimal care need to be designed around the needs of the person with the condition, as on a day to day basis most diabetes care is undertaken by the person with diabetes and not the health professional. Diabetes education plays a key role in empowering people with the knowledge and skills to manage their own condition effectively. In order to prevent or delay complications, people with diabetes may have to modify their lifestyle. People with type 2 diabetes often require oral drugs, and sometimes insulin to control their blood glucose levels (Albert et al., 2013).

2.6.1 Primary Prevention

In most Asian countries, the medical challenge posed by the burden of diabetes is huge. It is unmatched by the budget allocations for health care. Primary prevention is important to reduce the burden of diabetes faced by patients, families and society at large. Several prospective randomized clinical trials have shown that primary

prevention of type 2 diabetes mellitus is possible by lifestyle intervention or by the use of pharmacological agents such as metformin. The Chinese study and the Indian Diabetes Prevention Programs have shown the benefits of lifestyle modification focused on improved physical activity and healthy diet habits to prevent or at least delay the onset of diabetes in high risk subjects. Lifestyle intervention can have a sustained 43% reduction in the incidence of diabetes over a 20 year period. The Prevention of obesity and diabetes will be cost effective as it will prevent not only the development of diabetes but can also prevent the occurrence of complications (Park, 2005).

The serious epidemic nature of diabetes has been recognized by the United Nations and it recommends member countries to develop national policies to combat the disease. In several Asian countries, governments have initiated national programs for the prevention and control of non-communicable diseases. The health care programs implemented by Singapore have been effective and fruitful (Ambady et al., 2012).

There were two strategies for primary prevention has been suggested in the follows;

1. Population Strategies

The scope for primary prevention of type 2 diabetes mellitus or NIDDM based on elimination of environment risk factors because it is possible .there is pressing need for primordial prevention that is, prevention of the emergence of risk factors in countries in which they have not yet appear. The preventive measures comprise

maintenance of normal body weight through adoption of healthy nutritional habits and physical exercise. The nutritional habits include an adequate protein intake, a high intake of dietary fiber and avoidance of sweet foods. Elimination of other less well defined factors such as protein deficiency and food toxins may be considered in some populations. These measures should be fully integrated into other community based programmes for the prevention of non communicable diseases (Park, 2005).

1 High Risk Strategies

The high risk strategies special for NIDDM since it appear because there is linked with sedentary life style over nutrition and obesity, correction of those may reduce the risk of diabetes and its complication. Since alcohol can indirectly increase the risk of diabetes. It should be avoided. Subjects at risk should avoid diabetogenic drugs like oral contraceptives. It is wise to reduce factors that promote atherosclerosis; such as smoking, high blood pressure, elevated cholesterol and high triglyceride levels. The programmes may most effectively be directed at target population groups (William et al., 2014).

2.6.2 Secondary Prevention

Secondary preventions the prevention of diabetic complications through the optimization of glycaemic control, and the avoidance and treatment of coexisting risk factors. For optimal impact secondary prevention needs to begin at the biochemical presentation as opposed to the clinical presentation. The treatment and avoidance of hypertension, micro albuminuria, dyslipidaemia and cigarette smoking are

theoretically important secondary preventative strategies for lessening diabetic complications (Kriti et al., 2010).

Early diagnosis and treatment of hypertension is therefore, theoretically, an important factor in the secondary prevention of diabetes. Hypertension in NIDDM is associated with obesity and reduced insulin sensitivity. Lifestyle alterations that are aimed at weight reduction will help lower blood pressure and increase insulin sensitivity. Secondary prevention should include the screening for lipid abnormalities in NIDDM. Dietary and lifestyle advice are the first-line treatments but specific lipid-lowering therapy should be given when these alone prove ineffective. When diabetes is detected, it must be adequately treated. The aims of treatment are; to maintain blood glucose levels as close within the normal limits as practicable, and to maintain ideal body weight. Treatment is based on; Diet alone small balanced meals more frequently, Diet and oral anti diabetic drugs, Diet and insulin, and Good control of blood glucose protects against the development of complications. Proper management of the diabetic is most important to prevent complications. Routine checking of blood sugar, of urine for proteins and ketenes, of blood pressure, visual acuity and weight should be done periodically. The feet should examine for any defective blood circulation loss (park 2005).

2.6.3 Tertiary Prevention

Tertiary prevention is the early detection and treatment of diabetic complication; this includes the screening for diabetic retinopathy, nephropathy, cardiovascular and peripheral vascular disease. Retinopathy The most important

preventative strategy for delaying the progression of background retinopathy to sight threatening retinopathy is regular screening and early referral to an ophthalmologist. Earlier detection and treatment of diabetic maculopathy or proliferative retinopathy, with laser photocoagulation and or vitreo retinal surgery prevents blindness. Despite this, diabetic retinopathy remains the commonest cause of blindness between the ages of 30-64 years (Josepha, 2010).

The majority of diabetic blindness results from patients being inadequately screened and being referred too late for effective ophthalmological treatment.' All diabetic subjects are at risk of retinopathy, the prevalence increasing with increasing duration of the disease, such that approximately 80% of diabetic subjects will have detectable background retinopathy by 15 years, with a smaller percentage having maculopathy or proliferative retinopathy. Maculopathy is more frequently associated with NIDDM and due to the greater number of NIDDM subjects, represents the commonest cause of diabetic blindness. As diabetic care is dissolved more into the community it will become increasingly important to ensure adequately trained personnel are available to carry out this screening, using either local optometrist or retinal cameras (Amit et al., 2010).

Nephropathy it is likely that the most important preventative strategy for delaying the progression of nephropathy is the detection and treatment of micro albuminuria. Once nephropathy is established, then the management of coexisting hypertension is of paramount importance. Diet may also have an important role in reducing the rate of decline in renal function. In NIDDM systolic blood pressure is

correlated with the rate of decline in renal function. The place for these agents in NIDDM subjects with established nephropathy is not yet clears (Nam et al., 2013).

Lower limb amputations are about 15 times more likely in diabetic subjects; it has been estimated that up to 85% of these amputations are potentially preventable with adequate foot care. Peripheral vascular disease and neuropathy are important factors predisposing to lower limb amputation. Despite the proven benefits of regular chiropody, patient education, cessation of smoking and early treatment of infection, the early management of diabetic foot problems remain critically suboptimal. Annual screening of the feet is the minimum standard of care that the patient with NIDDM should expect. Identification of those feet at risk, early and appropriate surgical referral, and the treatment of associated risk factors should lessen the social and financial burden that lower limb amputations and their sequelae place on the community (Nam et al., 2013).

The importance of education for preventative strategies to be effective, long term co-operation and compliance from individuals is required. The degree of compliance required will only be achieved if the individual understands and takes some share in the responsibility of their disease. Primary prevention of NIDDM will require public health initiatives to lessen obesity and increase physical activity within the population as a whole. Secondary prevention will require screening initiatives for individuals at greatest risk of diabetes, including those with a family history or previous gestational diabetes. Education initiatives to heighten public awareness of

the early symptoms of diabetes are needed to allow for earlier diagnosis (David et al., 2015).

Successful secondary prevention will depend on identifying and treating cardiovascular risk factors early. Tertiary prevention should be helped with the acceptance of The St Vincent Declaration minimum standards for the delivery of diabetic care across Europe. Patient knowledge of these ideals should augment tertiary prevention. Health care providers need to be aware of these standards and to ensure that adequate provisions are available to screen and treat early diabetic complications at a time when diabetic mortality and morbidity can be reduced (Gatineau, 2014).

2.7 Management of Type 2 Diabetes Mellitus

The main aim in the management of diabetes is to maintain blood glucose levels as near to normal as possible, while avoiding hypoglycaemia. In order to achieve this, there are five tools involved in diabetes treatment which are education, exercise/activity, diet, oral medications and/or insulin, often used in combination. Management of type 2 diabetes includes: Healthy eating, Regular exercise, possibly, diabetes medication or insulin therapy, Blood sugar monitoring. These steps will help keep the blood sugar level closer to normal, which can delay or prevent complication (William et al., 2014).

2.7.1 Health Eating

Contrary to popular perception, there's no specific diabetes diet. However, it's important to center your diet on these high fiber, low fat foods such as; fruits,

vegetables and whole grains people with diabetes type 2 also need to eat fewer animal products, refined carbohydrates and sweets. Low glycemic index foods also may be helpful. The glycemic index is a measure of how quickly a food causes a rise in a blood sugar. Foods with a high glycemic index raise the blood sugar quickly. Low glycemic foods may help people with type 2 diabetes to achieve a more stable blood sugar. Foods with a low glycemic index typically are foods that are higher in fiber.

A registered dietitian can help people with type 2 diabetes to put together a meal plan that fits for health goals, food preferences and lifestyle, also can teach people with type 2 diabetes how to monitor their carbohydrate intake and let them know about how many carbohydrates a people need to eat with meals and snacks to keep the blood sugar levels more stable (Nam et al., 2013).

2.7.2 Physical Activity

Physical activity is defined as “any skeletal muscles movement which expends energy beyond resting level such as walking, gardening, stair climbing”. Everyone needs regular aerobic exercise, and people who have type 2 diabetes are no exception. People who have type 2 diabetes need to get OK from the doctor's before starting an exercise program. Then they can choose activities for enjoying, such as walking, swimming and biking. What's most important is making physical activity part of people who have type 2 diabetes daily routine. Aim for at least 30 minutes of aerobic exercise most days of the week. Stretching and strength training exercises are

important, too. If people who have type 2 diabetes haven't been active for a while, they can start exercise slowly and build up gradually (Amit et al., 2010).

A combination of exercises aerobic exercises, such as walking or dancing on most days, combined with resistance training, such as weightlifting or yoga twice a week ; often helps control blood sugar more effectively than either type of exercise alone. Physical activity can lowers blood sugar so people who have type 2 diabetes need to check the blood sugar level before any activity, also they might need to eat a snack before exercising to help prevent low blood sugar if you take diabetes medications that lower the blood sugar (Josepha, 2010).

2.7.3 Monitoring the Blood Sugar

people who have type 2 diabetes need to check their blood sugar level every day depending on the treatment plan, they also need to record the blood sugar level regularly, if they on insulin, multiple times a day. They can Ask the doctor how often they wants to check the blood sugar. Careful monitoring is the only way to make sure that the blood sugar level remains within the target range sometimes, blood sugar levels can be unpredictable. With help from the diabetes treatment team, the can learn how the blood sugar level changes in response to food, exercise, alcohol, illness and medication (David et al., 2015).

2.8 Diabetes Care

The young age at onset not only increases the health care burden of treating large numbers of people with type 2diabetes mellitus, but also increases the morbidity and premature mortality due to diabetic complications. The rate of complications

increases proportionally with the duration of diabetes. The cost of diabetes care is high and increasing worldwide. The economic burden is very high, especially in developing countries, and more so in the lower economic groups, who spend 25%-34% of their income on diabetes care. The cost of care increases substantially when complications occur or when admission to hospital, surgery or insulin treatment is needed. Studies from developed western countries and developing countries in Asia have shown similar results with respect to the quality of diabetes care and the glycemic outcome among the diabetic population less than 30% of the patients achieve the desired glycemic goals (William et al., 2015).

Source : (David et al., 2015).

Figure 2.2 The medication of type 2 diabetes mellitus

The figure 2.2 above describes type 2 diabetic mellitus medications to maintain the blood glucose by Healthy eating, maintaining a healthy weight Regular exercise, possibly, diabetes medication or insulin therapy, education, and Blood sugar monitoring (David et al., 2015).

CHAPTER III
CONSEPTUAL FRAMEWORK & RESEARCH HYPOTHESIS

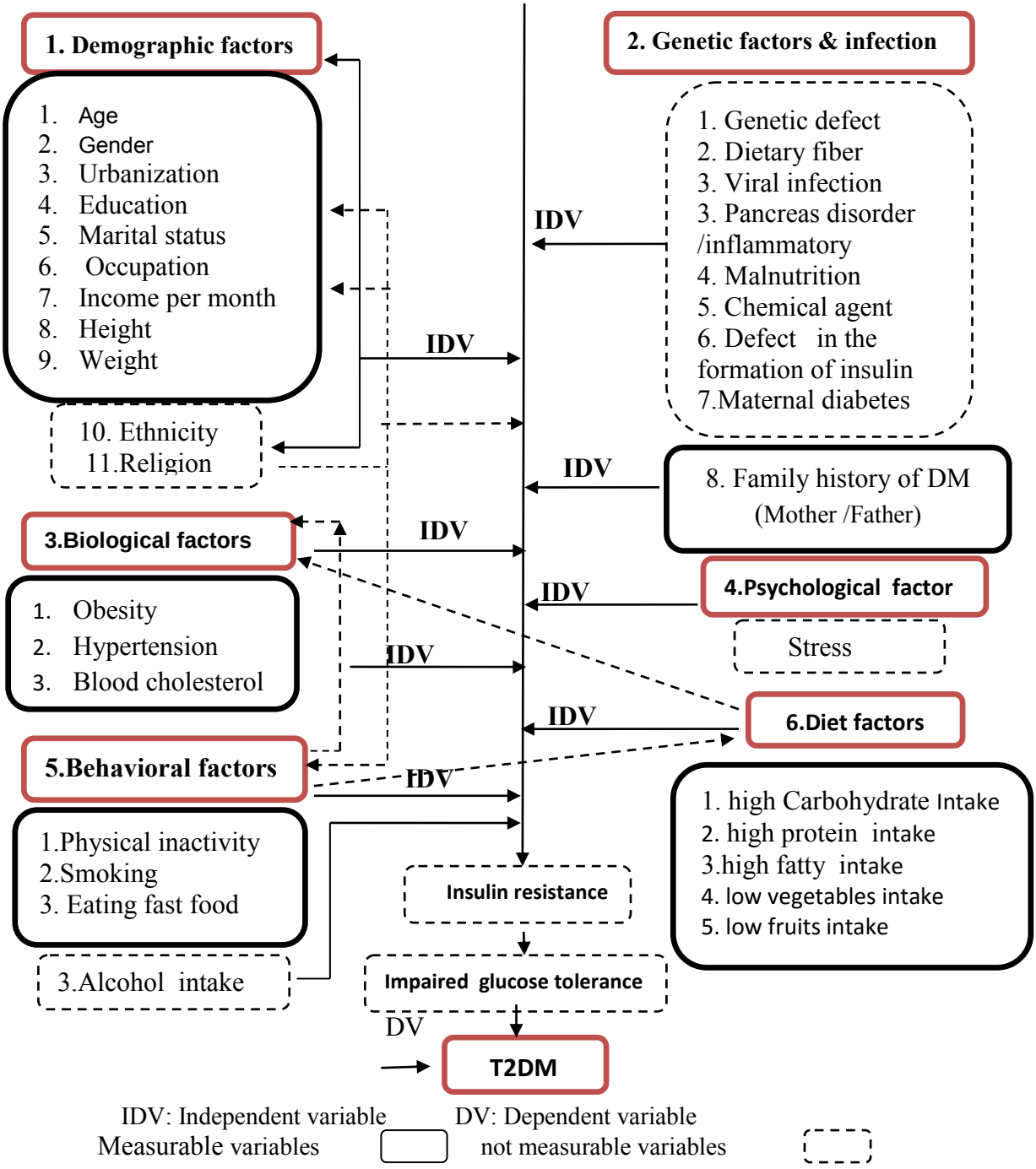


Figure (3.1) The conceptual frame work of the determinant factors of developing type 2 diabetes mellitus.

3.1 Conceptual Theory of type 2 Diabetes Mellitus

People with diabetes have an increased risk of developing a number of serious health problems. Consistently high blood glucose levels can lead to serious diseases affecting the heart and blood vessels, eyes, kidneys, nerves and teeth, lower limb amputation. Diabetes is a leading cause of cardiovascular disease; In addition, people with diabetes also have a higher risk of developing infections, and premature death. Diabetes also predisposes to arterial disease, not least because it is often accompanied by hypertension, lipid disorders and obesity. Many cases of diabetes and almost all of its unwanted long-term consequences are potentially avoidable, but this will require intervention at a societal as well as at a medical level.

Many studies have elaborated the associations between several risk factors and the developing of type 2 diabetes. Demographic factors (age, sex, marital status, occupation, socio economic status, education, height, weight, urbanization) is associated with developing type 2 diabetes mellitus, diet, Body mass index (BMI), blood pressure, blood cholesterol, smoking, physical inactivity, low education, dietary patterns, family history, and recently also specific genes are the most frequently documented risk factors for developing type 2 diabetes mellitus.

3.2 Hypothesis

The occurrence of diabetes mellitus among the patient influence by expose them to multi risk factor or determinant factors, there was reaction at cellular level already happened and the outcome of that reaction is type 2 diabetes mellitus. The determinants factor that lead to causes the DM among the patient such as host,

agent, and environmental factors that suggest an etiological suspected. In this study the hypothesis factors of occurrences type 2 diabetes mellitus includes; Socio demographic factors which includes; (elder ages>45 years, gender, urbanization, low education, marital status, occupational, high annually income), genetic factors (family history of diabetes mellitus), biological factors which includes (obesity, hypertension, high blood cholesterol), behavioral factors which includes (physical inactivity or exercises less than 3 times/ day, smoking, eating fast food), and diet factors which includes (carbohydrates, protein, fatty food, vegetables, and fruits), were associated with developing type 2 diabetes mellitus.

Hypothesis test for confirming or refuting the association between the determinants factors above which suspected factors occurred or developed the type 2 diabetes mellitus among the people in Surabaya. The participants from the PHCs in Surabaya as represent group of that population and the outcome of the research useful for generalizing into a whole of Surabaya population due to sampling technique.

CHAPTER IV

RESEARCH METHODOLOGY

4.1 Research Design

The research designed is epidemiological observational analytical study by using a case control approach for identifying the potential association between the determinant factors and the developing of type 2 diabetes mellitus diseases, by relating diabetic to host agent and environmental factors; that suggest an etiological hypothesis, and suspected factors lead to cause the diabetic disease among the people in Surabaya attempting to enhance prevention effort for reducing the occurrence of the complication of the type 2 diabetes mellitus among the people in Surabaya. This chapter describes all procedures will be used to conduct the research. It also describes how subjects will be selected and the instrumentation supposed to use in this study. Secondly, the chapter describes the statistics used to analyze the data. Lastly, limitations of the instrument and data collection procedures also will be discussed. The case control study is used to investigate cause of diseases among tow group. first group of people with type 2 diabetes mellitus and the second group of people as control group which is unaffected by the type 2 diabetes mellitus. The occurrence of the diabetes mellitus is compare between cases and controls. Data concerning and the information collected for both cases and control about the determinant factors of type 2 diabetes mellitus during (April – May) in 2016.

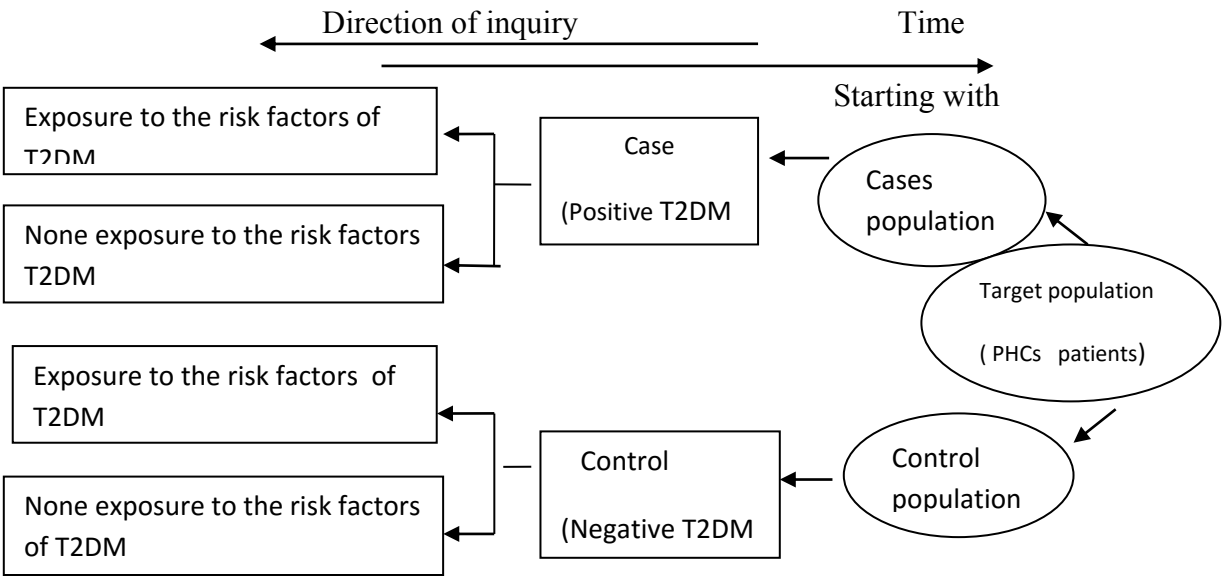


Figure (4.1) The design of case control study about type 2 diabetes mellitus

4.2 Population and Sample

4.2.1 Population

A population is the all inclusive group of subjects that have the characteristics we are interested in observing. The target population for this research are the patients that already registered in primary health care centers in Surabaya (5 PHCs out of 62 PHCs) during the six months in the past in December 2015 until May 2016. It is finite population and the researcher capable to enumerating each subject. The source population in case control study is divided into two main population; cases population (positiveT2DM), and control population (negative T2DM) in Wonkosumo, Peneleh, Jagir, Pacar keling, and Lontar PHCs in Surabaya.

1. Source of Cases

Cases population is patients of type 2 diabetes mellitus diseases, and registered in the primary health care centers record in the during the past of December 2015

until May 2016 in Surabaya; particularly people affected by type 2 diabetes mellitus are considered the source of cases. This is because the population at risk and must be confirmed in record and specified before the study is undertaken. we select by using simple random sampling technique the cases from the cases population, furthermore by using cluster random sampling technique we select the primary health care centers (5 PHCs out of 62 PHCs centers in whole Surabaya),then we select (44+12%) participants affected by T2DM during the past of December 2015 until May of 2016. The specific primary health care center which includes; 12 participant from Wonkosumo, 8 participant from Pacar keling, 11 participant Peneleh, 12 participant from Jagir, and 7 participant from Lontar PHCs to represents whole Surabaya.

2. **Source of Control**

Control group is patients free of type 2 diabetes mellitus diseases and registered in the primary health care centers record during the past of December 2015 until May 2016 in Surabaya; it is similar to the cases, except for absence of the diseases under study, and they will be representative of the population not at risk and confirmed the absent of diabetes in record in PHCs before the study undertaken. Furthermore we select randomly (simple random sampling technique) the control (44 participants+12%). cluster random sampling to determine the PHCs 5 primary health care out of 62 then by simple random sampling we select the participant (44control +12%) from the specific primary health care center which includes; 12 participant from Wonokosumo, 8 participant from Pacar keling, 11 participant from Peneleh, 12 participant from Jagir, and Lontar 7 participant to represents whole Surabaya.

4.2.2 Sample

A sample design is plan for obtaining a sample from a given population, it refer to technique that used by researcher to select items for sample. The sample should be representative the whole population. The researcher plan to drown his participant by using the simple random sampling technique to determine the sample size from the primary health care centers in Surabaya.

4.3 Sampling

This research project was designed to quantitative approach. The quantitative primary data collections randomly from the PHCs centers (finite population) to identify the sample size for computing how many participants will be selected in this study with more effort to decrease the random error. Simple Random sampling technique from a finite population refers to that method of sample selection which gives each element in the population (possible sample) combination an equal probability of being chosen, also have an equal chance of being included in the sample, and all choices are independent of one another also.

The Sample size in this research is compute by using case control formula in the following:

$$n = \frac{\left\{ z_{1-\alpha/2}\sqrt{2P_2^*(1-P_2^*)} + z_{1-\beta}\sqrt{P_1^*(1-P_1^*) + P_2^*(1-P_2^*)} \right\}^2}{\left(P_1^* - P_2^*\right)^2}$$

Description:

P1 = the proportion of exposure in the case group = 0.75

P2 = the proportion of exposure in the control group = 0.90

Z a = level of significance =0.20

With a level of confidence 80%

To calculate the sample size, we assumed alpha error of 0.20 and a 80% confidence level, the proportion of exposure in case group is 0.75 and the proportion of exposure in the control group is 0.90, and the odds ratio is 2.52 (Lina , 2013).

The sample size in this study is 50 cases and 50 controls will be conducted From fifth health care centers (Wonokosumo, Pacar Keling, Jagir, Peneleh, and Lontar) in Surabaya, we select randomly the cases and controls which includes; 12 cases and also 12 controls from Wonkosumo (PHCs) in northern of Surabaya, 8 cases and also 8 controls from Pacar Kelling (PHCs) in eastern of Surabaya, while 12 cases and also 12 controls from Jagir (PHCs) in southern of Surabaya, furthermore we select randomly 11 cases and also 11 controls from Peneleh (PHCs) in center of Surabaya, and 7 cases and also 7 controls from Lontar (PHCs) in western of Surabaya.

The sample determination conducted from Surabaya population furthermore from the health care center in Surabaya. Surabaya is the capital of East Java, and it is divided into fifth districts, which are includes; north, south, east, west and center of Surabaya.

Cluster random sampling is suitable way to draw sample for this study of the total area of Surabaya, a convenient way in which a sample could be taken in cluster sampling is to divide the area into a number of smaller areas (fifth districts), and then

to randomly (simple random sampling) we select a number of these smaller areas, with the ultimate sample consisting of all units in these small areas or clusters. In cluster sampling the total population is divided into a number of relatively small subdivisions which are themselves clusters of still smaller units and then some of these clusters are randomly selected for inclusion in the overall sample.

After we drown the sample size from the health care centers by using the case control formula above we need to know how to take a random sample in actual practice from whole Surabaya, we could, in simple cases like the one above, write each of the possible samples, write each names of a finite population (from the 2 different population; case and control separately) of the specific area on a slip of paper, mix these slips thoroughly in a container and then draw as a lottery either blind folded. We required number of all patients in case and control population for the sample one after the other without replacement. In doing so we must make sure that in successive drawings each of the remaining elements of the population has the same chance of being selected.

4.4 Inclusive Criteria for Cases and Control

4.4.1 Cases

1. Cases are diabetic's mellitus type 2 patients are registered during the past of December of 2015 until May of 2016 in the 5 PHCs health care centers in Surabaya .
2. Willing to become respondents with informed consent.

4.4.2 Controls

1. Patient independent from the diabetes mellitus diseases and may be affected by another disease and register in 5 primary health care centers in the past of December of 2015 until May of 2016 in Surabaya.
2. Willing to become respondents during the study period with informed consent.

Operational framework

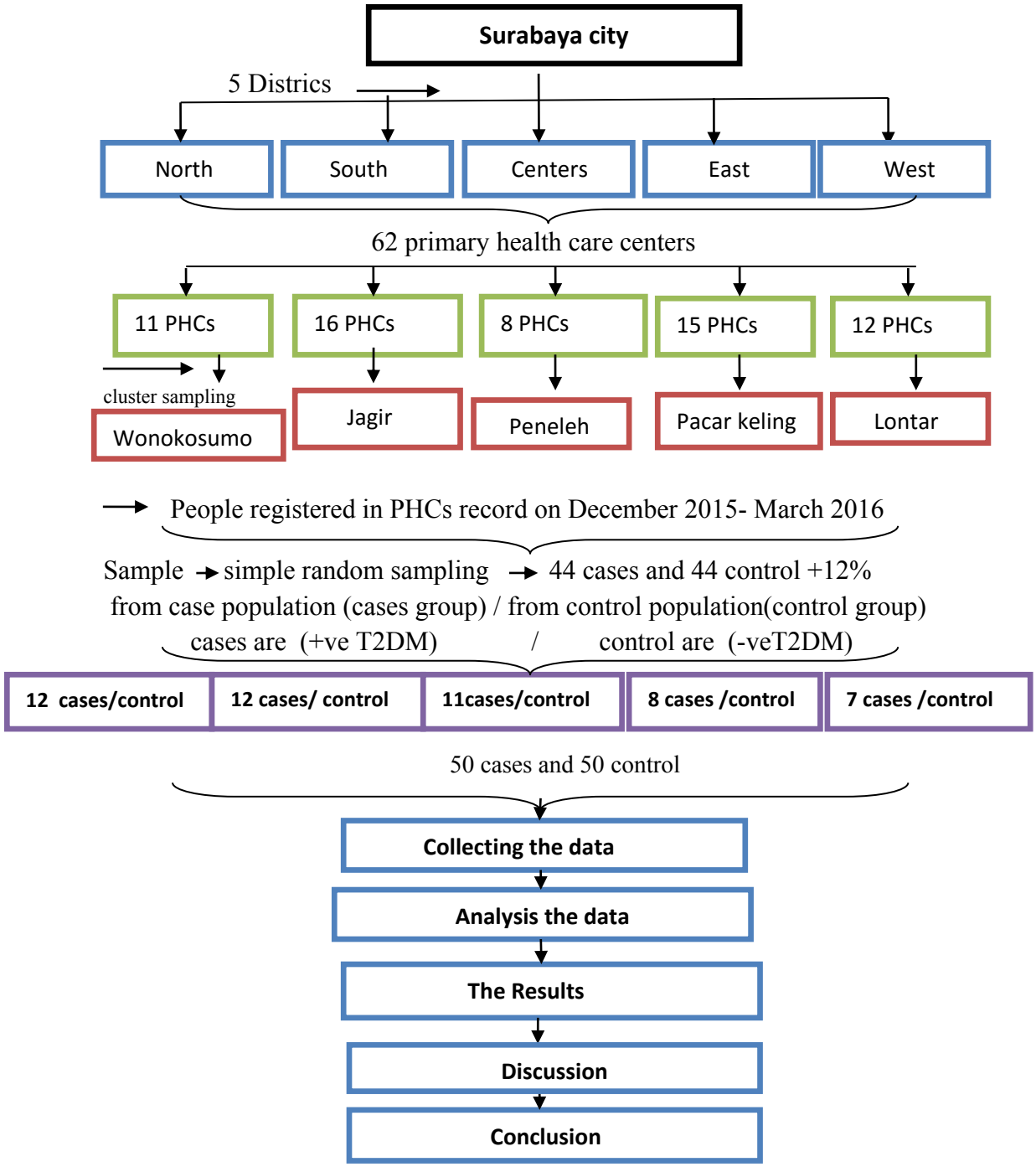


Figure (4.2) The operational frame of selecting the PHCs of Surabaya

4.5 Rational Variable of Study

The definition of variable is a characteristic of a person, object or phenomenon that can take on different value (Kothari, 2004). The variables can take on different values in this research such as a participant age, also Numerical variables because they are expressed in numbers (metric data), such as weight, height and monthly income in this research. The second types of variables are the categorical variables which are expressed in categories such as marital status occupational and disease condition (Josepha, 2010).

4.5.1 Dependent Variable

Dependent variable that variable is used to describe or measure the problem under study. Dependent variable in this research is type 2 diabetes mellitus (T2DM).

4.5.2 Independent Variable

The independent variable is described or measures the factors that are assumed to influence or causes the problem. There are several independent variables in this study as; background variables or characteristic, such as age, gender, educational status, genetic factor (Family history of diabetes), marital status, occupational, income per month, obesity. The second independent variables in this research are the environment and social variables; such as diet, smoking, change in life style, alcohol intake, sedentary life style (Physical inactivity) blood pressure, blood cholesterol, and

stress. Dietary fiber, viral infection , malnutrition, which are elements of what broadly known as social class but not are examined in this study due to time and limited of resources. So the High and low of diabetes mellitus have been linked to a number of these variables, the variables which categories into dependent and independent variables as the follows:

4.5 **Operational definition**

The Operational definition of the study of the determinant factors of developing type 2 diabetes mellitus in the primary health care centers in Surabaya are includes; the dependent variable of T2DM, and independent variables that suspected of occurrence the diseases among the people in Surabaya, also includes the researcher plan for measuring the variables in his research, and the Instrumentation that researcher plan to use it during collecting the data. The operational definition variables are mentioned on the following table;

Table (4.1) The operational definition table:

Variable	Definition	Instrument	Scale	The results
1.Diabetes condition	The occurrence of T2DM among the participants according to WHO, ADA criteria (random blood glucose concentration = 20 mg/dl or fasting blood glucose >126mg/dl , and after 2 hour plasma glucose =200mg/dl)	Questionnaire and secondary data (medical report in the PHCs)	Nominal	1. Yes 2. No
2.Age	The participants age based on his birthday from the medical report	Questionnaire and secondary data (medical report in the PHCs)	Ordinal	1.<45 years 2.≥ 45years
3.Gender	Participants sex: Male or female	Questionnaire	Nominal	1.Male 2.Female

4.Urbanization	The participants hometown (region place). Is he /she born in Surabaya or immigrant from another area? And how long he / she stayed in Surabaya	Questionnaire	Nominal	1. Yes 2.No
5.Education	The participants duration of the previous education (in years)	Questionnaire	Ordinal	1. ≥ 9 years 2. < 9 years
6. Marital status	Participants married condition	Questionnaire	Nominal	1..Married 2.Divorced /Widowed
7.Occupation	The Participants working condition	Questionnaire	Nominal	1.government workers / Police 2.Private employees 1.Retired / doesn't working 4.others
8.Income per month	Participant's salary per month by IDR.	Questionnaire	Ordinal	1.≥Rp1.000.000 2.Rp. 500.000 - Rp. 1000.000 3.< Rp.5.00000
9.Family history of diabetes	The existence of the T2DM disease among the participants family is his closed families (father / mother, sister /brother) were diabetics or the grandfather or grandmother /uncle /aunt) were diabetics	Questionnaire	Nominal	1. Yes 2.No
10.Height	The participant's height in centimeters measured by the researcher or by the medical team in the PHCs during collecting the data for calculating the BMI.	Centimeter	Ratio	Measuring lengthwise per centimeter
11.Weight	The participant's body weight in kilogram measured by the researcher or by the medical team in the PHCs during collecting the data for calculating the BMI	Weight balance	Ratio	Measuring in kg

12.Obesity	The obesity abnormal) condition (among the Participants measured based on 1.BMI (per kilograms per meter squared) 2.Waist circumference (by centimeter)	1.Height instrument (cm) 2.Weight instrument (kg) 3.Waist measuring instrument	Ordinal	a. BMI 1.Normal(<18.5-25) 2.Overweight (>25) b. WC 1.Normal (< 80cm for women, < 94 cm for men), 2.Overweight (≥ 80 cm for women ≥ 94 cm for men)
13.Hypertension	The participant's blood pressure (systolic / diastolic) and it recorded before we collect data in the medical record (patient history report).	Questionnaire	Nominal	a. Systolic 1. Normal (<120 mm Hg) 2. Abnormal (≥ 120 mm Hg) b. diastolic 1. Normal (< 80 mm Hg) 2. Abnormal (≥ 80 mm Hg)
14. Cholesterol	The participant's blood cholesterol (LDL / HDL / TG) which were recorded in medical record before we starting collecting the data (patients history record)	Questionnaire	Nominal	a. LDL 1.Normal (<100) 2.Abnormal (≥ 100) b.HDL 1.Normal (>40 for men & >50 for women) 2.Abnormal (≤40for men & ≤50 for women) c.TG 1.Normal (≤ 150) 2.Abnormal (> 150)
14.Physical activity	The existence of natural, routine (frequency) and the type of the participants' exercises or movements daily for losing energy (daily activity) at least 30 minute.	Questionnaire	Nominal	existence of exercise 1.yes 2.No Second the frequency 1. ≥ 3 times/ week /for 30 minutes 2.< 3 times /week /for 30 minutes Third types of exercise 1.Runing

				2.Bicycle 3. Dancing 4.walking 5.Other
15.Smoking	The existence of smoking habits among the participants and the frequency per day last years. And how many cigarettes were consumed daily	Questionnaire	Ordinal	1.No 2. yes The amount 1.1-9 cigarettes daily. 2.> 10 cigarettes daily
16. Frequency of eating fast food	The participant's tendencies of eating fast food frequently in restaurants or warung places last years	Questionnaire	Ordinal	1. Every day 2. sometimes 3. rarely
18. Diet	The participants food consuming frequency, and food types consuming per day/week. In this study we measure 1. Carbohydrate (food and drink), 2. fatty acid by using frequency food questionnaire in analysis become scales by scoring as the follows:' 1. >1times daily is High score 4 2.4-6times/ week is Moderates score 3 3.<1-3 times / week is Low score 2	Diet Questionnaire	score	a. Carbohydrate foods 1.<1-3times / week 2.4-6times / week 3.>1 times daily b. Protein 1.<1-3times / week 2.4-6times / week 3.>1 times daily c. fats 1.<1-3times / week 2.4-6 times / week 3.>1 times daily d. soft drinks 1.<1-3 times/ week 2.4-6 times /week 3.>1 times daily e. fried food 1.<1-3times / week 2.4-6times / week 3.>1 times daily f. vegetables 1.<1-3times / week 2.4-6times / week 3.>1 times daily g. fruits 1.<1-3times / week 2.4-6times / week

				3.>1 times daily

4.7 Instrumentation

The instrument used in data collection of this research consisted of a questionnaire and medical reports. The instrument was created to determine the risk for developing type 2 diabetes mellitus by measuring diet, snacking habit, and life style factors. The questionnaire included questions designed to obtain demographic information of length of time in Surabaya, physical activity, diabetes condition, medical history, and frequency of eating out. Of these questions, physical activity, length of time in Surabaya, cigarette smoking, and medical history were utilized to analyze risk for type 2 diabetes mellitus. Body mass index (BM1), determined from height and weight measurements, and waist circumference (WC) were also used to analyze risk for developing type 2 diabetes mellitus. The remaining assessments (physical activity, frequency of eating out, and snacking habits) were used to further describe lifestyle factors (diet and physical activity) that may be associated with developing type 2 diabetes.

The quantitative food frequency in the second part in the questionnaire is contained food choices typical of Surabaya diets a food list of a supplementary includes vitamins and anti oxidant added too. The questionnaire was designed to clump food items into food groups. Groups included were: carbohydrates (food and drinks), protein, fat, vegetables and fruits. The questionnaire asked how many times a

day, week the subjects ate each food item as well as the number of portions (amounts) consumed.

4.8 Methodological Considerations

The aim of an epidemiological study is to be both valid and reliable and to avoid random and systematic error. A measurement is valid if it measures what it is suppose to measure. This validity can be divided into an internal and an external validity. Internal validity is the degree to which the results of a study are correct for the sample of people being studied. External validity refers to whether the results from the study can be applied to other populations who were not actually studied (Josepha, 2010).

- **Random Error**

Random error is the chance of non reproducibility of a study finding. It can result in weakening of a true association between exposure and effect variables. It can be improved by increasing the size in this study to reduce sampling error (Kothari, 2004).

Random error was addressed by statistical inference. Estimation of the associated relative risk and its confidence interval were calculated. Hypotheses were tested at the 0.05 alpha levels with 80% confidence intervals. The null hypothesis was rejected if the chance of a random finding was less than 5% (p value < 0.05). Otherwise the null hypothesis was retained and the analysis reported as non significant (Kothari, 2004).

4.9 Research Location

This study was conducted in primary health care centers in Surabaya city. Surabaya is the capital of East Java, and the second most populous city in Indonesia, located on northeastern Java island and along the edge of the Madura Strait . At the 2010 census, the city had a population over 2.8 million. Surabaya is consist of 5th districts includes; North, East, center, west, and South of Surabaya. Surabaya city has 2.816.729 populations and also has the highest population density in east java with 8.509.76 k/ m^2. Javanese people are the majority in Surabaya, with Chinese Indonesians and Madurese being significant minorities in the city. Surabaya also has ethnic populations from other parts of Indonesia such as; Sundanese, Minang, Batak, Banjar, Balinese, and Bugis according to Ministry of Health Profile of East Java Province in 2014.primary health care (PHC) is first level of contact individuals families and communities have with the health care system. Surabaya has 62 health care centers as the follows

Table (4.2) The location of the health care centers in Surabaya

Districts	PHCs amount	PHCs selected	Total of cases	Sample +12%
North Surabaya	11	Wonokosumo	200	12
East Surabaya	15	Pacer Keling	142	8
West Surabaya	12	Lontar	121	7
South Surabaya	16	Jagir	200	12
Center Surabaya	8	Peneleh	195	11
Total	**62**	**5** PHCs	**858**	**50**

The researcher select randomly by using simple random sampling technique one of the primary health care centers from the districts of Surabaya furthermore the researcher collected the data from fifth health care center of 62 centers in Surabaya.

4.10 Time duration for research

The study was conducted during the months of October 2015 until June of 2016 in Surabaya health care centers.

4. 11 Data Collection

Data collection is systematic process of gathering and, measuring information on targeted variables and it is an important aspect for accurate and valid result and good outcome of any type of research study (Kothari, 2004).

After enrollment and informed consent is obtained; a standardized questionnaire was interviewed. The study questionnaire for the use of all cases and controls prepared for collecting the data from the participants from the fifth primary health care centers of Surabaya. The secondary data was collected from recorded, while the primary data will be carried out for the respondent on April 2016 through June 2016. Data include some identifying information, demographic information, date of onset, and a series of detailed questions about behaviors, practices, exposures, and underlying medical conditions.

The questionnaire was checked for inconsistency by health examination in department of health in Airlangga University, and it included questions on disease, habits with respect to physical activity, smoking, eating fast food, and work related

issues. The questionnaire included also questions on health condition, disease in the family, marital status, age, education level and more thorough questions on diet.

4.12 Data Analysis

The program used for analyzing this data was the Statistical Package for Social Sciences (SPSS). All statistical analysis was performed using.

A *p*- value < 0.05 was considered significant.

4.12.1 Descriptive analysis

Frequencies and chi square (crosstabs) descriptive analysis was used in this study. Frequencies descriptive analysis was performed to observe and judge the normal distribution of socio demographics characteristics among the cases and controls. The chi-square value is also used to judge the significance of population variance and to assess the determinant factors of developing type 2 diabetes mellitus in Surabaya and also to judge if a random sample has been drawn from a normal population, while a chi square test was used to study the association between the determinant factors of type 2 diabetes mellitus to study the impact of the selected socio demographic factors, BMI, smoking, diet, and other risk factors, of the developing of type 2 diabetes mellitus among the Surabaya population. Age and sex were matched before started collected the data. Education, occupation, annually income, physical inactivity, positive family history of diabetes, history of hypertension, BMI, WC, cholesterol, and diet as independent variables in this study.

4.12.2 Inferential analysis

When there are more than two independent variables, the analysis concerning relationship is known as multiple correlations and the equation describing the correlation or the relationship as the simple regression and multiple regression equation. There are more than two independent variables and one dependent variable in this study. In this situation the results are interpreted as bellow

Multiple regression equation assumes form

$$Y = e^{a+b1x1+b2x2+b3x3+xb4x4,\ldots}$$

Where, X1, and X2, et al are independents variables and Y being the dependent variable, a, b1 and b2, b3, b4 are constant (Kothari, 2004).

4.13 Informed Consent

Inform consent is a formal agreement that a patient or participants signs to give permission for a medical procedure after having been told about the potential risks, exclusion criteria and the benefits that he/she will get it from the research. All participants must be fully informed of the study and what is being asked of them, in order to make a fully informed decision about the whether or not to participate.

CHAPTER V

RESULTS

A case-control study has been carried out at primary health care centers of Surabaya (5 PHCs out of 62 PHCs) during the 6th months in the past in December 2015 until May in 2016. The research was conducted in primary health care of Surabaya city. The city was divided into five sub districts which includes Northern, Eastern, Western, Southern, and middle of Surabaya. Surabaya has 62 PHCS; we selected randomly the 5th primary health care includes; Wonokosumo, Jagir, Peneleh, Pacar keling, and Lontar.

Data was analyzed through descriptive statistics (frequencies and chi square) and by applying logistic regression statistical test (simple and multiple). Results from chi square that were showed significant association between the factors and T2DM carried to the second steps (logistic regression).

5.1 Descriptive Analysis (Frequencies)

Table 5.1 The Distribution Of Sociodemographic Characteristics Among The Participants In PHCs Of Surabaya 2016.

No	characteristics	parameters	frequency	percentage
1	Age	<45 Years	30	30.0
		≥45 years	70	70.0
Total			100	100.0
2	Gender	Male	36	36.0
		Female	64	64.0
Total			100	100.0
3	born in Surabaya	Yes	70	70.0
		No	30	30.0
Total			100	100.0
4	Education	< 9 years	75	75.0
		≥9 years	25	25.0
Total			100	100.0
5	Marital status	Married	58	58.0
		Divorced/widowed	42	42.0
Total			100	100.0
6	Occupational	Government sector	16	16.0
		Private sector	26	26.0
		Retired/doesn't working	38	38.0
		Other	20	20.0
Total			100	100.0
7	income per month	RP< 500000	21	21.0
		RP500000– 1000000	27	27.0
		> RP 1000000	52	52.0
Total			100	100.0

One hundred subjects participated in this study in both cases and control group; 100% subjects in cases (n=50), and same subjects 100% in controls group (n=50).

Matching in age and gender between the cases and controls were done before we started collecting the data. 36% of cases subjects (n=18) were males whereas 64% of them (n=32) were female in both of cases and controls group. The majority of study subjects among cases and controls group were elders,; 70% of participants were (≥ 45 years) in both of cases and controls subjects, whereas 30% of them (n=15) in them were youngest <45 years. Also the majority (75%) of the participants were low education, whereas only 25% of subjects were high education. The detail in table (5.1) in the bellow;

1.2 Bivariable Analysis

5.2.1 Sociodemographics

1. The Participants Place of Born

Table 1 The Distribution Of T2DM Among The Participants Based To Place Of Birth In PHCs Of Surabaya 2016.

Born in Surabaya	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	0.991
Yes	38	76.0	32	64.0	
No	12	24.0	18	36.0	
Total	50	100.0	50	100.0	

OR= 0.561 CI=80% 0.318< OR<0.991

The majority of study subjects of cases and controls group belonged to Surabaya region, 76.0% of cases subjects (n=38) and 64.0% of controls (n=32) were born in Surabaya. Subjects who weren't born in the Surabaya in cases subjects were consisted 24 % of cases subjects (n=12) and 36% of controls (n=18). Type 2 diabetes

mellitus is high among the Surabaya population. There was no statistically significant association between type 2 diabetes mellitus and born in Surabaya. Place of birth was not found to yield statistically significance in binary logistic regression test.

2. The Period Of Living In Surabaya

Table 2 Distribution Of T2DM Based To The How Long The Participants Being In Surabaya Among The Participant Who Were Not Born In Surabaya In PHCs Surabaya 2016.

How Long you being in Surabaya	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
<10 years	4	8.0	6	12..0	
≥10 years	8	16.0	12	24..0	0.424
Born in Surabaya	38	76.0	32	64.0%	
Total	50	100..0	50	100.0	

OR= 1.781 CI=80% 0.737< OR<4.305

When the participants weren't born in Surabaya religious compared according to how many years had lived in Surabaya the results showed that, 8% of cases subjects (n=4) and 12% of controls (n=6) they were lived in Surabaya for less than 10 years, while 16% of cases subjects (n=8) and 24% of controls (n=12) were lived more than 10 years in Surabaya. T2DM is high among the people lived in Surabaya more than 10 years. Long living in Surabaya was not found to yield statistically significance.

3 The Education Among The Participants

Table 3 Distribution Of T2DM Based To Education Between The Participants In PHCs Surabaya, 2016.

Education	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
< 9 years	46	92.0	29	58.0	0.015
≥ 9 years	4	8.0	21	42.0	
Total	50	100.0	50	100.0	

OR= 8.817 CI=80% 2.8< OR< 27.7

With regard to the education period in this study, 92% of cases subjects (n=49) and 58% of controls (n=29) were educated < 9 years, whereas 8% of cases subjects (n=4) and 42%of controls (n=21) were educated (≥ 9 years). T2DM is high among the people had low education (non educated peoples). A strong association was found between cases and controls with regard to the education (p<0.015). Logistic regression showed with odds ratio 8.817 and 80% (CI):(2.8< OR< 27.7(p0.015)), p value (less than 0.05) statistically significant which means that subjects who had low education (< 9years) were expose to the higher risk of developing T2DM as 8.817 fold compared to those had high education (≥ 9 years).

4. The Marital Status Among The Participants

Table 4 The Distribution Of T2DM Based To The Marital Status Between Cases And Controls In PHCs Surabaya, 2016.

Marital status	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Married	32	64.0	26	52.0	0.225
Divorced/widowed	18	36.0	24	48.0	
Total	50	100.0	50	100.0	

OR= 0.609 CI=80 0.361< OR<1.029

The Marital status among the cases and controls subjects showed that 64% of cases subjects (n=32) and 52% of controls (n=26) were Married, whereas 36% of cases subjects (n=18) and 48% of controls (n=24) were divorced/widowed. T2DM is high among the people who were married. There was no statistically significant association observed between cases and control with regard to marital status condition (p<0.225). Marital status was not found to yield statistically associated to develop T2DM. No single subjects in this study, all of them were married and widowed divorced.

5 The Occupations Among Participants

Table 5 The Distribution Of T2DM Based To The Occupations Among Participants In PHCs Surabaya, 2016.

. Occupation	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Government employee/ policy	4	8.0	12	24.0	0.002
Private employee	10	20.0	16	32.0	
Retired/ Doesn't working	28	56.0	10	20.0	
Other	8	16.0	12	24.0	
Total	50	100.0	50	100.0	

OR= 8.400 CI=80% 3.492< OR< 20.205

When the participants were compared according to occupation, it was found that 24% of control subjects (n=12) and 8% of cases (n=4) were Government employee, 32% of control subjects (n=16) and 20% of cases (n=10) were Private employee, 20% of control subjects (n=10) and 56% of cases (n=28) were retired/ Doesn't working were 24% of controls (n=12) and 16% of cases group (n=8) Other

occupational. T2DM is high among the people had job. Subject who were retired and doesn't working expose to high risk of developing T2DM more than the workers people. Private workers also had risk of getting the diseases more than the other, and the governor workers. A strong association was observed between type 2 diabetes mellitus and occupation (p<0.002). Logistic regression showed with odds ratio 8.400 and 80% (CI): (3.492<OR<20.205 (p0.002), p value (less than 0.05) statistically significant which means that subjects who Retired and doesn't working were expose to higher risk of developing T2DM as 8.400 fold compared to subjects had job.

6. Income per Month among the Participants

Table 6 The Distribution Of T2DM Based To Income Per Month Among The Participants In PHCs Of Surabaya 2016.

Income per month	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
< RP 500000	35	70.0	17	34.0	
RP 500000 – 1000000	8	16.0	19	38.0	0.002
≥ RP 1000000	7	14.0	14	28.0	
Total	50	100.0	50	100.0	

OR = 2.322 80% (CI) 1.627< OR< 3.313

When the participants were compared according to income per month, it was found that, 70% of cases (n=35) subjects and 34% of control (n=17) they had monthly income less than 500000 Rupiah, 16% of cases (n=8) subjects and 38% of controls (n=19) they had (RP 500000 – 1000000) monthly income, whereas 14.0% of

cases subjects (n=7) and 28% of controls (n=14) they had high monthly income more 1000000 Rupiah. T2DM is high among the subjects have low income per month(less than Rp500000). A strong association was observed between cases and controls with regard to income per month (p<0.002). with odds ratio 2.322 and 80% (CI): (1.627< OR< 3.313 (p0.002), p value (less than 0.05) which means for subjects who had low income per month were expose to high risk of developing type 2 diabetes mellitus 2.322 fold than the other who had high annually income.

5.2.2 Genetic Factor

1. Existence Of Diabetes Mellitus History Among Family

Table 1 The Distribution Of T2DM Based To Family History Of DM Among The Participants In PHCs Surabaya 2016.

Family history of DM	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Yes	35	70.0	20	40.0	0 .003
No	15	30.0	30	60.0	
Total	50	100.0	50	100.0	

OR = 3.500 80% (CI) 2.03< OR< 6.015

With regard to family history of DM, 70 % of cases subjects (n=35) and 40% of controls (n=20) had a family with history of DM, whereas 30% of cases subject (n=15) and 60% of controls (n=30) they didn't had a family with history of DM. The significant association observed was high (p<0.003). T2DM is high among subjects who had family with the diseases history. Family history was found to be an

important risk factor of developing type 2 diabetes mellitus, with odds ratio 3.500 and 80% (CI): (2.03< OR<6.015(p0.003), p value (less than 0.05) which means for participants had family history of diabetes mellitus they expose to highest risk of developing type 2 diabetes mellitus 3. 500 fold than the other without history of the disease.

2. Family Member and Diabetes

Table 2 The Distribution Of T2DM Based To Participant's Family Member Who Were Diabetic In PHCs Of Surabaya 2016.

Family member with diabetes mellitus	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Father/ mother / sister /brother	25	50.0	9	18.0	
Grandfather/grandmother/ uncle/aunt	10	20.0	11	22.0	0.002
NO family with DM	15	30.0	30	60.0	
Total	50	100.0	50	100.0	

OR = 0.160 80% (CI) 0.095 < OR< 0.342

A detailed study of the family member with diabetes mellitus showed that in 50% of cases (n=25) and 18% of controls (n=9) their family member (father, mothers,

sister and brother) were diabetic, whereas 20% of cases subjects (n=10) and 22%of controls (n=11) their family member were grandfathers/grandmother/ uncle/ aunt were diabetic. T2DM was high among subjects had Family member with DM (family blood, also higher among the mother group than the grandfather group. Family history of DM play main role of the occurrence and developing T2DM. With regarded Odd Ratio and its confidence interval (80%) and P value less than 0.05, family members with T2DM were not found statistically significance.

5.2.3 Biological Characteristics Among The Cases And Controls

1. Obesity

1.1 Body Mass Index Status

Table 1.1 The Distribution Of T2DM Based To BMI Status Among The Participants In PHCs Of Surabaya 2016.

BMI	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Overweight (>25)	32	64.0	17	34.0	0.003
Normal weight (<18.5-25)	18	36.0	33	66.0	
Total	50	100.0	50	100.0	

OR = 3.451 80% (CI) 2.016< OR< 5.907

When compared according to body mass index (BMI) the results showed that there were 64% of cases subjects (n=32) and 34% of controls (n=17) were overweight, they had BMI greater 25 kg/$m^{2,}$ whereas, 36% of cases subjects (n=18) and 66% of controls (n=33) were normal weight, they had less than 18.5 kg/m^2. A strong association was observed between cases and controls with regard to BMI and type 2 diabetic status was found (p<0.003). With odds ratio 3.451 and 80% (CI):(2.016<OR< 5.907 (p0.003)), p value (less than 0.05) statistically significant which means that over weight subjects (>25 kg/m^2) were expose to higher risk of developing T2DM as 3.451 fold compared to those had normal weight(<25 kg/m^2).

1.2 Waist Circumferences Among The Participants

Table 1.2 The Distribution Of T2DM Based On Waist Circumferences Among The Participants In PHCs Of Surabaya 2016.

Waist Circumferences	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
O\verweight	32	64.0	17	34.0	0 .003
Normal	18	36.0	33	66.0	
Total	50	100.0	50	100.0	

OR = 3.451 80% (CI) 2.016< OR< 5.907

With regard to waist circumferences, 64% of cases subjects (n=32) and 34% of controls (n=17) were overweight (at risk), they had waist circumferences (≥ 80 cm for women ≥ 94 cm for men) whereas, 36% of cases subjects (n=18) and 66% of controls (n=33) were normal; they had waist circumferences (< 80cm for women,< 94 cm for men). A strong association between waist circumferences and type 2 diabetes mellitus was found (p<0.003). WC was found to be an important risk factor of developing type 2 diabetes mellitus. Logistic regression test also found that with regarded OR and its confidence interval (80%) and P value less than 0.05, the odds ratio 3.451 and 80% (CI): (2.016< OR< 5.907 (p 0.003)), so participants have abnormal WC they were expose to higher risk of developing type 2 diabetes mellitus 3. 451 fold than the normal subjects.

2. Blood Pressure Status

2.1 Systolic Blood Pressure Status

Table 2.1 The Distribution Of T2DM Based To Systolic Blood Pressure Among The Participants In PHCs Of Surabaya 2016.

Systolic blood pressure	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Abnormal (≥ 120 mm Hg)	46	92.0	37	74.0	
Normal (<120 mm Hg)	4	8.0	13	26.0	0.017
Total	50	100.0	50	100.0	

OR = 4.041 80% (CI) 1.842< OR< 8.863

When the participants were compared according to Systolic blood pressure, 92 % of cases subjects (n=46) and 74% of controls (n=37) they had abnormal systolic blood pressure greater than 120 mm Hg, whereas 8 % of cases subjects (n=4) and 26 % of controls (n=13) were normal systolic blood pressure; they had blood pressure less than 120 mm Hg. There was strong association between Systolic blood pressure and type 2 DM was found ($p<0.017$). Systolic blood pressure was found to be an important risk factor of developing type 2 diabetes mellitus, with odds ratio 4.041 and 80% (CI): (1.842<OR< 8.863(p= 0.017)), p value (less than 0.05) which means participants have abnormal Systolic blood pressure they were expose to higher risk of developing type 2 diabetes mellitus 4.041 fold than the normal subjects. High systolic pressure (hypertension) make the heart work harder to beat and pushes the blood through the blood vessel and expose the subjects to many risk factors includes type 2 diabetes mellitus and heart attack.

2.2 The Diastolic Blood Pressure Among The Participants

Table 2.2 The Distribution Of T2DM Based To Diastolic Blood Pressure Among The Participants In PHCs Of Surabaya 2016.

Diastolic blood pressure	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Abnormal (≥ 80 mm Hg)	37	74.0	19	38.0	

Normal (< 80 mm Hg)	13	26.0	31	62.0	0.084
Total	50	100.0	50	100.0	

OR = 2.173 80% (CI) 1. 233 < OR< 3.862

With regard to diastolic blood pressure, 74% of cases group (n=37) and 38% of controls (n=19) were abnormal blood pressure they had a diastolic blood pressure greater than 80 mm Hg whereas, 26% of cases group (n=13) and 62% of control group (n=31) were normal they had a diastolic blood pressure less than 80 mm Hg. There was no statistically significant association between diastolic blood pressure and T2DM ($p<0.084$). With regard to odds ratio 2.173 and 80% (CI): ($1.233< OR< 3.862$ ($p<0.084$)), p value (less than 0.05) diastolic blood pressure was not found to yield statistically associated to develop T2DM among the participants. Diastolic blood pressure refers to the vessels relaxation between the heart beats.

1. Blood Cholesterol Status

3.1 LDL Cholesterol Blood Level Among The Participants

Table 3.1 The Distribution Of LDL Blood Level Among The Participants In PHCs Of Surabaya 2016.

LDL	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Abnormal (≥ 100)	35	70.0	20	40.0	
Normal (<100)	15	30.0	30	60.0	0.310
Total	50	100.0	50	100.0	

OR = 1.514 80% (CI) 0.897 < OR< 2.558

When the participants were compared according to LDL cholesterol, the results showed that 70% of cases subjects (n=35) and 40% of controls (n=20) were abnormal they had LDL high than one hundred, whereas 30% of cases subjects (n=15) and 60% of controls (n=30) were normal they had LDL less than one hundred. The LDL cholesterol level is high among cases subjects. The elevated of LDL (bad cholesterol) puts the cases subjects in higher risk of heart disease. There was no statistically significant association between LDL and T2DM (p<0.310). With regard to OR and CI (80%) and p value less than 0.05, LDL cholesterol level was not found yield statistically significance so, in this study LDL cholesterol level was not associated with developing type 2 diabetes mellitus in this study.

3.2 HDL Cholesterol Blood Level Among The Participants

Table 3.2 The Distribution Of T2DM Based To HDL Blood Level Among The Participants In PHCs Of Surabaya 2016.

HDL	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Abnormal	25	50.0	14	28.0	0.029
Normal	25	50.0	36	72.0	
Total	50	100.0	50	100.0	

OR = 0.358 80% (CI) 0.196 < OR< 0.654

The participants also compared regard to HDL cholesterol, 50% of cases subjects (n=25) and 28% of controls (n= 14) were abnormal HDL cholesterol, (≤40for men &≤50 for women) whereas, 50% of cases subjects (n=25) and 72% of controls subjects (n=36) were normal they had HDL cholesterol (>40for men &>50 for women). There was statistically significant association between HDL and T2DM was found (p<0.029). With regard to OR and CI (80%) and p value less than 0.05, HDL cholesterol level was not found yield statistically significance so, LDL cholesterol level was not associated with developing type 2 diabetes mellitus in this study. HDL cholesterol was found as protective factors of developing type 2 diabetes mellitus.

3.3 Triglycerides Cholesterol Blood Level Among The Participants

Table 3.3 The Distribution Of T2DM Based To Plasma Triglycerides Level Between Among The Participants In PHCs Of Surabaya 2016.

Triglycerides Level	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Abnormal	29	58.0	10	20.0	0.012
Normal	21	42.0	40	80.0	
Total	50	100.0	50	100.0	

OR = 0.265 80% (CI) 0.135 < OR< 0.521

With regard to plasma triglycerides level among the cases and controls subjects, 58% of cases subjects (n=29) and 20% of controls (n=10) were abnormal their plasma TG level (> 150) in their blood whereas, 42% of cases (n=21) and 80% of controls (n=40) were normal; they had plasma TG level (≤ 150) in their blood whereas only) With regard to OR and CI (80%) and p value less than 0.05, plasma triglycerides cholesterol level was found statistically significance so, TG cholesterol level was not associated with developing type 2 diabetes mellitus (TG was found as protective factor of T2DM).

5.2.4 Behavioral Factors

1. Physical activities

1.1 Existence of Exercises

Table 1.1 The distribution of T2DM based to the existence of exercises between among the participants in PHCs of Surabaya 2016.

Exercises	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Yes	16	32.0	39	78.0	0.000
No	34	68.0	11	22.0	
Total	50	100.0	50	100.0	

OR = 7.534 80% (CI) 4.197 < OR< 13.525

Assessment of physical activity showed that 32% of cases subjects (n=16) and 78% of control subjects (n=39) they had exercise, 68% of cases subjects (n=34) and 22% they didn't had exercise. A strong association between physical activity and T2DM was found (p<0.000). With odds ratio 7.534 and 80% (CI): (4.197< OR<13.525 (p<0.000)), p value (less than 0.05) statistically significant which means that subjects without involved in doing daily exercises has higher risk of T2DM 7.534 fold compared to those doing daily activity. Physical activity was associated with developing type 2 diabetes mellitus.

1.2 Exercises Frequency

Table 1.2 The Distribution Of T2DM Based To Frequencies Of Exercises Among The Participants In PHCs Of Surabaya 2016.

The Exercises frequency	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
≥ 3 times/week/for 30 minutes	5	10.0	15	30.0	0 .000
< 3 times/week/for 30 minutes	11	22.0	24	48.0	
No exercise	34	68.0	11	22.0	
Total	50	100.0	50	100.0	

OR =9.273 80% (CI) 4.178< OR< 20.580

A detailed study of the physical activity frequencies among the participants had exercise showed that, 10% of cases group (n=5) and 30% of controls (n=15) they involved with exercise more than times per week for 30minutes, 22% of cases subjects (n=11) and 48% of control subjects (n=24) were involved with (≥ 3 times/week/for 30 minutes). There was statistically significant association between the exercises frequencies and type 2DM (p<0.000). With odds ratio 9.273 and 80% (CI): (4.178< OR<20.580 (p<0.000)), p value (less than 0.05) statistically significant which means that subjects were involved in doing daily exercises less than 3 per week for 30 minutes has higher risk of developing T2DM 9.273 fold

compared to those doing activity ≥ 3 times/week/for 30 minutes Physical activity frequencies was associated with developing type 2 diabetes mellitus.

1.3 The Types of Exercises

Table 1.3 The Distribution Of T2DM Based To The Types Of Physical Activities Among The Participants In PHCs Of Surabaya 2016.

The types of Exercises	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Running	3	6.0	9	18.0	0.003
By bicycle	3	6.0	7	14.0	
Dancing	1	2.0	12	24.0	
Walking	5	10.0	10	20.0	
Other	4	80	1	2.0	
No exercise	34	68.0	11	22.0	
Total	50	50.0	50	100.0	

OR =9.273 80% (CI) 3.359< OR< 24.293

When the participants compared regard to types of physical activities that were involved with it the results showed that 6% of cases subjects (n= 3) and 18% of controls (n=9) were running daily, 6% of cases subjects (n= 3)and 14% of controls (n=7) they did exercises by bicycle, 2% of cases subjects (n= 1) and 12% of controls (n=6) were danced, 10 % of cases subjects (n= 5) and 20% of controls (n=10) were

walked, whereas 8% of cases subjects (n= 4) and 2% of controls (n=2) they had other types of exercises. A high statistically significant association between types of physical activities and the disease was found (p<0.003).

1.4 No Exercise Reasons

Table 1.4 The Distribution Of T2DM Based To The Reason Of Participants Who Have Not Involved With Exercises Among The Participants In PHCs Of Surabaya 2016.

Reasons of No Exercises	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Busy	14	28.0	7	14.0	
Lazy	4	8.0	1	2.0	
Other	16	32.0	3	6.0	0.000
have exercise	16	32.0	39	78.0	
Total	50	100.0	50	100.0	

OR =0.205 80% (CI) 0.101< OR< 0.415

When the Participants hadn't involved with any exercise asked about the reasons the results showed that 28% of cases group (n=14) and 14% of controls (n=7) were busy, 8% of cases group (n=4) and 2% of controls (n=1) were lazy, 32%

of cases group (n=16) and 6% of controls (n=3) they had other reasons. Subjects haven't involved with any exercise hah highest risk of getting T2DM.

2.Smoking Status

2..1 The Existence Smoking habits

Table 2..1 The Distribution Of T2DM Based To The Past Of Smoking Cigarettes Habit Among The Participants In PHCs Of Surabaya 2016.

Smoking habits	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Yes	10	20.0	4	8.0	0.094
No	40	80.0	46	92.0	
Total	50	100.0	50	100.0	

OR =2.875 80% (CI) 1.283< OR< 6.445

When compared according to smoking habit, 20% of cases subjects (n=10) out of 36% of males (n=18) and 8% of controls subjects (n=4) out of 36% of males (n=18) were tobacco user, whereas 80% of cases subjects (n=40) "64% of female (n=32) &16% of male (n=8)", and 92% of controls (n=46) "64% of female (n=32) &28% of male (n=14)", they weren't tried to smoke during the past of 2015. There was no statistically significant association between smoking and T2DM. The majority gender of this study 64% were females (n=32) in both of cases and controls and all of them they hadn't tried to smoke during the past of the of 2015.The distribution of males participants in this study were 36% of cases subjects (n=18).

2.2 Smoking amount

Table 2.2 The Distribution Of T2DM Based To The Amount Of Cigarettes Smoked By The Participants In PHCs Of Surabaya 2016.

The Cigarettes amount	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
> 10 cigarettes daily	7	14.0	2	4.0	
1-9 cigarettes daily	3	6.0	2	4.0	0.094
Total	50	100.0	50	100.0	

OR =0.248 80% (CI) 0.086< OR< 0.720

Assessment of cigarettes amount among the cases and controls tobacco users showed that 14% of cases subjects (n=7) and 4% of controls subjects (n=2) were used tobacco amount greater than 10 cigarettes daily, whereas 6% of cases subjects (n=3) and 4% of controls (n=2) used tobacco amount (1-9) cigarettes daily whereas. No statistically significant association between the amount of tobacco used and type 2 diabetes mellitus. Smoking habits was not associated with developing type 2 diabetes mellitus in this study.

5.2.5 Dietary Patterns

1. Consumption of fast food

Table 1 The Distribution Of T2DM Based To The Behavior Of Dinning (fast food) In Restaurant Among The Participants In PHCs Of Surabaya 2016.

The frequency of eating fast food (restaurant)	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
Every day	21	42.0	19	38.0	

sometimes	19	38.0	12	24.0	0.107
Rarely	10	20.0	19	38.0	
Total	50	100.0	50	100.0	

OR =0.476 80% (CI) 0.250< OR< 0.907

Subjects were also asked how many times a week they went to a restaurant or a quick place to eat. Results show that 42% of the cases subjects (n=21) and 38% of controls (n=19) were ate out in restaurant every day, 38% of cases subjects (n=19) and 24% of controls (n=12) sometimes they went to ate out whereas 20% of cases subjects (n=10) and 38% of controls (n=19) were rarely went to ate in restaurant or a quick place. There was no statistically significant association between eating out and type 2 diabetes mellitus. Dining out side is not associated with developing type 2DM.

2. Consumption of Carbohydrates

Table 2 The Distribution Of T2DM Based To Carbohydrate Intake Among The Participants In PHCs Of Surabaya 2016.

carbohydrate intakes frequency	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
<1-3 times / week	7	14.0	12	24.0	0.048
4-6 times /week	11	22.0	20	40.0	
>1 times daily	32	64.0	18	36.0	
Total	50	100.0	50	100.0	

OR = 3.048 80% (CI) 1.488 < OR< 6.242

The frequencies of carbohydrates intakes showed that, 14% of cases subjects (n=7) and 24% of controls (n=12) were ate carbohydrates <1-3 times / week, 22% of cases subjects (n=11) and 40% of controls (n=20) were consumed carbohydrates (4-6) times per week, whereas 64% of cases subjects (n=32) and 36% of controls (n=18) were daily consumed carbohydrates more than one times. Strong association between ate carbohydrates and type 2 diabetes mellitus was found (p<0.048). To determine the effect of carbohydrates as determinant factors of occurrence and developing type 2 diabetes mellitus. Logistic regression showed with odds ratio 3.048 and 80% (CI): (1.488< OR< 6.242(p 0.048)), p value (less than 0.05) statistically significant which means that subjects who had habit to consumed carbohydrates >1 times daily were expose to the higher risk of T2DM as 3.048 fold compared to those were consumed carbohydrates<1-3 times /week

3.Consumption of Protein

Table 3 The Distribution Of T2DM Based To Protein Intakes Among The Participants In PHCs Of Surabaya 2016.

proteins intake frequency	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
<1-3 times per week	20	40.0	25	50.0	
4-6 times per week	19	38.0	16	32.0	
>1times daily	11	22.0	9	18.0	0.603

Total	50	100.0	50	100.0	

OR =1.484 80% (CI) 0.831< OR< 2.652

The frequencies of protein intakes showed that, 20% of cases subjects (n=10) and 50% of controls (n=25) were ate protein (<1-3) times per week, 38% of cases subjects (n=19) and 32% of controls (n=16) were consumed protein (4-6) times per week, whereas 22% of cases subjects (n=11) and 18% of controls (n=9) were consumed protein more than one times daily. There was no statistically significant association between consumed the protein intakes and type 2 diabetes mellitus was found. In this study; protein intakes was not associated type 2 diabetes mellitus.

4. Consumption of Fatty Foods

Table 4 The Distribution Of T2DM Based To Fatty Foods Intakes Among Participants Among The Participants In PHCs Of Surabaya 2016.

Fatty foods frequency	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
<1-3 times per week	20	40.0	26	52.0	0 .363
4-6 times per week	21	42,0	19	38.0	
>1times daily	9	18.0	5	10.0	
Total	50	100.0	50	100.0	

OR =2.340 80% (CI) 1.041< OR< 5.261

The frequencies of fats intakes showed that, 40% of cases subjects (n=20) and 52% of controls (n= 26) they ate fatty food (<1-3) times per week, 42% of cases subjects (n=21) and 38% of controls (n=19) were consumed (4-6)times per week, whereas 18% of cases subjects (n=9) and 10% of controls (n=5) were consumed fats more than one times daily. There was no statistically significant association between

fats intakes and type 2 diabetes mellitus was found (p<0.363). In this study; fatty food intakes was not associated type 2 diabetes mellitus.

5. Consumption of Vegetables

Table 5 The Distribution Of T2DM Based To The Frequency Of Vegetables Intakes Among The Participants In PHCs Of Surabaya 2016.

The frequency of eating vegetables	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
<1-3 times per week	8	16.0	7	14.0	
4-6 times per week	20	40.0	28	56.0	0.256
>1times daily	22	44.0	15	30.0	
Total	50	100.0	50	100.0	

OR =0.487 80% (CI) 0.275< OR< 0.861

With regard to how many times a day, week the subjects ate vegetables, the results showed that 16% of cases subjects (n=8) and 14% of controls (n=7) were ate vegetables it (<1-3) times per week, 40% of cases subjects (n=20) and 56% of controls (n=28) were ate it (4-6) times per week, whereas 44% of cases (n=22) and 30% of controls (n=15) were ate vegetables more than one times daily. There was no statistically significant association between the frequency of eating vegetables and type 2 diabetes mellitus. In this study; vegetables intake was not associated type 2 diabetes mellitus.

2. Fruit Consumption

Table 6 The Distribution Of T2DM Based To The Frequency Of Fruit Intakes Among The Participants In PHCs Of Surabaya 2016.

The frequency of eating fruits	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
<1-3 times per week	5	10.0	3	6.0	
4-6times per week	26	52.0	28	56.0	0.750
>1times daily	19	38.0	19	38.0	
Total	50	100.0	50	100.0	

OR =0557 80% (CI) 0.205< OR< 1.513

The participants also asked about how many times a day, week the subjects ate fruit, the results showed that 10% of subjects from both cases and controls (n=5) and 6% of controls (n=3) they ate fruits <1-3 times per week, 52% of cases subjects (n=26) and 56% of controls (n=28) were ate it 4-6times per week, whereas 38% of cases (n=19) and also 38% of controls (n=19) were daily ate fruits >1times. There was no statistically significant association between the frequency of eating vegetables and type 2 diabetes mellitus.

7. Soft Drink Consumption

Table 7 The Distribution Of T2DM Based To The Soft Drink Intakes Among The Participants In PHCs Of Surabaya 2016.

soft drink frequency	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
4-6 times per week	19	38.0	17	34.0	0.881
<1-3 times per week	18	36.0	18	36.0	
>1times daily	13	26.0	15	30.0	
Total	50	100.0	50	100.0	

OR =0.775 80% (CI) 0.406< OR< 1.481

The soft drinks t intakes results showed that, 38% of cases subjects (n=19) and 34% of controls (n=17) they had habit to drink it (<1-3) times per week, 36% of cases subjects (n=18) and 36% of controls (n=18) were drink 4-6 times per week, whereas 26% of cases subjects (n=13) and 30% of controls (n=15) were drink it >1times daily. No statistically significant association between soft drinks intakes and type 2 diabetes mellitus was found. In this study; soft drink intakes was not associated type 2 diabetes mellitus.

8. Snacks Consumption

Table 8 The Distribution Of T2DM Based To Frequency Of Snacking Pattern Food Among The Participants In PHCs Of Surabaya 2016.

The frequency of eating fried food	Type 2 diabetes mellitus				p value
	Cases		Control		
	n	%	n	%	
<1-3 times per week	16	32.0	19	38.0	0.094
4-6 times per week	23	46.0	13	26.0	
>1times daily	11	22.0	18	36.0	
Total	50	100.0	50	100.0	

OR =2.101 80% (CI) 1.128< OR< 3.913

The snacking habits between cases and controls subjects showed that 32% of cases subjects (n=16) and 38% of controls (n=19) they snacked (1-3) times per week, 46% of cases subjects (n=23) and 26% of controls (n=13) were snacked 4-6 times per week, whereas 22% of cases (n=11) and 36% of controls (n=18) were daily snaked more than one time. There was no statistically significant association between snacking pattern and type 2 diabetes mellitus ($p<0.094$). In this study; snacking habits was not associated type 2 diabetes mellitus.

To test the hypothesis which includes; Family history, low education high income, high intakes of carbohydrates and soft drinks, protein, fats, and fried food (more sweet, protein, and fatty food), low intakes of vegetables and fruits, Obesity or overweight, life style (eating fasten food, smoking, hypertension, high cholesterol physical inactivity or exercises less than 3 times daily, are associated with developing type 2 diabetes mellitus.

First analysis is performed to see the association between the determinants factors and type 2 diabetes mellitus, in this stage predictor variables has the highest values($p>0.05$) was excluded. The variables valued less than 0.05 was remained and included in the second stage (logistic regression analysis).

5.3 Multiple Logistic Regression Analysis test

Validation of hypothesis is tested by applying binary logistic regression test. The multiple regression technique is used to explore the relationship between type 2

diabetes mellitus (one continuous dependent variable& dichotomous with two category Yes/ No) and a number of independent variables in this study such as education, marital status, occupational, income per month, family history with diabetes mellitus, systolic, diastolic, BMI, WC, exercise, LDL, HDL, TG, and carbohydrates (three or more categorical need to be recorded as dummy variables with 0/1 outcomes).

Logistic regression (binary regression) is used to assess the impact of the determinant factors of developing type 2 diabetes mellitus (predictor variables strongly related to T2DM or not). It's important that binary variables or dichotomous categorical variables in this study were coded as 0= No. Also, categorical variables with three or more categorical need to be recorded as dummy variables with 0/1 outcomes. In this binary logistic regression test, dependent variables (type 2 diabetes mellitus) were divided into two categories: no means free from T2DM disease is given 0 and 1 is given to yes means yes he/she have type 2 diabetes mellitus for coding the dependent variable while analysis the data .

The categorical predictor variables (independent variables code dichotomous variables using 0 and 1. After navigate the analysis and select binary regression from analysis trees and after categories of variables and selected from options classification hosmoer-lemeshow goodness of fit, casewise listing of residuals, CI (80%) for exp (B), continuous and after that click ok. The output of analysis is performed showed as the follows:

logistic regression was carried out using these all significant variables from the descriptive statistics chi square (14) independent variables (education, marital status, occupational, income per month, family history with diabetes mellitus, systolic, diastolic, BMI, WC, exercise, LDL, HDL, TG, and carbohydrates) included and only type 2 diabetes mellitus is dependent variable used (only one dependent variable). In this stage, stepwise removal probability is ($p < 0.1$). As we can see in this category of main variables, LDL cholesterol level has the highest value ($p=0.309$), so it was excluded in the proceeding step. Similar analysis was performed repetitively till the valued less than ($p<0.1$) is remained.

From Case Processing Summary the total numbers of cases included in analysis were 100 and the percent also (100%) that means all subjects in this study from both cases and controls group were included in the analysis process. The dependent variables encoding as no = 0 while yes =1. The categorical variables coding tables showed that the total number of cases in each category in column headed frequency were included equal 100 (included all subjects in both cases and control). Output of block 0: beginning block results showed that overall percentage correct =50.0, and the cut values is.500.

The Ommibus tests of model coefficients gives the result of the type 2 diabetes mellitus ratio (LR) test which indicates whether the inclusion of this block of variables contributes significantly, the model referred to the “goodness of fit”. The significant values in this table were highly significant value is ($p<0.000$), and it’s

really less than p<0.05; that means the (14) independent variables above associated with the occurrence of type 2 diabetes mellitus. The chi square value in this table is 85.997 with 18 degree of freedom. $x^2(df, N(100)) = 85.997$, p value is (p=0.000), which verifies the model is significant.

The results showed in the table headed Model Summary gives us information about the usefulness of the model. Cox & Snell R Square is 57.7%%, and Nagelkerke R Square is 76.9%, and estimates changed by less than 0.001. The results in the table headed Hosmer and Lemeshow Test also supports the model as being worthwhile and interpreted the goodness of fit test, poor fit of this test was indicated by a significant value less than .05, the significant in Hosmer and Lemeshow Test in this study was (p>0.109) and its really greater than (p >0.05), and chi square is 13.032, with eight degree of freedom. The value of 0.109 is larger than 0.05, therefore indicated supports for the model.

The classification table, the overall percentage of correctly predicted was 90.0 %and the cut value is 0.005. This means that if the probability of a case being classified into the "yes" category is greater than 0.500. All cases in this study in both cases and controls subjects they had same condition, because there were 90 percentages of participants in both cases and controls answering same to the question (PAC=90.0). The sensitivity (true positive) of the model is the percentage of the people who did have type 2 diabetes mellitus (90.0%). The specificity (true negative) of the model is the percentage of the people free from type 2 diabetes mellitus also

(90%). The positive predictive value is the percentage of the cases that the model classified with type 2 diabetes mellitus.(predicted yes & observed yes) equal (5+45 = 50) and multiply by 100 to give percentage (45/50*100=90%). The negative predictive value is the percentage of the cases that the model classified free from type 2 diabetes mellitus (predicted no & observed no) equal (45+5 =50) and multiply by 100 to give percentage (45/50*100=90%).

Finally, the "variables in the equation" tables summaries the importance of the independent variables individually associated with the occurrence and developing type 2 diabetes mellitus with regarded to in adjusted OR and CI (80%), and remained of p value less than (0.05). Results of the analysis as shown in the table below about the predicted determinants factors associated with the developing type 2 diabetes mellitus. The table is provided us by information about the importance of each of our predictor variables.. Education, occupational, income per month, family history of diabetes mellitus, body mass index (BMI), waist circumference (WC), triglycerides (TG), exercise, and carbohydrates were included in binary logistic regression model in this study. The OR and its confidence interval are shown in the table below as the follow

Table 5.3 logistic regression final analysis statistics (variables in the equation).

Variables	Category	B	Sig	OR	80% C.I
1.Education	≥ 9 years		-	-	-
	< 9 years	2.177	0.015	8.817	2.803-27.738
2.Occupational	Government employee// policy		0.339	-	
	Private employee	1.505	0.285	4.505	0.742- 27.341
	Retired/Doesn't working	2.729	0.084	15.324	2.022-116.142
	Other	1.925	0.216	6.857	0.934-50.327
3,income per month	< RP 500000		0.348		
	RP 500000 – 1000000	.673	0.551	1.959	0.462-8.304
	≥ RP 1000000	1.515	0.160	4.548	1.142-18.113
4.family history with DM	No		-		
	Yes	1.588	0.043	4.893	1.792-13.359
5. BMI	Normal		-	-	-
	Abnormal	1.900	0.012	6.687	2.525-17.708
6. WC	Normal				
	Abnormal	1.226	0.121	3.408	1.239-9.380
7.Triglycerides	Normal		-	-	-
	Abnormal	-3.024	0.003	0.149	0.013- 0.182
8..Exercise	Yes		--	-	
	No	2.619	0.001	13.722	4.793-39.288
9. carbohydrate	4-6 times / week		0.101		

	<1-3 times /week	0.978	0.368	2.660	0.660-10.713
	>1 times daily	2.163	0.048	8.700	2.145-35.296
Constant	-8.719		0.001	0.000	

Finally the binary logistic equation with regarded to independent variable showed significant (less than 0.05) which calculated as the follow:

$$y = e^{(-0.8179)+(2.177)L.O+(1.588)F.H+(1.900)O.B+(2.619)P.I+(2.163)CR}$$

O.B : overweight body mass index.
P.I : physical inactivity.
CR : carbohydrates.

So, low education, family history of diabetes mellitus, abnormality of the body mass index, and also physical inactivity, and daily consumption of carbohydrates more than ones time emerged as significant independent risk factors for the occurrence and developing type 2 diabetes mellitus.

To determine the effect of education as determinant factors of occurrence and developing type 2 diabetes mellitus by using the duration. Education is divided into two; ≥9 years and <9 years. Logistic regression showed with odds ratio 8.817 and 80% (CI): (2.8<OR<27.7(p<0.015)), p value (less than 0.05) statistically significant. Subjects who had low education (< 9years) were related to the higher risk of T2DM as 8.817 fold compared to those had high education (≥ 9 years).

Occupational was predicted as determinant factors of occurrence and developing type 2 diabetes mellitus. Occupational is divided into three groups which includes; government employee// policy, private employee, retired/doesn't working, and other. Occupational was not found to yield statistically significance in Covariates. Income per was divided into.≥ RP 1000000, RP 500000 – 1000000, and < RP 500000. With regarded OR and its confidence interval (80%) and P value less than 0.05, income per month was not found statistically significance.

Family history was found to be an important risk factor of developing type 2 diabetes mellitus, with odds ratio 4.893 and 80% (CI): (1.79<OR<13.36 (p<0.043), p value (less than 0.05). participants had family history of diabetes mellitus they associated with developing type 2 diabetes mellitus 4.893 fold than the other without history of the disease.

The body mass index appeared as a significant risk factor for the occurrence of T2DM. BMI was divided into two normal and overweight. The results showed that with odds ratio 13.722 and 80% (CI): (2.5< OR<17.7(p<0.012), p value (less than 0.05) statistically significant. Subjects who overweight body mass index (>25 kg/m^2) were associated to the higher risk of T2DM as 6.687 fold compared to those had normal weight (<18.5-25 kg/m^2). Waist circumference (WC) was predicted as independent factor of developing type 2 diabetes mellitus, WC was divided into two normal and overweight, with regard to OR and CI (80%) and p value less than

0.05, waist circumference was not found yield statistically significance so, WC was not associated with developing type 2 diabetes mellitus.

Triglyceride was predicted as determinant factors of occurrence and developing type 2 diabetes mellitus. Triglycerides is divided into two groups which includes; normal and abnormal with odds ratio 0.149 and 80% (CI): (0.13< OR< 0.182 (p<0.003)), p value (less than 0.05) which means for participants abnormal of triglycerides they associated with developing type 2 diabetes mellitus 0.149 fold than the other without history of the disease.

Physical activity was measured according to existence of natural exercises daily for losing energy at least 30 minute, and it's divided into two categories; yes and no. Results shown that, with odds ratio 13.722 and 80% (CI): (2.14< OR< 35.3 (p<0.001), p value (less than 0.05) statistically significant which means that subjects without involved in doing daily exercises correlated with higher risk of T2DM as 13.722 fold compared to those doing daily activity.

To determine the effect of carbohydrates intake as determinant factors of developing type 2 diabetes mellitus. Carbohydrates was measured by scoring used diet questionnaire which it divided the carbohydrates into 8 sub group includes (rice, nodal, breads, cassava, potato, sweet potato, cakes and sweet drinks), carbohydrates consumption was divided into three groups; 4-6 times / week, <1-3 times /week, and >1 times daily. Logistic regression showed with odds ratio 8.700

and 80% (CI): (2.8 < OR< 27.7(p< 0.048), p value (less than 0.05) statistically significant which means that subjects who had habit to consumed carbohydrates >1 times daily were correlated to the higher risk of T2DM as 8.700 fold compared to those were consumed carbohydrates<1-3 times /week.

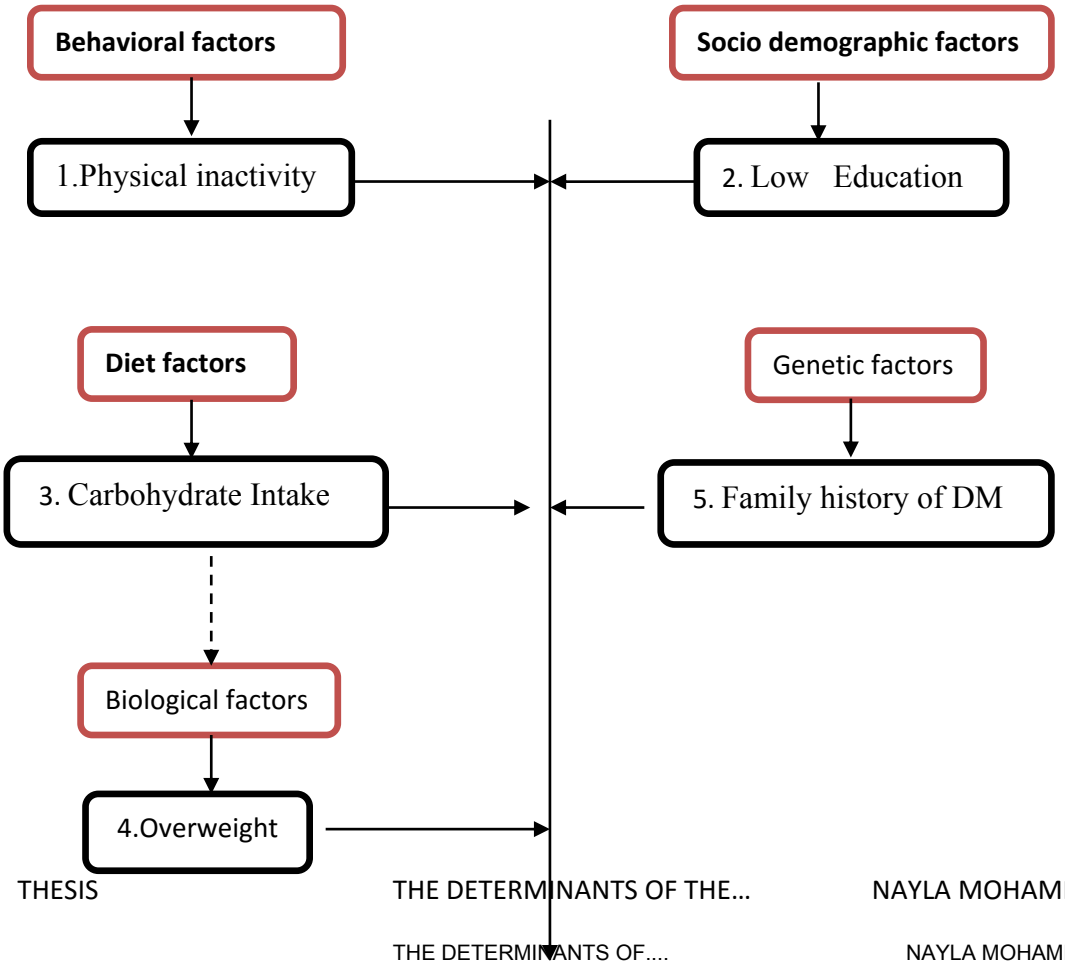


Figure (5.1) Conceptual frame work of finding of determinants factor of developing type 2 DM in Surabaya 2016

The figure 5.1 describes the findings of the determinants factors of developed type 2 diabetes mellitus among the Surabaya population. Physical inactivity shown strong correlation and it become the strong risk factors of type 2. Low education also found as highest risk factors of the diseases and it can play main role for developing besides others factors such as family history, life style, behavior such carbohydrates intakes every day more than one times in absent of awareness due to the lack of education, can lead to obesity or increased the body mass index. Cuisines in Surabaya can play risk factors of T2DM if it combined with other determinants factors such as physical inactivity low income and occupational. Rice is Surabaya cuisines sources (carbohydrate) and it accompaniment with sweet soy sauces when it cooked, and they mixed with noodle sometimes that made it high sources of glucose and can make people at high risk of several disease such as type 2 diabetes mellitus. A prospective study found that regular consumption of white rice is associated with an increased risk of type 2 diabetes (David et al., 2015).

Limitation of the study

The limitation of our analysis also should be noted. We used a large population-based sample of Surabaya to model the determinants of health associated with type 2 diabetes. Information and recall bias is main biases in cases control study because of retrospective study. Language problem is make the interview the participants is so difficult that's made the researcher used enumerators.

CHAPTER VI

DISCUSION

This chapter contains information about findings of this research compared to others studies and these findings will be discussed. The present study has demonstrated that, education, family history of diabetes mellitus, BMI, WC, triglyceride, physical inactivity, and carbohydrates are significant in between cases and controls subjects even after adjusting to age and sex. The other parameters such as urbanization, marital status, occupational, income per month, hypertension, LDL, HDL cholesterol level, smoking, eating fast food, diet patterns (protein, fats, soft drink, vegetables, and fruits have not shown any significant difference between diabetes and control groups.

Discussion

Age and gender is adjusted in this study. There was no influenced in the results due to the majority of subjects being elder ≥ 45 years, and female in this study. Even the elder's ages were places subjects at risk of type 2 diabetes. However, a study by (park, 2005) reported that Ageing is a key demographic transition indicator, has been reported to be a significant risk factor for T2DM. The prevalence rises steeply with age.

There was no significant association between type 2 diabetes disease and the place of born and the lengths of time living in the Surabaya. Results shown that the

majority of study subjects of cases and controls group belonged to Surabaya religious, the majority of them were born in Surabaya, This finding may be a result of the small sample size or early stages of acculturation for the Surabaya population. Urbanization reported an increased risk of occurrence and developing type 2 diabetes mellitus. However, a recent study by (Josepha, 2010), reported that the increase in urban population and aging are the main determinants of the global rise in prevalence of diabetes type 2. Urbanization and internal rural to urban migration result in several adverse impacts; physical activity decreases, diet habits shift towards high energy foods and body mass index (BMI) and upper body adiposity increase considerably. Our findings contrary with (Josepha, 2010)

A strong statistically significant association was found between type 2 DM and education. Results shown that, the low education related to the higher risk of T2DM to 8.817 fold, and the significance of this finding is that it will help greatly in planning the prevention. Education also was associated with health status, which confirmed that it is an important determinant independent of its association with income (Emily, 2013). Several studies showed a strong inverse relationship, particularly in women, between T2DM and Socio Economic Status as determined by educational level, income and deprivation score. Socio Economic Status includes educational level, income and occupation. Nevertheless, the relationship between educational level and health is complex, as it is mediated by anthropometric factors, lifestyle, behavior, access to health services and knowledge of health promotion (Carlotta et al., 2012). Furthermore, improving national

educational levels could be a feasible public health goal for worldwide countries, and would make the study of the association between educational level and risk of disease a basis of observation that could readily be translated into public health measures. These three indicators are strongly related and complementary, but are not interchangeable. In the current study, diabetic patients were more likely to be less educated; they were also more likely to have lower annual incomes. In a previous study, it was reported that low education and a higher annual income were associated with diabetes. Other authors showed that the prevalence of diabetes was higher in women who had low incomes and a low socioeconomic status. The findings of the present study about education were in conformity with (Josepha, 2010), Previous prospective studies found that low education is significant predictor of type 2 diabetes. People with less than high school diploma were almost twice as likely to report having diabetes as those with a bachelor degree or more. Women with low education had a higher prevalence of diabetes than the better educated.

We demonstrated that the developing of diabetes was higher in divorced/widowed persons due to stress and other things. Our findings showed that marital status associated with type 2 diabetes mellitus, people were married more likely to had type 2 diabetes mellitus than the divorced/ widowed people, but binary regression ignored that correlation between the marital status and occurrence and developing of the diseases, however, differences in the prevalence of diabetes were slightly more noticeable in widowed or divorced persons. Another study

showed that singlehood was associated with an increased risk of developing diabetes for women and an increased likelihood of death for men. Since it was not our aim to determine the associations between marital status and diabetes, further studies are warranted to explore this factor.

Occupational was predicted as determinant factors of occurrence and developing type 2 diabetes mellitus .Simple regression shown that strong association between the occupational and T2DM , but multiple regression ignored it even the occupational was associated with the education and the income per month (complementary indicators). Previous study found that occupation associated with Inactivity or a low quantity of physical activity and it can be a work associated factor for diabetes when considering that some professions or occupations. Our finding was contrary with (Victoria, 2011).

Income was predicted as independent risk factors of occurrence and developing type 2 diabetes mellitus, descriptive statistic shown that there was strong significant association between income and T2DM among the cases and control subjects, the majority of the cases subjects (70%) and (34%) of controls they had low income (Rp<500000) that reflect the low income is also associated with T2DM. logistic regression statistics test didn't found that significance correlation. Even the income was associated with the education. Perhaps there was no significance due to the small sample size. More studies would need to be done to know the relationship between income, and risk of developing T2DM.thes results didn't agrees with (David et al, 2015), reported that socioeconomic progress, have adversely affected the proportion

of people affected with lifestyle disorders such as obesity, diabetes, hypertension (HTN) and cardiovascular diseases (CVD).

Family history was found to be an important independent risk factor of developing T2DM, with odds ratio 4.893 and 80%(CI): (1.79<OR<13.36 (P= 0.043)) ;which means for participants had family history of diabetes mellitus they had chance of getting type 2 diabetes mellitus 4.893 fold than the other without history of the disease. The majority of cases (70%), they had family had diabetes mellitus, 50% of them his mother, father, sister, and brother have diabetes (family blood) which is consistent with the findings reported by (Kohei, 2010), The development of type 2 diabetes is clearly associated with a family history of diabetes. Previous study shown that; the development of type 2 diabetes is clearly associated with a family history of diabetes (Park, 2005). The finding of this study is very important in planning preventive strategy and will help identify the potential candidates who have a high chance to develop type 2 diabetes mellitus.

The present study has demonstrated that subjects who were overweight compare to those normal weights were associated with the higher risk of type 2 diabetes mellitus. BMI appeared as a significant risk factor for the occurrence of T2DM. Increased body weight and weight gain, may lead to obesity and elevated cholesterol and blood pressure. The results showed that with odds ratio 6.687 and 80% (CI): (2.5< OR<17.7(P<0.012), statistically significant which means that subjects who had abnormal body mass index (>25 kg/m^2) were associated to the higher risk of

T2DM to 6.687 fold compared to those had normal weight (<18.5-25 kg/m2). BMI is a strong risk factor for type 2 diabetes. The increasing prevalence of T2DM in the Surabaya population has been linked to obesity, which is a consequence of major socio cultural and lifestyle changes. The promotion of fast foods, change in the traditional Surabaya diet, both in quantity and quality, and physical inactivity are as a result of urbanization. Hence, similar to other authors, we propose weight reduction and weight gain prevention as measures to control the rising incidence of T2DM. This is important because adult onset diabetes, besides being high BMI in men, is also associated with the duration of weight gain. This study agree with (Gatineau et al, 2014), A strong positive association between obesity and type 2 diabetes mellitus is found both in men, and women, Obesity is associated with increased risk of developing insulin resistance and type 2 diabetes mellitus.

Waist circumference (WC) was predicted as independent factor of developing type 2 diabetes mellitus; descriptive statistic shown that there was high significant between WC and T2DM among the cases and control subjects (P<0.003) but covariate logistic regression was not found the correlation, so WC was not associated with developing type 2 diabetes mellitus in this study. However, central obesity, especially intra abdominal adipose tissue accumulation, has been found to be a key correlate of Obesity, especially intra abdominal adipose tissue accumulation. Waist circumference is considered a good estimate of the body fat; the dangerous internal fat which coats the organs especially the internal fat deposits

of developing weight related to diseases, it is more accurate predictor of cardiovascular risk, diabetes mellitus, and metabolic syndrome (Gatineau et al, 2014).

BMI and WC are the most easily detectable risk factors for type 2 diabetes mellitus. The Preventive measures should be taken by identifying the risk factors for diabetes and accordingly modifying the life style activities through counseling. Early detection of risk factors of diabetes can be possible by screening of asymptomatic individuals and follow up counseling programs as it not only helps in delaying the onset but also can reduce the burden of severity of the secondary complications such as stroke, heart diseases, micro vascular diseases, neuropathy, retinopathy and nephropathy. These in turn will help in reducing the morbid condition of health and economic burden on society.

The present study has demonstrated that no any correlation between hypertension and type 2 diabetes mellitus. Descriptive statistic shown that there were strong association between type 2 DM and hypertension in both systolic and diastolic blood pressure ($P<0.010$) for systolic and, ($P<0.000$) for diastolic. However our finding of an increased prevalence of hypertension in T2DM persons is similar to those reported in other studies. It has been shown that although both hypertension and diabetes occur independently, they are known to exacerbate each other. More aggressive treatment and lifestyle management are recommended to reduce blood

pressure to120/80 mmHg. However, most of the patients attended clinics for follow up and setup their blood pleasure by suitable medication according to the doctor advises.

The blood cholesterol level is predicted as independent risk factors of occurrence and developing type 2 diabetes mellitus. Study shown that; there was statistically significant association between LDL cholesterol (P<0.003), HDL cholesterol (P<0.024), triglycerides (TG) cholesterol (P<0.000) and T2DM. Binary logistic model didn't recognize the correlation between the cholesterol level and T2DM, but it found that HDL, TG was protective the participants from the disease. Binary regression also didn't recognize the correlation between T2DM and LDL, HDL. Even the majority of cases subjects (70%) they had abnormal LDL (>100), and also (50%) of them had abnormal HDL (≤40for men &≤50 for women). However, the abnormality of LDL, HDL, and TG blood cholesterol related with the dietary energy sources, particularly the saturated fat intake as unfavorable blood lipids (Kohi et al., 2010), and its associated with risk of the impaired glucose tolerance, higher fasting glucose, insulin levels and it's considered a major causes of heart attack and stroke combined with host factors such as non modifiable risk factors (age, gender, and genetic factors), and modifiable factors (smoking and hypertension) (David et al., 2015). The abnormality of LDL, HDL, and TG cholesterol were reported as a risk factor for developing type 2 diabetes mellitus our findings were contrary with the previous studies. Several studies found that The low level of HDL cholesterol to be a stronger risk factor for type 2 diabetes mellitus in women only. Previous study

measured non fasting triglycerides was found that an independent risk of type 2 diabetes connected to elevated triglyceride levels. High plasma triglycerides and low plasma HDL cholesterol levels are both seen in the insulin resistance syndrome, which is a pre diabetic state (Klein et al., 2013). Also there was another previous study shown that high BMI is associated with a higher level of total cholesterol and unfavorable lipids pattern, with low concentrations of HDL cholesterol and high triglycerides concentrations. The findings of the present study about cholesterol level were in conformity with (Klein et al, 2013), BMI change over time to be positively associated with changes in total cholesterol, triglycerides, and low density lipoprotein (LDL) cholesterol and negatively associated with HDL cholesterol change. Apart from triglycerides, all these lipids have been shown to convey diabetes risk independently of BMI, but how they interact have been little studied. The Preventive measures should be taken by identifying the risk factors for T2DM and accordingly modifying the life style activities and check the blood cholesterol level regularly every 4-6 years.

Physical activity was predicted as independent risk factors of occurrence and developing type 2 diabetes mellitus. The present of this study found the strong correlation between physical inactivity and type 2 DM. Descriptive statistic (chi square), also shown the high significant between physical activity, frequency of exercises, and exercises types that were associated with T2DM., majority of cases subjects (68%) they didn't involved with exercises before getting the disease. Physical

activity was measured according to existence of exercises for losing energy at least 30 minute. Results shown that, subjects not involved in doing daily exercises has higher risk of T2DM as 13.722 fold compared to those doing daily activity. Exercise can help to control the blood glucose and makes muscles use glucose without insulin. In other words, it doesn't matter if you're insulin resistant or if you don't have enough insulin: when you exercise, your muscles get the glucose they need, and in turn, your blood glucose level goes down. Obesity (particularly visceral fat obesity) due to a lack of exercise is accompanied by a decrease in muscle mass, induces insulin resistance, and is closely associated with the rapid increase in the number of middle and high aged patients. The changes in dietary energy sources, particularly the increase in fat intake, consumption of simple sugars, and the decrease in dietary fiber intake, contribute to obesity and cause deterioration of glucose tolerance (David et al., 2015). Physical activity was associated with substantially lower morbidity and mortality in men and women with T2DM. Previous study found that people with type 2 diabetes, need supervised exercise programs have been particularly effective in improving glycemic control, reducing the need for anti hyperglycemic agents and insulin, and producing modest but sustained weight loss. Physical activity can help people with T2DM to achieve a variety of goals, including increased cardio respiratory fitness, increased vigour, improved glycemic control, decreased insulin resistance, improved lipid profile, blood pressure reduction and maintenance of weight loss .the findings was conformity with (Josepha, 2010), Longitudinal studies have found that physical inactivity to be a strong risk factor for

type 2 diabetes. Prolonged television watching as a surrogate marker of sedentary life style was reported to be positively associated with diabetes risk in both men and women. Moderate and vigorous physical activity was associated with a lower risk of type 2 diabetes.

Smoking habits was predicted as independent risk factors of occurrence and developing type 2 diabetes mellitus, descriptive statistic shown that there was no significant between smoking habits and type 2 diabetes mellitus ($p<0.084$), also logistic regression was not found the correlation, Perhaps there was no significance due to the small sample size, and also due to gender because females (64%) is dominant in this study in both cases and control group while (36%) were males, 20% of them were smoked in past (a years ago). However several previous studies shown that there were strong association between smoking habits, obesity and T2DM. Smokers tended to have more risk factors of T2DM than nonsmokers. Tabasco use may increase the risk of developing T2DM and lead to insulin resistance and inadequate compensatory insulin secretion response, and this could be due to a direct effect of nicotinic or other components of cigarette smoke on beta cells of the pancreas. Our finding contrary with (Kohei et al., 2010) aging, obesity, insufficient energy consumption, alcohol drinking, smoking, etc; are independent risk factors of pathogenesis.

Behavior of dinning (fast food) in restaurant was predicted as independent risk factors of developing type 2 diabetes mellitus, results shown that there was no

statistically significant association between dinning fast food and type 2 diabetes mellitus although the frequency of eating fast food was high among the cases subjects than control, Perhaps there was no significance due to the small sample size whereas In Surabaya, dining out has increasingly become the metropolitan life style for people spending their leisure time and trying new exciting restaurants due to acculturation and globalization that influenced Surabaya as metropolis city (capital city of east java, openness international become the center of business activities commerce, industry, and education in eastern of Indonesia, and surrounding area) however, several study was examined the relation between the consumption of food from restaurants and risk of type 2 diabetes found that there was significant association between frequency of visits to fast food restaurants and increases in body weight and insulin resistance. Several cross sectional studies have also found an association between fast food consumption and body weight. Our finding was contrary with (Sheri et al., 2006). Although the exact causes of insulin resistance are not completely understood, scientists think the major contributors to insulin resistance are excess weight and physical inactivity.

Diet patterns was predicted as independent risk factors of occurrence and developing type 2 diabetes mellitus, diet patterns includes; carbohydrates (rice, nodal, breads, cassava, potato, sweet potato, cakes and sweet drinks), Protein (beef, chicken,fish sea food, egg, soy bean (tahu/tempe),beans), fatty food (milk, fried vegetables, cheese, butter, coconut milk), vegetables and fruits. Descriptive statistic shown that there was

high significant between carbohydrates intake and type 2 diabetes mellitus ($p<0.020$), and logistic regression was found the strong correlation between the carbohydrates intake type 2 diabetes mellitus. So the carbohydrates intake was highest risk factors of developing TDDM, our finding is conformity with (David et al., 2015) A prospective study found that regular consumption of white rice is associated with an increased risk of type 2 diabetes whereas replacement of white rice by brown rice or other whole grains was associated with a lower risk . Protein intakes fatty food intakes, fried food, soft drink, vegetables and fruits did not shown any significant associations in both of descriptive chi square and logistic regression model. Perhaps there was no significance due to the small sample size, and also due to same level of consumption proportions among the cases and controls subjects. However several previous studies shown that there were strong association between diet patters and type 2 diabetes mellitus. Our finding is contrary with several studies; prospective study found higher consumption of butter, potatoes and whole milk to be associated with increased risk of type 2 diabetes (Ramal, 2011). Obesity is associated with diet pattern and soft drink intakes, and it risk factors of occurrence and developing T2DM (Josepha, 2010). People consume fat, animal protein, and carbohydrates (simple sugar) tended to have more risk factors of T2DM than other vegetarian people. Previous studies also shown that high saturated fat intake has been associated with a higher risk of impaired glucose tolerance, and higher fasting glucose and insulin levels. A high proportion of saturated fatty acids in serum lipid or muscle phospholipids have been associated with higher fasting insulin, lower insulin sensitivity and a higher risk of type 2 diabetes mellitus. Current study found that Positive associations have been reported between the risk of type 2 diabetes and different patterns of food intake. Higher dietary

glycemic index has been consistently associated with elevated risk of type 2 diabetes in prospective cohort studies. (Ramal, 2011). An increase intake of wholegrain, cereal, vegetable and fruit were a feature of diet (park, 2007).

There was no significant association between type 2 diabetes disease and soft drinks intakes results showed that. In this study; soft drink intakes was not found associated type 2 diabetes mellitus despite soft drinks consumption is high among both of cases and controls subjects which means both of cases and controls were at risk of developing type 2 diabetes mellitus. however several studies found that soft drink was associated with developing type 2 diabetes mellitus and causes heart attack morbid and death. This finding may be a result of the small sample size. Increasing and developing T2DM in the Surabaya population has been linked to obesity; the results of dietary patterns, and sugary intakes habit with soft drink consumption, which is a consequence of major lifestyle changes. The promotion of fast foods related with behavior of dining out and snacking with soft drinks intakes, change in the traditional Surabaya diet, both in quantity and quality due to socioeconomic progress and physical inactivity are as a result of urbanization However, a recent study by (Asif, 2014) A study that followed 40,000 men for two decades found that those who averaged one can of a sugary beverage per day had a 20% higher risk of having a heart attack or dying from a heart attack than men who rarely consumed sugary drinks. Strong evidence indicates that sugar-sweetened soft drinks contribute to the development of diabetes. The Nurses' Health Study explored this connection by following the health

of more than 90,000 women for eight years. The nurses who said they had one or more servings a day of a sugar-sweetened soft drink or fruit punch were twice as likely to have developed type 2 diabetes during the study than those who rarely had these beverages. Our finding was contrary with (Asif, 2014).

Snacking habit was predicted as risk factors of developing type 2 diabetes mellitus of Surabaya population. Results found that there was no significant association between type 2 diabetes disease and snacking habits among cases and controls subjects, snacking habits was not found associated type 2 diabetes mellitus. This finding may be a result of the small sample size. However snacking habit or frequent fried-food consumption was significantly associated with risk of incident T2DM and moderately with incident Cardiovascular diseases, and these associations were largely mediated by body weight and comorbid hypertension and hypercholesterolemia. previous study by (Leah et al., 2014) shown that fried food consumption has been positively associated with several cardiometabolic risk factors including hypertension, low serum HDL cholesterol, and obesity. In prospective studies, the Western-style dietary pattern includes fried foods as a major component and is generally positively associated with increased risk of type 2 diabetes; however, to our knowledge, no prospective research has specifically quantified the association between fried food consumption and T2DM. Our finding was contrary with (Leah et al., 2014).

CHAPTER VII

CONCLUSION & RECOMMENDATION

VII.1 **CONCLUSION**

Type 2 diabetes mellitus is a major public health problem in Surabaya with rising numbers of people with T2DM and determinants related with the diseases. Type 2 diabetes mellitus can potentially affect anyone in Surabaya Most people have at least one major risk factor for diabetes which includes as the follows;

VII.1.1 Socio demographics factors which associated with developing type 2 diabetes mellitus include;

1. Education (uneducated peoples was affected with the disease),
2. Marital status (T2DM is high among the people who were married.
3. Occupational (Retired and doesn't working subjects)
4. Income per month: T2DM is high among the subjects have low monthly income

VII.1.2 Family history of diabetes mellitus

Family history of diabetes mellitus was found as higher risk factors of developing type 2 diabetes mellitus among the Surabaya population. People have family member (mother, father, sister, brother) more likely to developing T2DM than the other people.

VII.1.2 biological factors which associated with developing type 2 diabetes mellitus include;

1. Physical inactivity is highest risk factor of developing type 2 diabetes mellitus among the Surabaya population.
2. Overweight BMI is higher risk factors of developing type 2 diabetes mellitus among the Surabaya population.
3. Abnormal Systolic blood pressure is higher risk factors of developing type 2 diabetes mellitus.
4. Abnormal diastolic blood pressure is higher risk factors of developing type 2 diabetes mellitus.

VII.1.2 diet factor which associated with developing type 2 diabetes mellitus include; Consumed carbohydrates >1 times/daily is higher risk factor of developing type 2 diabetes mellitus

VII.2 RECOMMENDATION

The findings of study shown that Surabaya population were at risk of getting type 2 diabetes mellitus and also shown the determinants of the disease is highest need quick intervention to reduce the morbidity and mortality by improving adherence to important recommendation for preventing, detecting, and managing diabetic complication, so the recommendation to the Surabaya population includes; primary prevention to reduce the burden of diabetes and secondary prevention for

delaying complications. Risk factor management is important in avoiding life-threatening complications and preventing new onset diabetes. With diabetes rapidly increasing as a public health concern, Surabaya clearly needs an agenda for action. This action must involve commitment from the individual, community, health district, and provincial and federal governments as the follow

VII.2 Recommendation for Federal and Provincial Government

VII.2.1 Establish a tracking system for diabetes

1. Valid information about rates of diabetes and its complications in all sectors of east java is very important strategy for keeping track of all people diagnosed with diabetes in the province (type 2 diabetes mellitus is not included in top ten diseases with highest number of cases in east java profile in the years of 2014.

2. A system is needed to monitor the health impact of diabetes on the population, to study risk factors in the population, to track treatment and follow-up procedures, to monitor the incidence of diabetes-related complications, and to evaluate programs that have been implemented.

3. VII 2.2 **Ensure accessibility to diabetes care**

1. Efforts must be made to ensure the best coordination and comprehensive care for all Surabaya population with diabetes.

2. Create accessible resources to support diabetes education for clients, health care professionals, the public, and policy-makers

3. More diabetes education and programs are needed to increase knowledge about diabetes These programs need to be dispersed according to demographics and tailored to the needs of the population. For the public, education programs should raise awareness of the risk factors associated with diabetes and of the substantial burden that individuals, families, and caregivers endure as a result of diabetes. Educational programs should also provide people with diabetes and their families with information for managing the disease. Educational resources can include health fairs and readily accessible books, pamphlets, audio, video, or computerized information. Accessible sites for educational outreach include workplaces and grocery stores

4. he province can exercise a leadership role with the federal government to address this issue in the context of a national diabetes strategy.

5. Creation of environments and access to curriculum resources to support students' physical activity and healthy eating should continue.

6. The education of policy makers, who provide leadership and accountability, is critical for implementing recommendations. Policy makers must be informed about the broad determinants of health and the specific strategies that can help stem the diabetes epidemic. Policy makers need to be aware of the current and projected economic impact of diabetes, its incidence and prevalence, and its distribution in Surabaya .

7. **VII 2.43 Provide consumer information on the content of all foods**

1. Food labels promote healthy eating by enabling people to make wise choices in food selection.

2. The federal government should introduce policies for meaningful product labeling of all foods.

3. The information on labels should be presented in user friendly ways so people can easily understand what they are buying. To encourage consumers to read and understand labels, consumer education programs are needed when new labeling is implemented

VII2.4 Provide more funding for research projects in diabetes-related fields

Diabetes research should focus on understanding the causes of diabetes and reducing the burden of the disease and its complications. Much research is still needed in the areas of effective community based prevention strategies, improvements in quality of life and clinical management, behavior modification, and reduction of the economic and social costs of diabetes. Researchers need to collaborate, cooperate, and network to ensure that research funds are used efficiently. The public health sector through the Public Health Research, Education and Development Program and other initiatives can share leadership in this area.

VII.3 Recommendation for Communities

VII.3.**1 Boards of health must provide leadership for prevention**

VII.3.2 Communities must promote physical activity, healthy eating, and healthy weights

1. To foster a healthy community, opportunities for improving physical fitness, promoting healthy eating, and maintaining healthy weights must be made available to everyone in the community.

2. The ministry of health of Surabaya was responsible to promote health and prevent disease. One of their goals is to reduce premature death from preventable chronic diseases such as T2DM. Strategies for encouraging healthy eating, healthy weights, and regular physical activity include increasing public awareness and education, building skills, and developing policies for supportive social and physical environments.

3. Ministry of health must develop partnerships with community agencies, school boards, workplaces, health professionals, restaurants, food banks, grocery stores, and recreational facilities to increase access to regular physical activity and to sufficient, safe, nutritious and personally acceptable food.

4. Health promotion programs must inform the public about the need for preventing diabetes, and empower people to make healthy decisions.

5. Programs must target people at high risk for diabetes, people with undiagnosed diabetes, homeless and low income people, and people without regular access to public health information. Messages must be consistent and promote standardized referral to diabetes resources.

6. VII.4 Recommendation for Individuals and Families

VII.4.1 Reduce obesity

Being overweight is the major risk factor for diabetes. Everyone shares the responsibility of preventing or reducing obesity by;

1. Increasing physical activity

Exercise improves insulin sensitivity and enhances glucose tolerance. It removes glucose from the blood during activity and for several hours afterward. Exercise helps prevent obesity, a leading risk factor for type 2 diabetes. Regular physical activity can improve overall health and help protect against heart disease. It can improve mental outlook and increase energy. Before beginning an exercise program, people should consult a doctor about suitable activities, and use Physical Activity Guide to Healthy Active Living for guidance in types of physical activity, duration, and intensity. People should take up more leisure activities that involve physical activity, instead of ones that are inactive, such as watching television.

2. Maintaining healthy weights

People should develop and maintain healthy eating habits and activities that do not contribute to weight gain. Obese individuals at high risk for diabetes can reduce their risk with moderate weight loss. Achieving and maintaining a healthy weight is often difficult. Achieving a healthy weight is more likely to occur through changes in both eating habits and physical activity, rather than through focusing on eating habits

alone. An approach that balances the physical, emotional and behavioral needs of someone trying to lose weight will more likely result in the permanent maintenance of a healthy weight.

3. Eating a healthy and balanced diet

The amount of calories consumed is more important in decreasing the risk for diabetes than the types of food eaten. The amount consumed determines an individual's weight, and being overweight is a significant risk factor for diabetes. There is no evidence that eating or avoiding a specific food prevents diabetes. But a diet low in saturated fat and sugar, and high in complex carbohydrates and dietary fibre such as one with fruits, vegetables, whole grains, and legumes, is strongly recommended for promoting overall health. The nutritional needs of people with or without diabetes should be consistent with Food Guide to Healthy Eating.

4. Develop awareness of diabetes symptoms and screening guidelines

The early detection and treatment of diabetes can lead to preventing or delaying complications. When age and family history would become a risk factor and overall, prediabetic and high risk groups or people have symptoms of diabetes, should be identified and counseled early before the occurrence of diabetes, and monitoring their blood sugar to delay the disease and prevented them through diet, exercise and pharmacological intervention. The screening should preferably be undertaken before 45

years of age and early intervention should start at an earlier age in this region with regarded to increase concerning about the physical activates programs, dietary patterns. The screening should be considered every three years beginning at age 45 or annually at any age if BMI ≥ 25 kg/ m^2.

5. Smoking cessation

Smoking is a risk factor for diabetes related complications. It also reduces a person's ability to take part in regular physical activity.

6. **Reduce stress**

Stress can alter routines for diabetes management. It can break down stored forms of glucose and elevate glucose in the blood. Reducing stress can decrease the risk for diabetes related complications and increase emotional stability and well being. Tips for managing stress include exercise, meditation and relaxation, counseling, and a diabetes support group.

7. Monitoring the Hypertension and blood cholesterol level

Maintenance of normal high blood pressure, elevated cholesterol and high triglyceride levels for diabetes management. The essential treatment of diabetes was self management education and support, and life style intervention. Early diagnosis (an A1c of 6.5% or greater, confirmed by second test is diagnostic of diabetic of

fasting blood glucose and 2 hour post load glucose), and adequately treatment when diabetes is detected (glycemic management)**.** People who have type 2 diabetes need to check their blood sugar level every day depending on the treatment plan. Also they need meal plan by registered dietitian, exercise and pharmacological intervention.

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KUESIONER

FAKTOR DETERMINAN DIABETES MELLITUS TIPE 2

PHCS SURABAYA 2015

Catatan :

Jawaban anda tidak akan dicetak dalam bentuk apapun. Jawablah pertanyaan-pertanyaan berikut ini dengan sepenuhya dan jujur berdasarkan apa yang anda ketahui

Kode nomor responden	……	
Tanggal pengumpulan data	……	
Nomor telpon Responden	……	
Alamat	……	
Apakah anda penderita diabetes mellitus tipe 2?	1. Ya 2. Tidak	☐
A. KARAKTERISTIK DEMOGRAFI		
1. Usia Responden	…… tahun	
2. Jenis Kelamin Responden	1. Laki-laki 2. Perempuan	☐
3. Tempat kelahiran Responden	……	
4. Jika bukan kelahiran Surabaya, sudah berapa lama tinggal di sini ?	…… tahun	
5. Lama Pendidikan Responden	…… tahun 1. 0-6 tahun 2. >6-9 tahun 3. >9-12 tahun 4. >12 tahun	☐
6. Status perkawinan Responden	1. Kawin 2. Lajang 3. Cerai hidup 4. Janda/dud	☐
7. Pekerjaan Responden	1. PNS/TNI/POLRI 2.Karyawan Swasta 3. Pensiunan 4. tidak bekerja 5. lainya ……	☐
8. Pendapatan per bulan Responden	RP ……	

B.FAKTOR BIOLOGI		
9. Ada anggota keluarga atau relatif anda yang terdiagnosa diabetes (tipe 1 atau tipe 2)?	1. Ada 2. Tidak ada Bila ada siapa?	☐
10. Tinggi Badan Responden	…… cm	
11. Berat Badan Responden	…… kg	
12. BMI Responden	……kg/ m^2 1. Kurus 2. Normal 3. Overweight 4. Obesitas	☐

13. Lingkar pinggang Responden	…….. cm 1. Kurus 2. Normal 3. Overweight 4. Obesitas	☐
14. Hypertensi Responden	...../ …….. 1. Rendah 2. Normal 3. Tinggi	☐
15. Kolestrol darh Responden 1. LDL 2. HDL 3.TG	…… 1. Rendah 2. Normal 3. Tinggi …… 1. Rendah 2. Normal 3. Tinggi …… 1. Tinggi 2. Rendah 3. Normal	☐ ☐ ☐
AKTIVITAS FISIK		
16. Setahun yang lalu Apakah anda biasanya melakukan olahraga rutin selama 30 menit saat bekerja dan/atau waktu luang ?	1. Ya 2. Tidak Bila ya berapa kali per minggu dan apa jenis olahraga tersebut ? ……kali 1.<30mint1kali/mggu 2.30mint(2-3)kali/minggu 3. ≥30 setiap hari Jenis olahraga …… Bila tidak kenapa? ……	☐ ☐
17.setahun yang lalu Apakah anda merokok ?	1. Ya 2. Tidak Bila ya berapa batang rokok sehari? …… batang 1. Ringan (<10 batang rokok sehari) 2. Berat (>10 batang rokok sehari)	☐ ☐
18. setahun yang lalu apakah anda/keluarga /teman sering makan di restoran fast food dan berapa kali per minggu?	1. Ya 2. Tidak Bila ya berapa kali ? ……	☐

Tahap dua : Diet

Nama Bahan Makanan	Frekuensi			
	Sering		Jarang/tidak pernah	
	>1 x/hari	**4- 6x/minggu**	**< 1-3 x/minggu**	**Tidak pernah**
Sumber Karbohidrat (makanan/minuman)				
	Score 4	Score 3	Score 2	Score 1
1. Nasi				
2. Mi (nodal)				
3. Roti				
4. Singkong				
5. Kentang				
6. Ubi jalar				
7. Kue				
8.minuman manis (jus/ teh/ coffe/ kelapa)				
Sumber Protein				
Daging sapi				
Daging ayam				
Daging kambing				
Telur ayam				
fish segar				
Tempe/tahu				
Kacang-kacangan				
Sumber Lemak				
Susu Fullcream				
Minyak sayur				
Jeroan				
Keju				
Mentega				
Santan				
Sumber serat				
Sayuran				
Buah-buahan				
Makanan jadi /jajanana				
Soft drink				
Gorengan				

FAKULTAS KESEHATAN MASYARAKAT
DEPARTMEN EPIDEMIOLOGI KOMUNITAS
PROGRAM PASCASARJANA UNIVERSITAS AIRLANGGA
PENJELASAN PENELITIAN

Yth. : respondent di puskesmas puskesmas di surabaya

Dengan hormat ,

Penjelasan ini disampaikan dalam rangka ,enyelsaikan tugas akhir di program magister fakultas ilmu kesehatan masyarakat ,department epidemiologi , universitas airlangga bersama ini saya :

Nama : Nayla Mohammed Gomaa Nasr Awad
NIM : 101414553013
Studi program : magister Epidemiologi komunitas
Alamat : kampus C Asrama UNAIR . Surabaya

Saya mahasiswa dari kesehatan masyarakat unair department epidemiologi, Saya akan melakukan penelitian yang berjudul " determinan faktor yang berkembang penyakit diabetes mellitus tipe 2" tujuan dari penelitian ini adalah untuk menganalisis asosiasi antara determinant faktor faktor yang menyebab penyakit DM tipe 2 yang akan partisipasi derita dipuskesmas puskesmas di surabaya , manfaat penelitian ini sebagai bahan bertimabangan untuk semua penduduk surabaya dan keluarga yang derita DM tipe 2 juga bisa meningkat skill dan pengetahuanya , tentang penyakit DM tipe 2 yang merupakan salah satu penyakit dengan angka kesakitan dan kematian tertinggi disurabya selama 3 tahun yang lalu . ibu /saudara yang berpartisipasi dalam penelitian ini akan bertimbang berat badan diukur tinggi badan serta lingkar tubuh juga di ukur.ibu dan saudara juga diberikan liflet dan kusioner dan diwawancarai secara singkat tentang usia lama menderita penyakit DM tipe2..

Saya menjamin bahwa penelitian ini tidak akan berdampak negative pada ibu / bapak. Bila selama berpartisipasi dalam penelitian ini ibu /bapak mengelami ketidaknyamanan, maka ibu / bapak /saudara mempunyai hak untuk berhenti dan mendapatkan pelayanan kesehatan lainnya.

. Surabaya ,mei 2016

Peneliti

Phone: 081519333288

Yang member penjelasan Yang mendapatkan penjelasan

subjek (……..) penelit (……)

FAKULTAS KESEHATAN MASYARAKAT
DEPARTMEN EPIDEMIOLOGI KOMUNITAS
PROGRAM PASCASARJANA UNIVERSITAS AIRLANGGA
INFORMED CONSENT

(pernyataan untuk persetujuan untuk mengikuti penelitian)

Yang bertanda tangan di bawah ini :

Peneliti telah menjelaskan tentang penelitian yang akan dilaksanakan .saya mengerti bahwa tujuan penelitian ini adalah untuk mengetahui faktor faktor resiko kejadian diabetes mellitus pada pasien diabetes melltus .

Saya mengerti bahwa partisipasi saya dalam penelitian ini bermanafat untuk mendeteksi asosiasi antara faktor faktor yang menyebab infeksi diabetes mellitus yang mungkin saya alami

Saya mengerti risiko yang mungkin terjadi selama penelitian ini sangat kecil .saya berhak untuk menhentikan keikutsertaan dalam penelitian ini tanpa kehilangan hak untuk diberikan pelayanan kesehatan yang professional saya juga berhak mendapatkan jawab yang jelas mengenai prosedur penelitian yang akan dilaka]ukan .

Saya mengerti bahwa identitas dan catatan data dalam penelitian ini akan dijamin kerahasiaannya danhanya dipergunakan untuk keperluan penelitian .

Saya bersedia berpartisipaisi menjadi responden dalam penelitian ini dengan penuh kesadaran dan tidak ada unsure paksanaan dari siapapun

Tanda tangan Responden peneliti

Nayla Mohammed Gomaa

Surabaya , mei 2016

Tanggal : …….

Logistic Regression

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	100	100.0
	Missing Cases	0	.0
	Total	100	100.0
Unselected Cases		0	.0
Total		100	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
no	0
yes	1

Block 0: Beginning Block

Classification Table[a,b]

Observed		Predicted		
		T2DM status		Percentage Correct
		no	yes	
Step 0	T2DM status: no	0	50	.0
	T2DM status: yes	0	50	100.0
Overall Percentage				50.0

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.000	.200	.000	1	1.000	1.000

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	education(1)	15.413	1	.000
		maitalstatus(1)	1.478	1	.224
		occopational	14.711	3	.002
		occopational(1)	1.871	1	.171
		occopational(2)	13.752	1	.000
		occopational(3)	1.000	1	.317
		incomepermonth	13.046	2	.001
		incomepermonth(1)	6.139	1	.013
		incomepermonth(2)	12.981	1	.000
		familyhistory(1)	9.091	1	.003
		BMI(1)	9.004	1	.003
		patientwc(1)	9.004	1	.003
		systolic(1)	5.741	1	.017

	diastolic(1)	3.048	1	.081
	LDL(1)	1.033	1	.309
	HDL(1)	4.960	1	.026
	TG(1)	6.832	1	.009
	olahraga(1)	21.374	1	.000
	karbohydrate	7.849	2	.020
	karbohydrate(1)	3.787	1	.052
	karbohydrate(2)	7.840	1	.005
Overall Statistics		57.671	18	.000

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	85.997	18	.000
	Block	85.997	18	.000
	Model	85.997	18	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	52.633[a]	.577	.769

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	13.082	8	.109

Contingency Table for Hosmer and Lemeshow Test

		T2DM status = no		T2DM status = yes		Total
		Observed	Expected	Observed	Expected	
Step 1	1	10	9.999	0	.001	10
	2	9	9.922	1	.078	10
	3	10	9.453	0	.547	10
	4	9	8.198	1	1.802	10
	5	7	6.324	3	3.676	10
	6	3	4.046	7	5.954	10
	7	2	1.719	8	8.281	10
	8	0	.266	10	9.734	10
	9	0	.059	10	9.941	10
	10	0	.012	10	9.988	10

Classification Table[a]

	Observed		Predicted		
			T2DM status		Percentage Correct
			no	yes	
Step 1	T2DM status	no	45	5	90.0
		yes	5	45	90.0
	Overall Percentage				90.0

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	80% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	education(1)	2.975	1.181	6.345	1	.012	19.583	4.311	88.954
	maitalstatus(1)	.652	.885	.543	1	.461	1.919	.617	5.965
	occopational			5.639	3	.131			
	occopational(1)	2.984	1.882	2.514	1	.113	19.771	1.772	220.530
	occopational(2)	4.760	2.166	4.829	1	.028	116.733	7.272	1873.935
	occopational(3)	4.479	2.303	3.782	1	.052	88.184	4.607	1687.972
	incomepermonth			1.177	2	.555			
	incomepermonth(1)	-.077	1.244	.004	1	.951	.926	.188	4.560
	incomepermonth(2)	.974	1.179	.682	1	.409	2.648	.584	11.996
	familyhistory(1)	1.762	.939	3.519	1	.061	5.824	1.748	19.410
	BMI(1)	1.682	.887	3.597	1	.058	5.376	1.725	16.750
	patientwc(1)	.822	.891	.852	1	.356	2.275	.727	7.126
	systolic(1)	1.686	1.148	2.157	1	.142	5.398	1.240	23.499
	diastolic(1)	.895	1.039	.741	1	.389	2.447	.646	9.273
	LDL(1)	1.181	.838	1.985	1	.159	3.259	1.113	9.543
	HDL(1)	-2.082	1.047	3.954	1	.047	.125	.033	.477
	TG(1)	-4.072	1.399	8.471	1	.004	.017	.003	.102
	olahraga(1)	2.786	1.007	7.648	1	.006	16.210	4.458	58.938
	karbohydrate			5.494	2	.064			
	karbohydrate(1)	1.547	1.295	1.426	1	.232	4.695	.893	24.681
	karbohydrate(2)	3.190	1.439	4.914	1	.027	24.286	3.841	153.550
	Constant	-12.908	3.926	10.812	1	.001	.000		

a. Variable(s) entered on step 1: education, maitalstatus, occopational, incomepermonth, familyhistory, BMI, patientwc, systolic, diastolic, LDL, HDL, TG, olahraga, karbohydrate.

Casewise List[b]

Case	Selected Status[a]	Observed	Predicted	Predicted Group	Temporary Variable	
		T2DM status			Resid	ZResid
7	S	y**	.172	n	.828	2.194
56	S	y**	.258	n	.742	1.694
59	S	y**	.298	n	.702	1.534
84	S	n**	.783	y	-.783	-1.901
93	S	y**	.012	n	.988	9.033

a. S = Selected, U = Unselected cases, and ** = Misclassified cases.

b. Cases with studentized residuals greater than 2.000 are listed.

Block 0: Beginning Block

Classification Table[a,b]

	Observed		Predicted		
			T2DM status		Percentage Correct
			no	yes	
Step 0	T2DM status	no	0	50	.0
		yes	0	50	100.0
	Overall Percentage				50.0

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.000	.200	.000	1	1.000	1.000

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	education(1)	15.413	1	.000
		maitalstatus(1)	1.478	1	.224
		occopational	14.711	3	.002
		occopational(1)	1.871	1	.171
		occopational(2)	13.752	1	.000
		occopational(3)	1.000	1	.317
		incomepermonth	13.046	2	.001
		incomepermonth(1)	6.139	1	.013
		incomepermonth(2)	12.981	1	.000
		familyhistory(1)	9.091	1	.003
		BMI(1)	9.004	1	.003
		patientwc(1)	9.004	1	.003
		systolic(1)	5.741	1	.017
		diastolic(1)	3.048	1	.081
		HDL(1)	4.960	1	.026
		TG(1)	6.832	1	.009
		olahraga(1)	21.374	1	.000
		karbohydrate	7.849	2	.020
		karbohydrate(1)	3.787	1	.052
		karbohydrate(2)	7.840	1	.005
	Overall Statistics		57.144	17	.000

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	83.835	17	.000

	Block	83.835	17	.000
	Model	83.835	17	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	54.794[a]	.568	.757

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	14.248	8	.076

Contingency Table for Hosmer and Lemeshow Test

		T2DM status = no		T2DM status = yes		Total
		Observed	Expected	Observed	Expected	
Step 1	1	10	9.999	0	.001	10
	2	9	9.929	1	.071	10
	3	10	9.498	0	.502	10
	4	8	7.724	2	2.276	10
	5	7	6.394	3	3.606	10
	6	5	4.084	5	5.916	10
	7	1	1.985	9	8.015	10
	8	0	.314	10	9.686	10
	9	0	.061	10	9.939	10
	10	0	.012	10	9.988	10

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	80% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	education(1)	2.522	1.071	5.545	1	.019	12.449	3.156	49.104
	maitalstatus(1)	.579	.872	.441	1	.507	1.783	.584	5.449
	occopational			5.390	3	.145			
	occopational(1)	2.973	1.748	2.892	1	.089	19.555	2.080	183.834
	occopational(2)	4.533	2.021	5.031	1	.025	93.034	6.981	1239.927
	occopational(3)	4.013	2.129	3.553	1	.059	55.298	3.613	846.292
	incomepermonth			.832	2	.660			
	incomepermonth(1)	-.045	1.188	.001	1	.970	.956	.209	4.381
	incomepermonth(2)	.792	1.099	.519	1	.471	2.207	.540	9.024
	familyhistory(1)	1.890	.931	4.124	1	.042	6.619	2.008	21.819
	BMI(1)	1.415	.858	2.715	1	.099	4.115	1.369	12.364
	patientwc(1)	.879	.870	1.023	1	.312	2.409	.791	7.344

	systolic(1)	1.910	1.096	3.039	1	.081	6.756	1.659	27.518
	diastolic(1)	1.084	1.043	1.081	1	.298	2.957	.777	11.251
	HDL(1)	-2.094	1.042	4.039	1	.044	.123	.032	.468
	TG(1)	-4.006	1.405	8.133	1	.004	.018	.003	.110
	olahraga(1)	2.922	1.002	8.506	1	.004	18.579	5.145	67.087
	karbohydrate			4.921	2	.085			
	karbohydrate(1)	1.468	1.294	1.288	1	.256	4.343	.827	22.791
	karbohydrate(2)	3.014	1.445	4.351	1	.037	20.376	3.197	129.852
	Constant	-11.876	3.778	9.880	1	.002	.000		

a. Variable(s) entered on step 1: education, maitalstatus, occopational, incomepermonth, familyhistory, BMI, patientwc, systolic, diastolic, HDL, TG, olahraga, karbohydrate.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	55.247[a]	.566	.754

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	15.217	8	.055

Contingency Table for Hosmer and Lemeshow Test

		T2DM status = no		T2DM status = yes		Total
		Observed	Expected	Observed	Expected	
Step 1	1	10	9.998	0	.002	10
	2	9	9.903	1	.097	10
	3	10	9.384	0	.616	10
	4	7	7.951	3	2.049	10
	5	8	6.238	2	3.762	10
	6	6	4.174	4	5.826	10
	7	0	1.938	10	8.062	10
	8	0	.329	10	9.671	10
	9	0	.072	10	9.928	10
	10	0	.012	10	9.988	10

Classification Table[a]

	Observed		Predicted		
			T2DM status		Percentage Correct
			no	yes	
Step 1	T2DM status	no	45	5	90.0
		yes	8	42	84.0
	Overall Percentage				87.0

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	80% C.I.fo
								Lower
Step 1[a]	education(1)	2.362	1.027	5.293	1	.021	10.613	2.847
	occopational			5.714	3	.126		
	occopational(1)	2.972	1.704	3.044	1	.081	19.538	2.201
	occopational(2)	4.595	1.994	5.308	1	.021	98.979	7.683
	occopational(3)	4.063	2.058	3.897	1	.048	58.126	4.159
	incomepermonth			.834	2	.659		
	incomepermonth(1)	.115	1.149	.010	1	.920	1.122	.257
	incomepermonth(2)	.869	1.095	.630	1	.427	2.384	.586
	familyhistory(1)	1.711	.861	3.953	1	.047	5.534	1.837
	BMI(1)	1.518	.824	3.398	1	.065	4.564	1.588
	patientwc(1)	.902	.860	1.100	1	.294	2.463	.819
	systolic(1)	1.793	1.047	2.935	1	.087	6.010	1.571
	diastolic(1)	.972	.985	.975	1	.323	2.644	.749
	HDL(1)	-1.946	.998	3.802	1	.051	.143	.040
	TG(1)	-3.763	1.294	8.456	1	.004	.023	.004
	olahraga(1)	2.800	.941	8.860	1	.003	16.448	4.926
	karbohydrate			5.100	2	.078		
	karbohydrate(1)	1.490	1.265	1.387	1	.239	4.437	.877
	karbohydrate(2)	2.964	1.393	4.531	1	.033	19.379	3.253
	Constant	-11.429	3.559	10.313	1	.001	.000	

a. Variable(s) entered on step 1: education, occopational, incomepermonth, familyhistory, BMI, patientwc, systolic, diastolic, HDL, TG, olahr karbohydrate.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	80% C.I.for
								Lower
	education(1)	2.177	.894	5.923	1	.015	8.817	2.803
	occopational			3.363	3	.339		
	occopational(1)	1.505	1.407	1.144	1	.285	4.505	.742
	occopational(2)	2.729	1.580	2.983	1	.084	15.324	2.022
	occopational(3)	1.925	1.555	1.532	1	.216	6.857	.934
	incomepermonth			2.111	2	.348		
	incomepermonth(1)	.673	1.127	.356	1	.551	1.959	.462
	incomepermonth(2)	1.515	1.078	1.973	1	.160	4.548	1.142
Step 1[a]	familyhistory(1)	1.588	.784	4.103	1	.043	4.893	1.792
	BMI(1)	1.900	.760	6.254	1	.012	6.687	2.525
	patientwc(1)	1.226	.790	2.410	1	.121	3.408	1.239
	TG(1)	-3.024	1.029	8.635	1	.003	.049	.013
	olahraga(1)	2.619	.821	10.181	1	.001	13.722	4.793
	karbohydrate			4.589	2	.101		
	karbohydrate(1)	.978	1.087	.810	1	.368	2.660	.660
	karbohydrate(2)	2.163	1.093	3.920	1	.048	8.700	2.145
	Constant	-8.719	2.571	11.499	1	.001	.000	

a. Variable(s) entered on step 1: education, occopational, incomepermonth, familyhistory, BMI, patientwc, TG, olahraga, karbohydrate.

Casewise List[b]

Case	Selected Status[a]	Observed	Predicted	Predicted Group	Temporary Variable	
		T2DM status			Resid	ZResid
56	S	y**	.196	n	.804	2.026
59	S	y**	.089	n	.911	3.204
93	S	y**	.031	n	.969	5.610

a. S = Selected, U = Unselected cases, and ** = Misclassified cases.

b. Cases with studentized residuals greater than 2.000 are listed.