PREVALENCE, DETERMINANTS AND MICROVASCULAR COMPLICATIONS OF TYPE 2 DIABETES MELLITUS AMONG ELDERLY POPULATION OF KATHMANDU, NEPAL

MR. ABHISHEK RIMAL

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for the Degree of Master of Public Health Program in Public Health

College of Public Health Sciences

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ความชุก ปัจจัยกำหนด และอาการแทรกซ้อนของเส้นเลือดขนาดเล็กในผู้ป่วยสูงอายุโรคเบาหวานประเภท ๒ เมืองกาฐมาณฑุ ประเทศเนปาล

นายอบิเชริก ริมาล

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรมหาบัณฑิต

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Thesis Title	PREVALENCE, DETERMINANTS AND MICROVASCULAR COMPLICATIONS OF TYPE 2 DIABETES MELLITUS AMONG ELDERLY POPULATION OF KATHMANDU, NEPAL.
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Field of Study	Public Health
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ความชุก ปัจจัยกำหนด และอาการแทรกซ้อนของเส้นเลือดขนาดเล็กในผู้ป่วยสูงอายุโรคเบาหวานประเภท ๒ เมืองกาฐมาณฑุ ประเทศเนปาล (PREVALENCE, DETERMINANTS AND MICROVASCULAR COMPLICATIONS OF TYPE 2 DIABETES MELLITUS AMONG ELDERLY POPULATION OF KATHMANDU, NEPAL) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: Alessio Panza, M,D., M.Com.H., DTM & H, 111 หน้า.

ความเป็นมา: โรคเบาหวาน (DM) เป็นโรคเรื้อรังที่มีอัตราอุบัติการณ์เพิ่มมากขึ้นเรื่อยๆ และเป็นปัญหาทางด้านสาธารณสุขทั่วโลก โดยเฉพาะโรคเบาหวานชนิดที่ 2 ซึ่งทำให้เกิดภาวะแทรกซ้อนหลายประเภทโดยเฉพาะอย่างยิ่งภาวะแทรกซ้อน โรคหลอดเลือดหัวใจ โดย มีผลกระทบต่อผู้ป่วย และระบบการดูแลรักษาโรคนั้น ถึงแม้ว่ามีรายงานอัตราความชุกของการเกิดโรคเบาหวานชนิดที่ 2 และภาวะแทรกซ้อนด้วยโรคหลอดเลือดหัวใจในผู้สูงอายุจำนวนน้อยนั้น ผู้วิจัยมีความสนใจที่จะศึกษาในเรื่องนี้ โดยมีวัตถุประสงค์หลักของการศึกษาคือ เพื่อศึกษาอัตราความชุกของโรคเบาหวานชนิดที่ 2 และภาวะแทรกซ้อน โรคหลอดเลือดหัวใจ และศึกษาปัจจัยที่เกี่ยวข้องกับการเกิดโรคเบาหวานชนิดที่ 2 และภาวะแทรกซ้อน โรคหลอดเลือดหัวใจ ในกลุ่มผู้สูงอายุของ เมืองกาฐมาณฑุ ประเทศเนปาล

วิธีการศึกษา: เป็นการศึกษาวิจัยเชิงพรรณนา แบบภาคตัดขวาง กลุ่มประชากรที่ศึกษาคือกลุ่มผู้สูงอายุ อายุ 60 ปี ขึ้นไป จำนวน 306 คน ที่อาศัยอยู่ในพื้นที่เขตเมืองและชนบท ของอำเภอเมืองกาฐมาณฑุ วิธีการศึกษาโดยการจัดเก็บข้อมูลจากการเยี่ยมบ้านและใช้แบบสอบถามสัมภาษณ์ โดยการวัดค่าดัชนีมวลกาย การวัดค่าความดันโลหิต และการตรวจหาค่าปริมาณน้ำตาลกลูโคสในเลือด โดยใช้เครื่องมือทางการแพทย์ที่ได้มาตรฐาน หากพบว่าป่วยด้วยโรคเบาหวานในระหว่างการเยี่ยมบ้านนั้นได้เชิญให้เข้าค่ายบำบัดรักษาสุขภาพ โดยได้รับบริการตรวจร่างกายอย่างละเอียด และตรวจค้นหาภาวะแทรกซ้อน โรคหลอดเลือดหัวใจด้วย สถิติที่ใช้ในการวิเคราะห์ข้อมูลคือ ความสัมพันธ์แบบถดถอย 2 ตัวแปร โดยมีนัยสำคัญทางสถิติเท่ากับ 0.05

ผลการศึกษา: พบว่าอัตราความชุกของโรคเบาหวานชนิดที่ 2 ร้อยละ 23.5 ซึ่งคล้ายกับผลการศึกษาก่อนหน้านี้ในเมืองกาฐมาณฑุและพบผู้ป่วยรายใหม่ที่ได้รับการวินิจฉัยในช่วงการสำรวจ ร้อยละ 26.3 ร้อยละ 43.1 พบว่ามีปัจจัยที่สำคัญหนึ่งปัจจัยหรือมากกว่า คือภาวะแทรกซ้อน โรคหลอดเลือดหัวใจ การออกกำลังกายที่ไม่เพียงพอ การไม่ควบคุมอาหาร การรับประทานอาหารชนิดที่มีไขมันสูง มีประวัติคนครอบครัวป่วยด้วยโรคเบาหวานชนิดที่ 2 มีภาวะโรคความดันโลหิตสูงและมีประวัติของโรคเบาหวานในขณะตั้งครรภ์อย่างมีนัยสำคัญทางสถิติ มีความสัมพันธ์เชิงบวกกับการป่วยด้วยโรคเบาหวานชนิดที่ 2 ร่วมกับ ภาวะอ้วน และระยะเวลาการป่วยด้วยโรคเบาหวานชนิดที่ 2 อย่างมีนัยสำคัญทางสถิติ และมีความสัมพันธ์เชิงบวกกับภาวะแทรกซ้อน จากโรคหลอดเลือดหัวใจ ในผู้ป่วยด้วยโรคเบาหวานชนิดที่ 2

สรุป: อัตราความชุกของผู้ป่วยโรคเบาหวานชนิดที่ 2 และภาวะแทรกซ้อน โรคหลอดเลือดหัวใจ มีอัตราความชุกสูงขึ้นในกรุงกาฐมาณฑุ ประเทศเนปาล โดยไม่มีการเฝ้าระวังและคัดกรองเพื่อค้นหาผู้ป่วยโรคเบาหวานชนิดที่ 2 และโรคหลอดเลือดหัวใจ ปัญหาดังกล่าวควรได้รับการแก้ไขและส่งเสริมสนับสนุน ด้านนโยบายและกลยุทธ์ในการดำเนินการควบคุมป้องกันโรคดังกล่าวอย่างเป็นรูปธรรมที่ชัดเจน รวมไปถึงการเข้าถึงระบบการดูแลสุขภาพ การให้ความรู้สุขศึกษาเกี่ยวกับโรค และการเสริมสร้างความตระหนักในเรื่องการควบคุมป้องกันการเกิดโรคเบาหวานชนิดที่ 2 เพื่อลดภาระค่าใช้จ่ายทางด้านสุขภาพที่มีแนวโน้มที่สูงขึ้น

สาขาวิชา สาธารณสุขศาสตร์ มือชื่อนิสิต: .....

ปีการศึกษา 2554 ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก: .....

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ABHISHEK RIMAL: PREVALENCE, DETERMINANTS AND MICROVASCULAR COMPLICATIONS OF TYPE 2 DIABETES MELLITUS AMONG ELDERLY POPULATION OF KATHMANDU, NEPAL. ADVISOR: ALESSIO PANZA, M.D., M.Com.H., DTM&H, 111pp

Background: Diabetes Mellitus (DM) has caused global pandemic which principally involves Type 2 DM. DM can cause several complications including microvascular complications that impose a tremendous burden on the individual and on the health care system. There is little known about prevalence of Type 2 DM and its complications among elderly. The main purpose of this study was- To determine the prevalence of Type 2 DM and its microvascular complications and to identify factors associated with them among elderly population of Kathmandu, Nepal.

Methods: Cross sectional study was conducted among 306 participants above age 60 from urban and rural areas of Kathmandu district. Firstly home visits were conducted, where structured questionnaire was used to collect information from the participants. Anthropometric measurements, blood pressure and fasting blood glucose test was done using standard medical tools. Those who were identified as diabetic during home visits were invited to a health camp later, where detailed physical examination, was done for detecting microvascular complications. Data Analysis was done using binary logistic regression with statistical significance of each analysis against the p value of 0.05.

Results: Prevalence of Type 2 DM in this study was 23.5% which is similar to the findings of previous studies in Kathmandu. Among all cases of Type 2 DM 26.3% were the new cases diagnosed during survey and 43.1% have one or more of the microvascular complications. Inadequate Physical activity, Unhealthy Diet, Frequent visit to Fast food centers, Family history of Type 2 DM, Presence of Hypertension and History of Gestational Diabetes Mellitus were significantly positively associated with presence of Type 2 DM. Likewise, Above Normal waist circumference and DM Duration were significantly positively associated with microvascular complications of Type 2 DM. Whereas, Healthy Diet was negatively associated with microvascular complications.

Conclusions: Prevalence of Type 2 DM and its microvascular complication is high in Kathmandu, along with undetected cases of Type 2 DM. The burden of DM and its microvascular complications calls the attention of the policy makers to devise some strategy to increase access to health care facilities. Health education and cost effective preventive interventions must be promoted to prevent the rising trend of Type 2 DM.

Field of Study: Public Health ..... Student's Signature……..

Academic Year: 2011 ..... Advisor's Signature …….

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I am grateful to all those people who participated in this study. My gratefulness also goes to Nepal Health and Research Council, for providing invaluable suggestions and ethical approval.

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CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

List of Abbreviations

ADA: American Diabetic Association

BMI: Body Mass Index

CI: Confidence Interval

COPD: Chronic Obstructive Pulmonary Diseases

DM: Diabetes Mellitus

ESRD: End Stage Renal Disease

FBG: Fasting Blood Glucose

GDM: Gestational diabetes Mellitus.

GDP: Gross Domestic Products

HbA1c: Glycosylated hemoglobin

IDF: International Diabetes Federation

IDDM: Insulin Dependent Diabetes Mellitus

NCDs: Non communicable diseases

NIDDM: Non-Insulin Dependent Diabetes Mellitus

NIH: National Institute of Health

OR: Odds Ratio

VDC: Village Development Committee

WHO: World Health Organization

CHAPTER I

INTRODUCTION

1.1 Background and Rationale:

Diabetes mellitus (DM) is a clinical syndrome characterized by hyperglycemia due to absolute or relative deficiency of insulin (Frier and Fisher, 2007). Several distinct types of DM exist and depending on the etiology of the DM, factors contributing to hyperglycemia include reduced insulin secretion, decreased glucose utilization, and increased glucose production. The metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ systems that impose a tremendous burden on the individual with diabetes and on the health care system (Fauci, 2008).

DM is classified on the basis of the pathogenic process that leads to hyperglycemia; the two broad categories of DM are designated as Type 1 and Type 2 DM (Fauci, 2008). Both types of diabetes are preceded by a phase of abnormal glucose homeostasis as the pathogenic processes progresses. Type 1 diabetes is the result of complete or near-total insulin deficiency. Type 2 DM is a heterogeneous group of disorders characterized by variable degrees of insulin resistance, impaired insulin secretion, and increased glucose production (Fauci, 2008).Glucose intolerance may develop during pregnancy. However, most women revert to normal glucose tolerance post-partum but have a substantial risk of developing DM later in life (Frier and Fisher, 2007).

The American Diabetes Association defines diabetes as having 2 separate occasions of fasting blood glucose levels of at least 126 mg/dL after an 8-hour fast. Other criteria are random blood glucose level of at least 200 mg/dL in the presence of polyuria, polydipsia, weight loss, fatigue, or other characteristic symptoms of diabetes. Moreover, testing of HbA1c level can be useful for diagnosis and screening of diabetes. HbA1c level of at least 6.5% on 2 separate occasions is diagnostic for diabetes (Patel and Macerollo, 2010).

Diabetes occurs world-wide and the incidences of type 1 and type 2 diabetes are rising; global pandemic principally involves Type 2 DM, to which several factors contribute, including greater longevity, obesity, unsatisfactory diet, sedentary lifestyle and increasing urbanization. Many cases of type 2 DM remain undetected. However, the prevalence of both types of diabetes varies considerably around the world, and is related to differences in genetic and environmental factors (Frier and Fisher, 2007).

Chronic complications of Type 2 DM can be divided into Microvascular (retinopathy, neuropathy, and nephropathy) and macrovascular complications [coronary artery disease (CAD), peripheral arterial disease (PAD) and cerebrovascular disease] (Fauci, 2008). The risk of Microvascular complications of Type 2 DM increases with duration of hyperglycemia; they usually become apparent in the second decade of hyperglycemia. Since type 2 DM often has a long asymptomatic period of hyperglycemia, many individuals with type 2 DM have complications even at the time of diagnosis (Fauci, 2008).

Non-Communicable Diseases (NCDs) are in epidemic proportion worldwide, particularly four diseases - Cardiovascular diseases, Chronic Obstructive Pulmonary Diseases, Cancer and Diabetes Mellitus. These four diseases have the greatest share in the morbidity and mortality accounting for around 60% of all deaths worldwide (World Health Organization [WHO], 2011a).

According to data published by World Health Organization (WHO) around 346 million people worldwide have diabetes. Deaths due to diabetes will be doubled in 2030 as compared to 2005.

NCDs have emerged as the major causes of mortality and morbidity, not only in economically advanced countries, but also in Low and Middle Income Countries (Lopez et al., 2006). In 2008, there were around 57 million global deaths, out of which 36 million, or 63%, were due to non-communicable diseases. Moreover, nearly 80% of non-communicable disease deaths, which is around 29 million, have occurred in low and middle income countries (World Health Organization [WHO], 2011a).

In Nepal like other developing countries disease pattern is changing from infectious to chronic due to epidemiological transitions. Burden of infectious diseases is still high; on the top of that it is also facing the problem of NCDs (Bandari et al., 2010). This double burden of disease is creating new challenges for public health system in resource scarce country like Nepal.

NCDs are major contributors in mortality in Nepal accounting for 50% of all mortality in Nepal. According to a recent data published by World Health Organization, the prevalence of raised blood glucose, overweight, obesity, tobacco smoking and physical inactivity is 8.4%, 9.1%, 4%, 23.3% and 14.2% respectively (WHO, 2011b).

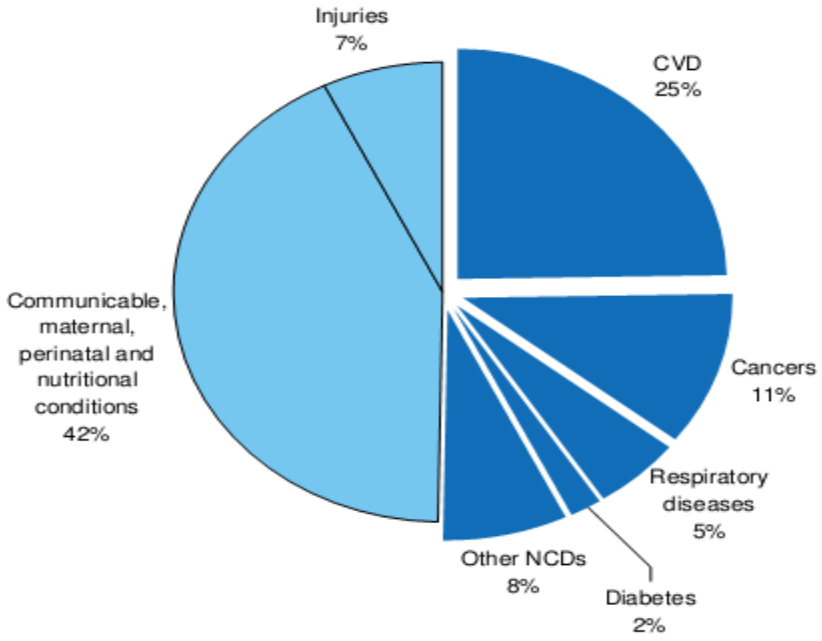


Figure 1: Proportional Mortality in all ages in Nepal

Diabetes has become a significant public health problem in urban Nepal. Education and awareness, timely diagnosis and adequate treatment are important in

patients with Type 2 DM. Several complications associated with Type 2 DM, such as nephropathy, retinopathy, neuropathy, cardiovascular disease, stroke, and death, can be delayed or prevented with adequate and timely treatment of elevated blood glucose (Patel and Macerollo, 2010). In a resource scarce country like Nepal for many reasons diagnosis of Type 2 DM is delayed or even never been diagnosed. People either do not have access to adequate health care or they lack awareness about the importance of regular health check-ups. The budget allocation for Non-Communicable Diseases is very less around 0.7% and even lesser for Diabetes Mellitus (Word Bank [WB], 2011). Such low budget allocation further hinders interventions to check rising trend of Diabetes Mellitus. Studies carried out by the Nepal Diabetes Association in towns and cities throughout the country have revealed a diabetes prevalence of around 15% among people aged 20 years and above, and 19% among people aged 40 years and above (Bhattarai and Singh, 2007). Most of the studies regarding Type 2 DM in Nepal are hospital based. However, there are not sufficient community based studies in Nepal regarding Diabetes Mellitus and its determinant targeting elderly population. Moreover complications of Type 2 DM and its association with risk factors and duration of Type 2 DM have been ignored in many studies.

This study is a sincere effort to find out prevalence of Type 2 DM as well as factors associated with Type 2 DM and strength of association with Type 2 DM and also to determine the burden of Microvascular complication associated with Type 2 DM. In addition, this study has also reviewed various literatures around the globe that is relevant to this study.

1.1.1 Country Profile:

Nepal is a land-locked country nestled in the foothills of the Himalayas. The country is sandwiched between the two most populous countries of the world, India to the east, south, and west and China to the north. Nepal is rectangular in shape and stretches 885 kilometers in length (east to west) and 193 kilometers in width (north to south). The total land area of the country is 147,181 square kilometers. Topographically, the landscape is divided into three main regions to the south lies terai, to the north lies hills

and further north Himalayan region covers the country. Nepal is administratively divided into 14 administrative zones, which are divided into 75 districts. The 14 administrative zones are grouped into five development regions. Kathmandu is the capital of the country. Nepal is a developing country with a 3.5% GDP growth rate and facing numerous challenges due to political uncertainties (WB, 2010). According to the 2001 Census, the population of Nepal is just over 23 million (CBS, 2001). In which, 50.1 percent of the population is male and 49.9 percent female. Moreover, if we see the population pyramid 39.4 percent of the population is less than 15 years of age, 54.1 percent was 15 to 59 years of age, and 6.5 percent was 60 years of age or older. Life expectancy at birth was 60.1 years for males, 60.7 years for females, or 60.4 overall (CBS, 2001).

The population pyramid of Nepal is changing over the time and in future Nepal is going to have larger number of people is elderly group bracket (U.S.Census, 2010). Hence the concern for Noncommunicable disease and its effect on the population mainly aging population is increasing.

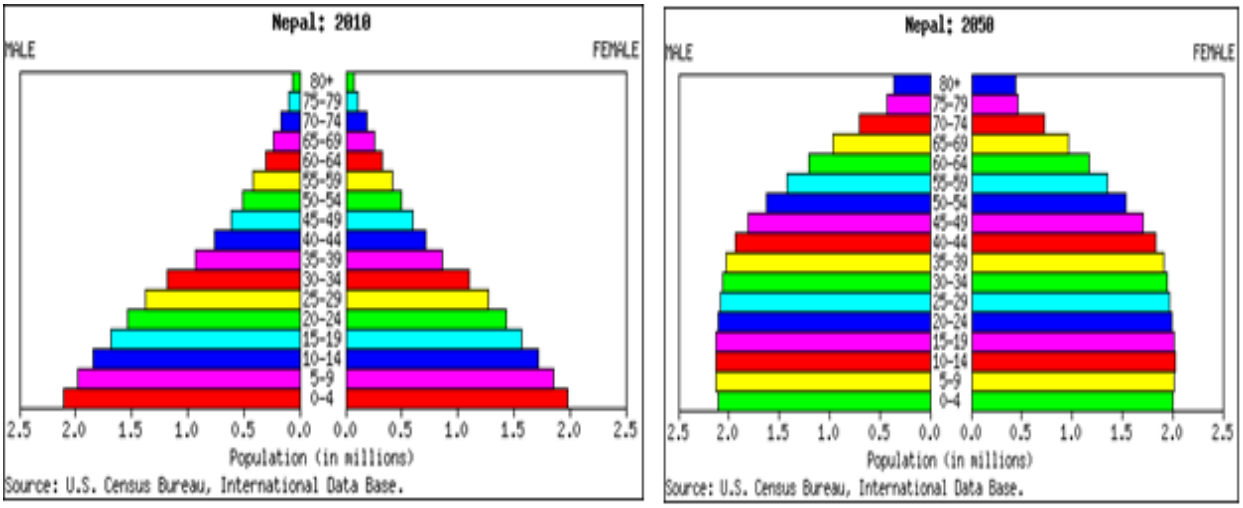


Figure 2: Population Pyramid Comparison

1.2 Research Questions:

This study aims to answer the following questions:

1. What is the prevalence and factors associated with Type 2 DM among elderly population of Kathmandu, Nepal?
2. What is the prevalence and factors associated with Microvascular complications of Type 2 DM among elderly population with Type 2 DM of Kathmandu, Nepal?
3. What is the burden of undetected type 2 DM among elderly population of Kathmandu, Nepal?

1.3 Study Hypothesis:

There is association between factors associated with Type 2 DM (socio-demographic factor, lifestyle factors, medical history and Anthropometric measurements) with prevalence of Type 2 DM and its Microvascular complications among elderly.

1.4 Objectives:

The overall objective of this study is therefore-

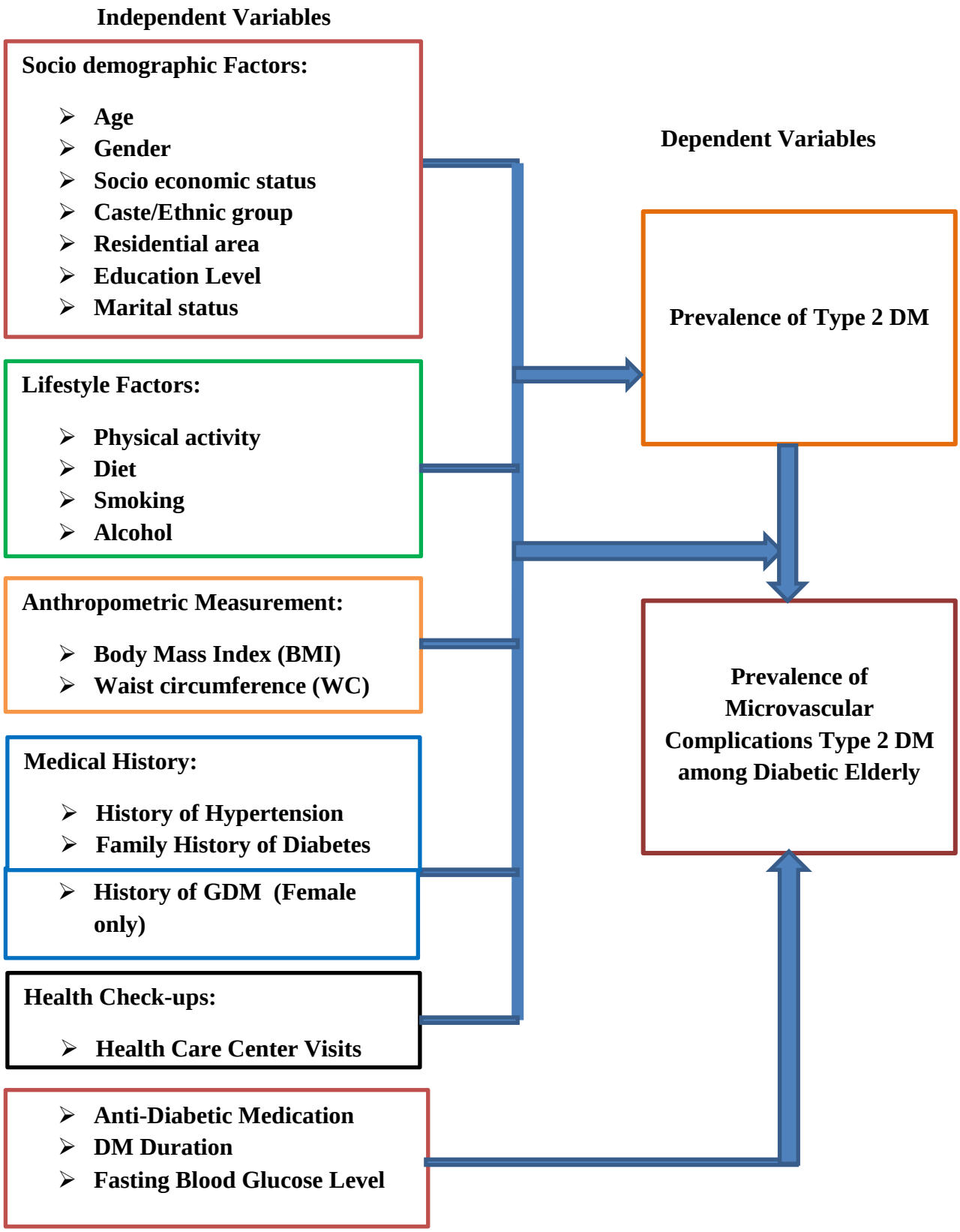
To determine the prevalence of Type 2 DM and to identify factors associated with Type 2 DM among elderly population of Kathmandu, Nepal.

1.4.1 Specific Objectives:

1. To determine the burden of Microvascular complications associated with Type 2 DM and to identify factors associated with Microvascular complications among elderly population with Type 2 DM of Kathmandu, Nepal.
2. To identify proportion of undetected Type 2 DM among elderly.

1.5 Conceptual Framework:

After analyzing number of literatures and conceptual frameworks on Type 2 DM and various risk factors associated with the Type 2 DM as well as its complication, the conceptual framework given below is proposed for the current study.


Independent Variables
Socio demographic Factors:
Age
Gender
Socio economic status
Caste/Ethnic group
Residential area
Education Level
Marital status
Lifestyle Factors:
Physical activity
Diet
Smoking
Alcohol
Anthropometric Measurement:
Body Mass Index (BMI)
Waist circumference (WC)
Medical History:
History of Hypertension
Family History of Diabetes
History of GDM (Female only)
Health Check-ups:
Health Care Center Visits
Anti-Diabetic Medication
DM Duration
Fasting Blood Glucose Level
Dependent Variables
Prevalence of Type 2 DM
Prevalence of Microvascular Complications Type 2 DM among Diabetic Elderly

1.6 Operational Definitions:

Diabetes Mellitus Diabetes is a chronic disease, which leads to an increased concentration of glucose in the blood due to deficiency or inefficiency of insulin. In this study if a person fasting blood glucose level of ≥ 126 mg/dl (American Diabetes Association [ADA], 2011d) or if a person is on anti-diabetic medication irrespective of fasting blood glucose test result or previously diagnosed as diabetic by a doctor were considered diabetic.

New Case of Diabetes Mellitus: In this study if a person's fasting blood glucose level is ≥ 126 mg/dl on two successive days and was never diagnosed as diabetic before was considered as new case of Diabetes Mellitus.

Microvascular Complications of Type 2 DM: Type 2 DM can damage the small blood vessels leading to Microvascular complications. The three main types of Microvascular complications are retinopathy, nephropathy and neuropathy. In this study participants having one or more of the Microvascular complications were all considered as Type 2 DM with Microvascular complications.

Diabetic retinopathy: Type 2 DM affects blood vessel formation in the retina of the eye, can lead to visual symptoms, reduced vision, and potentially blindness. For this study diagnosed case of diabetic retinopathy, well documented in medical records or diagnosed during study period by ophthalmoscopic examination were considered as having diabetic retinopathy.

Diabetic nephropathy: Type 2 DM can lead to scarring changes in the kidney tissue, loss of small or progressively larger amounts of protein in the urine, and eventually kidney failure. For this study diagnosed case of diabetic nephropathy, well documented in medical records were considered as having diabetic nephropathy.

Diabetic neuropathy: Type 2 DM can affect nerves commonly causing numbness, tingling and pain in the feet and also increasing the risk of skin damage due to altered sensation. For this study diagnosed case of diabetic neuropathy, well documented in

medical records or diagnosed by doctor in the camp after detailed physical examination will be considered as having diabetic neuropathy.

Elderly: In this study we define the population whose age is 60 years or above as elderly because United Nation has agreed the cutoff of 60 and above years to refer as elderly population (WHO, 2011c). It is generally associated with the age at which one can receive pension benefits.

Fasting Blood Glucose test: No calorie intake for 8 hours before the test. It is basically an overnight fast ((Fauci, 2008).

Usual Resident: Usual residencies defined as the place where the person lives and sleeps most of the time. Tourist and visitors are not included in this category (CBS, 2001).

Residential area: This is the area of the district where people have their residence. In this study, those people living in wards were considered as people living in urban area, whereas people living in VDCs (Village Development Committee) were considered as people living in rural area.

Age: The length of time that one has lived generally expressed in years.
Gender: It is a biological determination of a person to be male or female.
Caste: It is social stratification of a community. In this study it is classified as Brahmin; Chhetri; Janjatis; Newar and Others.

Marital Status: It indicates whether a person is married or not. In this study marital status is classified as married; unmarried; widow/widower and divorced.

Economic Status: The total amount of money the participant makes in a year and the assets the participant own. It includes total household income $\geq$ 50,000/ annum; house ownership; house structure (made with brick and tiles) and owning a car/jeep or a motorcycle/scooter. For this study it was classified in 3 categories low income $\leq$ 1 item out of four; middle income 2 -3 item out of four; high income all four items.

Education level: It is the highest level of schooling a person has attended in terms of gaining education. For this study it was classified into 5 categories: Illiterate – never went to school and unable to read and write; literate – able to read and write but no formal schooling; primary education - grade one to grade eight; secondary education - grade nine to grade twelve and higher education - University degree .

Anthropometric Measurement: It is a set of non-invasive technique for measuring human body.

BMI: It refers to weight in kilograms divided by height in meter square. It provides reliable indicator for body fatness. For this study, it was classified into 4 categories: Underweight- Below 18.5 kg/m^2; Normal- 18.5 to 22.9kg/m^2; Overweight – 23 – 27.5 kg/m^2 ; Obese – 27.6 kg/m^2 and above (WHO, 2004) .

Waist Circumference: It account for regional abdominal adiposity. In this study normal waist circumference for Men: $\leq$ 90 cms; Women: $\leq$ 80cms (Cameron et al., 2010).

Hypertension: It is the term used to describe high blood pressure. For this study Systolic blood pressure 140 mm of Hg or above and diastolic 90 mm of Hg or above (JNC7, 2004) or previously diagnosed hypertension by a doctor were considered hypertensive. Moreover, if a participant was diabetic in that case, Systolic blood pressure 130 mm of Hg or above and diastolic 80 mm of Hg or above were considered hypertensive.

Gestational Diabetes Mellitus (GDM): GDM is a condition in which women without previously diagnosed diabetes exhibits diabetic range of blood glucose level with onset or first recognition during pregnancy.

Family history of Type 2 DM: Family members suffering from Type 2 DM. For this study a positive family history was any of the first degree relative of the participant suffering from Type 2 DM.

Smoking status: It refers to the participant cigarette smoking behavior. For this study smoking status were classified in 3 categories- never; past smoker; current smoker.

Moreover, in this study current smokers were classified as light smokers < 5 cigarettes /day; Moderate smokers 5 – 14 cigarettes/day; Heavy smokers ≥ 15 cigarettes/day.

Alcohol Consumption: It refers to consumption of alcoholic drinks. In this study it is classified in three categories- non- drinker; past drinker and current drinker. Moreover, current drinkers were further categorized as social drinker; healthy drinker – 1 – 2 drinks/day and heavy drinker ≥ 3drinks/ day (Peele, 2000). (*One drink is equal to 12-ounces of beer; 5-ounces of wine; 5-ounces or a "shot" of 80-proof distilled spirits or liquor (e.g., gin, rum, vodka, or whiskey {1oz = 29.5ml})*

Physical activity: Physical activity refers to any movement of the body that leads to energy expenditure. In this study physical activities was categorized in 3 categories - no physical activity; inadequate physical activity – leisure walking or moderate exercise less than 150 minutes or vigorous exercise less than 75 minutes per week and adequate physical activity - at least 75 minutes of vigorous or at least 150 minutes of moderate intensity exercise per week (WHO, 2011d), which include swimming, brisk walking, jogging, running, gardening, household work like cleaning floor, dancing, yoga or any activity that builds up the sweat, etc.

Diet: It refers to the participant daily food habit. For this study it was classified in 2 categories such as healthy diet - 50% or more of food plate is having fruits and vegetables and 25% or less of fatty foods for most of the days of the week (at least 4 days a week) with a frequency of 2 -3 times per day; unhealthy diet- food plate having less than 50% of fruits and vegetables or more than 25% of fatty food or food frequency of 1 time a day or more than 3 times a day. Moreover in this study frequency of fast food center visit is classified as never; less than once a week; 1 - 2 times a week and more than 2 times a week.

Health Check-ups: It refers to visiting health care center for health check-ups. For this study it was classified in 3 categories such as regular - at least once a *year*; rarely and never.

CHAPTER II

LITERATURE REVIEW

2.1 General Overview:

The population ageing is increasing at an alarming rate. In year 2000, the population aged 60 years or over numbered 600 million, triples the number present in 1950. In 2009, the number of older persons had surpassed 700 million. By 2050, 2 billion older persons are projected to be alive, implying that their number will once again triple over a span of 50 years (UN-DESA, 2009). This rapid growth of ageing is attributed to advancement in modern medicine including effective drugs and vaccines and decrease in deaths due to communicable diseases. The fast ageing of populations around the world is presenting challenges not only for developed countries but also for developing countries as 70% of all older people now live in low or middle-income countries (WHO, 2011e). Older people in low and middle income countries are at especially high risk of cardiovascular disease, stroke and diabetes, as well as Alzheimer's and other dementias. People over 60 years of age accounted for 75% of the 35 million deaths from NCDs worldwide in 2004, with the majority in the low- and middle-income world (WHO, 2010).

DM is one of the major non communicable diseases vastly affecting worldwide morbidity and mortality, is increasing due to population growth, aging, urbanization, and increasing prevalence of obesity and physical inactivity. It is estimated that the prevalence of diabetes for all age-groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030. The total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030 (Wild et al., 2004). In a study where data from 91 countries were studied to find out prevalence of diabetes from 2010 to 2030 and it was estimated that total population of diabetes in age group between 20 – 79 years will increase from 285 million in 2010 to 439 million by 2030 (Shaw, Sicree and Zimme, 2009).

The prevalence of undetected Type 2 DM is high especially in low income countries (International Diabetes Federation [IDF], 2011). In a cross sectional study where a group of 623 elderly participated, it was found that the prevalence of undetected Type 2 DM was 13.2% (Dankner et al., 2008).

American Diabetic Association (ADA) recommends any of the following tests for the diagnosis of Diabetes Mellitus - Fasting Blood Glucose, Random Blood Glucose, HbA1c, 75 gram OGTT (Oral Glucose Tolerance Test) 2 hour Blood Glucose test (Cox and Edelman, 2009). Fasting Blood Glucose has sensitivity between 40% and 65% with a specificity > 90% for values ranging from 110 – 160mg/dL (WHO, 2003). HbA1c for the value of 6.5% ($\pm$2 SD) has sensitivity and specificity of 65% and 88% respectively (Kumar et al., 2010).

India has one of the world largest diabetic populations. According to data published by International Diabetic Federation the number of people with diabetes in India in the year 2006 was 40.9 million and is expected to rise to 60.9 million by the year 2025. Similarly, in Pakistan the prevalence of diabetes was 6.9 million in the year 2007 and is expected to be 11.5 million by the year 2025 unless until some measure are taken to prevent it.

In a study in Nepal to determine the Prevalence of Hypertension, Obesity, Diabetes, and Metabolic Syndrome in Nepal, 14,425 people were recruited between ages 20 - 100 years mean age (41.4 + or – 15.1). The result showed that the prevalence of diabetes was 6.3% whereas; prevalence of Hypertension was 33.9% (Sharma et al., 2011). Another study in Nepal to determine the Prevalence and determinants of Hypertension and Diabetes Mellitus among Elderly population in Kathmandu, Nepal it was seen that the overall prevalence of Type 2 DM was around 25.9% and almost half of the cases were diagnosed during the study (Chhetri and Chapman, 2009). A study in India shows the prevalence of diabetes mellitus is 11% among people aged between 60 -69 years. The same study also states that, more than half of diabetics (53%) are above 60 years of age (Gupta, Diabetes in Elderly Patients, 2002).

People of all ages and ethnic groups around the globe are affected by Type 2 DM. The burden of diabetes, however, is particularly heavy among the elderly. In United States, 41 percent of the populations with diabetes are elderly. The elderly account for only 12 percent of the general population, however the elderly population has higher rates of diabetes than the younger population (National Academy on an Aging Society, 2000).

Incidence of complication of Type 2 DM is significantly associated with hyperglycemia. The rate of development of Microvascular complication is greater than other complication with persistent hyperglycemia (Stratton et al., 2000) .

A population based study in Thailand shows that there is higher prevalence of Microvascular complications as compared to Macrovascular complications among Diabetic participants with mean DM Duration of 7 years. The study shows the following prevalence of Microvascular complications: Diabetic Nephropathy 33.9%, Diabetic Retinopathy 22.8% and prevalence of Macrovascular complications are Myocardial Infraction 3.5%, Peripheral Arterial Disease 5.5%, Stroke 7.0% and Amputation 2.0% (Rattana et al., 2006).

Diabetic retinopathy is the major cause of new cases of blindness among adults aged 20–74 years. During the first two decades of disease, nearly >60% of patients with Type 2 DM have retinopathy (Fong et al., 2004). In the Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR) 1.6% of Type 2 DM patients were legally blind. In India, a cohort study involving 6792 Type 2 DM patient attending a diabetes center at Chennai, India the prevalence of Diabetic retinopathy was 34.1 per cent. However, in the Chennai Urban Rural Epidemiology Study (CURES) eye study where 1382 individuals (urban component), participated the overall prevalence of Diabetic Retinopathy was 17.6% among diabetic patients (Rema and Pradeepa, 2007).

Diabetic nephropathy is the leading cause of end-stage renal disease (ESRD) worldwide, and it is estimated that 20% of type 2 diabetic patients reach ESRD during their lifetime (Ayodele et al., 2004) . In United States also Diabetic nephropathy is the leading cause of End Stage Renal Disease (ESRD) which is a leading cause of DM-related morbidity and mortality (Fauci, 2008). In U.S., diabetic nephropathy accounts for

about 40% of new cases of ESRD, and in 1997, the cost for treatment of diabetic patients with ESRD was in excess of $15.6 billion (American Diabetes Association, 2004).

Diabetic neuropathy occurs in almost 50% of individuals suffering from longstanding Type 2 DM. It may manifest as polyneuropathy, mononeuropathy, and autonomic neuropathy and most common form of diabetic neuropathy is distal symmetric polyneuropathy. The development of neuropathy correlates with the duration of diabetes and glycemic control. Additional risk factors are BMI (the greater the BMI, the greater the risk of neuropathy) and smoking (Fauci, 2008). The prevalence of diabetic neuropathy was 17.8% in a cross-sectional hospital-based study which was carried out in four different cities of China where 1,524 Type 2 DM, outpatients participated (Liu et al., 2010) .

Diabetes mellitus is not only a health problem but also imposes an increasing economic burden on national health care systems worldwide. Diabetes Mellitus along with its complications have a substantial economic impact on individuals, families, health systems and countries. In China alone it is estimated that between the timeframe of 2006-2015, it will lose USD 558 billion national income due to heart disease, stroke and diabetes (WHO, 2011g). The global health expenditure on diabetes is expected to a total of at least USD 376 billion in 2010 and USD 490 billion in 2030. It was estimated that globally, 12% of the health expenditure is to be spent on DM in 2010 (Zhang et al., 2010). The expenditure varies by region, age group, gender, and country's income level.

2.2 Risk factors

There are numerous studies showing that socio demographic factor, certain lifestyle factors (smoking, diet, exercise, etc.); medical history (hypertension, history of Gestational Diabetes Mellitus (GDM), family history, etc.); anthropometric measurement (BMI, etc.) and health check-ups are related to prevalence Type 2 DM

Socio demographic factors:

The prevalence of Type 2 DM increases with age. In a data analysis of 11 population-based studies from four Asian countries, it was found that the peak age for Type 2 DM in Chinese and Japanese is at 70 – 89 years of age, but peak age for Indian participant were at 60 – 69 years of age (DECODA Study Group, 2003).

The prevalence of Type 2 DM in United States in age group 65 years and above is 10.9 million, or 26.9% of all people in this age group. In men of 20 years and above the prevalence of diabetes is 13.0 million whereas, prevalence in women of same age group is 12.6 million (American Diabetic Association [ADA], 2011a). In a study in China where 46,239 participants participated to find out prevalence of diabetes among men and women it was concluded that the age-standardized prevalence of total diabetes was 9.7% (10.6% among men and 8.8% among women) as shown in figure 3. In the same study it was seen that prevalence of diabetes was higher among urban residents than rural residents which was 11.4% and 8.2% respectively (Yang et al., 2010).

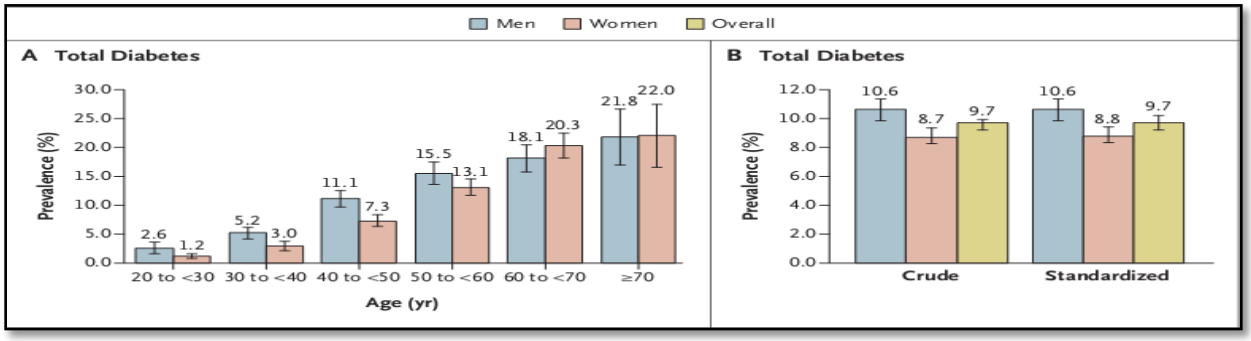


Figure 3: Age - Specific Prevalence of Diabetes

Socio economic status is considered as important determinants of health. Numerous studies have proved that low economic status is associated with lower life expectancy (Winkelby and Cubbin, 2003). Diabetes related deaths increases with socioeconomic disadvantage class of people (Webbie, 2005). Although, effective treatment is available

for managing Type 2 DM, the facilities remain underutilized by people of low socio economic status (Brown et al., 2003).

Lifestyle Factors:

Physical inactivity and obesity are the major modifiable risk factors for Type 2 DM (Hu et al., 2004b). Exercise has been considered as a mainstay in diabetes management, along with diet and medication. Regular physical activity can reduce the risk of developing Type 2 DM. Many researches have shown that lower rates of Type DM are seen with at least 120 minutes per week of moderate-intensity aerobic activity (CDC, Physical Activity for Everyone, 2011). In a prospective cohort study among nurses it was seen that sedentary lifestyle, especially watching television, was associated with increased risk of obesity and Type 2 DM, whereas even light to moderate physical activity reduces the risk substantially (Hu et al., 2003). In a meta-analysis of 10 prospective cohort studies, an inverse relation was seen between physical activity of moderate intensity and risk of Type 2 DM. Those who regularly engaged in physical activity of moderate intensity had 30% lower risk of type 2 diabetes as compared with sedentary individuals (Jeon et al., 2007).

In a prospective population based cohort study in nurses, it was seen that lack of exercise, poor diet, current smoking and abstinence from alcohol was associated with increased risk of Type 2 DM (Hu et al, 2001). A study in southern India found that higher dietary carbohydrates and glycemic load are associated with increased risk of newly diagnosed Type 2 DM, whereas, dietary fiber with decreased risk (Mohan et al., 2009). According to Department of Nutrition at the Harvard School of Public Health a healthy food plate must constitute 50% of vegetables and fruits excluding potatoes, 25% proteins and 25% whole grains.

In Coronary Artery Risk Development in Young Adults (CARDIA) study, it was seen that participants with infrequent visit (less than once a week) of fast-food restaurant at baseline and follow-up when compared with those with frequent (more than twice a

week) visits to fast-food restaurants at baseline and follow-up gained an extra 4·5 kg of bodyweight and had a two-fold greater increase in insulin resistance (Pereira et al., 2005).

Smoking is an important risk factor for Type 2 DM. The risk of Type 2 DM increases with increase in pack years. Quitting smoking decreases risk of Type 2 DM to nearly the same level as nonsmokers (Manson, et al., 2000). In a Finnish prospective study it has been observed that smoking increases the risk of Type 2 DM at all levels of BMI and physical activity (Patja et al., 2005). In another study it has been observed that smoking more than 15 sticks a day increases the risk of Type 2 DM by 1.34 times. In the same study it has been found that consuming alcohol more than 10grams per day act as protective factor (Hu et al., 2001).

In a study to clarify the dose-response relationship between alcohol consumption and Type 2 DM, 20 cohort studies, it was revealed that consuming around 22 g/day alcohol is most protective and consuming more than 60gm/day is injurious to health (Baliunas et al., 2009).

Anthropometric Measurement:

Obesity is a state of excess adipose tissue mass. There is no direct measure of obesity, the most widely used method to measure obesity is the body mass index (BMI), which is equal to weight in kg/height in meter^2 (Fauci, 2008). Around the globe more than 1 billion of adults are overweight and at least 300 million of them are clinically obese, which is a major factor for the global burden of chronic diseases (WHO, 2011f).

Excess body fat is one of the most important risk factor for Type 2 DM and weight control would be the most effective way to reduce the risk of Type 2 DM. In a 16 year long cohort study where around 84,941 nurses participated it was seen that relative risk of Type 2 DM was 38.8 for women with a body-mass index of 35.0 or higher and 20.1 for women with a body-mass index of 30.0 to 34.9, as compared with women who had a body-mass index of less than 23.0 (Hu et al., 2001). Insulin resistance is a persistent feature of obesity. Insulin resistance is more strongly linked to intraabdominal fat than to

fat in other part of the body (Fauci, 2008). In a study to determine the utility of waist circumference (WC) in predicting Type 2 DM and cardiovascular disease (CVD) it was observed that the medium and high WC were more likely to have diabetes and CVD compared with the low WC (Janiszewski et al., 2007).

Medical History and Health Check-ups:

In a study to determine the global burden of hypertension, data from different regions of the world were collected to estimate the overall prevalence of hypertension in 2000, and to estimate the global burden in 2025. The analysis of data has shown that estimated total number of adults with hypertension in 2000 was 972 million and it will increase to 1.56 billion by the year 2025 (Kearney et al., 2005).

The American Diabetes Association (ADA) and the National Institutes of Health recommend a target blood pressure of less than 130/80 mmHg for living people with diabetes mellitus. Blood pressure below 130/80 mmHg, will lower the risk for diabetes complication like retinopathy, nephropathy as well as cardiac complication (ADA, 2011b).

In a retrospective cohort study, to determine association of different antihypertensive drug with new onset of diabetes mellitus, it was seen that drugs like calcium channel blockers, beta-blockers and diuretics were significant increase in the risk of New Onset Diabetes (Jong et al., 2009).

Gestational diabetes mellitus (GDM) assessment is very essential in pregnancy. The prevalence may vary from 1 to 14% of all pregnancies, depending on the population studied. Women who are diagnosed with GDM are at increased risk for the development of Type 2 DM, in later life. Obesity and other factors further enhance the risk of Type 2 DM (ADA, Gestational Diabetes Mellitus, 2003). In a study 168 offspring of age 19 – 27 years of women with GDM during their birth were examined for diabetes and out of them 21% has diabetes or prediabetes (Damm, 2009). In a Danish cohort study it was seen that

risk of metabolic syndrome increases by 3 fold in women with GDM (Lauenborg et al., 2005).

Type 2 DM has a stronger link to family history than Type 1 DM, although it too depends on other factors as well. Studies of twins have shown that genetics play a very strong role in the development of Type 2 DM (ADA, 2011c). In a study 1,473 people with Type 2 DM were recruited. It has been seen that prevalence of diabetes in mother, father and other relative, was 27.7, 11.0 and 10.7%, respectively (Papazafiropoulou et al., 2009).

Regular health check-up is one of the vital things that one can do to stay healthy and prevent diseases and its complications. Regular health check-up gives an opportunity to screen the disease as well as adequate follow up if one already has a disease. Health care provider can assess your risk of disease based on your family history and other factors and recommend things that can help to prevent disease (CDC, Family Health, 2010).

A study to determine Prevalence and risk factors for Diabetes Nephropathy where 1,363 participated; shows that smoking, duration of diabetes and blood pressure were significantly positively associated with nephropathy. (Unnikrishnan et al., 2007).

A study in India to see the risk factors for Diabetes Neuropathy where 1629 diabetic people participated, shows age, glycated hemoglobin (HbA1c) and duration of diabetes were significantly associated with Diabetic Neuropathy (Pradeepa et al., 2008).

In Chennai Urban Rural Epidemiology Study (CURES) eye study where 1382 individuals, of mean age of 52 years participated; shows duration of diabetes as strongest predictor for Diabetic Retinopathy. (Rema and Pradeepa, 2007).

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Design:

A cross sectional (descriptive and analytical) study was conducted to find out prevalence of Type 2 DM and its Microvascular complication as well as factors associated with Type 2 DM among elderly population of Kathmandu district, Nepal. This study mainly relies on information provided by primary informant, their medical records, detailed physical examination by doctor and fasting blood glucose testing. The data was collected from urban and rural areas of Kathmandu district, Nepal. Anthropometric measurement, blood pressure measurement and Fasting blood glucose test were done by using standard medical equipment. Quantitative Research methodology was applied in this research.

3.2 Study Area:

This study was conducted in Kathmandu district and had included two urban areas and two rural areas. The urban areas of Kathmandu, which was included in this study, were Ward No. 32 and Ward No. 10. Similarly, the rural areas of Kathmandu, which was included in this study, were Jorpati VDC (Village Development Committee) and Gokarna VDC. These four study sites have been selected by simple random sampling method.

3.3 Study Period:

The study took place in the month of February and March, 2012

3.4 Study population*:*

The target populations of this study were usual resident of the study area who were 60 years of age or above.

3.4.1 Inclusion Criteria:

- Participants who were 60 years of age or above.

- Participants who were usual resident of the study area (Ward No. 32; Ward No. 10; Jorpati VDC and Gokarna VDC).
- Participants who gave informed written consent.

3.4.2 Exclusion Criteria:

- Persons who were not able to respond to the questionnaire due to language barrier (does not understand Nepali or English language).
- Persons who were not able to respond to the questionnaire due to senile dementia or other mental illness, etc.

3.5 Sampling Technique:

Multistage sampling techniques were adopted; first a simple random sampling was done to select study sites from Kathmandu district. Two study sites were selected from all 35 Wards and another two from 57 VDCs of Kathmandu district, Nepal. Furthermore, list of all elderly people from four different study sites were prepared; including their house number and the records were taken from Ward office and VDC office of the study areas. Systematic sampling procedure was carried out, in which all elderly people living in study area was compiled in a single list and an identification code was given to each of them separately by the researcher. There were around 5208 elderly living in these four sites as per records available at the Ward and VDC offices. This was slightly higher than the elderly population in the area, calculated by using an estimation of 6.5% of total population of the area is elderly (CBS, 2001) which is around 4900. The estimated number of participants from selected four different study areas of Kathmandu was 306. Sampling interval was set at 17 (obtained from dividing total elderly population by sample size).

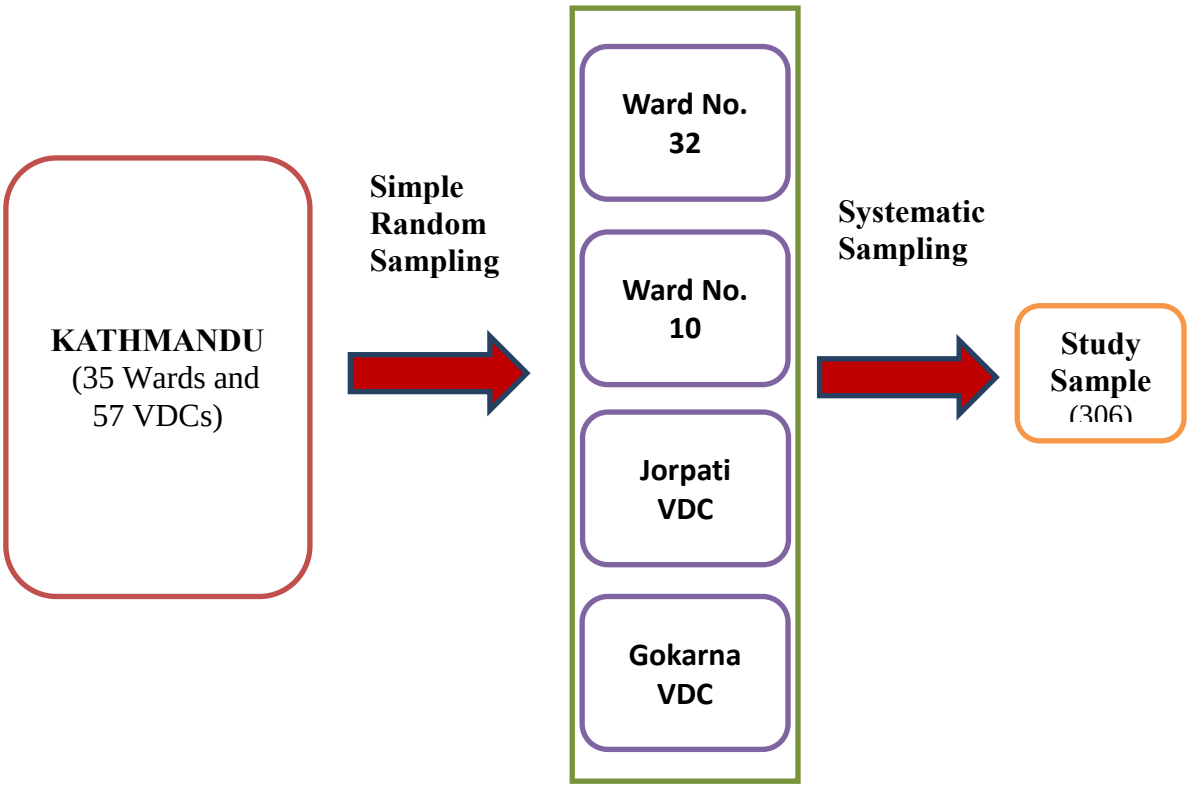


Figure 4: Sampling Technique

3.6 Sample Size:

Extensive literature search was done to find out the prevalence of diabetes mellitus in elderly population of Kathmandu, Nepal. It was observed that different studies have shown different prevalence of Type 2 DM. Thus, for this study, sample size was calculated by estimating 26% as the prevalence for Type 2 DM with confidence interval of 95% for the total population of 5208. A previous study to determine prevalence of Type 2 DM among elderly in Kathmandu, Nepal has shown 25.9% as the prevalence of Type 2 DM (Chhetri and Chapman, 2009).

Sample size calculation:

$n = n_0 / 1 + (n_0 - 1) / N$

$$n_0 = \frac{Z^2 pq}{(e)^2}$$ (Cochran)

$$n_0 = \frac{(1.96)^2 \, 0.26 \, (1 - 0.26)}{(0.05)^2}$$

$n_0 = 295$

Hence, sample size (**n**) = 278

Where,

p = estimated proportion of the elderly population that is likely to have Diabetes

q = 1-p

e = desired level of precision.

Z = value from normal distribution associated with 95% confidence interval which is 1.96.

N= Total population of the area

The sample size from above calculation is 278 participants but there is always chances of potential refusal or dropout in the middle of interview, in order to adjust such cases 10% of the total calculated sample size was added to the before calculated sample size. Hence the new sample size is 306. As the estimated sample size is 306, which could be a good representation of study population.

3.7 Measurement Tool:

A structured questionnaire was developed in English after extensive literature review, studying theories and concepts related to diabetes mellitus that will cover the objective of the research. The developed questionnaire was then translated to Nepali language (local language) and again translated back to English to verify that the actual

content of the questionnaire was retained in the translated version. This translation was done by hiring two different translators. This questionnaire was used to collect data related to lifestyle factors; socio demographic factors; health check-ups and Medical history related to Type 2 DMs as well as complication of Type 2 DM.

During home visit, standard medical protocol was followed to measure height and weight; waist circumference, blood pressure and fasting blood glucose level. Height and weight was measured without shoes and with light clothing. BMI was calculated as weight in kilograms divided by the square of the height in meters. Waist circumference was measured midway between the lower rib margin and iliac crest (Hu et al., 2004a). Blood pressure was measured in upper arm using standard sphygmomanometer and stethoscope. Rest period of 15 minutes was ensured before measuring blood pressure. In case of first time diagnosis of hypertension, blood pressure was measured in both arms in sitting and standing position after 15 – 30 minutes of rest. Fasting blood glucose level was measured by glucometer in a person who had not consumed any calories at least for 8 hours basically after an overnight fast (National Institutes of Health [NIH], 2008). In case of first time detection of diabetes mellitus, a second test was done on next day before diagnosing a person as diabetic. Standard sterile protocols were maintained during blood testing. Moreover, safe lancet and strip disposable procedures were strictly followed.

During health camp, ophthalmoscopic examination was done among all diabetic patients to detect Diabetic Retinopathy. Medical records were reviewed for Microvascular complications especially to find out cases of Diabetic Nephropathy. Ten gram monofilament test for fine touch, tuning fork test for vibration sensation, needle prick test for pain sensation and ankle jerk was performed for diagnosing Diabetic Neuropathy. Furthermore a small structured questionnaire adapted from Michigan Neuropathy Screening Instrument was also administered for diagnosing Diabetic Neuropathy.

3.8 Validity:

Three research experts and research advisor were consulted to ensure content validity and completeness of the questionnaire. Similarly, standard medical instruments were used for anthropometric measurements, blood pressure measurement and fasting blood glucose testing.

3.9 Pretesting of Questionnaire:

Pretesting of the translated questionnaire was done among 32 elderly participants (more than 10% of total sample size) outside the study population. During pretesting of the questionnaire, the whole interview process was monitored closely by the principal researcher to ensure proper understanding of questions by the participants.

In the light of pretesting of questionnaire few modifications have been done in the questionnaire (Example: addition of pictures of food plate in the questionnaire).

3.10 Data collection:

Two days orientation session was organized for the interviewers (5 Health Volunteers) about the modalities of current study. The orientation was focused on overall objective of the study, better understanding of questionnaire and confidentiality of the participants. A medical team was formed consisting of three doctors and three medical interns; one day orientation program was organized for them.

After finalizing participant selection by sampling technique mentioned above, health volunteers went to the selected household and requested them not to consume any calorie after 8 pm till the research team visits the household next morning (overnight fast). The members of mobile research teams for household visit were one doctor, one medical intern and two health volunteers. At the household visit the mobile research team measure the height; weight; waist circumference, blood pressure and fasting blood glucose after obtaining an informed written consent from the participant. A pretested structured questionnaire was administered to the participant by the trained interviewers (health volunteers). All the participants whose fasting blood glucose were more than

125mg/dl and were not diagnosed as diabetic before were advised not to consume any calorie after 8 pm (overnight fast) and again fasting blood glucose was measured in the next morning.

All participants diagnosed as diabetic during home visit or on anti-diabetic medication or previously diagnosed as diabetic by a doctor were invited to health camps, where a medical team comprising of three doctors and two medical interns did detailed physical examination for peripheral neuropathy, retinal examination and reviewing of medical records to find out Microvascular complications regarding Type 2 DM.

3.11 Data Analysis:

Once the data collection process was over, the collected data was edited and coded carefully. Coded data was manually tabulated as well as categorized and entered into database by the researcher.

According to this study dependent variable (Type 2 DM and Microvascular Complications) have been classified into two categories Type 2 DM (Presence or Absence); Type 2 DM with Microvascular complications (Presence or Absence). The independent variables and their scale of measurement are shown as below:

Age	Continuous Variable
Gender	Nominal Scale (Male, Female)
Socioeconomic status	Ordinal Scale (Low, Middle and High Income)
Caste	Nominal Scale (Brahmin, Chhetri, Janjatis, Newar and Others)
Residential area	Nominal Scale (Urban, Rural)
Education Level	Ordinal Scale (Illiterate, Primary education, Secondary education, and Higher education)
Marital status	Nominal Scale (Married, Unmarried, Widow/Widower and Divorced)
Physical activity	Ordinal Scale (No Exercise Inadequate Exercise , Adequate Exercise)
Diet	Nominal Scale (Healthy, Unhealthy)

Smoking	Nominal Scale (Non-smoker, Past smoker, Current Smoker) For Current Smoker Ordinal scale (Light, Moderate, Heavy)
Alcohol	Nominal Scale (Nondrinker, Past drinker and Current Drinker) Current Drinker Ordinal scale (Social Drinker, Healthy drinker and Heavy drinker
Body Mass Index	Continuous Variable
Waist Circumference	Continuous Variable
Gestational Diabetes Mellitus	Nominal Scale (Yes, No)
Family History of Type 2 DM	Nominal Scale (Yes, No)
Hypertension	Nominal (Yes, No)
Health Check-ups	Nominal Scale (Never, Rarely, Regularly)

Descriptive Statistics: The prevalence of Type 2 DM; prevalence of Microvascular complications of Type 2 DM among diabetic elderly and components of independent variable which have been categorized in nominal and ordinal scale as shown above were presented by using frequency and percentage. Moreover, age, BMI, waist circumference and fasting blood glucose were presented using frequency, percentage median, minimum, maximum values and range.

Analytical Statistics: Bivariate analysis was done to assess the association between each independent variable and the dependent variable. Bivariate analysis was done using logistic regression.

Results of the bivariate analysis were used to construct multivariable model for multivariable analysis. This multivariable model included variables for which p-value ≤ 0.20 in bivariate analysis. Moreover, independent variable whose p value was > 0.20 but has been significantly associated with Type 2 DM in several other studies was also

included in multivariable model. Odds Ratio (OR) was calculated to find out the strength of association between dependent and independent variables. All statistical analyses was done using SPSS 17.0 for Windows, with the level of statistical significance set at ≤0.05

3.12 Ethical Consideration:

The thesis proposal and measurement tools was reviewed and approved by Nepal Health Research Council (NHRC), Ministry of Health and Population (MoHP). The questionnaire does not elicit any sensitive information. The objective and the purpose of the study were explained to the respondents before giving the questionnaire; medical examination and blood testing. Informed written consent was obtained from the participant before starting the test. Healthy snacks were given to the participants after fasting blood glucose testing. Moreover, during blood testing if any participant has very high blood glucose – 250 mg/dl or more (Hendel, 2005), the participant was escorted to the hospital by health volunteer. In addition, during the test if any participant becomes hypoglycemic – blood glucose level falls below 55mg/dl with symptoms (Fauci, 2008) then immediate first aid would be provided by giving some sugar drink to the participant and then escorted to the hospital by a health volunteer. In addition, all new cases of Type 2 DM were given counseling by doctor present at the camp and advice to seek medical attention as soon as possible. Address and contact detail of nearest healthcare provider was given to the participant according to their residential area. The participation in this study will remain confidential. The data will be presented in aggregated tables so there is no way to link any specific participant with the result. All the questionnaires will be coded by the principal researcher. There will be no way to relate the questionnaire's participant code with the name of the participant in questionnaire as the list relating participant's name with the code will be available with the principal researcher only, which will be destroyed after the completion of the research. No one has been forced to participate in this study; it has been a voluntary participation. The data will be used for the purpose of research work only for the partial fulfillment of MPH degree. A copy of the thesis will be submitted to the relevant department of Ministry of Health and

Population (MoHP), Nepal; highlighting key finding and recommendations for policy purposes with a covering letter.

3.13 Limitations:

1. Prevalence of Type 2 DM, among elderly does not represents overall prevalence of diabetes mellitus in Kathmandu, Nepal.
2. This study does not test lipid profile, which is another important risk factor for diabetes.
3. This study does not test for renal function or urine for microalbuminuria, which are important to determine diabetic nephropathy.
4. This study was conducted in Kathmandu; even though the study includes VDCs (Village Development Committees), but these VDCs are within Kathmandu district hence these areas may not be the representation of actual rural areas of Nepal.

CHAPTER IV

RESULTS

This chapter includes results of descriptive and analytical statistics based on data collected by quantitative study method among elderly population of Kathmandu, Nepal in the month of February and March, 2012.

Data analysis began with descriptive statistics such as frequency and percentage for all independent variables and for continuous variable such as age, BMI waist circumference and fasting Blood glucose were presented using median (in case of skewness), minimum value, maximum value and range.

Analytical statistics was done to see the association and to measure strength of association between dependent and independent variables. Bivariate analysis was done using logistic regression to see association between dependent and independent variables. Strength of association between dependent and independent variables was seen using Odds Ratio (OR). Multivariable analysis was also done using logistic regression for all those variables whose p-value ≤ 0.20 in bivariate analysis and those variables whose p value is > 0.20 but has been significantly associated with Type 2 DM in several other previous studies.

4.1 Descriptive Analysis

Table 4.1: **Socio Demographic factors of study population (n = 306**)

Variables	Frequency	Percentage
Age Group		
60 – 69 Years	135	44.1
70 – 79 Years	109	35.6
80 Years and Above	62	20.3
Gender		
Male	149	48.7
Female	157	51.3
Socio economic status		
Low Income	141	46.1
Middle Income	113	36.9
High Income	52	17.0
Residential Area		
Urban	180	58.8
Rural	126	41.2
Marital Status		
Married	207	67.6
Unmarried	30	9.8
Widow/Widower	46	15

Table 4.1: **Socio Demographic factors of study population** (**n = 306**) (Continued)

Variables	Frequency	Percentage
Caste		
Brahmin	79	25.8
Chettri	57	18.6
Janjati	36	11.8
Newar	80	26.1
Others	54	17.6
Education Level		
Illiterate	125	40.8
Literate (Able to read and write but no formal Schooling)	16	5.2
Primary Education	60	19.6
Secondary Education	57	18.6
University Degree	48	15.7

Age group of 60 – 69 years has highest number of participants. There were 149 (48.7%) male participants and 157 (51.3%) female participants. In this study most participants resides in urban areas out of which 31% - Ward No.32 and 27.8% - Ward No.10; and rest of the participants resides in rural areas - 21.2% - Jorpati VDC and 19.9% - Gokarna VDC. Over 45% of the participants didn't have formal schooling.

Table 4.2: Lifestyle factors of study population (**n = 306**)

Variables	Frequency	Percentage
Physical Activity		
No Physical Activity	80	26.1
Inadequate Physical Activity	164	53.6
Adequate Physical Activity	62	20.3
Diet		
Healthy Diet	141	46.1
Unhealthy Diet	165	53.9
Fast Food Visit		
Never	185	60.5
Less than once a week	63	20.6
1 – 2 times per week	46	15.0
More than 2 times per week	12	3.9
Smoking		
Never Smoking	152	49.7
Past Smoking	88	28.7
Current Smoking	66	21.6
Current Smoker		
Not a current Smoker	240	78.4
Light Smoker	29	9.5
Moderate Smoker	20	6.5
Heavy Smoker	17	5.6
Alcohol drinker		
Non Drinker	165	53.9
Current Drinker	141	46.1

Table 4.2: Lifestyle factors of study population (**n = 306**) (Continued)

Variables	Frequency	Percentage
Current Alcohol Drinking		
Not a Current Drinker	165	53.9
Social Drinker	65	21.2
Healthy Drinker	42	13.7
Heavy Drinker	34	11.1

Majority of participants were involved in some physical activity like leisure walking with friends or walking to the temple but not adequate to produce significant health benefits. In this study 21.6% were current smokers. Among current smokers 83.1% have been smoking for more than 10 years. The number of participants having healthy food habits were 141 (46.1%) of the total study population. However, only 3.9% of the total participants visits fast food restaurant more than twice a week.

Table 4.3: The results of frequency and percentage of Anthropometric Measurements of study population (**n = 306**)

Variables	Frequency	Percentage
Body Mass Index		
Normal	66	21.6
Underweight	5	1.6
Overweight	147	48.0
Obese	88	28.8

Table 4.3: Anthropometric Measurements of study population (**n = 306**) (Continued)

Variables	Frequency	Percentage
Waist Circumference Male		
Normal	89	59.7
Above Normal	60	40.3
Waist Circumference Female		
Normal	43	27.4
Above Normal	114	77.6

Anthropometric measurement was carried out in all the participants in the study population. Almost 50% of the total participant fall under the bracket of overweight as far as BMI is concerned. Almost 60% of the male participants have waist circumference within Normal range whereas, only 27.4% of women have waist circumference with Normal range.

Table 4.4: Medical History and Health Check-ups of study population (**n = 306**)

Variables	Frequency	Percentage
Hypertension		
No Hypertension	206	67.3
Hypertension	100	32.7
Family History of Type 2 DM		
Positive Family History	76	24.8
Negative Family History	230	75.2

Table 4.4: Medical History and Health Check-ups of study population (Continued)

Variables	Frequency	Percentage
Gestational Diabetes Mellitus (n=157)		
Positive History of Gestational Diabetes Mellitus	17	10.8
Negative history of Gestational Diabetes Mellitus	140	89.2
Health Check-ups (n = 306)		
Regularly	152	49.7
Rarely	140	45.8
Never	14	4.6

Hypertension was seen among 100 (32.7%) participants out of all 306 participants. The median blood pressure among all the participants was 130/80 mm of Hg. All the participants in the study were asked about family history of Type 2 DM among their first degree relatives and it was seen that 24.8% have positive family history of Type 2 DM and among relatives of the participants with a positive family history - father have highest prevalence of Type 2 DM -51.3% followed by brothers/sister in close second position with the prevalence of 47.4%. In this study population 49.7% participant's visits health center regularly for health check-ups. This study had shown that majority of participant with established Type 2 DM before the study goes to health care center more regularly.

Table 4.5: Descriptive analysis for continuous variables **(n = 306)**

	Age in Years	**Fasting Blood Glucose (mg/dl)**	**BMI**	**Waist Circumference (cm) Male (n=149)**	**Waist Circumference (cm) Female (n=157)**
Median	71.00	101	25.50	86.36	83.82
Range	38	349	23.60	45.72	48.26
Minimum	60	58	15.20	66.04	58.42
Maximum	98	407	38.80	111.76	106.68
Skewness	0.47	2.97	0.45	0.15	- 0.06

The median age of the participants in this study was 71 years, with 98 years as the highest and 60 years as the lowest age among all the participants. Maximum participants in this study were 60 years of age. The median BMI of the participants in this study was 25.50. Later on, it was categorized in four categories – Normal 66 (21.6%), Underweight 5 (1.6%), Overweight 147 (48.0%) and Obese 88 (28.8%). The median waist circumference of all male and female participants in this study was 86.36 and 83.82 respectively.

In this study Prevalence of Type 2 DM was 23.5%. All the participants in this study were asked about the four main symptoms of Type 2 DM – excessive thirst, frequent micturition (especially at night), sudden weight loss and excessive fatigue, it was found that out all participants 225 (73.5%) have no symptoms, 32 (10.5%) have at least one symptom, 34 (11.1%) have at least two symptoms, 12 (3.9%) have three symptoms and only 3 (1.0%) have all four symptoms.

The total number of New cases of Type 2 DM diagnosed during this study alone was 19 which accounts for 26.3% of all Type 2 DM cases (n = 72).

Out of all Type 2 DM patient in this study, 31 (43.1%) have one or more Microvascular complications. Among those who have Microvascular complications, some have one complication and some have more than one complication – 15 participants have one complication, 14 participants have two complications and 2 participants have all three complications. The prevalence of Diabetic Retinopathy, Diabetic Nephropathy and Diabetic Neuropathy among Diabetic participants was 31.9%, 18.1% and 22.2% respectively. In this study median Duration of Type 2 DM was 6 years.

Table 4.6: Prevalence of Type 2 DM: Socio demographic factors (n=306)

	Type 2 Diabetes Mellitus		
Variables	**No**	**Yes**	**Total**
Age Group			
60 – 69 Years	105 (77.8%)	30 (22.2%)	135
70 – 79 Years	83 (76.1%)	26 (23.9%)	109
80 Years and Above	46 (74.2%)	16 (25.8%)	62
Gender			
Male	109 (73.2%)	40 (26.8%)	149
Female	125 (79.6%)	32 (20.4%)	157
Socio economic status			
Low Income	116 (82.3%)	25 (17.7%)	141
Middle Income	83 (73.5%)	30 (26.5%)	113
High Income	35 (67.3%)	17 (32.7%)	52
Residential Address			
Rural	92 (73.0%)	34 (27.0%)	126
Urban	142 (78.9%)	38 (21.1%)	180

Table 4.6: (Prevalence of Type 2 DM) Socio demographic factors (n=306) (Continued)

Variables	Type 2 Diabetes Mellitus		
	No	**Yes**	**Total**
Marital Status			
Married	157 (75.8%)	50 (24.2%)	207
Unmarried	24 (80.0%)	6 (20.0%)	30
Widow/Widower	39 (84.8%)	7 (15.2%)	46
Divorcee	14 (60.1%)	9 (39.1%)	23
Education Level			
Illiterate	104 (83.2%)	21 (16.8%)	125
Literate (*Able to read and write but no formal Schooling*)	13 (81.2%)	3 (18.8%)	16
Primary Education	44 (73.3%)	16 (26.7%)	60
Secondary Education	41 (71.9%)	16 (28.1%)	57
University Degree	32 (66.7%)	16 (33.3%)	48
Caste			
Brahmin	58 (73.4%)	21 (26.6%)	79
Chettri	47 (82.5%)	10 (17.5%)	57
Janjati	28 (77.8%)	8 (22.2%)	36
Newar	60 (75.0%)	20 (25.0%)	80
Others	41 (75.9%)	13 (24.1%)	54

The descriptive analysis of socio demographic factors reveals that the Type 2 DM was more prevalent in higher age group people. The people who reside in rural area have more Type 2 DM than those in urban area, whereas people with low income group have less prevalence of Type 2 DM. Highly educated (university degree) participants were

having higher prevalence of Type 2 DM. Brahmin caste have higher prevalence of Type 2 DM followed by Newars in near second position.

Table 4.7: Prevalence of Type 2 DM: Lifestyle factors (n = 306)

	Type 2 Diabetes Mellitus		
Variable	**No**	**Yes**	**Total**
Smoking			
Never Smoking	125 (82.2%)	27 (17.8%)	152
Past Smoking	66 (75.0%)	22 (25.0%)	88
Current Smoking	43 (65.2%)	23 (34.8%)	66
Current Smoker			
Not a current Smoker	190 (79.2%)	50 (20.8%)	240
Light Smoker	24 (82.8%)	5 (17.2%)	29
Moderate Smoker	14 (66.7%)	6 (30.0%)	20
Heavy Smoker	6 (35.3%)	11 (64.7%)	17
Alcohol drinker			
Non Drinker	134 (81.2%)	31 (18.8%)	165
Current Drinker	100 (70.9%)	41 (29.1%)	141
Current Alcohol Drinking			
Not a Current Drinker	134 (81.2%)	31 (18.8%)	165
Social Drinker	47 (72.3%)	18 (27.7%)	65
Healthy Drinker	36 (85.7%)	6 (14.3%)	42
Heavy Drinker	17 (50.0%)	17 (50.0%)	34

Table 4.7: Prevalence of Type 2 DM: Lifestyle factors (n = 306) (Continued)

	Type 2 Diabetes Mellitus		
Variables	**No**	**Yes**	**Total**
Physical Activity			
Adequate Physical Activity	53 (85.5%)	9 (14.5%)	62
Inadequate Physical Activity	118 (72.0%)	46 (28.0%)	164
No Physical Activity	63 (78.8%)	17 (21.2%)	80
Diet			
Healthy Diet	120 (85.1%)	21 (14.9%)	141
Unhealthy Diet	114 (69.1%)	51 (30.9%)	165
Fast Food Center Visit			
Never	154 (83.2%)	31 (16.8%)	185
Less than once a week	49 (77.8%)	14 (22.2%)	63
1 – 2 times per week	28 (60.9%)	18 (39.1%)	46
More than 2 times per week	3 (25.0%)	9 (75.0%)	12

The descriptive analysis of Lifestyle factors reveals that current smokers have higher prevalence of Type 2 DM. Moreover among current smokers those who fall under the category of heavy smoking have much higher prevalence of Type 2 DM. Heavy alcohol drinking category have highest prevalence of Type 2 DM whereas, those who fall under healthy drinking have the least prevalence.

Table 4.8: Prevalence of Type 2 DM: Anthropometric measurements (n = 306)

	Type 2 Diabetes Mellitus		
Variable	**No**	**Yes**	**Total**
Body Mass Index			
Normal	61 (92.4%)	5 (7.6%)	66
Underweight	5 (100%)	0 (0.0%)	5
Overweight	104 (70.7%)	43 (29.3%)	147
Obese	64 (72.7%)	24 (27.3%)	88
Waist Circumference Male (n = 149)			
Normal	73 (82.0%)	16 (18.0%)	89
Above Normal	36 (60.0%)	24 (40.0%)	60
Waist Circumference Female (n= 157)			
Normal	38 (88.4%)	5 (11.6%)	43
Above Normal	87 (76.3%)	27 (23.7%)	114

The descriptive analysis of anthropometric measurements shows that, those participants, whose BMI is normal or fall in underweight category have much less prevalence of Type 2 DM then those under overweight and obese. The prevalence of Type 2 DM in both male and female is higher in those participants whose waist circumference is above normal but prevalence seems to be more in males.

Table 4.9: Prevalence of Type 2 DM: Medical history and health care center visits (n = 306)

	Type 2 Diabetes Mellitus		
Variable	**No**	**Yes**	**Total**
Hypertension			
No Hypertension	174 (84.5%)	32 (15.5%)	206
Hypertension	60 (60.0%)	40 (40.0%)	100
Family History of Type 2 DM			
Negative Family History	195 (84.8%)	35 (15.2%)	230
Positive Family History	39 (51.3%)	37 (48.7%)	76
Gestational Diabetes Mellitus (GDM) (n = 157)			
Negative history of GDM	120 (85.7%)	20 (14.3%)	140
Positive history of GDM	5 (29.4%)	12 (70.6%)	17
Health Check-ups			
Regularly	110 (72.4%)	42 (27.6%)	152
Rarely	111 (79.3%)	29 (20.7%)	140
Never	13 (92.9%)	1 (7.1%)	14

Medical history analysis shows that person with history of hypertension have higher prevalence of Type 2 DM. Those participants having positive family history have

higher prevalence of Type 2DM. Females with history of GDM have much higher prevalence of Type 2 DM. Those participants who regularly visits health care center have higher prevalence of Type 2 DM.

Table: 4.10 Prevalence of Microvascular Complications: Socio Demographic factors (n=72)

	Microvascular Complications		
Variables	**No**	**Yes**	**Total**
Age Group			
60 – 69 Years	20 (66.7%)	10 (33.3%)	30
70 – 79 Years	13 (50.0%)	13 (50.0%)	26
80 Years and Above	8 (50.0%)	8 (50.0%)	16
Gender			
Male	25 (62.5%)	15 (37.5%)	40
Female	16 (50.0%)	16 (50.0%)	32
Socio economic status			
Low Income	15 (60.0%)	10 (40.0%)	25
Middle Income	19 (63.3%)	11 (36.7%)	30
High Income	7 (41.2%)	10 (58.8%)	17
Residential Address			
Rural	20 (58.8%)	14 (41.2%)	34
Urban	21 (55.3%)	17 (44.7%)	38

Table: 4.10 Prevalence of Microvascular complications: Socio Demographic factors (n = 72) (Continued)

	Microvascular Complications		
Variables	**No**	**Yes**	**Total**
Marital Status			
Married	30 (60.0%)	20 (40.0%)	50
Unmarried	5 (83.3%)	1 (16.7%)	6
Widow/Widower	1 (14.3%)	6 (85.7%)	7
Divorcee	5 (55.6%)	4 (44.4%)	9
Education Level			
Higher Education	10 (62.5%)	6 (37.5%)	16
Secondary Education	8 (50.0%)	8 (50.0%)	16
Primary Education	7 (43.8%)	9 (56.2%)	16
Literate (No Schooling but able to Read and Write)	0 (0.0%)	3 (100.0%)	3
Illiterate	16 (76.2%)	5 (23.8%)	21
Caste			
Brahmin	12 (57.1%)	9 (42.9%)	21
Chettri	4 (40.0%)	6 (60.0%)	10
Janjati	4 (50.0%)	4 (50.0%)	8
Newar	15 (75.0%)	5 (25.0%)	20
Others	6 (46.2%)	7 (53.8%)	13

The data in the above table reflects that, the prevalence of Microvascular complications was more common after 70 years of age. Participants who reside in urban areas suffer more from Microvascular complications of Type 2 DM. Higher income

group have higher prevalence of Microvascular complications. Newars have lesser prevalence of Microvascular complications than other caste even though, prevalence of Type 2 DM was high among them.

Table: 4.11 Prevalence of Microvascular complications: Lifestyle factors (n = 72)

	Microvascular Complications		
Variables	**No**	**Yes**	**Total**
Smoking			
Never Smoking	16 (59.3%)	11 (40.7%)	27
Past Smoking	14 (60.9%)	9 (39.1%)	23
Current Smoking	11(50.0%)	11 50.0%)	22
Current Smoker			
Not a current Smoker	30 (60%)	20 (40%)	50
Light Smoker	4 (80%)	1 (20%)	5
Moderate Smoker	3 (50.0%)	3 50.0%)	6
Heavy Smoker	4 (41.2%)	7 (58.8%)	11
Alcohol drinker			
Non Drinker	19 (61.3%)	12 (38.7%)	31
Current Drinker	22 (53.7%)	19 (46.3%)	41
Current Alcohol Drinking			
Not a Current Drinker	19 (61.3%)	12 (38.7%)	31
Social Drinker	10 (55.6%)	8 (44.4%)	18
Healthy Drinker	6 (100.0%)	0 (0.0%)	6
Heavy Drinker	6 (35.3%)	11 (64.7%)	17

Table: 4.11 Prevalence of Microvascular complications: Lifestyle factors (n = 72) (Continued)

	Microvascular Complications		
Variables	**No**	**Yes**	**Total**
Physical Activity			
Adequate Physical Activity	5 (55.6%)	4 (44.4%)	9
Inadequate Physical Activity	29 (63.0%)	17 (37.0%)	46
No Physical Activity	7 (41.2%)	10 (58.8%)	17
Diet			
Healthy Diet	9 (42.9%)	12 (57.1%)	21
Unhealthy Diet	32 (62.7%)	19 (37.3%)	51
Fast Food Center Visit			
Never	16 (51.6%)	15 (48.4%)	31
Less than once a week	11 (78.6%)	3 (21.4%)	14
1 – 2 times per week	9 (50.0%)	9 (50.0%)	18
More than 2 times per week	5 (55.6%)	4 (44.4%)	9

Analysis of lifestyle factors reveals that current smokers have higher prevalence of Microvascular complications. Moreover, among current smokers, heavy smokers have much higher prevalence of Microvascular complications. Likewise, heavy drinkers have higher prevalence of Microvascular complications. In this study, lesser prevalence of Microvascular complications is seen in those who take unhealthy diet. For fast food center visit those who visit it for more than twice a week have higher prevalence of Microvascular complications.

Table: 4.12 Prevalence of Microvascular complications: Anthropometric measurements (n = 72)

	Microvascular Complications		
Variable	**No**	**Yes**	**Total**
Body Mass Index			
Normal	4 (80.0%)	1 (20.0%)	5
Overweight	24 (55.8%)	19 (44.2%)	43
Obese	13 (54.2%)	11 (45.8%)	24
Waist Circumference Male (n = 40)			
Normal	13 (81.2%)	3 (18.8%)	16
Above Normal	12 (50.0%)	12 (50.0%)	24
Waist Circumference Female (n= 32)			
Normal	3 (60.0%)	2 (40.0%)	5
Above Normal	13 (48.1%)	14 (51.9%)	27

In case of anthropometric measurement those who have overweight or are obese have higher prevalence of Microvascular complications. In case of waist circumference both in male and female those who have above normal waist circumference have higher prevalence of Microvascular complications.

Table: 4.13 Prevalence of Microvascular complications: Medical history and Health check-ups (n = 72)

Microvasular Complications

Variable	No	Yes	Total
Hypertension			
No Hypertension	23 (71.9%)	9 (28.1%)	32
Hypertension	18 (45.0%)	22 (55.0%)	40
Family History of Type 2 DM			
Negative Family History	26 (74.3%)	9 (25.7%)	35
Positive Family History	15 (40.5%)	22 (59.5%)	37
Health Check-ups			
Regularly	26 (61.9%)	16 (38.1%)	42
Rarely	14 (48.3%)	15 (51.7%)	29
Never	1 (100.0%)	0 (0.0%)	1
Anti- Diabetic Medications			
Type 2 DM with Medication	23 (47.9%)	25 (52.1%)	48
Type 2 DM without Medication	18 (75.0%)	6 (25.0%)	24

Table: 4.13 Prevalence of Microvascular complications: Medical history and Health check-ups (n = 72) (Continued)

	Microvasular Complications		
Variable	**No**	**Yes**	**Total**
DM Durations			
Less than 5 years	28 (84.8%)	5 (15.2%)	33
5 - 10 years	8 (47.1%)	9 (52.9%)	17
More than 10 years	5 (22.7%)	17 (77.3%)	22
Fasting Blood Glucose			
Less than 12 6mg/dl	7 (53.8%)	6 (46.2%)	13
126 – 200 mg/dl	23 (54.8%)	19 (45.2%)	42
More than 200 mg/dl	11 (64.7%)	6 (35.3%)	17

Hypertensive participant have higher prevalence of Microvascular complications. Those participants that have positive family history have higher prevalence of Microvascular complications. In this study it was found that Type 2 DM participant who were on medication have higher prevalence than those without medication.

4.2 Analytical Statistics*:*

Bivariate and Multivariable analyses were done to identify association between factors associated with Type 2 DM (independent variables) and dependent variable. In this analysis dependent variable was assessed as presence or absence of Type 2 DM.

Table 4.14: Bivariate analysis for Type 2 DM

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio (OR)	95% Confidence Interval
Age			0.855		
60 – 69 Years (Ref)				1.00	
70 – 79 Years	0.09	0.30	0.763	1.09	0.60 to 1.99
80 – 89 Years	0.19	0.35	0.581	1.21	0.60 to 2.44
Gender					
Male (Ref)				1.00	
Female	-0.36	0.27	0.184	0.69	0.41 to 1.18
Residential Address					
Rural (Ref)				1.00	
Urban	-0.32	0.27	0.234	0.72	0.42 to 1.23
Marital Status			0.177		
Married (**(**Ref)				1.00	
Unmarried	-0.24	0.48	0.617	0.78	0.30 to 2.02
Widow/Widower	-0.57	0.44	0.194	0.56	0.23 to 1.33
Divorcee	0.70	0.45	0.124	2.01	0.82 to 4.99
Total Annual Income			0.063		
Low Income (Ref)				1.00	
Middle Income	0.51	0.30	0.092	1.67	0.92 to 3.05
High Income	0.81	0.36	0.028	2.25	1.09 to 4.64

Table 4.14: Bivariate analysis for Type 2 DM (Continued)

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio (OR)	95% Confidence Interval
Caste			0.797		
Brahmin (Ref)				1.00	
Chettri	-0.53	0.43	0.218	0.58	0.25 to 1.36
Janjati	-0.23	0.47	0.618	0.78	0.31 to 2.00
Newar	-0.08	0.36	0.820	0.92	0.45 to 1.87
Others	-0.13	0.40	0.745	0.87	0.39 to 1.94
Education			0.151		
Higher Education				1.00	
Secondary Education	-0.24	0.42	0.560	0.78	0.33 to 1.79
Primary Education	-0.31	0.42	0.452	0.72	0.31 to 1.66
Literate (No formal Schooling)	-0.77	0.71	0.276	0.46	0.11 to 1.85
Illiterate	-0.90	0.38	**0.020**	0.40	0.18 to 0.86
Smoking Status			**0.034**		
Never Smoker				1.00	
Past Smoker	0.47	0.32	0.137	1.61	0.85 to 3.03
Current Smoker	0.86	0.33	**0.011**	2.36	1.22 to 4.58

Table 4.14: Bivariate analysis for Type 2 DM (Continued)

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio (OR)	95% Confidence Interval
Current Smokers			**0.002**		
Not Current Smoker (Ref)				1.00	
Light Smoker	-0.23	0.51	0.651	0.79	0.28 to 2.17
Moderate Smoker	0.48	0.51	0.342	1.62	0.59 to 4.45
Heavy Smoker	1.94	0.53	<**0.001**	6.96	2.45 to 19.75
Alcohol Consumption					
Never Drinker (Ref)				1.00	
Current Drinker	0.28	0.13	**0.036**	1.33	1.02 to 1.73
Current Alcohol Consumption			**0.001**		
No current Drinking (Ref)				1.00	
Light to Moderate Drinking	0.22	0.30	0.466	1.25	0.68 to 2.27
Heavy Drinking	1.46	0.39	<**0.001**	4.32	1.98 to 9.40
Physical Activity			0.093		
Adequate Physical Activity (Ref)				1.00	
Inadequate Physical Activity	0.83	0.40	**0.038**	2.29	1.04 to 5.03
No Physical Activity	0.46	0.45	0.30	1.58	0.65 to 3.85

Table 4.14: Bivariate analysis for Type 2 DM (Continued)

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio (OR)	95% Confidence Interval
Diet					
Healthy Diet (Ref)				1.00	
Unhealthy Diet	0.93	0.29	**0.001**	2.55	1.44 to 4.51
Fast Food Center Visit			**<0.001**		
Never Visit (Ref)				1.00	
Less than one a week	0.35	0.36	0.332	1.41	0.69 to 2.88
1-2 times/ week	1.16	0.36	**0.001**	3.19	1.57 to 6.47
More than 2 times/ week	2.70	0.69	**<0.001**	14.90	3.81 to 58.20
Family History					
No Family History (Ref)				1.00	
Family History	1.66	0.29	**<0.001**	5.28	2.97 to 9.40
Gestational Diabetes Mellitus (GDM) (n = 157)					
No GDM History (Ref)				1.00	
GDM History	2.66	0.58	**<0.001**	14.40	4.57 to 45.28
Hypertension (HTN)					
No Hypertension (Ref)				1.00	
Hypertension	1.28	0.28	**<0.001**	3.62	2.09 to 6.28

Table 4.14: Bivariate analysis for Type 2 DM (Continued)

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio (OR)	95% Confidence Interval
Body Mass Index			**0.006**		
Normal or low BMI (Ref)				1.00	
Overweight	1.57	0.49	**0.002**	4.81	1.81 to 12.79
Obese	1.52	0.52	**0.004**	4.57	1.64 to 12.75
Waist Circumference					
Normal Waist Circumference (Ref)				1.00	
Above Normal Waist Circumference	0.78	0.29	**0.007**	2.19	1.24 to 3.87
Health Check-ups					
Regular (Ref)				1.00	
Never or Less than once a year	-0.45	0.27	0.094	0.63	0.37 to 1.08

Note: *Ref – Reference Group*

The above table shows whether 20 independent variables were significantly associated or not with the dependent variable (presence or absence of Type 2 DM).. In case of BMI, the Normal BMI and underweight have been merged and rest components in BMI remain the same. For health check-ups also never visit to health center and less than once a year was merged in a single category. The result of Bivariate analysis reveals that, independent variables such as, Smoking status, Current smokers, Alcohol drinking, Current alcohol drinking, Diet, Fast food center visits, Family history of Type 2 DM,

GDM, Hypertension, BMI and Waist circumference were statistically significant and positively associated with Type 2 DM having p-value less than 0.05.

Results obtained from bivariate analysis were used to construct multivariable model for multivariable analysis. This multivariable model, included variables for which p-value was less than or equal to 0.20 in Bivariate analysis which includes Gender, Marital status, Total annual income, Education, Smoking status, Current smokers, Alcohol drinking, Current alcohol drinking, Diet, Fast food center visits, Physical Activity Family history of Type 2 DM, Hypertension, BMI, Waist circumference and Health Check-ups. GDM was not analyzed in in this multivariable model as it was only seen among female participants. A separate model was constructed for GDM involving only female participants and multivariable analysis was done which shows that GDM had significant and positive association with Type 2 DM (OR = 11.53 and p-value = 0.001)

Table 4.15: Multivariable analysis for Type 2 DM

Variables	**Coefficient (B)**	**Standard Errors (SE)**	**P- Value**	**Odds Ratio (OR)**	**95% Confidence Interval**
Gender (Ref- Male)				1.00	
Female	-0.39	0.39	0.319	0.67	0.31 to 1.45
Marital Status (Ref - Married)			0.598		
Unmarried	0.02	0.60	0.970	1.02	0.31 to 3.32
Widow/Widower	-0.59	0.57	0.299	0.55	0.18 to 1.69
Divorcee	0.42	0.59	0.477	1.52	0.47 to 4.93
Total Annual Income (3 levels; Low [Ref] to and High Income)	-0.32	0.26	0.218	0.72	0.43 to 1.21
Education (5 levels; Higher Education [Ref] to Illiterate)	0.04	0.13	0.751	1.04	0.79 to 1.36
Smoking Status (3 levels; Never Smoker [Ref] to Current Smoker)	-0.05	0.33	0.876	0.95	0.49 to 1.81
Current Smokers (4 levels; Not a current Smoker [Ref] to Heavy Smokers)	0.21	0.30	0.471	1.24	0.68 to 2.25

Table 4.15: Multivariable analysis for Type 2 DM (Continued)

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio (OR)	95% Confidence Interval
Alcohol Consumption (3 levels; Never Drinker [Ref] to Current Drinker)	-0.31	0.38	0.405	0.72	0.34 to 1.53
Current Alcohol Consumption (4 level; No current Drinking [Ref] to Heavy Drinking)	0.55	0.55	0.320	1.74	0.58 to 5.19
Physical Activity (3 levels; Adequate Physical Activity [Ref] to No Physical Activity)	0.60	0.25	**0.020**	1.82	1.10 to 3.01
Diet (Ref – Healthy Diet)				1.00	
Unhealthy Diet	0.82	0.34	**0.019**	2.27	1.14 to 4.50
Fast Food Center Visit (4 levels; Never Visit [Ref] to >2times/week)	0.49	0.20	**0.017**	1.64	1.09 to 2.47

Table 4.15: Multivariable analysis for Type 2 DM (Continued)

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio (OR)	95% Confidence Interval
Family History (Ref – No Family History)				1.00	
Family History of DM	1.35	0.37	**<0.001**	3.87	1.86 to 8.06
Hypertension (Ref – No Hypertension)				1.00	
Hypertension	1.08	0.33	**0.001**	2.95	1.52 to 5.73
Body Mass Index (3 levels; Normal or low BMI [Ref] to Obese)	0.35	0.26	0.186	1.42	0.84 to 2.40
Waist Circumference (WC) (Ref – Normal WC)				1.00	
Above Normal WC	0.72	0.41	0.081	2.07	0.91 to 4.69
Health Check-ups (Ref- Regular)				1.00	
Never or Less than once a year	-0.52	0.33	0.120	0.59	0.30 to 1.14

Note: *Ref is Reference Group*

The above table illustrates the result of multivariable analysis. Independent variables such as Diet, Fast Food Center visits, Family history of Type 2 DM and Hypertension were found statistically significantly and positively associated with Type 2 DM in multivariable analysis. Physical activity, which was statistically not significant in

bivariate analysis, has become statistically significant and positively associated with Type 2 DM in multivariable analysis.

Bivariate and Multivariable analysis for Microvascular Complications

Bivariate analysis was done among Type 2 DM patient (n = 72) to identify association between factors associated with Microvascular complications (independent variables) and dependent variable. All those independent variables which were used in bivariate analysis of Type 2 DM except GDM were used for bivariate analysis for Microvascular complications. Moreover, Fasting blood glucose level, Anti diabetic medications and DM duration was also added as independent variables. Fasting blood glucose was categorized in three categories as – less than 126mg/dl, 126 – 200 mg/dl and more than 200 mg/dl. In education variable two sub categories – Illiterate and literate (able to read and write but never went to school) in one category- no formal schooling. In marital status too subcategories – unmarried, divorcee, and widow had been merged into one – currently unmarried. In this analysis dependent variable was assessed as presence or absence of Microvascular complications.

Table 4.16: Bivariate analysis for Microvascular Complications (n = 72)

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio (OR)	95% Confidence Interval
Age			0.375		
60 – 69 Years (Ref)				1.00	
70 -79 Years	0.69	0.55	0.20	2.00	0.67 to 5.89
80 Years and Above	0.69	0.63	0.27	2.00	0.57 to 6.90
Gender					
Male (Ref)				1.00	
Female	0.51	0.48	0.289	1.66	0.64 to 4.28
Residential Address					
Rural (Ref)				1.00	
Urban	0.14	0.47	0.761	1.15	0.45 to 2.94
Marital Status					
Married (Ref)				1.00	
Currently Unmarried	0.40	0.51	0.431	1.50	0.54 to 4.11
Total Income			0.323		
Low Income (Ref)				1.00	
Middle Income	-0.14	0.55	0.800	0.86	0.29 to 2.58
High Income	0.76	0.64	0.234	2.14	0.61 to 7.51
Caste			0.356		
Brahmin (Ref)				1.00	
Chettri	0.69	0.78	0.375	2.00	0.43 to 9.25
Janjati	0.28	0.83	0.730	1.33	0.26 to 6.82
Newar	-0.81	0.67	0.232	0.44	0.11 to 1.68
Others	0.44	0.71	0.534	1.55	0.38 to 6.25

Table 4.16: Bivariate analysis for Microvascular Complications (n = 72) (Continued)

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio	95% Confidence Interval
Education			0.469		
Higher Education (Ref)				1.00	
Secondary Education	0.51	0.71	0.477	1.66	0.40 to 6.81
Primary Education	0.76	0.72	0.291	2.14	0.52 to 8.81
No formal Schooling	-0.18	0.67	0.787	0.83	0.22 to 3.12
Smoking Status			0.729		
Never Smoker (Ref)				1.00	
Past Smokers	-0.06	0.58	0.908	0.93	0.30 to 2.91
Current Smokers	0.37	0.57	0.518	1.45	0.46 to 4.52
Current Smoker			0.380		
Not Current Smokers (Ref)				1.00	
Light Smokers	-0.98	1.15	0.396	0.37	0.03 to 3.60
Moderate Smokers	0.40	0.86	0.640	1.50	0.27 to 8.18
Heavy Smokers	0.96	0.69	0.162	2.62	0.67 to 10.15
Alcohol Consumption					
Non Drinker (Ref)				1.00	
Current Drinker	0.31	0.48	0.518	1.36	0.53 to 3.52

Table 4.16: Bivariate analysis for Microvascular Complications (n = 72) (Continued)

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio	95% Confidence Interval
Current Alcohol Consumption			0.123		
No Drinking (Ref)				1.00	
Light to Moderate Drinking	-0.23	0.56	0.681	0.79	0.26 to 2.41
Heavy Drinking	1.06	0.62	0.089	2.90	0.84 to 9.92
Physical Activity			0.306		
Adequate Physical Activity (Ref)				1.00	
Inadequate Physical Activity	-0.31	0.73	0.673	0.73	0.17 to 3.10
No Physical Activity	0.58	0.83	0.486	1.78	0.34 to 9.12
Diet					
Healthy Diet (Ref)				1.00	
Unhealthy Diet	- 0.80	0.52	0.125	0.44	0.15 to 1.25
Fast Food Center Visit			0.370		
Never Visit (Ref)				1.00	
< 1 time/week	-1.25	0.74	0.097	0.29	0.06 to 1.25
1-2 time/week	0.06	0.59	0.913	1.06	0.33 to 3.40
> 2 times/week	-0.15	0.76	0.835	0.85	0.19 to 3.79

Table 4.16: Bivariate analysis for Microvascular Complications (n = 72) (Continued)

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio	95% Confidence Interval
Family History of DM					
No Family History of DM (Ref)				1.00	
Family History of DM	1.44	0.51	**0.005**	4.23	1.55 to 11.54
Hypertension					
No Hypertension (Ref)				1.00	
History of Hypertension	1.13	0.50	**0.024**	3.12	1.16 to 8.41
Body Mass Index			0.585		
Low or Normal BMI				1.00	
Overweight	1.15	1.15	0.320	3.16	0.32 to 30.72
Obese	1.21	1.19	0.306	3.38	0.32 to 34.91
Waist Circumference					
Normal Waist Circumference (Ref)				1.00	
Above Normal Waist Circumference	1.20	0.58	**0.039**	3.32	1.06 to 10.45
Health Check-ups					
Regular (Ref)				1.00	
Never or Less than once a year	0.48	0.48	0.316	1.62	0.62 to 4.19

Table 4.16: Bivariate analysis for Microvascular Complications (n = 72) (Continued)

Variables	Coefficient (B)	Standard Errors (SE)	P- Value	Odds Ratio	95% Confidence Interval
Fasting Blood Glucose			0.761		
<126 mg/dl (Ref)				1.00	
126 – 200 mg/dl	-0.03	0.63	0.95	0.96	0.27 to 3.35
>200 mg/dl	-0.45	0.75	0.54	0.63	0.14 to 2.78
Anti-Diabetic Medications					
DM with Medication (Ref)				1.00	
DM without Medication	-1.18	0.55	**0.033**	0.30	0.10 to 0.90
DM Duration			**<0.001**		
< 5 Years (Ref)				1.00	
5 – 10 Years	1.84	0.68	**0.007**	6.30	1.63 to 24.21
>10 years	2.94	0.70	**<0.001**	19.04	4.79 to 75.55

Note: *Ref: Reference Group*

Table 4.16 reveals that independent variables such as Family History of Type 2 DM, Waist Circumference, Hypertension, and DM Duration were statistically significant and were positively associated with presence of Microvascular Complications. Whereas, Anti-Diabetic Medication (OR – 0.30) was statistically significant and was negatively associated with presence of Microvascular Complications.

Results obtained from bivariate analysis were used to construct multivariable model for multivariable analysis. This multivariable model included variables for which p-value was less than or equal to 0.20 in Bivariate analysis which includes Current alcohol drinking, Diet, Family history of Type 2 DM, Hypertension, Waist circumference, Anti-Diabetic medication and DM Duration. Fasting blood glucose level was also added to the multivariable model because several literatures do state that glycemic load is important predictor of Microvascular complications.

Table 4.17: Multivariable analysis for Microvascular Complications (n = 72)

Variables	**Coefficient (B)**	**Standard Errors (SE)**	**P- Value**	**Odds Ratio (OR)**	**95% Confidence Interval**
Current Alcohol Drinkers (3 levels; No Current Drink (Ref) to Heavy Drinker)	0.97	0.51	0.057	2.64	0.97 to 7.22
Diet (Ref – Healthy Diet)				1.00	
Unhealthy Diet	-1.84	0.91	**0.043**	0.15	0.02 to 0.94
Family History of Type 2 DM (Ref- No Family History of DM)				1.00	
Family History of DM	0.97	0.73	0.18	2.63	0.62 to 11.05

Table 4.17: Multivariable analysis for Microvascular Complications (n = 72) (Continued)

Variables	**Coefficient (B)**	**Standard Errors (SE)**	**P- Value**	**Odds Ratio (OR)**	**95% Confidence Interval**
Hypertension (Ref - No Hypertension)				1.00	
Hypertension	0.39	0.72	0.588	1.48	0.35 to 6.14
Waist circumference (Ref - Normal Waist Circumference)				1.00	
Above Normal waist Circumference	2.58	0.95	**0.007**	13.27	2.037 to 86.55
Anti-Diabetic Medications (Ref – DM with Medication)				1.00	
DM without Medication	0.23	0.97	0.810	1.264	.186 to 8.58
DM Duration (3 levels; <5 years [Ref] to >10 y	2.18	0.60	**<0.001**	8.87	2.72 to 28.89
Fasting Blood Glucose Level (3 levels; <126mg/dl [Ref] to >200mg/dl)	0.23	0.59	0.691	1.26	0.39 to 4.10

Note: *Ref: Reference Group*

Table 4.17 shows that Independent variables such as Waist circumference and DM Duration remain statistically significant and have positive association with presence of Microvascular Complication in multivariable analysis. Diet which was statistically not significant during bivariate analysis became statistically significant and negatively associated with presence of Microvascular Complication in multivariable analysis.

CHAPTER V

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

The main objective of this thesis was to determine the prevalence of Type 2 DM and its Microvascular complications and to identify factors associated with Type 2 DM among elderly population of Kathmandu, Nepal. After extensive literature reviews several factors associated with Type 2 DM, like Age, Gender, Socio-economic status, Caste, Residential area, Educational Level, Marital Status, Physical activity, Diet, Smoking, Alcohol drinking, Body Mass Index, Waist Circumference, Hypertension, Family History of Type 2 DM, History of GDM and health check-ups were taken into consideration, that may have the potential to contribute in the prevalence of Type 2 DM and its Microvascular complications among elderly population of Kathmandu, Nepal.

This Chapter is divided into following five sections:

5.1 General Discussion on characteristics of study population

5.2General Discussion on the key findings of the study

5.3 Benefits from the study

5.4 Conclusions

5.5 Recommendations

5.1 General Discussion on Characteristics of study population

This study population had median age of 71 years with maximum number of participants in the age bracket of 60 – 69 years. The average life expectancy in Nepal is 65 years and 69 years for male and female respectively (WHO, 2011h). Hence it was obvious that maximum number of participants do fall under the age bracket of 60 – 69 years. According to preliminary results of Census 2011 sex ratio in Nepal was 0.94 male: female (CBS, Preliminary Result of National Population Census 2011, 2012). In this study too population of female was higher than male 149 (48.7%) male participants and 157 (51.3%) female participants. This study shows that 40.8% of the participants were

illiterate and 46.1% belongs to low income group. World Bank has classified Nepal as a low income, with 25.2% people still living below poverty line. World Bank report also suggests that 59% of Nepalese above 15 years of age are literate (WB, World Bank data sets, 2012). This study had good mix of all caste with Newars being the highest and Brahmin followed in close second position. Similar result was shown by Population Census 2001 (CBS, Population Census 2001- National Report, 2001). All these findings do suggest that the study population do match the socio demographic characteristics of general population.

5.2 General Discussion on the key findings of the study

As presented in section IV (Result section), findings have been broadly divided into two categories descriptive portion and analytical portion.

In this study Type 2 DM was seen among 72 (23.5%) of all the participants. A previous study among 1710 participants to determine prevalence of Type 2 DM among elderly in Kathmandu, Nepal has shown 25.9% as the prevalence of Type 2 DM (Chhetri and Chapman, 2009). The result of both the studies were quiet similar. Another study in Nepal shows, 19% prevalence of Type 2 DM among people aged 40 years and above (Bhattarai and Singh, 2007) which is less than the current study finding. The reason for lower prevalence in Dr. Bhattarai's study than the current study may be due to the fact that Dr. Bhattarai's study involves participant of 40 years and above while current study involves participant who were 60 years and above. Moreover, Dr. Bhattarai's study was done 5 years before; it is obvious by seeing the global trend that Type 2 DM is at a rise. It was estimated that worldwide prevalence of Type 2 DM in all age group will increase from 2.8% in 2000 to 4.4% in 2030 (Wild et al., 2004). A community based study involving 19,211 participants of age 30 years and above in Gaddap town in Pakistan reveals that prevalence of Type 2 DM was 8.73% (Mahar et al., 2010). A prevalence study at Thailand among participants above 35 years shows prevalence of diabetes in Thai adults was 9.6% (Aekplakorn et al., 2003). This variation is possible because the study at Gaddap town and Thailand has participants from much younger age groups and studies have proved that with advancement of age prevalence increases. Population based

studies from four Asian countries shows that peak age of Type 2 DM among Indian participants were 60 – 69 years (DECODA Study Group, 2003).

The total number of new cases of Type 2 DM diagnosed during this study alone were 19 (26.3%) among all Type 2 DM cases (n = 72). In Gaddap study too total number of new cases of Type 2 DM was 419 (33.3%) out of 1258 cases of Type 2 DM (Mahar et al., 2010). Prevalence study at Thailand shows 4.8% as newly diagnosed case of Type 2 DM (Aekplakorn et al., 2003). Thailand being far more developed than Nepal and Pakistan; having better health facilities can be cited as a reason for such a lower detection of new cases of Type 2 DM within population based study.

Out of all 72 cases of Type 2 DM in this study 31 (43.1%) have one or more of the Microvascular complications. In this study 23 (31.9%) participants have diabetic retinopathy, 13 (18.1%) - diabetic nephropathy and 16 (22.2%) - diabetic neuropathy. A study in urban southern India involving known cases of Type 2 DM with mean age of 51 years where 1,363 participated, shows that among all diabetic patient only 2.2 % have overt nephropathy and 26.9% were in the initial stages of nephropathy (Unnikrishnan et al., 2007). The reason for higher prevalence of Diabetic Nephropathy in South Indian study may be due to the fact that current study only relies on medical records for diagnosing Diabetic Nephropathy whereas the previous study had tested microalbuminuria and macroalbuminuria for diagnosing Diabetic Nephropathy. Globally it is estimated that 20% of Type 2 diabetic patients reach ESRD during their lifetime (Ayodele et al., 2004) .

Cross-sectional health facility-based studies carried out in four different cities of China where 1,524 Type 2 DM with mean age of 63 years participated, shows prevalence of diabetic neuropathy 17.8% (Liu et al., 2010). In Bangladesh 294 Type 2 DM outpatient with mean age of 50.8 years were studied for prevalence of Diabetic Neuropathy which reveals prevalence of 19.7% (Morkrid, Ali and Hussain, 2010). However, a study in Malaysia involving 1077 Type 2 DM patient shows 54.7% prevalence of Diabetic Neuropathy (Abougalambou et al., 2011). The finding of current study tends to be near approximation of the findings in China and Bangladesh studies but the prevalence in

Malaysia is too high, the possible reason for this may be Malaysian study was conducted in teaching hospital where referred patient usually comes, with every possibility these patients tends to have more complication. The average duration of DM patient in Malaysian study was 11 years which is almost double to the median duration in the current study and duration do play a vital role in prevalence of complications.

In Chennai Urban Rural Epidemiology (CURES) eye study where 1382 individuals, of mean age of 52 years participated shows that prevalence of Diabetic Retinopathy was 17.6% among diabetic patients (Rema and Pradeepa, 2007). In United States in a population based study involving diabetic people above 40 years where 1006 diabetic participated shows 28.5% of the study population had Diabetic Retinopathy. Moreover, in the same study when prevalence of Diabetic Retinopathy was seen among 40 – 60 years and more than or equal to 65 years it came out to be 28% and 29.5% respectively (Zhang et al., 2010). Globally, in a pooled analysis where data of 22,896 diabetic were studied and it was seen that 34.6% have Diabetes Retinopathy (Yau et al., 2012). In CURES eye study prevalence of Diabetic Retinopathy is less than current study. Lower mean age of the participants can be one reason for such variation in prevalence in CURES eye study, as median age in current study was 71 years. The current study finding tends to be in near approximation to the global finding as well as finding in population based study in United States.

5.2.1 Factors associated with Type 2 DM

As shown in Result section with the advancement of age, prevalence of Type 2 DM increases. Nevertheless, this finding was not significant in bivariate analysis but descriptive study clearly shows increasing trend with advancement of age. Data analysis of 11 population-based studies from four Asian countries shows peak age for Type 2 DM in Chinese and Japanese is at 70 – 89 years of age, but peak age for Indian participant were at 60 – 69 years of age (DECODA Study Group, 2003).

Smoking cigarettes was significantly positively associated with Type 2 DM, especially current smoking during Bivariate analysis although current smoking became

statistically not significant in multivariable analysis but it still shows positive associations. Similar results were seen in a prospective cohort among nurses where it was observed that smoking more than 15 sticks a day increases the risk of Type 2 DM by 1.34 times. Another prospective study shows quitting smoking decreases risk of Type 2 DM to nearly the same level as nonsmokers (Manson, et al., 2000). Current and past studies cumulatively suggest that current heavy smoking can increase prevalence of Type 2 DM.

A J-shaped relationship was observed in this study between alcohol consumption and Type 2 DM. Descriptive statistics (Table 4.7) shows that having 1-2 drinks/day have least prevalence of Type 2 DM. However, in Bivariate analysis current alcohol drinking was significantly positively associated with Type 2 DM and there was no J-shaped relationship which may be due to the fact that light and moderate drinking include two categories (healthy and social drinking); social drinking could have act as a confounder. Nevertheless, current drinking was insignificant in multivariable analysis. A meta-analysis of 15 prospective cohort shows that consuming $\leq$ 6gm alcohol per day has protective effect on Type 2 DM (Relative Risk: 0.87) (Koppes, 2005). Such J-shaped relationship was also seen in several other studies (Baliunas et al., 2009), (Hu et al., 2001).

Physical activity was not significant during Bivariate analysis but had become significantly positively associated with and prevalence of Type 2 DM in multivariable analysis; Odds Ratio of 1.82. Similarly a study in Kathmandu among elderly also reveals significant association between physical activity and prevalence of Type 2 DM with Odds Ratio of 1.24 (Chhetri and Chapman, 2009). According to WHO, physical inactivity is responsible for approximately 27% of diabetes (WHO, 2012). Global data, previous study and current study all signifies the importance of physical activity to counter Type 2 DM. In this study it was observed that maximum number of elderly participants 53.6% was doing inadequate exercise i.e. either insufficient moderate or vigorous intensity exercise or was just doing leisure walking. This may be due to the fact that Kathmandu

does not have adequate number of park free of traffic and on top of that lack of volunteer trainers to teach elderly oriented adequate exercise that can have beneficial health impact.

Food habit (diet) shows significant positive association with Type 2 DM (OR 2.27) i.e. with unhealthy food habits (high in fatty food, low in fruits and vegetables, etc.) the odds of having Type 2 DM will be 2.27. A prospective cohort study at United States with 12 years follow up shows that, prudent diet characterized by higher consumption of vegetables, fruits; fish, etc. have lower risk for Type 2 DM (relative risk 0.84). Whereas, the western diet rich in red meat, french fries, fatty foods, etc. was associated with an increased risk for type 2 diabetes (relative risk, 1.59) (Van Dam et al., 2002). In a Finnish cohort study with 23 year follow up among 4,304 participants (age group 40 - 69 years) shows that diet rich in vegetables and fruits protective factor against Type 2 DM (relative Risk 0.72) whereas, diet rich in potatoes, whole milk, butter, etc. enhance the risk of Type 2 DM (relative risk: 1.49) (Montonen et al., 2005). Current and all other studies do emphasize that healthy food habits can prevent the incidence of Type 2 DM. Fast food center visit among elderly in Katmandu was uncommon as more than 60% participants never visited fast food center in the current study population. In current study it had been seen that those who go to fast food center was significantly, positively associated with Type 2 DM with OR of 1.64. In Coronary Artery Risk Development in Young Adults (CARDIA) study, where 3031 people participated and were followed for 15 years, shows that those participants who visited fast food center less than once a week of fast-food restaurant when compared with those who visited more than twice a week visits had a two-fold greater increase in insulin resistance (Pereira et al., 2005). Both CARDIA and current study emphasize that frequent visit to fast food center can increase the prevalence of Type 2 DM.

As shown in result section Odds Ratio of Type 2 DM among those participants having positive family history of Type 2 DM was 3.87 as compared to those participants without such history. Several studies had proven that Type 2 DM have strong genetic linkage. If both the parents have Type 2 DM then the risk of having Type 2 DM among offspring nears 40% (Fauci, 2008). In Framingham Offspring Study, where 2527 people

participated with mean age of 54 years, it was seen that Odds Ratio for children having Type 2 DM was 3.5 if any one of the parents had it but Odds Ratio becomes 6.1 if both the parents suffer from Type 2 DM (Meigs, Cupples, and Wilson, 2000) . All these studies confer that Type 2 DM have strong genetic linkage.

In this study Gestational Diabetes Mellitus (GDM) was statistically significant and positively associated with Type 2 DM with the Odds Ratio of 14.40 and 11.53 in bivariate and multivariable analysis respectively. Odds Ratio seems to be inflated, which can be due to the fact that in this study only 17 people have positive history of GDM and out of them 12 have developed Type 2 DM which is around 70.6%. Hence in such small sample (n =17), 70.6% of participants with positive GDM history have Type 2 DM Odds Ratio tends to inflate as Relative risk moves away from one. In such circumstances Relative Risk can be a better measure (Osborne, 2006). Relative Risk in this case was 4.94. However, several studies show that GDM has 30 – 60% risk of developing Type 2 DM in later life (Fauci, 2008). In China a group of women were studied 5 – 10 years after delivery who were diagnosed as GDM in their previous pregnancies shows that 33.3% develop Type 2 DM (Bian et al., 2000). All these studies do suggest that those women having history of GDM are more likely to suffer from Type 2 DM in near future.

In this study hypertension was significantly positively associated with Type 2 DM, with Odds Ratio of 2.95 in multivariable analysis. Another study in Nepal also shows that Hypertension was significantly associated with Type 2 DM (Chhetri and Chapman, 2009). A study at Turkey where 727 people participated, shows that the odds of having Type 2 DM was 3.23 in participant with hypertension then without hypertension (Aksu et al., 2006). In UK a study where 3648 new diabetic cases with mean age of 52 years participated shows that 39% of the total study population have hypertension (UK Prospective Diabetes Study (UKPDS), 1993). A population based study in India where 15,662 people participated, shows coexistence of Hypertension and Diabetes Mellitus in 20.6% cases. Moreover, both Hypertension and Diabetes Mellitus

have positive association (p value - <0.05) (Joshi et al., 2012). All these studies do suggest that Diabetes and Hypertension have close positive association.

In this study 48% of the participants are overweight and 28.8% are obese with median BMI of 25.50. A study in Chandigarh, India where people above 65 years participated shows that 41% of the total participants were overweight or obese (Swami et al., 2005). Another study in India among elderly females shows more than 50% of the participants are overweight or obese with mean BMI of 25.2 + 5.39 (Tyagi and Kappor, 2010). The reason for higher prevalence of overweight and obesity in study can be due to the fact that cutoff point was lower in current as compared to other two studies conducted in India (BMI $\geq$ 23 was considered overweight in this study whereas, in later studies BMI $\geq$ 25 was considered overweight). On top of that around 65 participants have BMI within the range of 23.00 to 25.00 in this study.

Waist circumference was significantly positively associated (OR: 2.19) with Type 2 DM during Bivariate analysis but became statistically insignificant during multivariable analysis. Increase in intra-abdominal fat leads to increase in waist circumference. Intra-abdominal fat is more strongly associated with Insulin resistance than fats in other part of the body (Fauci, 2008). A study where 14,924 adult participants in the third National Health and Nutrition Examination Survey, grouped into categories of BMI and Waist Circumference according to National Institutes of Health cutoffs, shows Waist Circumference and not BMI, explains obesity-related health risk (Janssen et al., 2004). Contrast with this study, Nurse Studies where 84,941 nurses participated, shows overweight or obesity as one of the important predictor for Diabetes. Moreover, this study also suggests BMI not Waist Circumference to explain obesity that is hazardous to health (Hu et al., 2001). It is not yet definitive regarding BMI or Waist circumference; as a better predictor of Type 2 DM.

5.2.2 Factors associated with Microvascular Complications of Type 2 DM

Microvascular Complications associated with Type 2 DM is a major cause of disability among elderly. In this study as shown in Result section (Chapter IV); (Table

4.17) reveals that Independent variables such as Waist circumference and DM Duration were statistically significant and have positive association with presence of Microvascular Complication whereas, Diet which was statistically not significant during bivariate analysis became statistically significant and negatively associated with presence of Microvascular Complication during multivariable analysis.

In this study age of the participants was not significantly associated with prevalence of one or more Microvascular complications. In contrast, age of the participant in many studies had been significantly associated with prevalence of one or more Microvascular complications. Nevertheless, in descriptive analysis as shown in Table 4.10 the prevalence of Microvascular complications increases above 70 years of age. A study in India to see the risk factors for Diabetes Neuropathy where 1629 diabetic people participated; shows that age was significantly associated with Diabetic Neuropathy (Pradeepa et al., 2008). A health facility based study in India where 4067 diabetic patients participated; shows that age was significantly positively associated with Microvascular complications (Agrawal et al., 2004). All above studies do illustrated that age can be the predictor for Microvascular complications but in presence of other risk factors can certainly enhance the prevalence.

Healthy diet was statistically significant and negatively associated with Microvascular complication during multivariable analysis i.e. unhealthy diet is a protective factor for Microvascular complications. In contrast American Diabetic Association, recommends food plate rich in vegetables, fruits, whole grains and dietary fibers for better glycemic control and prevention of complications among Type 2 DM patient (ADA, Diabetes Diet, 2012). It has been well established in several studies that glycemic control is an important predictor for Microvascular complications (Mayurasakorn et al., 2009) (Pradeepa et al., 2008). In this study unhealthy diet seems to be protective against Microvascular complication even though it was insignificantly associated may be due to the fact that among diabetic participant in this study; 73.3% middle income and 70.6% high income group participants do take unhealthy diet.

Moreover, these participants have better access to health care services and medication. In participants with Type 2 DM (n=72) in this study 64.7% of high income group participant regularly visit health care center whereas, just above 50% in low income group do the same. Moreover, in the same population 76.5% of high income group participant regularly take medication whereas, only 56% in low income group do so. Low income group may have difficulty in managing compliance with diabetic treatment as it is very expensive and can drain out household resource of a low income family. In absence of any medical aid from government of Nepal for elderly especially low income bracket it would be hard for them to maintain compliance with physician instructions and medications. Hence it can be presumed that its high and middle income group access to health care that was protective against Microvascular complication rather than unhealthy diet. It is also possible that it was just a matter of chance in this study that such result appears during multivariable analysis.

In this study waist circumference was significantly positively associated with prevalence of one or more Microvascular complications with Odds Ratio 3.32 and 13.27 during bivariate analysis and Multivariable analysis respectively. A prospective study at Montes de Barbanza public health center, where 376 diabetic patients participated shows that those Type 2 DM participants who had above normal waist circumference tends to have Microvascular complications; mean waist circumference of Type 2 DM patient with Microvascular complication was 103$\pm$ 12 which was statistically significant too (Gómez et al., 2011). A comparison between current study and study at Montes de Barbanza public health center is hard to make as both the study have been conducted in different settings. Nevertheless, some inference can be drawn as mean age of participants in both studies were similar. Both the studies indicate that having waist circumference above normal range can increase the risk of Microvascular complication among Type 2 DM patients. In this analysis Odds ratio and Confidence interval may appear inflated during multivariable analysis may be due to the fact that the sample size for assessing Microvascular complication (n = 72) is small or it may also arise as a result of multicollinearity (when two or more independent variables are highly correlated in a

multiple regression which can lead to enormous change in coefficient estimate when small changes are done in the model). Chi square test was done to see association between waist circumference and all other variables in present in multivariable model (table 4.17) but none of the variables were significantly associated with waist circumference.

A population based study in Sri Lanka where 2517 type 2 diabetic patients with mean age of 52.7 years participated shows that BMI was significantly positively associated with Diabetic Nephropathy (OR: 1.20; CI: 1.11-1.29) and if duration of Type 2 DM was more than 10 years even diabetic Neuropathy was significantly associated with high BMI (Wijesuriya et al., 2012). A study in Pakistan where 500 diabetic patients participated with mean age of 55.2 years shows that obesity was associated with Microvascular complications (Shera et al., 2004). In contrast, in current study BMI was not significantly associated with Microvascular complications. However, in descriptive analysis portion (Table 4.12) clearly shows that overweight and obese have higher prevalence of Microvascular complications. All these findings do suggest that obesity is a predictor for Microvascular complications.

History of Hypertension was significantly positively associated with prevalence of one or more than one Microvascular complications in this study during bivariate analysis (OR: 3.12) but became statistically insignificant in multivariable analysis. Several studies have shown significant association between Hypertension and one or more Microvascular complications. A study in Southern India, shows blood pressure was significantly positively associated with nephropathy (OR: 1.031) (Unnikrishnan et al., 2007). Population based Sri Lankan study also shows that hypertension is significantly associated with Microvascular complications – with Retinopathy OR: 2.0, Neuropathy OR: 2.01 and Nephropathy OR 1.53 (Wijesuriya et al., 2012). A prospective study where 376 Type 2 DM patients participated shows Hypertension as important risk factor for Microvascular complication (OR: 2.4) (Gómez et al., 2011). UKPDS studied the influence of tight blood pressure control on progression of Diabetes Retinopathy where

1,148 hypertensive patients with Type 2 DM participated; shows 34% reduction in progression of retinopathy with tight blood pressure control (Fong et al., 2004). All these findings collectively state that proper management of Hypertension among Type 2 DM patient can delay the onset of Microvascular complications.

Several studies in India clearly show that there is significantly positive association between blood glucose level and Microvascular complications (Unnikrishnan et al., 2007) (Rema and Pradeepa, 2007) (Pradeepa et al., 2008). A cross sectional study in Thailand in 13 primary health care center shows that HbA1C $\geq$ 8 was significantly positively associated with diabetic nephropathy (OR: 2.2) (Mayurasakorn et al., 2009). In contrast, a meta-analysis of all randomized controlled trail, comparing effect of standard and intensive blood glucose control on vascular complications shows that intensive glycemic control have no significant benefit on outcome of vascular complications (Ma et al., 2009). In this study fasting blood glucose was not significantly associated with Microvascular complications. However, fasting blood glucose shows positive association even though that association was not significant. The reason for glycemic control being insignificantly associated with Microvascular complications can be in current study out of all diabetic participants 26.3% are newly diagnosed cases of Type 2 DM during the survey and have median blood glucose level of 164 mg/dl which was higher than median blood glucose among known diabetic patient – 143 mg/dl; which can be a reason for glycemic load not being significantly associated with Microvascular complications in this study and DM duration too play a vital part in prevalence of Microvascular complications.

In this study Anti diabetic medication was significantly negatively associated with Microvascular complication in bivariate analysis i.e. not taking anti diabetic medication was protective for Microvascular complication but was not significant during multivariable analysis. In contrast, a retrospective observational study was done among Type 2 DM patient with mean age of 54 years shows with proper adherence with anti-diabetic medication, glycemic control is better achieved (10% increase in adherence of

anti-diabetic drugs was associated with a 0.1% HbA1C decrease (P value= 0.0004) (Rozenfeld et al., 2008). Several studies as stated above do prove that better glycemic control can be preventive against Microvascular complications (Unnikrishnan et al., 2007) (Rema and Pradeepa, 2007) (Pradeepa et al., 2008). In this study such variation may be due to the fact that out of all diabetic in this study 48 took medication and 24 don't. Among those 24 cases 19 were new cases diagnosed during the study. This could be cited as a reason why no medication is protective against Microvascular complication as studies had proved that duration of Type 2 DM is one of the important predictor of Microvascular complications (Fauci, 2008). Nepal being a resource scare country with not very strong health care system and patients too are reluctant to go to health care providers until and unless symptoms are very pronounced and with every possibility by the time they go to health care providers complications had already started and after that they began the medications. This is also possible that this finding is a matter of chance in this study.

In this study duration of Type 2 DM was significantly and positively associated with Microvascular complications (OR: 8.87 and p-value: <0.001 during multivariable analysis). Several literatures do prove that duration of Type 2 DM as a very important predictor of Microvascular complications among Type 2 DM patient. Risk of Microvascular complications increases as the duration of Type 2 DM increases and usually in second decade of Type 2 DM Microvascular complications becomes more evident (Fauci, 2008). A study at health care facility in urban Thailand where 287 participants with Type 2 DM participated, shows duration of diabetes of 4 years or more was significantly positively associated with Microvascular complication- Diabetic Nephropathy (OR: 1.5), Diabetic Retinopathy (OR: 9.5) (Mayurasakorn et al., 2009). In India Chennai Urban Rural Epidemiology study shows, duration of DM significantly and positively associated with Microvascular complications – Diabetes Nephropathy (OR: 1.073) (Unnikrishnan et al., 2007); 41.8% Type 2 DM have Diabetic Retinopathy with DM duration of 15 years or more (Rema and Pradeepa, 2007); Diabetes Neuropathy (OR: 5.7) with duration of Type 2 DM 15 or more years as compared to 5 or less years

(Pradeepa et al., 2008). All these findings collectively suggest that duration of Type 2 DM is a robust predictor of Microvascular complications in Type 2 DM patients.

5.3 Benefits of the study:

1. This study will enhance the knowledge of policy makers and healthcare providers regarding the burden of Type 2 DM and its Microvascular complications and proportion of undetected Type 2 DM among elderly population in Kathmandu.
2. This study can be of great help to policy makers to formulate their health policy to tackle Type 2 DM keeping in mind, the key findings and recommendations of the study.
3. Findings of this study can be used to generate hypothesis for future research.

5.4 Conclusion

Cross sectional study was conducted among 306 participants above age 60 from urban and rural areas of Kathmandu district, Nepal. Firstly home visits were conducted, where structured questionnaire was used to collect information from the participants. Anthropometric measurements, blood pressure and fasting blood glucose test was done using standard medical tools. Those who were identified as diabetic during home visits were invited to a health camp later, where detailed physical examination, ophthalmoscopic examination and reviewing of medical records were done for detecting Microvascular complications. Data Analysis was done using binary logistic regression with statistical significance of each analysis against the p value of 0.05.

Prevalence of Type 2 DM in this study was 23.5% which is similar to the findings of previous studies in Kathmandu, Nepal. Among all cases of Type 2 DM 26.3% were the new cases diagnosed during survey. Likewise, among all cases of Type 2 DM 43.1% have one or more of the Microvascular complications. Inadequate Physical activity, Unhealthy Diet, Frequent visit to Fast food centers, Family history of Type 2 DM, Presence of Hypertension and Gestational Diabetes Mellitus were significantly positively associated with presence of Type 2 DM. Likewise, Above Normal waist circumference

and DM Duration were significantly positively associated with Microvascular complications of Type 2 DM. Whereas, Diet was significantly negatively associated with Microvascular complications of Type 2 DM.

It can be concluded from above findings that prevalence of Type 2 DM and its Microvascular complication is high in Kathmandu, Nepal. In addition, the burden of undetected Type 2 DM is also substantially high. Unless Type 2 DM is identified in its incipient stage and timely proper management is provided, it can impose health and economic threat to the nation as a whole. Complications associated with Type 2 DM are one of the leading causes of disability and even deaths in modern world and Nepal is no exception to it. Hence timely interventions are required to combat rising trend of Type 2 DM and its Microvascular complications in Nepal.

5.5 Recommendations

5.5.1 Recommendations for Policy Makers

1. To detect the hidden cases of Type 2 DM, several screening program should be launched in close coordination with Nepal Medical Council across Kathmandu. Furthermore, if adequate budget is available then nationwide screening program should be launched.
2. Workshops to sensitize general physicians too measure blood glucose in patients above 40 years or above and follow up properly if someone is diagnosed with Type 2 DM. On top of that counseling the patients about the importance of healthy diet and exercise.
3. Pilot medical schemes can be launched such as issuing voucher or medical card to the elderly especially those with low income or no income at all that enables them to have easy access to health care services.

4. Feasibility study can be conducted for construction of Joggers Park at various places around Kathmandu to promote exercise among elderly and general public as well.
5. Volunteer trainers should be available at local parks to guide elderly during their exercise.
6. Culturally accepted simple and cost effective prevention techniques (pictorial messages, billboards, etc.) should be designed to promote healthy living among elderly.

5.5.2 Recommendations for Future Research

1. There are several other factors like blood cholesterol, psychological factors, etc. which can be associated with prevalence of Type 2 DM that can be studied in future research.
2. A large population based research (Type 2 DM patient) can be more fruitful in determining the risk factors for Microvascular complications.
3. Anthropological studies can also give us a clearer picture about elderly's perception to Diabetes and their belief in allopathic medicine.
4. A Case Control or Cohort study in a larger Diabetic population can be a better design to see the association of various risk factors that contribute to the prevalence of Type 2 DM and Microvascular complications among Diabetic populations.
5. A study on cost effectiveness of DM management can be conducted.

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APPENDICES

Appendix A

Interviewer's Code: …….

Questionnaire

1. General Information:

1.1 Name: ……..

1.2 Age: …….

1.3 Gender: Male ☐ Female ☐

1.4 Address: Ward No. 32 ☐ Ward No. 10 ☐
Jorpati VDC ☐ Gokarna VDC ☐

1.5 Marital status: Unmarried ☐ Married ☐
Widow/Widower ☐ Divorcee ☐

1.6 Total annual income: …….

1.7 Do you own a house? (*If No go to question 1.9*)

Yes ☐ No ☐

1.8 With what material is your home built?

Bricks and tiles ☐ Mud with thatched roof ☐ Others ☐

1.9 Do you own any vehicles? (*If No go to Question 1.11*)

Yes ☐ No ☐

1.10 Which type of vehicle do you own? (*You can choose more than one answer*)

Car/Jeep ☐ Motorcycle/Scooter ☐ Bicycle ☐

1.11 Caste/Ethnic group: Brahmin ☐ Chhetri ☐ Janjatis ☐

Newar ☐ Others ☐

1.12 Education Level: Never went to school (Not able to read and write) ☐

Able to read and write (No schooling) ☐ Grade 1-8 ☐

Grade 9-12 ☐ University degree ☐

2. Lifestyle:

2.1 Cigarette Smoking (*If never or past smoker go to question 2.4*)

Never ☐ Past Smoker ☐ Current Smoker ☐

2.2 How long you have been smoking?

< 5 years ☐ 5 – 10 years ☐ > 10 year ☐

2.3 How many Cigarette sticks/day?

< 5 ☐ 5 – 14 ☐ ≥ 15 ☐

2.4 Do you ever Drink Alcohol? *(If answer is No go to question 2. 7*)

Yes ☐ No ☐

2.5 How often do you drink alcohol? (*If answer is past drinker go to question 2.7*)

Past Drinker ☐ Current Drinker ☐

2.6 How many drinks do you consume in an average per day? (*Here social occasions refer to celebration, ceremony, etc*.)

1 - 2 ☐ 3 or more ☐ Social Occasions ☐

2.7 Do you do any sort of physical activity like brisk walking, jogging, gardening, yoga, household work like cleaning floor, etc.?

Yes ☐ No ☐ (*If No go to question 2.11*)

2.8 What sort of Physical activity you do? (*If moderate go to question 2.10 and leisure walking go to question 2.11*)

Leisure walking ☐

Moderate intensity (*brisk walking, gardening, yoga, household work like cleaning floor, etc)* ☐

Vigorous intensity *(jogging, running, push-ups, playing football, etc.)* ☐

2.9 How much time do you spend in doing your vigorous intensity physical activity per week?

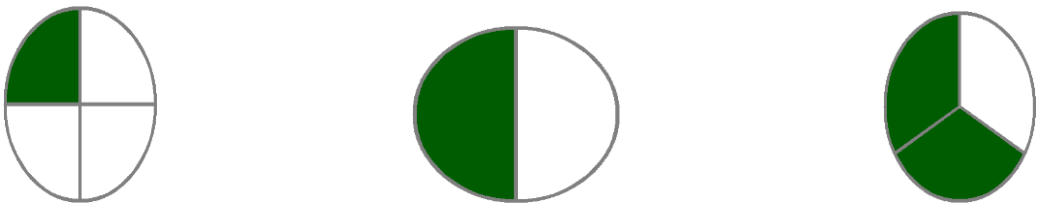
<75 minutes ☐ 75 – 150 minutes ☐ > 150 minutes ☐

2.10 How much time do you spend in doing your moderate intensity physical activity per week?

<150 minutes ☐ 150 - 300 minutes ☐ > 300 minutes ☐

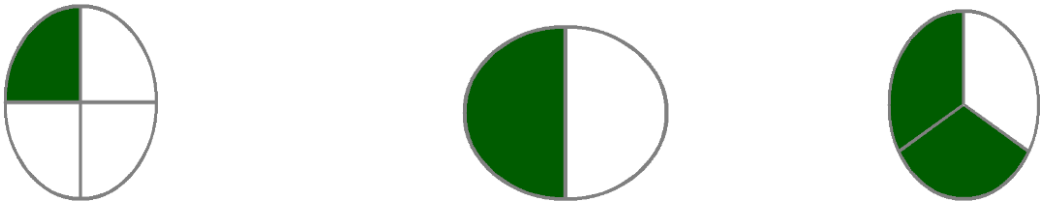
2.11 What is the proportion of fruits (*papaya, apple, etc.)* and vegetables (*do not count potatoes*) in your food plate?

≤ ¼ ☐ ½ ☐ > ½ ☐



2.12 What is the proportion of fried foods, meat with fats and heavy dairy products in your food plate?

≤ ¼ ☐ ½ ☐ > ½ ☐



2.13 How often in a week is your food plate is similar as stated above?

1- 3 days/ week ☐ 4 – 7 days/ week ☐

2.14 How many such meals do you have in a day?

1 times ☐ 2 – 3 times ☐ more than 3 times ☐

2.15 How often do you eat at Fast food centers, etc.?

Never ☐ < 1 time a week ☐ 1 – 2 times a week ☐

> 2 times a week ☐

3. Medical History and Anthropometric Measurements

3.1 Have you been diagnosed with diabetes mellitus? Yes ☐ No ☐
(*If No go to Question 3.4*)

3.2 Are you taking any anti diabetic medications? Yes ☐ No ☐

3.3 How long you have been diagnosed with Diabetes Mellitus ……

3.4Have you been diagnosed with Hypertension? Yes ☐ No ☐
(*If No go to Question 3.6*)

3.5 Are you taking any anti-hypertensive medications? Yes ☐ No ☐

3.6 Do you have history of diabetes mellitus among any of your relatives*? (Can choose more than one answer*)

None ☐ Father ☐ Mother ☐

Brother /Sister ☐ Son ☐ Daughter ☐

3.8 If female, do you have history of Gestational Diabetes Mellitus?

Yes ☐ No ☐

3.9 Do you have any of the following symptoms in the past one month? (*Can choose more than one answer*)

Excessive Thirst ☐ Excessive Urination ☐

Unexpected Weight loss ☐ Excessive Tiredness/ Fatigue ☐

4. How often you visit health center for health check-ups?

Never ☐ Rarely ☐ At least once a year ☐

5. Physical Examination:

5.1 Height…… Meters

5.2 Weight……. Kg.

5.3 BMI …….. kg/m^2

5.4 Waist Circumference ……cms

5.5 Blood pressure ……..mm of Hg

6. Fasting Blood Glucose……mg/dl

7. Only Diabetic person needs to answer these questions (previously diagnosed or diagnosed during study)

7.1 Have you been diagnosed with Diabetic Nephropathy?	Yes	☐	No	☐
7.2 Have you been diagnosed with Diabetes Retinopathy?	Yes	☐	No	☐
7.3 Have you been diagnosed with Diabetes Neuropathy	Yes	☐	No	☐
7.4 Do you visit your ophthalmologist at least once a year?	Yes	☐	No	☐
7.5 In last one month did you observe any numbness in your feet?	Yes	☐	No	☐

7.6 In last one month did you observe any burning sensation in your feet or leg? Yes ☐ No ☐

7.7 In last one month did you observe any pricking sensation in your feet or leg? Yes ☐ No ☐

7.8 In last one month did you observe any pain in your feet or leg while walking?

Yes ☐ No ☐

7.9 Can you sense your feet when you walk Yes ☐ No ☐

7.10 Does your any of the symptoms got worse during night Yes ☐ No ☐

7.11 Do you ever had open sores in your feet Yes ☐ No ☐

8. Physical Examination:

8.1 Ankle reflex

Right Ankle	Normal	☐	Reinforcement	☐	Absent	☐
Left Ankle	Normal	☐	Reinforcement	☐	Absent	☐

8.2 Examine sensation on the great toe (*write **N** – Normal and **A** for Abnormal in the box*)

	Right Toe	Left Toe
Vibration	☐	☐
Pain Sensation	☐	☐
Temperature	☐	☐
Fine Touch	☐	☐

8.3 Doctor's Comment (Physical examination for Peripheral Neuropathy, Ophthalmoscopic examination, Medical Record Review etc.)

……..

……

……

Appendix B

Informed Consent Form

Dear Participants,

Please consider this information carefully before deciding whether to participate in this research.

Objective of the research: To determine the prevalence of Type 2 Diabetes Mellitus and its Microvascular complications and to identify factors associated with Type 2 Diabetes Mellitus among elderly population of Kathmandu, Nepal.

Study Population: The study will include usual resident of Kathmandu district (Ward No.10 and 32 as well as Gokarna and Jorpati VDC) who are 60 years and above. A total of 306 people will participate in this study.

Role of participant in this research: Participant will respond to a questionnaire regarding socio demographic factors, lifestyle factors, medical history and health check-ups. In addition to the questionnaire participant's height, weight, blood pressure and blood glucose will be measured using standard medical protocol by trained medical practitioner. Moreover, if any participant is diabetic then detailed physical examination will be done by a doctor for complications related to diabetes mellitus.

Time required: Participation will take approximately 45 - 60 minutes to complete.

Benefits/Risk: At the end of your participation, you will be given result of blood pressure, blood glucose and anthropometric measurement (height, weight, etc.). Moreover, for diabetic participants medical examination report will also be given. During blood testing if any participant has very high blood glucose – 250 mg/dl or more, the participant will be escorted to the hospital by health volunteer. In addition, during the test

if any participant becomes hypoglycemic – blood glucose level falls below 55mg/ dl with symptoms then immediate first aid would be provided by giving some sugar drink to the participant and then escorted to the hospital by a health volunteer. In addition all new cases of Type 2 Diabetes will be given counseling by doctor present at the camp and advice to seek medical attention as soon as possible. Address and contact detail of healthcare provider will be given to the participant nearest to their residential area. Moreover, healthy snacks will be provided after blood testing to all the participants. There are no anticipated risks associated with participating in this study.

Confidentiality: Your participation in this study is anonymous and will remain confidential. There will be no link between your responses and your identity. Data will be presented in an aggregated way and there is no way to link the result with your identity.

Participation and withdrawal: Your participation in this study is completely voluntary, and you may withdraw at any time without penalty (no questions asked).

Agreement:

The nature and purpose of this research have been sufficiently explained and I agree to participate in this study. I understand that I am free to withdraw at any time without incurring any penalty.

Participant's Signature:_____ Date: _____

Witness Signature:_____ Date: _____

Appendix C

Budget

No.	Activity	Items	Price (THB)	Unit	Total budget (THB)
1	Tool Development and validation		5000	1	฿5,000.00
2	Pre-testing of questionnaire	Questionnaire sets and stationary	100	25	฿2,500.00
3	Data Collection				
3.1	Interviewer (5)	perdiem for 10 days	200	50	฿10,000.00
3.2	Doctor	perdiem for 7 days	500	7	฿3,500.00
3.3	Interns (2)	Perdiem for 7 days	300	14	฿4,200.00
3.4	Health Assistant (3)	Perdiem for 7 days	250	21	฿5,250.00
4	Blood glucose testing		100	280	฿28,000.00
5	Orientation Session		2500	2	฿5,000.00
6	Document Printing		1	500	฿500.00
6.1	Photo copy		0.5	500	฿250.00
6.2	Stationary		500	1	฿500.00
6.4	Binding	3 Sets	300	3	฿900.00
7	Ethical Approval in Nepal	One Time	3000	1	฿3,000.00
8	Snacks for Participants	One Time	40	280	฿ 11,200.00
9	Article Publishing	One Time	3000	1	฿ 3,000.00
	TOTAL				**฿ 82,800.00**

Appendix D

Time Schedule

Activities	**Time Schedule in Months**									
	Aug, 2011	Sept, 2011	Oct, 2011	Nov, 2011	Dec, 2011	Jan, 2012	Feb, 2012	Mar, 2012	Apr, 2012	May, 2012
Literature Review										
Writing Thesis Proposal										
Validity Testing of Questionnaires										
Field testing of Questionnaires										
Thesis Proposal Exam										
Thesis proposal Submission										
Ethical Consideration by NHRC										
Data Collection										
Data Analysis										
Thesis writing										
Thesis examination										
Thesis Submission										

VITAE

A. Personal Details

Full Name : Dr. Abhishek Rimal

Address: House No.407; Kalikasthan, Kathmandu, Nepal.

Phone: 0876801014

Email: abhishekrimal@gmail.com

Date of birth: 12th September, 1983.

Nationality: Nepali

Sex: Male

B. Education/Qualifications

Course Completed	Institution	Date of Completion
Bachelor of Medicine, Bachelor of Surgery (MBBS)	Jahurul Islam Medical College; Dhaka University; Bangladesh	2007
CBSE Class 12	Birla Vidya Mandir; Nainital; India	2001
CBSE Class 10	Birla Vidya Mandir; Nainital; India	1999

C. Professional Work Experience

1. **Health Coordinator:** Health Service Department; Nepal Red Cross Society, NHQs since August 2010 to May 2011.
2. **Medical Officer:** Alka Hospital in Emergency Medicine Department since April, 2010 to July, 2010.
3. **Medical Officer:** Meridian Healthcare Centre in Radiology Department since January 2009 to March 2010.