Sujita Dahal

Prevalence of Diabetes Among Married Women in Rural District Nepal and Associated Risk Factors

Master's thesis in Global Health
Supervisor: Professor, MD, Ph. D Unni Syversen, St Olav's hospital/ NTNU
Co-supervisor: Researcher, Scientist Astrid Kamilla Stunes, NTNU

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Trondheim, 1st September, 2021

Norwegian University of Science and Technology (NTNU)

Faculty of Medicine

Department of Public Health and Nursing

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Preface

As a part of **MSc. in Global Health** at the **Department of Public health and Nursing**, during the fall semester 2020 till the spring semester of 2021 this Master's thesis was conducted at the **Norwegian University of Science and Technology (NTNU).** This thesis explores the prevalence of diabetes among women in rural Nepal and associated risk factors.

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Master's in Global Health

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Acknowledgement

Abstract

Introduction

There are few studies addressing the diabetes burden in the Nepalese population, and no studies on prevalence of diabetes among Nepalese women. In this study, we therefore aimed to investigate the prevalence of diabetes and prediabetes, and associated risk factors among women in a rural district of Nepal.

Methodology This is a cross-sectional study in which inclusion criteria were married, and non-pregnant women above 15 years of age. Exclusion criteria were physical and mental conditions that made participation difficult. Height, weight, blood pressure, waist circumference were measured, blood sampes were collected and a questionnaire was filled in. Diabetes and prediabetes were classified according to the American Diabetes Association (ADA) as HbA1c $\geq$ 6.5% and prediabetes 5.7-6.4%. Overweight and obesity were categorized according to the Asian cut-offs as recommended by WHO. Analysis of the data was done in SPSS version 20.0 (SPSS Inc, Chicago, USA).

Results The study included 748 women with mean age 48.5 (SD= 11.8) years, age range 21- 81 years. Mean HbA1c level was 5.6 ± 0.8. The prevalence of diabetes and prediabetes was 4.4% and 34.0%, respectively. The prevalence of prediabetes and diabetes increased with age with an OR of 4.3 (95% CI: 2.36, 7.74, p < 0.001) and 10.3 (95% CI: 1.33,79.61, p<0.005), respectively in the age group >55 years compared to the youngest age group. Prediabetes was also prevalent in the youngest age groups. Overweight was observed in 38.4% of the total population and obesity in 24.5%. Among those with diabetes, 48.5 and 36.4 % were overweight and obese, respectively. Overweight, obesity, central obesity and smoking were identified as risk factors for diabetes and/or prediabetes among those women aged more than 55 years. Fruit intake less than five times weekly was associated with decreased risk. Hypertension was also associated with prediabetes and diabetes. The awareness on diabetes was low in the study population.

Conclusion The prevalence of diabetes and prediabetes among rural Nepalese women was high. Overweight/obesity and central obesity were frequent in the total population and even more so in those with diabetes. Risk factors were increasing age age, overweight/obesity, central obesity and smoking. women of those study areas. Increased attention is needed to reduce the burden of diabetes and its complications. Health education about diabetes, risk factors and prevention should be initiated.

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Abbreviations

ADA	American Diabetes Association
BMI	Body- Mass Index
BP	Blood pressure
COPD	Chronic Obstructive Pulmonary Disease
CVDs	Cardiovascular diseases
CI	Confidence Interval
DH	Dhulikhel Hospital
DM1	Diabetes Mellitus Type 1
DM2	Diabetes Mellitus Type 2
FCHVs	Female Community Health Volunteers
FPG	Fasting Plasma Glucose
GDM	Gestational diabetes
GNI	Gross National Income
GPAQ	Global Physical Activity Questionnaire
HDI	Human Development Index
IGT	Impaired Glucose Tolerance
JNC VI	Joint National Committee revised recommendation
KAP	Knowledge, Attitude, and Practice
LMICs	Low- and Middle- Income Countries
MENA	Middle East and North Africa region
MOHP	Ministry of Health and Population
MUAC	Mid-upper Arm Circumference
NCDs	Non-communicable Diseases
NDSP	National Diabetes Survey of Pakistan
NNR	Nordic Nutrition Recommendation
OGTT	Oral Glucose Tolerance Test
OR	Odds Ratio
SAARC	South Asian Association for Regional Cooperation
SHCA	South of Central America

SPSS	Statistical Package for the Social Sciences
WC	Waist Circumference
WHO	World Health Organization

Prevalence of Diabetes Among Married Women in a Rural District of Nepal and Associated Risk Factors

CHAPTER I: INTRODUCTION

1.1 Nepal- general background

Nepal is a landlocked country, with almost 30 million and gross domestic product (GDP) reliant on agriculture and tourism (1, 2). Nepal's life expectancy has increased to 71.7 to both sexes years in 2020 (Nepal Demographic, 2020), with women living on average of 73.2 years and men living on average of 70.1 years (3). In 2011, the sex ratio was 94 males for every 100 females, the lowest in the South Asian Association for Regional Coperation (SAARC) region (4). Nepal is a multilinguistic and multicultural country with 92 languages officially recognized by the nation and 100 ethnic groups officially recognized by government. The country's national language is Nepali, and the majority of Nepalese are Hindus (81.3%) with Buddhists (9%), Muslims (4.4%), Kirats (3%), and Christians (1.4%), and others trailing behind (5, 6). Some castes and ethnic groups in Nepal, such as Dalits and other indigenous communities, janajati, and adhivasi, are defined by constitutions as marginalized people with poor socio-economic status (7, 8). The Growth National Income (GNI) per capita for the 2018/19 fiscal year is $1034, nearly doubling from 2010 to 2018/19 (World bank, 2019) (9).

Non-communicable diseases (NCDs) accounts for more than 44% of death and 80% of outpatient visits, whereas most common NCDs among outpatients followed by chronic obstructive pulmonary disease (COPD) 43%, and cardiovascular disease (CVD) accounting for 40% (10, 11). Sedentary lifestyles, fast urbanization, an unbalanced diet, and significant advances in maternal and child health have all contributed to the increase of noncommunicable diseases, which has shifted disease patterns. Other pre-existing and most common risk factors include tobacco and alcohol intake along with smoking habits (12, 13). According to cross-sectional study for finding hospital-based prevalence in Nepal shows that 36.50% of people had NCDs, with 12% diabetes, 40% heart disease, 33% having hypertension, 33% having COPD (14).

1.2 Diabetes

According to World Health Organization (WHO), diabetes is one of the leading causes of cardiovascular death worldwide, with hypertension and obesity as additional risk factors (15).

Diabetes is characterized by a high blood glucose level due to lack of insulin production by the pancreas (type 1 diabetes (DM1) or low insulin production and/or insulin resistance (type 2 diabetes (DM2) (15).

1.2.1 Diagnostic criteria for diabetes and prediabetes

According to World Health Organization (WHO), there are four diagnostic criteria or tests for diabetes: fasting plasma glucose (2-h) FPG $\geq$ 7.0 mmol/l or a 2-h plasma glucose $\geq$ 11.1 mmol/l (200 mg/dl) following an oral glucose tolerance test (OGTT), HbA1c $\geq$ 6.5% (48 mmol/mol) or random blood glucose $\geq$ 11.1 mmol/L (200 mg/dl) in the presence of risk factors (16).

Prediabetes is defined as having a HbA1c level of $\geq$ 5.7 to 6.4% (39 to 47mmol/mol), and impaired fasting glucose level of 100 to 125 mg/dl (5.6 to 6.9 mmol/L). An international expert committee explains the advantages of employing HbA1c:

- No need for fasting or scheduled samples,
- Currently used for guiding management and adjusting therapy.
- Test parameters that are well- known
- It enables precise and accurate measurements of chronic glycemic levels (17)

1.3 Prevalence of diabetes

1.3.1 Global prevalence of diabetes

DM2 comprises around 90% of all diabetes cases and is one of the most common NCDs (18). The prevalence of DM2 has increased in recent decades, especially in low and middle income countries, and it is now one of the leading causes of morbidity and mortality (19, 20). According to IDF, 463 million adults were living with diabetes in 2020 (21). When comparing data from 1980 to 2014, the prevalence of DM1 in adult populations increased from 4.7 percent to 8.5%, whereas, the global prevalence of DM2 tripled (22). Women with a history of gestational diabetes are at higher risk of acquiring DM2 and cardiovascular illness (23). Diabetes affects 58% of the world's population with a BMI above 21 kg/m^2 (24). According to the recent article published in World Journal of Diabetes Mellitus, the prevalence of DM2 is increasing in children and adolescents globally across all ethnicities, also in those with a low prevalence of obesity (25). The increase in prevalence av DM2 is attributed to among others a sedentary lifestyle and dietary changes leading to overweight/obesity promoting development of DM2 (24, 26).

Table 1 Estimated global and regional prevalence of diabetes

Countries/region	Year of publication	Estimated prevalence of diabetes
Globally **(27)**	2019	9.3%
Middle East and North Africa region (MENA) **(28)**	2014	10.9%
Europe **(29)**	2014	8.5%
Australia **(30)**	2017-18	5%
South and Central America (SACA) Region **(31)**	2014	8.0%
United States of America (USA) **(32)**	2020	10.5%
Western Pacific region **(33)**	2015	36%
South east Asia **(34)**	2016	8.2%

1.3.2 Prevalence of diabetes in Asia

Nepal, India, Pakistan, Bhutan, Maldives, Sri Lanka, Bangladesh, and Afghanistan are eight countries with a population of 1.5 billion people, accounting for 20% of the world's population (35). With one quarter of the world's population, South Asia is a melting pot of ethnic, linguistic, and religious groups. South Asians are more susceptible to DM2 than Western populations (35, 36). There are sex differences in the occurrence of DM2 across the life span. Women have significantly higher rates of DM2 in youth, whereas men have a significantly higher prevalence in midlife (37). Early-onset of DM2 among children and adolescents is an emerging phenomenon worldwide with a higher burden in Asia than Europe and America combined (37). Given the early onset of diabetes, many women are affected during fertile age. The offspring of mothers with diabetes have increased risk of diabetes later in life, thus contributing to the accelerated rise in prevalence of DM2 in young Asians (38).

In comparison to the rest of the globe, India has the largest diabetes population. Diabetes has increased from 2.1% in the 1970s to 12.1% recently in India's urban population. In addition, many people are expected to acquire DM2 in the future as a result of impaired glucose tolerance (IGT) (39). India and China contribute with a large proportion of the global diabetes population, accounting for 31.7 million and 110 million cases respectively (40, 41). In comparison to the global average, India has a slightly higher diabetes prevalence than the global norm (9.1% vs. 8.3%), with 3.1% of self-reported cases in rural areas and 7.3% in urban areas (42). DM1 rates are high in Caucasians, more than 20 cases/year/100,000 people, but they are low in Asian countries, with less than 1/cases/year/100,000 people (36).

Table 2 Estimated prevalence of diabetes in South Asia

Countries	Year of publication	Estimated prevalence of diabetes
China (43)	2018	11.2%
India (44)	2018	10.4%
Nepal (45)	2020	8.5%
Bangladesh (46)	2016	7.4%
Pakistan (47)	2006	10.6%
Sri Lanka (48)	2012	10.3%
Bhutan (49)	2016	4.9%

1.3.3 Prevalence of diabetes in Nepal

A systematic review and meta-analysis by Shestra et al. in 2020 showed an overall prevalence of prediabetes and diabetes of 9.2% (95% CI 6.6-12.6%), and 8.5% (95% CI 6.9-10.4%), respectively (45). In another systematic review and meta-analysis published in 2015, the prevalence of DM2 ranged from 1.4 to 19.0%, with an 8.4% pooled prevalence of DM2, The prevalence in urban and rural populations differed significantly, 8.1% and 1.0% respectively (50). A cross-sectional study of diabetes patients' knowledge, attitude, and practice conducted at the Manipal teaching hospital

in Western Nepal showed that they had a low awareness, indicating that diabetes patients require educational intervention and awareness (51).

Age, urban residency, family history, lack of physical activity, nutrition, alcohol consumption, and smoking are all risk factors for DM2, in addition to overweight, obesity and increased waist circumference (50, 52). Obesity prevalence in the urban population of Nepal has increased considerably from 1.6% to 10% since 1996 (53). Overweight and obesity, as well as current smoking, were reported among 11.4% of women in the Nepal Demographic health survey 2016, with substantial risk variables related with education, province, wealth index, age, and ethnicity (54). A higher risk of diabetes was linked to family history, urban residency, increasing age, higher BMI, sedentary lifestyle, hypertension, the and higher waist-hip ratio (45, 50). In Nepal, 15.5% of the population has been identified as having a risk factor for NCDs. Women are less likely to be diagnosed with NCDs and treated (54).

1.4 Risk factors of diabetes

Several factors may increase the risk of DM2, including increasing age, gender, dietary factors, obesity, sedentary lifestyle, lack of physical activity.

1.4.1 Diet/ nutrition and diabetes

Globally, there has been a significant shift in foods and beverages consumed, as well as decreased physical activity. Dietary changes and activity/inactivity patterns are usually the result of four underlying factors. The first is labor-saving equipment for economic work (example, robots, mechanized assembly lines, reapers, and so on), the second is urbanization, third is a shift in income per capita, and general economic welfare relative cost of food in a country and last or fourth is an enormous expansion of global trade (55).

South Asians eat more refined cereals like white rice and fine flour and instant noodles, which contain more carbohydrates. They also consume excess fat and have a low intake of dietary fiber and minerals. Consumption of milled and polished grains such as rice and wheat has increased as a result of urbanization, as opposed to unpolished brown rice, corn, millet. The dietary carbohydrates and glycemic load of South Indians put them at risk for DM2 (56).

Due to the multiplicity of ethnic groups in Nepal, food culture in various location is diverse. Rice, wheat, potato, ghee, animal products, and vegetables make up the majority of people's diets. They

eat animal products if they have their own cows or buffalo. Meat, milk, ghee and other animal products on the other hand are more expensive to (57).

1.4.2 Obesity and diabetes

According to WHO, obesity or overweight is defined as abnormal and excessive fat buildup that might harm one's health. Due to dietary changes and a sedentary lifestyle, obesity is increasing rapidly at an alarming rate, in year 2021 and 1.9 billion adults (18 years and older) were overweight and over 600 million people were obese (58). Obesity among youth has been on the rise in the United States, affecting people of all ages and ethnicities. After looking at evidence from the last 20-30 years, the number has doubled among children aged 2 to 5, nearly tripled among teenagers 6 to 19, and has disproportionately affected minorities and obesity among youth with DM2 was higher than that of youth with DM1 (59). Obesity is on the rise in low- and middle- income countries, particularly in urban areas, due to urbanization and change in eating habits (60). Obesity is a risk factor for CVDs and DM2 (61).

Nepal is suffering from the consequences of rising obesity rates. In 2005, the WHO reported that 8.8% of men and 8.0% of women in the USA were overweight (62). Three National surveys (Demographic Health Surveys (DHS) Nepal 2016, Micronutrients Survey 2016, and STEPS Survey 2019) estimated that 14.5-17% of Nepalese adult women were underweight, and 22-25% overweight or obese. Among men, 17-23.4% were overweight or obese, and 17% underweigh(63-65). According to the Nepal DHS 2016, there was no substantial variation in ecological zones or between urban and rural populations (64).

1.4.3 Hypertension and diabetes

Hypertension is a strong risk factor for CVDs and is associated with increased morbidity and mortality among diabetes patients. DM2 increases the risk of hypertension because of insulin resistance (66). WHO recommends hypertensive patients to undergo diabetes screening based on their risk factors. According to ADA, adults with no known risk for diabetes undergo screening for 3 years and those who have high-risk for diabetes undergo every 1 to 2 years based on a family history of disease, hypertension, overweight or obesity (67). According to Joint National Committee revised recommendation (JNC VI), the cut-off for management of hypertension in the general population is 140/90 mmHg, whereas it is 130/85 mmHg for diabetic patients. Although,

adjusting for age and weight the prevalence of hypertension among diabetic patients is 1.5 times higher than normal population (68).

1.4.4 Smoking, alcohol consumption and diabetes

Smoking and alcohol consumption are well-known modifiable risk factors for many chronic diseases such as CVD, cancer, asthma, lung diseases and diabetes. A study in Korea showed that current and past smoking along with increasing number of cigarettes increased the risk of DM2 significantly (OR1.55, 95% CI: 1.51 to 1.60) (69). The primary cause of oral cancer are tobacco and alcohol consumption in both developed and developing countries, accounting for 75% approximately. In Nepal, tobacco smoking and use of other tobacco products causes 15,000 deaths each year. The prevalence of tobacco smoking among the 15 to 19 years age group was reported to be about 17% in a recent study on Nepalese adolescents (70).

1.5 Rationale of the study

Data on the prevalence of diabetes among women in rural Nepal are sparse. Given that women are affected at a younger age than men and are more susceptible to diabetes due to poverty, malnutrition, and illiteracy, we aimed to explore the magnitude of the problem of diabetes among rural women in Nepal. Moreover, we aimed to study risk factors and the knowledge of diabetes among women in this area.

1.6 Research questions

- What is the prevalence of diabetes among married women in a rural community in Nepal applying HbA1c as diagnostic criterion?
- What are the risk factors for diabetes?
- How is the awareness of diabetes in the study population?

1.7 Objectives

General objective

To gain knowledge on the prevalence of diabetes, prediabetes, and associated risk factors, as well as awareness on diabetes among women in rural Nepal with the purpose to reduce the burden of diabetes and its complications.

Specific objectives

- To estimate the prevalence of diabetes and prediabetes

- To assess the risk factors for diabetes/prediabetes
- To assess the awareness on diabetes.

CHAPTER II: MATERIALS AND METHODS

2.1 Study area, design, population and data collection

This is a sub-study of a cross-sectional study, "Early-onset and increasing burden of diabetes in Nepalese women. Risk factors, complications, and relation with vitamin A and D. A prospective cohort study in rural Nepal". This study was conducted in five villages of Timal rural municipality and Bolde phediche. One of the outreach health centers of Dhulikhel hospital is localized in Bolde. The participants were recruited from women (N=1289, age: 17-86 years) who originally took part in a study conducted in 2012-2013. This study was a collaborative study between the Norwegian University of Science and Technology and Kathmandu university/Dhulikhel hospital. The inclusion criteria were the same as in the original study: married, non-pregnant women above 15 years of age. Exclusion criteria were physical and mental conditions that made it difficult to participate. During October-December 2019, 800 women, 21-80 years of age, were included. A questionnaire regarding socio-demographic profile, income, knowledge on diabetes, dietary habits, physical activity, alcohol consumption, and smoking was filled in (see questionnaire). For the current study, 16 predictors of diabetes and prediabetes were evaluated: age, education, marital status, ethnicity, income, vegetable consumption, fruit intake, physical activity, smoking, and alcohol consumption, body mass index (BMI), waist circumference (WC), blood pressure (systolic and diastolic). Fasting blood samples were collected in gel tubes and centrifuged within 30-60 min after collection. Sera were stored at -20°C at Bolde health center and later transferred to the Biochemistry department at DH and stored at -80°C. Blood samples were collected in EDTA tubes and stored at 4 to 8°C. HbA1c was analyzed consecutively in full blood within 96 hours at the Department of Biochemistry Department of Dhulikhel hospital.

Figure 1 Flow diagram of selection process of the study population
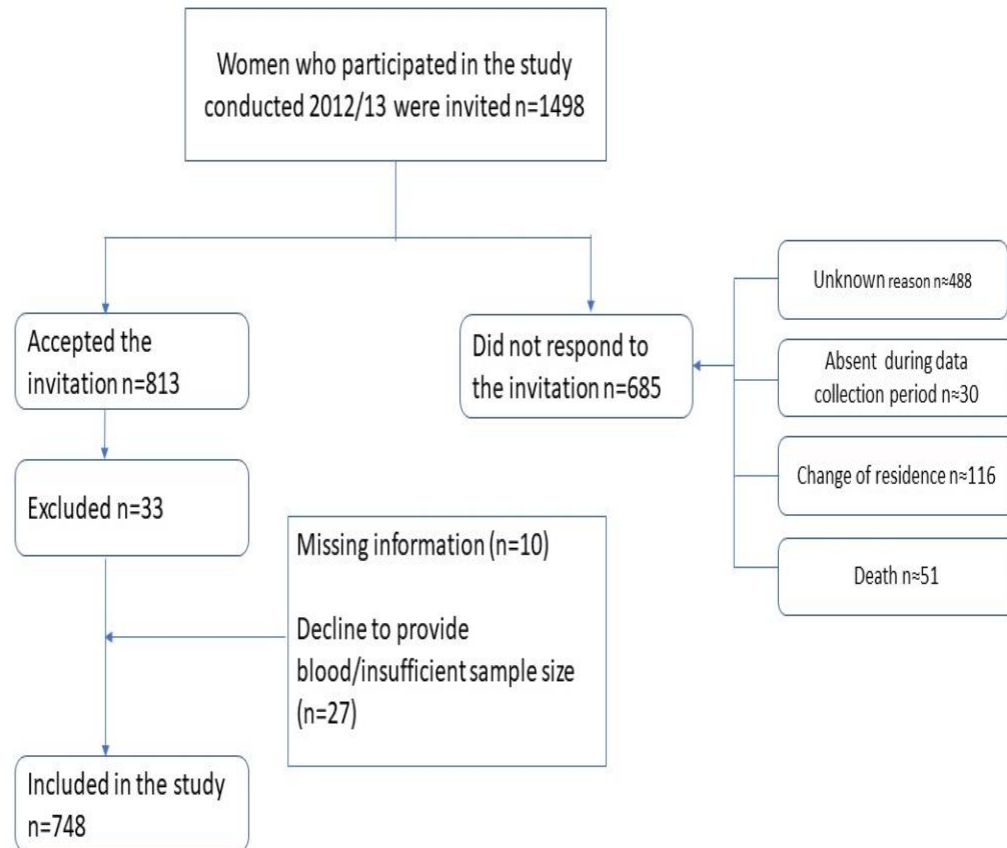
2.2 Measurements

2.2.1 Height and weight measurements

Height and weight were measured to calculate body mass index (BMI, kg/ m^2) to determine the prevalence of overweight and obesity (71). Height was measured by a stadiometer, after removal of footwears and headgear, and any fancy or high hairdos may have to be pressed. Height measurements were recorded in centimeters.

Weight was measured by a portable digital weighing scale, making sure the scale was placed on a firm, flat surface. Participants were asked to remove their footwear, heavy belts, empty their pockets and remove mobiles, wallets, and coins. Weight was recorded in kilograms.

2.2.2 Obesity

According to the WHO we applied the Asian cutoff for BMI at 27 kg/ m² (71).

Table 3 Classification of overweight and obesity, Asian cut-off

Classification	WHO-Asian range (kg/ m²)
Underweight	< 18.5
Normal range	18.5- 23.0
Overweight	23.0- 27.5
Obesity	≥ 27.5

2.2.3 Waist circumference

Waist circumference was measured to assess central obesity. It was measured in cm in a standing position with non-stretchable measuring tape after removing clothes and accessories, in a separate room by female health workers. The measurement was taken at midpoint between the lower margin of the last palpable rip (12th rib) in the mid axillary line and top of the iliac crest (hip bone). Cut-off value for increased metabolic risk was set at ≥80 cm as recommended for by Asians (72).

2.2.4 Blood pressure (BP)

Digital BP was measured by experienced health professionals using an Omron automatic digital BP (Omron). The participants were requested to take off thick clothes during measurement and excess clothes in the arm were removed or rolled up. Two measurements were taken during the middle (after 15-20 minutes) and at the end of the interview. The mean BP was included in the analyses. According to ADA, BP cut-off values were set at 140/90 mmHg (73).

2.2.5 Blood glucose

HbA1c was used as a diagnostic criterion for diabetes and prediabetes according to ADA. The cut off for diabetes was HbA1c ≥ 6.5%, and for prediabetes 5.7- 6.4%, and < 5.7% for normoglycemia (74).

2. 3 Categorization of variables

The participants were divided into four age groups: ≤ 34, 35- 44, 45- 54, and 55 years and older. Education was categorized in three levels: no formal education, secondary or lower and college

level or above. Household income less than 24000 NPR and greater than or equal to 24000 NPR were used to classify socio- economic status. According to Global Physical Activity Questionnaire (GPAQ) version 2, physical activity was categorized as high, moderate, and low by translating each domain's response to metabolic equivalent task- minutes/week (75). A GPAQ analysis guide was followed for cleaning and analyzing the data. Information on work, travel, and recreational time which was not available.

2.4 Statistical analysis

We used IBM SPSS Statistics version 20.0 (SPSS Inc, Chicago, USA) for the statistical analysis. Continuous variables are presented as mean with standard deviation, and categorical variables as counts and percentage. The differences among the covariates between the three groups (normal, prediabetes and diabetes) were analyzed using a one-way ANOVA test for continuous variables and a Pearson's χ^2 test for the categorical variables. A normality test was done, and Q-Q plot were plotted to test for normal distribution of continuous variables. Multinominal logistic regressions were performed to analyze the association between the outcome variable prediarbetes and diabetes (DM2) and covariates. The results are presented as odds ratios (OR) with 95% confidence intervals (CIs). All statistics analyses were performed using the IBM SPSS statistics (v 25.0). A p-value < 0.05 was considered as significant.

The direct acyclic graph (DAG) model shows potential confounders
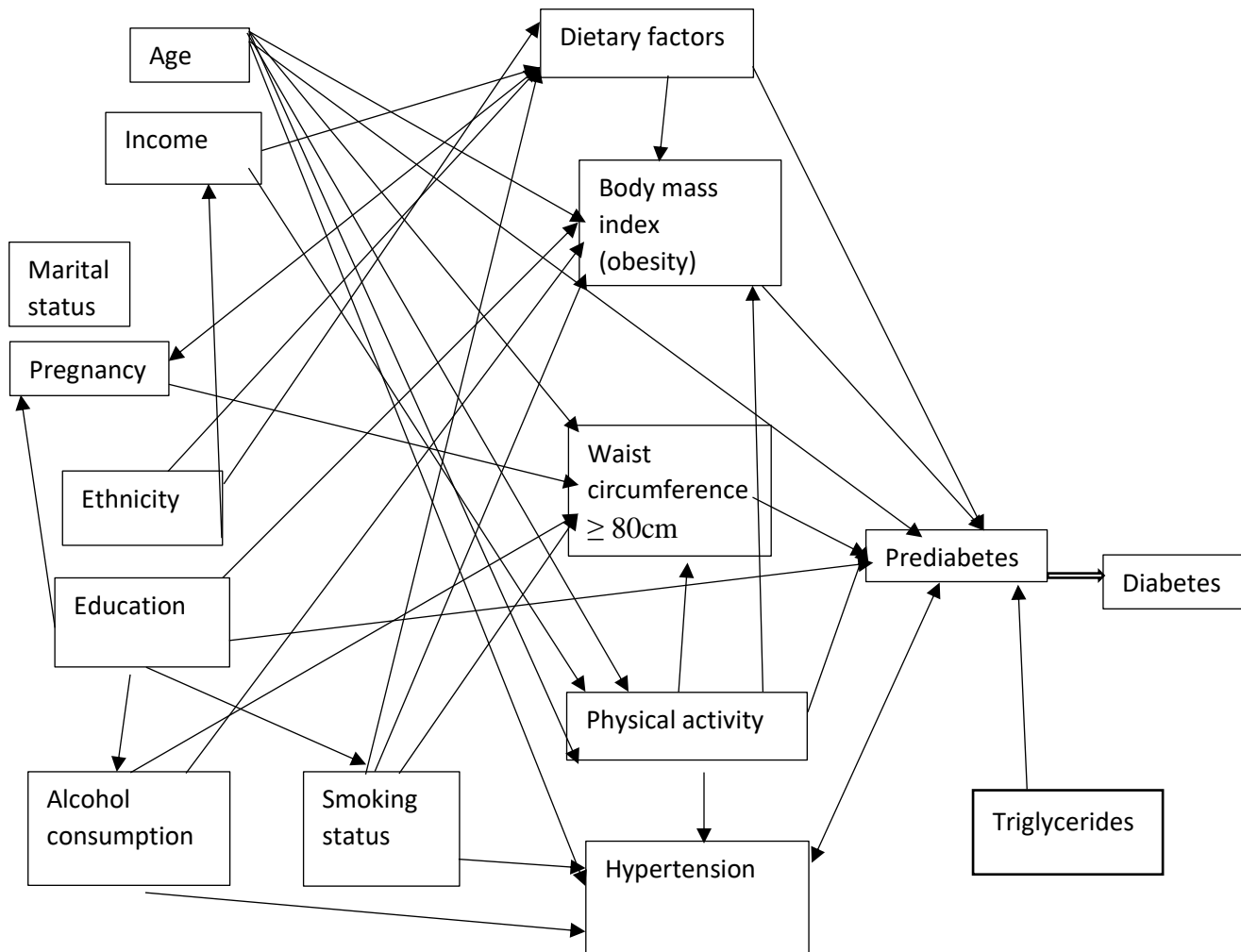
Figure 2 Direct acyclic graph (DAG) model for casual relationship between diabetes and prediabetes and its associated risk factors

2.5 Ethical consideration

The Regional Ethical Committee approved this study in Norway (REK Midt-Norge 13003, May 2019) and the local ethical committee at Kathmandu University/Dhulikhel hospital (124/19, May 2019) and the National Ethical Committee in Nepal (National Health Research Council (2715) May 2019). Written or verbal informed consent was obtained from all women before participating in the study, by the use of fingerprint or signature. Participants could withdraw from the study at any time.

CHAPTER III: RESULTS

The current study included 748 women from whom data on HbA1c were available. Mean age was 48.4 (SD 11.8) years, the age range was 21 to 81 years.

In table 5, 7 and 8, general baseline characteristics are presented using mean (SD) for continuous variables and frequency, percentage for categorical variables.

3.1 Characteristics of the study population

Table 4 shows distribution of age, socio-demographic characteristics,lifestyle factors, anthropometrics, blood pressure data and HbA1c among the women. The majority of participants belonged to the age group 45-54 years (n= 241, 32.2%), followed by the age group above 55 years (n= 226, 30.2**%).** The majority belonged to Adhivasi/Janajati ethnicity (n=625, 83.6%). A substantial number of the women were uneducated (n= 672, 89.8%). Most of the women did not consume alcohol (n= 523, 71.4%) and did not smoke (n= 602, 80.5%). Mean HbA1c was 5.6 ± 0.8.

Table 4 Characteristics of the study population (N=748)

Characteristics	n (%) or mean ± SD
Age (years)	48.4 ±11.8
Age groups (years)	
≤ 34	90 (12.0)
35-44	192 (25.7)
45-54	240 (32.1)
≥ 55	226 (30.2)
Caste/ethnicity	
Disadvantaged/Dalit	34 (4.4)
Adhivasi/Janajati (Newar/Tamang)	625 (83.6)
Advantaged high caste (Brahmin/Chhetri)	90 (12.0)
Educational status	
Uneducated	672 (89.8)
Secondary and lower	48 (6.5)
College and above	28 (3.7)
Number of children	3.6 ± 1.6
Monthly income (NPR), (n=547)	
≤ 24000	522 (95.4)
> 24000	25 (4.6)
Dietary factors (n=717)	
Vegetarian diet (days in week)	

0-3 times	7 (1.0)
4-5 times	125 (17.4)
>5 times	585 (81.6)
Fruits intake (days in week), (n=589)	
0-3 times	502 (85.2)
4-5 times	62 (10.5)
>5 times	25 (4.2)
Smoking status	
Current	130 (17.4)
Former	16 (2.1)
Never	602 (80.5)
Number of cigarettes smoked per day, Median (IQR)	7.0 (6.0)
Alcohol intake	
Current	129 (17.2)
Former	96 (12.8)
Never	523 (70.0)
Physical activity	
High	106 (14.2)
Moderate	400 (53.4)
Low	243 (32.4)
Family history of non-communicable diseases	
Diabetes	35 (4.7)
Hypertension	127 (17.0)
Anthropometric measurements	
Height (cm)	148.6 ± 6.4
Weight (kg)	54.7 ± 10.2
Body mass index (kg/m^2)	24.7 ± 4.4
Waist circumference (cm)	78.0 ± 11.4
HbA1c (%)	5.6 ± 0.8

Numbers may not sum to 748 due to missing data
SD: Standard Deviation
NPR: Nepali Rupees
IQR : Interquartile range

3.2 Prevalence of diabetes and prediabetes and of overweight/obesity

Table 5 shows the prevalence of prediabetes to be 34.0% and of diabetes 4.4%. Twenty eight women reported that they had diabetes; among them 11 women had normal HbA1c, nine were in the prediabetes group, and eight had diabetes according to HbA1c. Eleven females had HbA1c level $\geq 8.0\%$, six of them belonged to age group 45 to 54 years and five to the age group ≥ 55 years. Table 6 shows the prevalence of overweight and obesity. Among women with diabetes,

48.5% were overweight and 36.4% obese. Central obesity assessed by waist circumference >80 cm was most prevalent in the diabetes group.

Table 5 Prevalence of prediabetes and diabetes stratified by age and ethnicity

Characteristics	N	Prevalence of prediabetes[a] (HbA1c 5.7-6.4 %) % (95% CI)	N	Prevalence of diabetes[a] (HbA1c ≥ 6.5 %) % (95% CI)
Overall (n=757)	254	34.0 (28.9-35.3)	33	4.4 (2.9-5.7)
Age groups (years)				
≤ 34 (n= 90)	17	18.9 (11.9-27.9)	1	1.1 (0.1-5.1)
35-44 (n= 192)	43	24.4 (16.9-28.7)	4	2.1 (0.7-4.9)
45-54 (n= 240)	88	36.7 (30.8-42.9)	13	3.1- 8.8
≥ 55 (n= 226)	106	46.9 (40.5-53.4)	15	6.6 (3.9-10.4)
Caste/ethnicity				
Disadvantaged/Dalit (n= 34)	20	58.8 (42.1-74.1)	1	2.9 (0.3-12.9)
Adhivasi/Janajati (n= 625)	190	30.4 (26.9-34.1)	29	4.6 (3.2-6.5)
Advantaged high caste (n= 89)	44	49.4 (39.2-59.7)	3	3.4 (1.0-8.7)

[a] Prediabetes and diabetes based on American Diabetes Association (ADA) HbA1c cut off

Table 6 Prevalence of overweight and obesity stratified by diabetes status (N=748)

Characteristics	Total population	Diabetes status			P-value
		Normal (n=461)	Prediabetes (n=254)	Diabetes (n=33)	
Body mass index, kg/m^2					0.003
Underweight	43 (5.7)	25 (5.4)	18 (7.1)	0 (0.0)	
Normal	235 (31.4)	154 (33.4)	76 (29.9)	5 (15.1)	
Overweight	287 (38.4)	189 (41.0)	82 (32.3)	16 (48.5)	
Obese	183 (24.5)	93 (20.2)	78 (30.7)	12 (36.4)	
Waist circumference, cm					
< 80	455 (60.9)	298 (64.6)	144 (56.7)	14 (42.4)	**0.010**
≥ 80	299 (39.1)	163 (35.4)	110 (43.3)	19 (57.6)	

3.3 Characteristics of study population according to diabetes classification (normal, prediabetes and diabetes)

Table 7 shows that all the diabetes women 33 (100%) were uneducated. There were more current and previous smokers among women with prediabetes and diabetes compared to non-diabetics. The proportion of women reporting to drink alcohol was similar in the three groups. Women with diabetes displayed the highest BMI and waist circumference.

Table 7 Characteristics of the study population according to diabetes status

Characteristics (n=748)	Diabetes status n (%)			p value
	Normal n= 461 (61.6)	**Prediabetes** n=254 (34.0)	**Diabetes** n=33 (4.4)	
HbA1c (%)	5.2 ± 0.3	5.9 ± 0.2	7.8 ± 1.8	**< 0.001**
Age (years)	45.9 ± 11.4	52.2 ± 11.3	54.5 ± 11.0	**< 0.001**
Educational status				**0.033**
Uneducated	404 (87.6)	235 (92.5)	33 (100.0)	
Secondary or lower	33 (7.2)	15 (5.9)	0 (0.0)	
College and above	24 (5.2)	4 (1.6)	0 (0.0)	
Lifestyle factors				
Vegetarian diet (days in week), (n=717)				0.267
0-3	3 (0.7)	4 (1.6)	0 (0.0)	
4-5	70 (16.0)	46 (18.6)	9 (28.1)	
>5	365 (83.3)	197 (79.8)	23 (71.9)	
Fruits intake (days in week), (n=589)				0.262
0-3	301 (86.0)	175 (83.3)	26 (89.7)	
4-5	39 (11.1)	21 (10.0)	2 (6.9)	
>5	10 (2.9)	14 (6.7)	1 (3.4)	
Smoking status, (n=747)				**0.009**
Current	71 (15.4)	52 (20.5)	7 (21.2)	
Former	4 (0.9)	11 (4.3)	1 (3.0)	
Never	385 (83.7)	191 (75.2)	25 (75.8)	
Alcohol consumption				0.972
Yes	129 (28.0)	75 (29.5)	9 (27.3)	
No	332 (72.0)	179 (70.5)	24 (72.7)	
Physical activity				0.289
Low	145 (31.5)	83 (32.7)	15 (45.5)	
Moderate	247 (53.6)	135 (53.1)	17 (51.5)	
High	69 (15.0)	36 (14.2)	1 (3.0)	
Anthropometric measurements				
Height (cm)	148.4 ± 9.8	148.4 ± 5.9	148.1 ± 7.4	0.970

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Weight (kg)	54.0 ± 10.0	54.6 ± 11.5	60.3 ± 9.7	**0.004**
Body mass index (kg/m^2)	24.4 ± 4.0	24.8 ± 4.6	27.8 ± 6.8	<0.001
Waist circumference (cm	76.3 ± 11.8	79.8 ± 11.0	83.8 ± 11.2	**<0.001**
Blood pressure (mm Hg)				
Systolic	122.4 ± 16.9	128.9 ± 22.8	138.3 ± 21.0	**<0.001**
Diastolic	79.7 ± 11.4	82.8 ± 11.8	88.0 ± 9.8	**<0.001**

The continuous data are presented in mean with standard deviation and categorical data as number and percentage

3.4 Factors associated with diabetes and prediabetes

The following factors were associated with increased risk for prediabetes and/or diabetes (Table 8): increasing age, smoking, waist circumference $\geq$ 80, overweight and obesity, and blood pressure. The significant associations persisted after adjustment for age. The disadvantaged/Dalits ethnic group seemed to have a lower risk for prediabetes. Fruit intake less than 5 times a week was associated with decreased risk of prediabetes.

Table 8 Risk factors associated with diabetes and prediabetes in the study population

Characteristics	Prediabetes (n=254)		Diabetes (n=33)	
	COR (95% CI)	**AOR (95% CI)**	**COR (95% CI)**	**AOR (95% CI)**
Age group, years				
17-34	Reference		Reference	
35-44	1.3 (0.67, 2.36)		2.0 (0.22, 18.10)	
45-54	2.7 (1.48, 4.85)[**]		6.7 (0.86, 52.51)	
> 55	4.3 (2.36, 7.74)[**]		10.3 (1.33, 79.61)[*]	
Caste/ethnicity				
Advantaged high caste	Reference		Reference	
Disadvantaged/Dalit	0.4 (0.28, 0.70)[**]	0.4 (0.27,0.70)	1.0 (0.29, 3.42)	0.9 (0.28, 3.40)
Adhivasi/Janajati	1.4 (0.65, 3.32)	1.5 (0.65, 3.49)	1.1 (0.10, 11.2)	1.1 (0.11, 12.0)
Lifestyle factors				
Vegetarian diet in days per week				
$\leq$ 5 days	1.3 (0.85, 1.90)	1.2 (0.80, 1.83)	2.0 (0.91, 4.44)	1.8 (0.79, 4.12)
>5 days	Reference		Reference	
Fruits intake in days per week				
$\leq$ 5 days	0.4 (0.18, 0.94)[*]	0.3 (1.03, 1.06)	0.8 (0.10, 6.67)	0.8 (0.09, 6.75)
>5 days	Reference		Reference	
Smoking status				
Current	5.5 (1.74, 17.64)[*]	5.4 (1.67, 17.70)[*]	3.8 (0.41, 35.7)	
Former	1.5 (0.10, 2.20)[*]	1.2 (0.81, 1.85)	1.5 (0.63, 3.64)	1.2 (0.50, 2.93)
Never	Reference		Reference	
Alcohol intake				
Current	1.2 (0.81, 1.82)	1.2 (0.81, 1.06)	1.3 (0.53, 3.08)	1.3 (0.55, 3.30)

Former	1.0 (0.61, 1.53)	1.0 (0.62, 1.60)	0.4 (0.10, 1.90)	0.5 (0.11, 2.04)
Never	Reference		Reference	
Physical activity				
Low	1.1 (0.67, 1.78)	0.9 (0.55, 1.51)	7.1 (0.92, 55.1)	5.5 (0.70, 43.2)
Moderate	1.0 (0.66, 1.65)	0.9 (0.58, 1.49)	4.5 (0.62, 36.3)	4.0 (0.53, 31.4)
High	Reference		Reference	
Body mass index (BMI) [§], Asian cut-offs				
Normal	Reference		Reference	
Overweight	1.6 (1.13, 2.55)[*]	2.4 (1.53, 3.71)[**]	4.0 (1.37, 11.77)[*]	7.2 (2.33, 22.29)[**]
Obese	0.9 (0.60, 1.28)	1.0 (0.67, 1.48)	2.6 (0.93, 7.28)	3.2 (1.14, 9.24) [*]
Waist circumference				
< 80 cm	Reference		Reference	
≥ 80 cm	1.4 (1.02, 1.90)[*]	1.6 (1.16, 2.24)[*]	2.5 (1.21, 5.06)[*]	3.1 (1.50, 6.58)[**]
Blood pressure (mm Hg)				
Systolic BP				
< 140	Reference		Reference	
≥ 140	2.0 (1.38, 3.07) [**]	1.5 (1.00, 2.23)[*]	2.2 (0.94, 5.06)[*]	1.4 (0.58, 3.38)
Diastolic BP				
<90	Reference		Reference	
≥ 90	1.6 (1.11, 2.43)[*]	1.4 (0.92, 2.07)	2.8 (1.32, 6.12) [*]	23 (1.04, 5.00)[*]

COR, Crude odds ratio

AOR, Adjusted odds ratio

[*]P-value ≤0.05

[**]P- value ≤0.001

[§]BMI, underweight (BMI < 18.5) (n=43) was excluded from the analysis

CHAPTER IV: DISCUSSION

4.1 Main findings

Diabetes and prediabetes were found to be prevalent in this study, 4.4% and 34%, respectively, with a larger prevalence with increasing age. Overall, 6.6% of women ≥55 years had diabetes and 46.9% had prediabetes. The occurrence of prediabetes was also high in the youngest age groups, with a prevalence of 18.9 and 24.4%, respectively in women < 34 years and 35-44 years of age. Overweight was observed in 38.4% of the total population and obesity in 24.5%. Among those with diabetes, 48.5% and 36.4 % were overweight and obese, respectively. Increasing age, overweight and central obesity were associated with increased risk both for diabetes and prediabetes. Smoking showed an association with prediabetes only. Intake of fruit less than 5 times weekly seemed to reduce the risk of diabetes. Hypertension was associated with both prediabetes and diabetes. The awareness of diabetes was low among the participants. About 76% of the women were not aware of any of the risk factors, and 84% had never had blood sugar tested. Only 4% of the women observed to have diabetes had been diagnosed previously.

4.2 Comparing main findings with other studies

The prevalence was lower than reported in the two previous meta-analyses on diabetes prevalence in Nepal. However, these meta-analyses included few studies from rural districts, and the data were not stratified for gender. In the meta-analysis by Gyawali et al, the prevalence rates in three rural districts were reported to be 1.3%, 2.5%, and 0.03%, respectively (50), which is substantially lower than in our study. The high prevalence of prediabetes in our study population corresponds to the prevalence of 35.7% observed among females in China (2013) (76) but is substantially higher than reported by Gyawali in semi-urban Nepal (77). According to an expert panel of ADA, 70% of subjects with prediabetes will develop diabetes in the future (78). Moreover, a recent meta-analysis including 129 studies and more than 10 million participants reported that prediabetes was associated with enhanced risk of all cause mortality and CVDs in the general population (79).

In the present study, we did not analyze C-peptide or auto-antibodies and can therefore not differentiate between DM1 and DM2. However, given the preponderance of DM2 in Asia, it is very likely that the majority of women had DM2. Altogether, 28 women reported to have been diagnosed with diabetes before, but only eight of these women had HbA1c > 6.5%. Whether they were treated with anti-diabetic drugs was not reported.

In contrast to previous studies on diabetes prevalence in Nepal, we used HbA1c as a diagnostic tool. HbA1c has several advantages, including stability at ambient temperature, low intraindividual variability, assay standardization, and long-term association with future development of diabetes. Moreover, blood sampling can be carried out in a non-fasting state and at any time of the day. It also has some drawbacks, as it can be affected by among others red blood cell turnover, hemoglobinopathies, medications, race, and age (80). Two measurements of HbA1c are required to make a diagnosis of diabetes in absence of symptoms, hence only one measurement as was performed in the present study, may have affected the result. Previous studies in Nepal, have used fasting plasma glucose (FPG) and/or oral glucose tolerance test (OGTT) as diagnostic criteria. Notably, FPG and OGTT may underestimate the burden of diabetes compared to HbA1c. Thus, HbA1c may identify more people at risk of diabetes than FPG. This has been observed in several Asian populations, but not in US adults (81, 82).

4.3 Risk factors and diabetes status

In line with previous studies of DM2, we observed an increase in prevalence with age. Prediabetes also increased with age, but was also frequent in younger age groups. Overweight and obesity, as well as central obesity were found to be more frequent among women with diabetes. Obesity was observed in 20%, 30.4% and 36.4% of those with normoglycemia, prediabetes and diabetes, respectively. The same pattern was seen for obesity and central obesity. Notably, overweight and obesity were more prevalent in our study than in the Nationwide survey (83).

Intake of vegetables <5 times a week tended to reduce the risk of both DM2 and prediabetes. Likewise, fruit intake less than five times weekly seemed to decrease the risk of prediabetes and diabetes, although not significant for the latter. This is in contrast to a study showing that adults who ate two servings of fruits per day were 36% less likely to develop DM2 during 5 years of follow-up, compared to those who ate less than half a serving of fruit daily (84).

According to the World Bank 2018, the overall prevalence of smoking among Nepalese women was 15.3%, whereas the prevalence of current smoking in the present study was 12.8%. Smoking promotes inflammatory changes in the body, which can lead to CVD, hypertension and diabetes. We observed a significant association between smoking and prediabetes. This is in line with previous studies, showing that chronic smokers exhibited a higher risk of insulin resistance, and to develop DM2 (85). Heavy smokers (at least 20 cigarettes daily) displayed a 61% higher risk,

while less than 20 cigarettes daily were correlated to a 29% increase of the risk. Former smokers had just a 23% higher risk (85).

Hypertension is reported to be present in more than 50% of patients with diabetes and contributes significantly to both micro- and macrovascular disease in these patients (86). In concordance with that we observed a higher prevalence of hypertension both in those with prediabetes and diabetes compared to non-diabetics. A strong association of blood pressure and prediabetes/diabetes was seen. Hypertension and DM2 are both components of metabolic syndrome, a condition that also includes obesity. Metabolic syndrome is a strong risk factor for CVDs. In the non-diabetic state, hypertension is more common among men. At the age of 64, however, the prevalence in females and males are simlar (87). Notably, the incidence of hypertension is higher in women with IGT and diabetes than in their male counterparts. Moreover, women with diabetes have higher relative risk for death from CVDs than diabetic men.

4.4 Consequences of the study

Taken together, our study shows a higher prevalence of diabetes and prediabetes among rural women than previously reported. Previous studies were, however, not stratified for gender, which makes comparison difficult. Overweight/obesity, hypertension were also common. Together with diabetes these are components of the metabolic syndrome. Our findings are of concern as they imply that a substantial proportion of these women display metabolic syndrome, which translates to an increased risk for CVDs. We identified similar risk factors as previous studies, including aging, overweight and smoking. The fact that many of the women with prediabetes were in fertile age, may contribute to acceleration of the diabetes epidemics, as the offspring have increased risk of obesity and diabetes later in life. The awareness of diabetes was very low among the women. Thus, to combat the diabetes epidemics there is a need for increased awareness at all levels and development of cost-effective measures to identify individuals at risk for diabetes. Given that women are taking care of the household of the family in Nepal, they are the key persons with respect to accomplishment of lifestyle changes.

4.5 Limitations

The study has limitations. The findings may not be generalizable to women in all rural districts of Nepal and not to men. Since the study is cross-sectional, the causal association between diabetes and its related risk factors can not be established. The information collected from the questionnaire relies on self-report and may be influenced by recall bias and social desirability bias. HbA1c should ideally have been measured twice.

CHAPTER V: CONCLUSION

Our study revealed a high prevalence of prediabetes 34.0% and diabetes with 4.4% among married women in rural Nepal. Increasing age, overweight/ obesity, central obesity and smoking were identified as risk factors for diabetes. An association of hypertension and prediabetes/diabees was also observed.

These estimates will help health practitioners and policymakers focus their efforts on developing preventive interventions and improving primary health care for individuals and families in order to prevent diabetes from being passed down through generations. A task force for prevention, early diagnosis, fast treatment, protection against complications, and health education should be activated.

CHAPTER VI FUTURE IMPLICATIONS

Despite the fact that Nepalese women have long being affected by prediabetes and diabetes, current data should be regarded crucial in order to develop prevention and management strategies. Awareness among women, proper exercise, regular screening, proper physical exercise and appropriate diet plan are highly recommended to the women of those study areas. There should be other approached such as counseling and health education to the women and men about risk factors and its prevention as well as continual support, surveillance, encouragement through monitoring. These can be carried out through primary health care because of its availability in each community and focus on local people. Educational institutions and workplaces should be used to disseminate knowledge on diabetes. Social media can be very useful to educate people.

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Annex

Questionnaire

Diabetes among women in rural Nepal; risk factors, complication and relation with vitamin A and D. A prospective cohort study

Location and date		Response	Code
1.	Name of village		
2.	Ward No.		
3.	Local Place Name		
4.	Interviewer ID		

Participants ID number					
Consent, interview language and name		Response			Code
	Consents has been read and obtained	Yes No (If No, End)			
	Interview language	Nepali Tamang Newari			
	Time of interview				
	Family Surname				
	First name				
	Husband Name				
	Contact phone number where possible				

Personal information				Code	
	How old are you?	Year		Mention complete year	P1
	What is your ethnicity? Brahmin/Cheetri Newar/Tamang Dalit/lower cast Others			Mention if others	P2
	What is your religion? Hindu Buddhist Christina Muslim			Mention if others	P3
	What is your highest education level you have completed? Illiterate Primary education Secondary Higher /SLC College Refuse				P4
	Are you involved in income generating group/activities? Yes 2. No If Yes, Since how many years …………				P5
	Which of the following best describes your main work status over the past 12 months? Employee (gov/non gov) Self-employee … Retried Housewife Others (specify)……				P6
	What is your average income (NRS)……….				P7

Household Information				
	How many family members do you live with?	Number		H1
	What is the average family income per month? (NPR)			H2
	Your husband education? Uneducated c. Primary education Secondary d. Higher	Escape for widow and divorce women		H3

e. University education f. No response			
Your husband occupation Employee (gov/non-gov) d. Self-employee c. Homemaker Retired e. Others		H4	
Did anyone from your family go abroad for work? Yes 2. No If Yes, How many months………….	If No go to H6	H5 H5a	
What are the most common energy source for cooking ? LPG c . Traditional Improved cooking stove d. Others (specify)..		H5	
How long time do you spend for cooking daily ?	Hours ……. Min…..	H7	

Marital and reproductive information			
What is your current marital status? Married living with husband Married husband is not with me Widow Divorced	Mention if others	MR1	
What was the age when you were married?	Years	MR2	
How many children do you have? 	Son	
Daughter	
Total			If Null go to Q.D	MR3a MR3b MR3c	
What was the birth weight of your last-born child?	…………… (Kg)	MR4	
When was your last child born?	Years …………….	MR5	
How old were you when you had your first baby?	Years	MR6	
Where did you give birth your last baby? House Health institution Others specify		MR7	
How many days did you have on an average for postnatal care?	Days	MR8	

How long did you exclusively breastfeed your last baby? < 2 weeks 2-6 weeks 6 weeks -3 months 3-6 month 6-12 months >12 months		MR9	
In the first 5 months after delivery of your last baby, did your baby get anything to eat or drink other than breast milk?	Yes b. No	MR10	

What was the extra food and fluid given to your baby?
 	
  Formula   Water   Cerelac
 	
  Lito   Buffalo /cow Milk   Others
		MR11	

Generally, how many times did you breastfeed your baby per day?	Frequency………	MR12	
For how many months did you breastfeed your baby?	Number of days	MR13	
Do you have regular menstrual bleedings?	Yes No	MR14	
Have you had your menopause? (If women age > 40 years)	Yes , Mention age …… No	MR15	

Tobacco and alcohol use				
Tobacco use				
	Do you smoke?	Yes b. No	If yes, go to T8	T1
	Do you currently smoke and use any tobacco products, such as cigarettes, bidis, hukhs or tamakhus?	Yes b. No	If No go to T8	T2
	Do you smoke tobacco products daily?	Yes b. No		T3
	How old were you when you started smoking ?	Years		T4
		Don't know		
		Weeks		
	How many cigarettes do you smoke daily?	Number……..		T5
	During any visit to a doctor or other health worker in the past 12 months, were you advised to quit smoking tobacco?	Yes No No visit during last 12 months	If T2 = yes, go to T12, if T2=NO, go to c9)	T6
			If T2 = yes, go to T12, , if T2=NO, go to c9)	
			If T2 = yes, go to T12, , if T2=NO, go to c9)	
	In the past, did you ever smoke daily ?	Yes b. No	If No, go to C12	T8
	How old you were you when you stopped smoking?	Years		T9
		Don't know		
	How long ago did you stop smoking	Years		T10a

	(**Record only 1, not all 3**)	Months			T10b
		Weeks			T10c
	Do you currently use any smoke-less tobacco products such as (snuff, chewing tobacco, khaaini surti, gutak)	Yes b. No			T11
	Do you currently use smokeless tobacco products daily?	Yes b. No	If no go to T15		T12
	On average, how many times a day/week do you use.		Daily	Weeks	
		Chewing tobacco			T14a
		Betel			T14b
		Other			T14c
		Don't know			T14d
	In the past, did you ever use smokeless tobacco products such as (snuff, chewing tobacco, nasal snuff, Khaini, surti, gutka) daily	a .Yes b .No			T15
	In the past , did you ever use smokeless tobacco products such as (snuff, chewing tobacco, nasal snuff, Khaini, surti, gutka) daily	Yes b. No			T16

Alcohol consumption				
	Have you ever consumed an alcoholic drink such as beer, wine, spiritis, fermented cider or (jaad, raksi, tungba) ?	Yes b . No	If no, go to K	A1
	Have you consumed an alcoholic drink within the past 12 month ?	a. Yes b . No	if no, go to K (other section)	A2
	During the past 12 months, how frequently have you had at least one alcoholic drink ?	Daily		
		5-6 days per week		
		1-4 days per week		
		1-3 days per month		A3

		Less than once a month		
	Have you consumed alcohol in the past 30 days	a. Yes b. No	if no, go to K	A4
	If yes How often did you drink	Daily		
		5-6 days per week		
		1-4 days per week		
		1-3 days per month		
		Less than once a month		
				A5
	How many standard drinks did you have on each occasion **(show card)**			
	How often did you have meals together with the drink ?**(do not count snacks)**			
	During the last week, how many standard drinks did you have each day?			
	During each of the past 7 days, how many standard alcoholic drinks did you have each day? **(Use Showcard)**	Sunday		A8a
		Monday		A8b
		Tuesday		A8c
		Wednesday		A8d
		Thursday		A8e
		Friday		A8f
		Saturday		A8g
		Donot know		77

Diet

SNO	Questionnaire	Response		Code
	In a typical week, on how many days do you eat fruit**? (Show card)**	if zero days , go to D3		D1
	Number of days……………………………….	Don't know		
	How many servings of fruit do you eat on one of those days ? (**Show card**)	number of servings		D2
		Don't know		
	In typical week, on how many days do you eat vegetables?	Number of servings		D3
		Don't know		
	How many serving of vegetables do you eat on one of those days?	Number of servings		D4
		Don't know		
	What type of oil or fat is most often used for meal preparation in your household?	Mustard oil		D5a
		Refined vegetable oil		D5b
		lard or suet		D5c
		Butter or ghee		D5d
		noodles oil		D5e
		None used		D5f
		don't know		d77
		Others (specify)		D5g

Show portion size picture to for estimating portion size

	Food name	Frequency of eating								Portion size			
		2-4 times a day	Once a day	2-4 times a week	Once a week	2-4 times a month	Once a month	Once every 4 months	less than 1 every four month	Average size	Less	Average	More
	Cereal												
1.1	Rice	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
1.2	Beaten rice	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
1.3	Whole wheat flour	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
1.4	Maize/corn	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
1.5	Choumin	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
1.6	Sooji	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
1.7	Other like kodo, fapar, bajra	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
	Legumes												
2.1	Sprouts	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
2.2	Cheakpeas, dry peas, dry beans	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
2.3	Soyabean	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
	Vegetables (in season)												

3.1	Broccoli, Cauliflower	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.2	Radish, Turnip	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.3	Cabbage/ Kohlrabi	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.4	Watercress	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.5	Spinach	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.6	Pumpkin	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.7	green beans, peas	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.8	Eggplant	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.9	Tomato	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.10	Garlic	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.11	Onion/ Shallot	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.12	Carrot	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.13	Cucumber	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.14	Potato	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.15	Yam	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
3.16	Sweet potato	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
4.	Eggs and Milk Product												
4.1	Eggs	☐	☐	☐	☐	☐	☐	☐	☐				

4.2	Milk	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
4.3	Consensed milk	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
4.4	Curd	☐	☐	☐	☐	☐	☐	☐	☐	1 cup	☐	☐	☐
4.4	Chees, panner etc	☐	☐	☐	☐	☐	☐	☐	☐				
5.0	Junk Food												
5.1	Instance noodles	☐	☐	☐	☐	☐	☐	☐	☐				
5.2	Fruit juices/carbonated drinks (coca cola, pepsi etc)	☐	☐	☐	☐	☐	☐	☐	☐				
5.3	Cookies (biscuit)	☐	☐	☐	☐	☐	☐	☐	☐				

	Physical activity			
SNO	Questionnaire	Response		Code
	Does your work involve vigorous-intensity activity that causes large increase in breathing or heart rate like carrying or lifting heavy loads, digging or construction work, etc.. for at least 10 minutes continuously	Yes No	if no go toP4	P1
	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	No of days …		P2
	How much time do you spend doing vigorous-intensity activities at work on a typical day	Hours ____	Minu_ ____	P3
	In a typical year, how many months are you involved in this activity	Months ____		P4
	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?	Yes No	if no go to P7	P5
	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Days_____		P6
	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours___ __	Mins_ _	P7
	Do you walk for at least 10 minutes continuously to get to and from places	Yes No		P8
	In a typical week, on how many days do you walk for at least 10 minutes continuously to get to and from places?	number of days ___		P9
	How much time do you spend or walking for travel on a typical day ?	Hours___ __	Mins	10
	Sedentary behavior			
	How much time do you usually spend sitting or reclining on a typical day?	Hours___ __	Mins___ __	

Medical History – Blood pressure (BP)				
Questionnaire		Response		Code
Any chronic diseases you are suffering from? If Yes, What …………..		Yes No		H0
	Have you ever had your BP measured by a doctor or other health worker?	Yes No if no, go to Diabetes section		H1
	Have you been told that you have raised BP or hypertension?	Yes No if no, go to Diabetes section		H2a
	Have you been told in the past 12 months?	Yes No		H2b
Are you currently receiving any of the following treatment/advice for high BP prescribed by a doctor or other health workers?				
4.	Drugs (medication) that you have taken in the past two weeks	Yes	No	H3a
	Advice to reduce salt intake			H3b
	Advice or treatment to decrease weight			H3c
	Advice or treatment to stop smoking			H3d
	Advice to start or do more exercise			H3e
5.	Have you ever seen a traditional healer for raised BP or hypertension?			H4
6.	Are you currently taking any herbal or traditional remedy for your raised BP?			H5
7	Has anyone in your family suffered from high BP?			H6
	Who---			H7
	Since how long			H8

	Any medication				H9

Knowledge on Diabetes				
S.No	Questionnaire	Response		Code
	Do you have diabetes?	Yes 2. No		DK1
	If Yes, what type	Type 1 Type 2 Don't know		DK1a
	Have you ever had your blood sugar measured?	Yes 2. No		DK1b
	What was the result?	Normal 2. Elevated 3. Don't know		DK1c
	Where the test was done?	Hospital 2. Primary health center 3. Others		DK1d
	Do you think, in general, more and more people are getting affected with diabetes ?	Yes No Don't know		DK2
	Do you think occurrence of diabetes is increasing?	Yes 2. No 3. Donot know		
	Which factors do you think contribute to diabetes? Obesity Decreased physical activity Family history of diabetes Mental stress Consuming more sweets Others			DK3
	Do you know that diabetes can cause complications in other organs? Yes No			DK4

	Don't know			
	If yes, what are they?	_____	1	Dk4 a
		_____	2	Dk4 b
		_____	3	Dk4 c
	Can diabetes be prevented	Yes No Don't know		
	Is anyone in your family suffering from diabetes? If **Yes,**	Yes No		Dk7
	Who			Dk7 1
	Since how long			Dk7 b
	What type			Dk7 c

Physical measurement				
Height	in centimeter		.	
Weight	in Kilogram			
Waist	in centimeter			
Hip Circumference	In Centimeter			
Blood pressure 1	Systolic mmHg			
	Diastolic mmHg			
Blood pressure 2	Systolic mmHg			
	Diastolic mmHg			

Thank you !