# AN EPIDEMIOLOGICAL STUDY OF DIABETES MELLITUS IN PRODUCTIVE AGED URBAN NEPALESE OF MAKALBARI AREA OF GOKARNESHWOR MUNICIPALITY

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## ABSTRACT

Diabetes mellitus is a chronic disease that through its complications can seriously impact the quality of life of an individual. The incidence of diabetes mellitus is starting to rise at a younger age. This study is carried out to determine the prevalence of diagnosed diabetes mellitus in productive aged persons and to study the association of socio-demographic characteristics, body mass index (BMI) and blood pressure among persons with and without diabetes mellitus. A community-based cross-sectional, observational study was conducted in Makalbari area. Systematic random sampling technique was used to select the households. The family members from those households who met the inclusion criteria were interviewed with self-constructed semi-structured questionnaire which included socio-demographic information of respondents. Height, weight and blood pressure were recorded. BMI was interpreted as per WHO guidelines and hypertension was defined as per Joint National Committee (JNC) VII guidelines. Among total 662 participants, 342 (51.7%) were female and 320 (48.3%) were male. About 196 (29.6%) of subjects were between 25 to 34 age group followed by 145(21.9%) of them in 35 to 44 age group. Prevalence of diagnosed diabetes mellitus in productive aged persons in urban area was 3.8%. The prevalence of BMI of ≥25 was 42.4%. Out of total subjects, maximum number of respondents were prehypertensive 406 (61.3%). Mean age of total participants was 37.9±13.59 and BMI was 24.15±3.89.The age of respondents was highly statistically significant among the persons with diabetes (p = 0.000). The number of diabetes mellitus increased with increase in age and BMI of the participants. Prevalence of diabetes mellitus was almost same in both male 13 (52.0%) and female 12 (48.0%). Diabetes mellitus was seen more in subjects who had completed secondary level education 11 (44.0%) and in homemakers and government job holders, 3 (33.3%) each. In conclusion, most of the people in productive age groups were preobese and were in prehypertensive stage which may increase the risk of acquiring diabetes mellitus in future. This necessitates the screening of more persons in productive age group for diabetes mellitus.

## KEYWORDS

Cross sectional study, BMI, hypertension, diabetes mellitus

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## INTRODUCTION

Diabetes mellitus (DM) is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Hyperglycaemia, or raised blood sugar, is a common effect of uncontrolled DM and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels. It is a major modifiable risk factor leading to premature death due to cardio and cerebrovascular diseases. The worldwide prevalence of diabetes mellitus has risen dramatically in the developing countries over the past two decades. As of 2016, 422 million people have DM worldwide, up from an estimated 382 million people in 2013 and from 108 million in 1980. The total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030. An estimated 1.6 million deaths were directly caused by diabetes. Another 2.2 million deaths were attributable to high blood glucose in 2012. The World Health Organization (WHO) is warning that the number of people with DM is rapidly increasing. It has estimated that 91 million persons in the Southeast Asia region have DM and around 49 million are still unaware of their condition. It was the seventh leading cause of death in 2016. Almost half of all deaths attributable to high blood glucose occur before the age of 70 years.[1]

The percentage of deaths attributable to high blood glucose or DM that occurs prior to age 70 is higher in low- and middle-income countries than in high-income countries.[2] Shaw *et al.* estimated that the world prevalence of DM among adults aged 20–79 years was 6.4% (285 million) in 2010, and will increase to 7.7% (439 million) by 2030.[3] Of special note is that there will be a 67% increase in the prevalence of diabetes in developing countries from 2010 to 2030. Thus, DM is an important health problem because of its high morbidity and mortality.[4] This rapid increase in the global prevalence of DM is attributed to population growth, aging, urbanization and increasing prevalence of obesity and physical inactivity. Hence, regular screening of adults is essential for early detection and care.[2]

As per International Diabetes Federation 2017, South-East Asia is home to one fifth (19 %) of the total number of people with DM in the world. Almost 84 million people have diabetes which is the second highest regional number. If we do not act now, this figure will rise to 156 million (86%) by 2045. More than half (58%) of them have not been diagnosed and are at a higher risk of developing harmful and costly complications. Close to half (48.8%) of all adults with diabetes in the region live in urban areas. About 1.3 million deaths were due to diabetes. Nepal has 3.7% of its populace diagnosed with diabetes mainly due to rapid urbanization, high junk food consumption, and sedentary lifestyles. About 13,431 died of diabetes in Nepal in 2017. Family support has lot of impact on improving health outcomes for people with diabetes. But, not even 1 in 4 of a family has access to diabetes education programs. Coming to ill-effects, studies show that persons with diabetes are 2-4 times at a higher risk of heart attack compared to those without diabetes. It is also the major cause of non-traumatic lower limb amputation and chronic complication of eyes and kidneys.[5] Diabetes and its complications also bring about substantial economic burden to people with diabetes and their families, and to health systems and national economies through direct medical costs and loss of work and wages.[2] Quantifying the prevalence of diabetes and the number of people affected by diabetes, now and in the future, is important to allow for rational planning and allocation of resources.[6]

Obesity has emerged as one of the strongly associated modifiable risk factors of type 2 DM owing to its role in insulin resistance. By 2025, there are reports that obesity, which is related to diabetes, would rise to an alarming number of 300 million.[7] Hypertension (HTN) is another risk factor associated with type 2 DM. Its prevalence in diabetic patients is almost double as compared to non-diabetics.[8] The presence of HTN expedites the development of complications in a diabetic patient like stroke, myocardial infarction, retinopathy, neuropathy, and nephropathy. The concomitant presence of HTN increases the mortality and morbidity in a diabetic patient.[9]

The incidence of DM is starting to rise at a younger age.[10] Adults of the productive age group are dynamic and productive; and are expected to be in optimal health condition, so they can work optimally in life. The "Definition of Productive Age is a range of age when people can work for paid employment optimally". People should work during their productive age for paid employment.[11] Nepal has a specific range of productive age that is from 15 years-of-age until 64 years-of-age.[12] In Nepal's STEP Survey, which was a population-based household survey of adults aged 15-69 years for non-communicable diseases, the prevalence of raised fasting blood glucose (fasting blood

glucose ≥ 126 mg/dl) or currently on medication for raised blood glucose was 5.8%.[13] Hence, this study was conducted to determine the prevalence of diagnosed DM in productive aged urban Nepalese of Makalbari area and to study the association of socio-demographic characteristics, BMI and blood pressure among persons with and without diabetes mellitus.

## MATERIALS AND METHODS

A community-based cross-sectional, observational study was conducted among the residents of Makalbari of Kathmandu district from May 2019 to October 2019. Makalbari is a part of 4, 6 and 8 wards of Gokarneshwor Municipality with estimated 800 households. Using systematic random sampling technique, every 4$^{th}$ household was selected till required number of sample size was obtained. Ethical clearance was taken from the Nepal Medical College Institutional Review Committee (NMC-IRC). The study participants were the people in productive age group 15 years to 64 years who were (physician) diagnosed DM and/or on anti-hyperglycemic agents. Individuals <15 years and >64 years, pregnant ladies and seriously ill people in that area were excluded from the study. Consent was taken from each participants prior to the interview. During the interview, the information regarding socio-demographic characteristics, medical and family history and anthropometric measurements were obtained. After measuring the height by measuring tape and weight by bathroom weighing scale as per CDC standards,[14] BMI was calculated as weight(Kg)/height(m$^2$) and interpreted as per WHO criterion measure for the cutoff points for overweight (25 kg/m$^2$) and obesity (30 kg/m$^2$).[15] The blood pressure was measured by auscultatory method using standard aneroid sphygmomanometer. The method of blood pressure measurement and criteria for diagnosis of hypertension was done according to JNC VII guidelines that is, systolic blood pressure (SBP) ≥ 140 mm Hg or diastolic blood pressure (DBP) ≥ 90 mm Hg and/or concomitant use of antihypertensive medications.[16]

Sample size was calculated using formula $Z^2pq/d^2$, where (p) was taken as 18.5% [17] and d was taken as 16% of p. The minimum sample size calculated was 662. Statistical analysis of the collected data was carried out using SPSS version 16. Frequency distribution of socio-demographic data, BMI, HTN and DM were calculated. Chi-square test was used to study association between categorical variables.

## RESULTS

A total of 662 participants with 342 (51.7%) females and 320 (48.3%) males were enrolled. Most of the subjects 196 (29.6%) were between 25 to 34 age group which was followed by 35 to 44 age group which had 145 (21.9%) subjects. Maximum number of the respondents 195 (29.5%) had completed secondary level of education followed by higher secondary level 21.5% and bachelor level 20.7% whereas 15.4% of them were illiterate. Most of the participants were homemakers 219 (33.1%), followed by private job holders 126 (19%) and students 78 (11.8%). Among the total respondents, 46.6% of them had income of Rs.10000 to 30000 and 36.1% had income of Rs 30001 to 50000. Family history of diabetes mellitus was present in 17(2.6%) respondents (Table 1).

**Table 1: Socio- demographic profile of the study population**

| Characteristics (n = 662) | N | % |
|---|---|---|
| **Gender** | | |
| Male | 320 | 48.3 |
| Female | 342 | 51.7 |
| **Age group** | | |
| 15 to 24 | 115 | 17.4 |
| 25 to 34 | 196 | 29.6 |
| 35 to 44 | 145 | 21.9 |
| 45 to 54 | 89 | 13.4 |
| 55 to 64 | 117 | 17.7 |
| **Education level** | | |
| Primary level | 37 | 5.6 |
| Secondary level | 195 | 29.5 |
| Higher secondary level | 142 | 21.5 |
| Bachelor level | 137 | 20.7 |
| Master level | 49 | 7.4 |
| Illiterate | 102 | 15.4 |
| **Occupation** | | |
| Unemployed | 53 | 8.0 |
| Home maker | 219 | 33.1 |
| Student | 78 | 11.8 |
| Private job | 126 | 19 |
| Government job | 43 | 6.5 |
| Business | 70 | 10.6 |
| Others | 73 | 11 |
| **Income (n = 266) (USD1=NPR 117.91)** | | |
| 10000 to 30000 | 124 | 46.6 |
| 30001 to 50000 | 96 | 36.1 |
| 50001 to 70000 | 29 | 10.9 |
| above 70000 | 17 | 6.4 |
| **Family history of DM** | 17 | 2.6 |

**Table 2: Prevalence of "diagnosed Diabetes Mellitus" in productive aged persons (n=662)**

| Diagnosed Diabetes Mellitus | N | % |
|---|---|---|
| Yes | 25 | **3.8** |
| No | 637 | 96.2 |

As shown in table 2, the prevalence of "diagnosed Diabetes Mellitus" in productive aged persons in urban area was found to be 25 (3.8%) whereas the majority, 637 (96.2%), of the study participants did not have diabetes mellitus.

As revealed in table 3, half of the participants 341 (51.5%) had normal BMI followed by pre-obesity 228 (34.4%), obese class I 47 (7.1%) and only 2(0.3%) had obesity class III. The prevalence of overweight and obese was 42.4%. However, 38 (5.7%) were underweight.

**Table 3: Prevalence of obesity as per WHO BMI Classification (n=662)**

| BMI classification | N | % |
|---|---|---|
| Underweight | 38 | 5.7 |
| Normal | 341 | 51.5 |
| Pre-obese | 228 | 34.4 |
| Obese class-I | 47 | 7.1 |
| Obese class-II | 6 | 0.9 |
| Obese class-III | 2 | 0.3 |
| Total | 662 | 100.0 |

Out of total subjects, maximum number of respondents were prehypertensive 406 (61.3%) followed by Stage 1 hypertension 121 (18.3%) and Stage 2 hypertension 30 (4.5%) (Table 4).

As depicted in table 5, age was significantly associated with DM (p = 0.000). Prevalence of DM was more among older subjects, who had lesser income and who were preobese. But, there was no significant association of DM with income as well as BMI of the respondents.

**Table 4: Distribution of respondents in different Blood Pressure categories as per JNC VII Criteria (n=662)**

| Categories of BP | SBP (%) | DBP (%) | N (%) |
|---|---|---|---|
| Normal | 178 (26.9) | 208 (31.4) | 105 (15.9) |
| Prehypertension | 405 (61.2) | 323 (48.8) | 406 (61.3) |
| Stage 1 hypertension | 67 (10.1) | 99 (15.0) | 121 (18.3) |
| Stage 2 hypertension | 12 (1.8) | 32 (4.8) | 30 (4.5) |

**Table 5: Association of Diabetes Mellitus with age, income and BMI of respondents (n=662)**

| Characteristics | Diabetes Mellitus | | Chi Square Test P value |
|---|---|---|---|
| | Absent | Present | |
| **Age** | | | |
| 15 to 24 | 115 (18.1%) | 0 (0.0%) | 0.000* |
| 25 to 34 | 196 (30.8%) | 0 (0.0%) | |
| 35 to 44 | 140 (22.0%) | 5 (20.0%) | |
| 45 to 54 | 85 (13.3%) | 4 (16.0%) | |
| 55 to 64 | 101 (15.9%) | 16 (64.0%) | |
| **Income** | | | |
| 10000 to 30000 | 118 (47.0%) | 6 (40.0%) | 0.055 |
| 30001 to 50000 | 87 (34.7%) | 9 (60.0%) | |
| 50001 to 70000 | 29 (11.6%) | 0 (0.0%) | |
| Above 70000 | 17 (6.8%) | 0 (0.0%) | |
| **BMI** | | | |
| Underweight | 38 (6.0%) | 0 (0.0%) | 0.069 |
| Normal | 333 (52.3%) | 8 (32.0%) | |
| Preobese | 216 (33.9%) | 12 (48.0%) | |
| Obese class 1 | 43 (6.8%) | 4 (16.0%) | |
| Obese class 2 | 5 (0.8%) | 1 (4.0%) | |
| Obese class 3 | 2 (0.3%) | 0 (0.0%) | |

*significant p value < 0.05

As shown in table 6, the prevalence of DM was almost same in both males 13 (52.0%) and females 12 (48.0%). DM was seen more in subjects who had completed secondary level education 11 (44.0%) , who were homemakers and government job holders, 3 (33.3%) each and who were prehypertensive 13 (52.0%).

**Table 6: Association of Diabetes Mellitus with Sex, Education,Occupation and Hypertension.**

| Characterstics | Diabetes mellitus | | Chi Square Test p value |
|---|---|---|---|
| | Absent | Present | |
| **Sex** | | | |
| Male | 307(48.2%) | 13 (52.0%) | 0.709 |
| Female | 330 (51.8%) | 12 (48.0%) | |
| **Education** | | | |
| Primary level | 35 (5.5%) | 2 (8.0%) | |
| Secondary level | 184 (28.9%) | 11(44.0%) | |
| Higher Secondary level | 138 (21.7%) | 4 (16.0%) | 0.109 |
| Bachelor level | 136 (21.4%) | 1 (4.0%) | |
| Master level | 48(7.5%) | 1(4.0%) | |
| Illiterate | 96 (15.1%) | 6 (24.0%) | |
| **Occupation** | | | |
| Uneployed | 19 (8.6%) | 0 (0.0%) | |
| Homemaker | 74(33.3%) | 3 (33.3%) | |
| Student | 27 (12.2%) | 0 (0.0%) | 0.055 |
| Private job | 44 (19.8%) | 1(11.1%) | |
| Government job | 12 (5.4%) | 3 (33.3%) | |
| Business | 24 (10.8%) | 0 (0.0%) | |
| Others | 22(9.9%) | 2(22.2%) | |
| **Hypertension** | | | |
| Normal | 101 (15.9%) | 4(16.0%) | |
| Prehypertension | 393 (16.7%) | 13(52.0%) | 0.667 |
| Stage1 hypertension | 114 (17.9%) | 7(28.0%) | |
| Stage 2 hypertension | 29 (4.6%) | 1(4.0%) | |

*significant p value < 0.05

However, there was no significant association of DM with education, occupation and HTN in the study participants.

## DISCUSSION

In Nepal, the estimated number of persons with diabetes in 2000 was 436,000 and it is expected to rise to 1,328,000 by 2030. This study showed that the prevalence of DM was 25 (3.8%). This finding is comparable to the International Diabetes Federation estimate of DM for Nepal (3.7%),[5] to those of studies done in Indonesia (4.6%)[11] and Ayder Referral Hospital (1.3%).[18] On the other hand, the result is lower than those of other studies done in Gondar Town and Dabat residential districts which together reported 5.11%, Bishoftu town in which a prevalence of 5% was detected.[19,20] in Southwest Ethiopia 6.5%,[21] in Saudi 2279 (30%),[6] 10% in India,[22] in Eastern Nepal 26.3% [23] and in Kathmandu 18.56%.[17] This discrepancy may be due to differences in the study area, study designs, sample sizes used, and the year the studies were conducted. The prevalence of diabetes is increasing day by day in Nepal may be due to urbanization. Mehta *et al* and Singh *et al* showed the prevalence of diabetes in urban area were higher in compare to the rural area.[24, 25]

Alqurashi *et al* conducted a study among 6024 patients attending the Department of Primary Care at King Fahad Armed Forces Hospital in Saudi and showed that 2279 (37.8%) were males and 3744 (62.2%) females. The prevalence of BMI of ≥25 was 72.5.[6] In similar study conducted in India found that 54% were females and 46% were males.[22] The present study also had similar finding; 320 (48.3%) were males and 342 (51.7%) were females. However, the prevalence of BMI of ≥25 in the respondents was lower 42.4%.

In a cross-sectional survey carried out in Indonesia among 15,332 adults, aged 18-55 years, living in an urban area found that DM affected more women than men, which increased with age, was higher among the high socioeconomic group and increased with increasing BMI.[11] In another study done in Iran showed the prevalence of diabetes increased in the older age and in the obese subjects.[26] Similar findings were found in our study in which DM was more prevalent among the older subjects and those with higher BMI. In contrast to these studies, prevalence of DM was almost same in both males and females. Diabetes was seen more in those who were preobese 12 (1.8%) followed by obese class I 4 (0.6%) and in those persons who had less income.

Muninarayana C in India found that most of the diabetic patients (54.8%) were in the age group of 30-45 years. This showed diabetes in young adults is common. About 43.7% of the respondents were illiterates and 56.3% of them were literates; 80% of the study population was sedentary in occupation (teachers, clerk, businessmen and home makers). About 70% of participants had normal weight and only 8.7% of them were obese.[22] In contrast to this study, most of the persons with diabetes 16 (2.4%) were in age group 55 to 64 years in present study. Only 15.4% of the participants were illiterates and 84.6% of them were literates. Majority of the respondents (63.5%) were sedentary in occupation (unemployed, homemakers, students and businessmen). About 51.5% participants had normal weight, 34.4% of them were pre-obese and only 8.3% were obese.

Sharma SK *et al* conducted a study in Eastern Nepal which revealed that about 12.3% of the participants had a family history of diabetes, 28% were overweight, and 32% were obese. Prevalence was higher in the females, people working at home, and less educated.[23] In our study, family history of DM was present in 2.6% respondents only. DM was seen more in subjects who had completed secondary level education 11 (1.7%) and in homemakers and government job holders, 3 (1.3%) each. However, fewer numbers of respondents were obese 55 (8.3%).

In another study done in Kathmandu, Nepal by Paudel VP, a total of 291 subjects were screened in which 78% of the population studied were males and only 22% were females. About 46.7% were overweight, 15.8% obese and 2.1% had morbid obesity. Half (50.5%) of the population had normal Blood Pressure (BP) while 24.4% had borderline BP.[17] Nepal's STEP Survey showed the prevalence of raised fasting blood glucose or currently on medication for raised blood glucose was 5.8%, prevalence of raised BP (SBP ≥ 140 and/or DBP ≥ 90 mmHg or currently on medication for raised BP) was 24.5%, overweight (BMI ≥ 25 kg/m2 ) was 24.3% and obese (BMI ≥ 30 kg/m2 ) was 4.3%.[13] In our study, the prevalence of overweight and obesity and hypertension were lower. About half of the participants 341 (51.5%) were in normal BMI category followed by those in pre-obese category 228 (34.4%), in obese class I category 47 (7.1%) and only 2(0.3%) were in obese class III category. However, 38 (5.7%) were in underweight category and majority of the respondents (61.3%) were prehypertensive and 18.3% of them had stage 1 hypertension.

There was a relationship between hyperglycemia and HTN. Participants with HTN had a 2.2-fold risk of hyperglycemia compared with participants without HTN. Some studies reported increased hypertension with increased hyperglycemia.[27] The study conducted in Indonesia showed a prevalence of hypertension of >40% in the diabetes mellitus groups.[11] Ferranninin *et al.*[28] reported that high blood pressure was present in over two-thirds of patients with type 2 diabetes. However, in our study, prehypertension was seen in 13 (52.0%) subjects and Stage 1 hypertension was seen in 7(28.0%) subjects with diabetes.

A meta-analysis of observational studies done in India found that the pooled odds ratio from the included studies showed that the association between obesity and HTN was strongly positive and T2DM was moderately positive compared with healthy non-obese adults, a statistically significant association between obesity and T2DM (OR = 1.14, 95%CI: 1.04 to 1.24) with a high degree of variability.[29] In another cross-sectional study, data from adult population aged 20 to 79 years residing in 9 LMICs in 4 broad geographic regions: Africa, East Asia, South America, and South Asia depicted that associations of obesity measures with diabetes were strongest in South Africa among men and in South America among women.[30] In our study, subjects who were preobese 12

(48.0%) and obese class1 4 (16.0%) had diabetes mellitus but there was no significant association between obesity and DM.

**LIMITATIONS**

This is a small study and it has some limitations. Only persons with previously diagnosed diabetes mellitus were included in this study and no screening was carried out for pre-diabetics or undiagnosed diabetics. Although blood pressure was measured twice when the first record was high, the effect of recently taken diet or smoking and other confounding variables were not taken into consideration. Other risk factors like physical activity, smoking and dietary habits were also not assessed.

From the results presented, we showed that prevalence of diagnosed DM in productive age group in urban area was 3.8%. The respondents in the productive age groups had many risk factors that is, obesity, hypertension and positive family history. Diabetes mellitus was more prevalent among the older subjects, who were prehypertensive and those with higher BMI. Hence screening of DM among productive persons with high BMI, HTN and positive family history should be carried out. Preventive strategy to such modifiable risk factors should be promoted in the community to reduce prevalence of DM.

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