Prevalence of type 2 diabetes and its associated factors among general population of Pokhara Metropolitan City

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ABSTRACT

Introduction: Diabetes mellitus is emerging as a major public health problem in Nepal. This study aimed to assess the prevalence of type 2 diabetes and its associated factors among the general population of Pokhara Metropolitan City. **Methods:** A community-based cross-sectional study was conducted from August 2018 to October 2019, involving a total of 617 participants aged 30 to 90 years in Pokhara Metropolitan. Participants were selected using a systematic random sampling technique. Data were collected using face-to-face interviews from consented participants. Data analysis was done using SPSS 20.0. Descriptive statistics, chi-square tests, and binary logistic regression were utilized. The level of significance was set at a p-value < 0.05. **Results:** The overall prevalence of type 2 diabetes was 112(18.2%), with 58(19.4%) among males and 54(17%) among females. Out of the participants with diabetes, 54(48.2%) were newly identified by the study. Older age, illiteracy, physical inactivity, family history of diabetes, known cases of hypertension, alcohol consumption, and obesity were found to be significantly associated with type 2 diabetes. **Conclusions:** The study revealed a relatively higher prevalence of type 2 diabetes. Interventions on promoting physical activity, controlling alcohol consumption, maintaining body weight, and controlling hypertension may help in the prevention of diabetes among the study population. It shows there is an urgent need for community awareness programs focusing on the disease and its risk factors.

Keywords: Diabetes, prevalence, risk factors.

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INTRODUCTION

Diabetes is a metabolic syndrome clinically characterized by polyuria, polyphagia, polydipsia, hyperglycemia, and glycosuria due to absolute or relative deficiency of the hormone insulin, which controls the metabolism of carbohydrates, proteins, fats, and electrolytes.[1] Type 2 diabetes is non-insulin-dependent diabetes mellitus resulting from inadequate production of insulin and the body's reduced responsiveness to insulin, defined as insulin resistance. While commonly seen in older individuals, it can also occur in adolescents and younger adults.[2] The prevalence of diabetes is increasing alarmingly, reaching epidemic levels and affecting individuals across all age groups.[3,4] The WHO states that the Southeast Asia and Western Pacific Regions have the largest number of people with diabetes.[5] In 2017, all South-East Asia (SEA) countries were classified as low and middle-income countries, with an annual economic growth of over 3-7% during the year.[6] India, after China, was home to the second-largest number of adults living with diabetes worldwide.[7]

Nepal is experiencing an epidemiological transition with a prevalence of NCDs estimated to range from 31% to 36.5%.[8,9] The deaths due to NCDs have increased from 60% of all deaths in 2014 to 66 % in 2018.[10] In 2016, the diabetes profile has shown that 9.1%

Nepali population are living with diabetes, where males contribute 10.5% and females contribute 7.9%.[5] Wide variation was seen where the urban prevalence of diabetes was 14.6% and in rural areas was 2.5 %.[11] And National diabetes prevalence was 3.7 %.[2] NCDs (including diabetes) are already killing more people than communicable diseases. Thus, the Government of Nepal has prioritized NCDs in the National Health Policy 2015 and the National Health Sector Strategy 2015-2020.[8,9] Additionally, it has adopted and contextualized the Package of Essential Non-Communicable Diseases (PEN package) intervention for primary care in low-resource settings, developed by WHO since 2015.[12] Although diabetes is one of the major emerging public health problems in our country, very few community-based studies have been conducted in Pokhara Metropolitan City. Therefore, the study aimed to find out the prevalence of type 2 diabetes and its associated factors in Pokhara metropolitan city.

METHODS

A cross-sectional study was conducted from August 2018 to October 2019 in Pokhara Metropolitan City, Kaski District, Gandaki Province, Nepal to assess the prevalence of type 2 diabetes and its associated factors among the population. The study was conducted as a part of the thesis of MD Community Medicine. A total of 617 participants aged 30 years and above were study population. The sample size was calculated by using Cochran's formula taking the prevalence of diabetes (14.6%) in a study conducted by Nepal-by-Nepal Diabetes Association.[13] A total of six wards were selected out of 33 wards, using a systematic random sampling technique, arranging the population of Pokhara in ascending order. The first ward number was chosen from the Nepali Rupee 1000's last serial number '668365', which was 5, and then every 5th interval was chosen. The study areas included ward numbers 4, 7, 10, 16, 22, and 32, with populations of 9119, 12875, 14870, 20278, 7391, and 10677, respectively. A particular area was selected using the spinning bottle method, and then the first house was selected using a simple random sampling technique followed by subsequent houses until the required number of subjects were covered. All members aged 30 years and above in the households were included in the study. Men and women aged 30 years and above, residents of Pokhara Metropolitan City for more than six months, and those willing to participate were included in the study. Individuals too frail or mentally unfit to participate in the study, those suffering from Type I diabetes mellitus (obtained from the medical report card), unwilling to provide informed consent, pregnant women, and terminally ill patients were excluded.

A face-to-face interview was conducted using a structured questionnaire by the researcher herself. As the study was conducted among community members, the community ward office and the residents were informed the day before data collection. For the measurement of the outcome variable, they were requested to fast overnight and the researcher went the next morning for data collection. The researcher took blood samples and checked the fasting blood sugar levels of all individuals using a glucometer who met the criteria and asked for their prescriptions and medications for those with type 2 diabetes. Fasting blood sugar levels of all 617 participants (including old diabetes cases) were examined regardless of whether they had type 2 diabetes. For individuals who couldn't participate on that day, we noted their house number, scheduled another date, obtained permission in a similar manner, and conducted a visit on the next day.

Study participants were also measured for their weight, to the closet 0.1 kg, using a standard portable weighing machine without wearing footwear and socks. Similarly, they were measured for their heights using a standard stadiometer and recorded to the closest 0.1 cm. Physical activity was measured by asking questions and they were categorized as little/light physical activity for those who spend most of the time sitting such as reading, watching television, doing light work, walking on one level, and no heavy lifting at all, fishing, yoga, easy walking; moderate activity (walking on climbing stairs, or walking uphill, no lifting heavy objects and doing mild to moderate exercise like walking, riding bicycle or light gardening at least four times per week); vigorous physical activity (occupation with lots of moving around, heavy lifting, moderate daily activity combined with strenuous physical exercise). Exercise was assessed and classified into two such as no exercise group if a person does daily routine activities but is not involved in physical activities, and the regular exercise group if a person does the physical activity of >30 minutes of moderate intensity at least 3 times per week such as walking/playing/running/swimming.

Hypertension was also measured and it was defined as individuals diagnosed by a physician and on antihypertensive medications (self-reported) and/or those who had systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg—Joint National Committee 8 (JNC-8) criteria.[14]

The collected data were entered into SPSS version 20.0, and editing and analysis were done. Descriptive analysis was done in terms of frequency and percentage. The relationship between independent variables (risk factors) and dependent variables (diabetes) was shown using the

chi-square test and binary logistic regression. The level of significance was set at p-value<0.05. The adjusted odds ratio was computed and presented with a 95% confidence interval.

Ethical clearance was obtained from the Ethical Research Clearance Committee of Manipal College of Medical Sciences, Pokhara, before proceeding further. Local authorities were informed prior to data collection, and efforts were made to ensure compliance with religious, social, and cultural norms and values. Full co-operation from local health authorities was ensured. The nature and objectives of the study, potential harm and benefits, participant rights, and the researcher's duties were explained to each participant. Respondents were assured that the information provided would only be used for research purposes, and confidentiality would be maintained. Participation in the research was voluntary, and participants could withdraw consent at any time. Informed verbal and written consent were obtained from all potential participants.

RESULTS

Table 1 illustrates that among 617 participants, half 318(51.5%) of them were females. Out of 617 subjects, 262(42.5%) belonged to age-group 30 to 45 years. Similarly, 178(28.8%) belonged to age-group 46 to 60 years and 177(28.7%) belonged to age-group who are >60 years. Regarding ethnicity, more participants were Brahmin, accounting for 238(38.6%), followed by Janajati 196(31.8%), and the smallest group belonged to others 27(4.4%).

Table 1: Socio-demographic factors of study population (N=617)

Socio-demographic factors	Categories	Frequency (n)	Percentage (%)
Gender	Male	299	48.5%
	Female	318	51.5%
Age in years	30-45	262	42.5%
	46-60	178	28.8%
	>60	177	28.7%
Ethnicity	Brahmin	238	38.6%
	Chhetri	107	17.3%
	Janajati	196	31.8%
	Dalit	49	7.9%
	Others	27	4.4%
Education	Illiterate	191	31%
	Primary school	45	7.3%
	Middle school	93	15.1%
	High school	129	20.9%
	Intermediate or diploma	63	10.2%
	Graduate or postgraduate	96	15.6%

Table 2 illustrates that among 617 participants, 145(23.5%) were known cases of hypertension, and 92(14.9%) had diabetic parents. In terms of lifestyle habits, 60(9.7%) were smokers, 154(25%) were alcohol consumers, and 327(53.0%) engaged in moderate physical activity, while 279(45.2%) had little/light physical activity, with the fewest engaged in vigorous physical activity, with total 11(1.8%).

Table 2: Biological and behavioral characteristics of the study population (n=617)

Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Hypertension	Yes	145	23.5%
	No	472	76.5%
BMI	Normal weight	206	33.4%
	Over weight	247	40.0%
	Obese	158	25.6%
Smoking	Yes	60	9.7%
	No	557	90.3%
Alcohol consumption	Yes	154	25%
	No	463	75%
Physical activity	Little/Light	279	45.2%
	Moderate	327	53%
	Vigorous	11	1.8%
Exercise	Yes	262	42.5%
	No	355	57.5%
Serving of vegetable	Once a week or less	43	7.0%
	2-4 times a week	167	27.1%
	5-6 times a week	261	42.3%
	1-2 times a day	146	23.7%
Servings of fruits	Rarely/never	38	6.2%
	Once a week	113	18.3%
	2-4 times a week	286	46.4%
	5-6 times a week	143	23.2%

Table 3 shows out of 617 participants, 112(18.2%) were diabetic. Among 112 diabetic participants, 54(48.2%) were identified by this study and 58(51.8%) were already known cases of diabetes.

Table 3: Prevalence of diabetes

Prevalence of diabetes	Frequency (n)	Frequency (%)
Yes	112	18.2
No	505	81.8
Types of cases		
Newly Identified	54	48.2
Previously existing cases	58	51.8

Table 4 and 5 showed a significant association between prevalence of diabetes and age, occupation, education, family history, hypertensive known case, BMI, smoking, alcohol, physical activity, and serving of vegetables and fruits.

Table 4: Association between type 2 diabetes and socio-demographic variables

Variables	Categories	Diabetes		Chi-square	p-value
		Yes n(%)	No n(%)		
Sex	Male	241(80.6%)	58(19.4%)	0.61	0.436
	Female	264(83.0%)	54(17.0%)		
Ethnicity	Brahmin	196(82.4%)	42(17.6%)	2.32	0.677
	Chhetri	90(84.1%)	17(15.9%)		
	Janajati	155(79.1%)	41(20.9%)		
	Dalit	40(81.6%)	9(18.4%)		
	Others	24(88.9%)	3(11.1%)		
Age (in years)	30-45	232(88.5%)	30(11.5%)	14.50	0.001*
	46-60	140(78.7%)	38(21.3%)		
	>60	133(75.1%)	44(24.9%)		
Occupation	Unemployment	131(72.4%)	50(27.6%)		
	Unskilled	21(67.7%)	10(32.3%)	24.53	0.01*
	Semiskilled	51(87.9%)	7(12.1%)		
	Skilled	186(88.6%)	24(11.4%)		
	Clerk, shop-owner, farmer	58(81.7%)	13(18.3%)		
	Professional	58(87.9%)	8(12.1%)		
Education	Illiterate	141(73.8%)	50(26.2%)		
	Primary school	37(82.2%)	8(17.8%)		
	Middle school	85(91.4%)	8(8.6%)	14.99	0.01*
	High school	109(84.5%)	20(15.5%)		
	Intermediate or post high school diploma	53(84.1%)	10(15.9%)		
	Graduate or post-graduate	80(83.3%)	16(16.7%)		

*p<0.05 denotes statistical significance

Table 5: Association between type 2 diabetes and behavioral factors, dietary factors, biological factors

Factors	Categories	Diabetes		Chi-square	p-value
		No n(%)	Yes n(%)		
Current Smoking	Yes	44(73.3%)	16(26.7%)	3.24	0.072
	No	461(82.8%)	96(17.2%)		
Current Alcohol Consumption	Yes	115(74.7%)	39(25.3%)	7.11	0.008*
	No	390(84.2%)	73(15.8%)		
Exercise	Yes	221(84.4%)	41(15.6%)	1.92	0.166
	No	284(80%)	71(20%)		
Physical activity	Light	212(76%)	67(24%)		
	Moderate	283(86.5%)	44(13.5%)	11.92	0.003*
	Vigorous	10(90.9%)	1(9.1%)		
Serving of vegetable	Once a week/less	29(67.4%)	14(32.6%)		
	2-4 times a week	130(77.8%)	37(22.2%)	11.64	0.009*
	5-6 times a week	218(83.5%)	43(16.5%)		
	1-2 times a day	128(87.7%)	18(12.3%)		
Serving of fruits	Rarely/never	24(63.2%)	14(36.8%)		
	Once a week	91(80.5%)	22(19.5%)	11.40	0.022*
	2-4 times a week	238(83.2%)	48(16.8%)		
	5-6 times a week	123(86%)	20(14%)		
		29(78.4%)	8(21.6%)		
Family History of type 2 diabetes	Yes	65(70.7%)	27(29.3%)	9.12	0.003*
	No	440(83.9%)	85(16.2%)		
Known hypertension case	Yes	95(65.5%)	50(34.5%)	34.02	0.01*
	No	410(86.9%)	61(13.1%)		
BMI	Underweight/ Normal	185(87.3%)	27(12.7%)	8.01	0.018*
	Overweight	200(81%)	47(19%)		
	Obese	120(75.9%)	38(24.1%)		

Table 6 presents the association of socio-demographic factors, biological, behavioral, and dietary factors with the prevalence of type 2 diabetes using binary logistic regression. After adjusting for possible risk factors such as age, family history, known hypertensive case, BMI, education, physical activity, alcohol consumption, and a portion of vegetable intake, the odds ratio (OR) increased for both the age groups 30-45 years and 46-60 years. The respondents aged 30 to 45 were 0.48 times less likely to be found with diabetes as compared to the age group of >60 years. The association was statistically significant among the age group of 30 to 45 years [Adjusted Odds Ratio (AOR) 0.48(95% CI 0.25-0.90, p-value <0.05)]. A positive family history of diabetes was found to be 2.7 times more at risk of developing diabetes than individuals without a family history, and the association was statistically significant (AOR 2.74, 95 % CI 1.53-4.90, p-value <0.01). Participants with hypertension known case were 2.6 times more likely to exhibit type 2 diabetes than normal individuals; the association was statistically significant (AOR2.60, 95% CI 1.59-4.26, p-value<0.001). Participants who consumed alcohol were 2.29 times more likely to be found with diabetes than those who didn't consume alcohol (AOR 2.29, 95% CI 1.38-3.83, p-value <0.01).

Table 6: Logistic regression analysis of factors associated with type 2 Diabetes among the general population of Pokhara Metropolitan

Factors		COR (95% CI)	P-value	AOR (95% CI)	P-value
Age	30-45 years	0.39(0.23-0.65)	0.00	0.48(0.25-0.90)	0.02
	46-60 years	0.82(0.50-1.34)	0.82	0.97(0.55-1.70)	0.92
	>60 years	Ref			
Education	Illiterate	1.77(0.95--3.32)	0.07	1.48(0.71-3.10)	0.30
	Primary School	1.08(0.42-2.75)	0.87	1.17(0.42-3.20)	0.77
	Middle school	0.47(0.19-1.16)	0.10	0.55(0.21-1.46)	0.23
	High school	0.92(0.45-1.88)	0.81	0.87(0.39-1.93)	0.73
	Intermediate	0.94(0.40-2.24)	0.90	0.79(0.30-2.03)	0.62
	Graduate/ Postgraduate	Ref			
Family history	Present	2.15(1.29-3.56)	0.00	2.74(1.53-4.90)	0.00
	Absent	Ref			
Hypertensive known case	Present	3.48(2.25-5.37)	0.01	2.60(1.59-4.26)	0.00
	Absent	Ref			
Alcohol	Present	1.81(1.16-2.81)	0.00	2.29(1.37-3.83)	0.01
	Absent	Ref			
BMI	Overweight	1.61(0.96-2.69)	0.07	1.33(0.76-2.33)	0.32
	Obese	2.17(1.26-3.74)	0.01	2.10(1.16-3.80)	0.01
	Underweight/ Normal weight	Ref			
Physical activity	Sedentary	3.16(0.39-25.14)	0.28	2.28(0.25-20.51)	0.46
	Moderate	1.56(0.19-12.45)	0.68	1.31(0.14-11.73)	0.81
	Heavy	Ref			
servings of vegetable	Once a week	3.43(1.53-7.69)	0.001	4.52(1.81-11.30)	0.00
	2-4 times a week	2.02(1.10-3.74)	0.024	2.29(1.16-4.51)	0.02
	5-6 times a week	1.40(0.78-2.54)	0.263	1.56(0.80-3.01)	0.19
	1-2 times a day	Ref			

*Each variable is adjusted with age, family history, known hypertensive case, BMI, education, physical activity, and a portion of vegetable

DISCUSSION

To determine the prevalence of type 2 diabetes and its associated factors among the general population aged 30 years and above in Pokhara Metropolitan City, a cross-sectional study was conducted. The prevalence of type 2 diabetes was found to be 18.2% in this study, which is almost similar to the prevalence of 18.56%, found in a study done among political cadres of Nepal.[15] Strong positive associations were established between the prevalence of type 2 diabetes and certain socio-demographic factors such as education and occupation. The prevalence of diabetes showed a strong association with increasing age. Similar results were found in studies conducted in Pokhara and Kathmandu, Nepal.[16,17] The prevalence of type 2 diabetes was found to be higher among illiterate individuals and those with primary school education. This study showed a statistically significant association with education (X2=14.996, df=5, p-value=0.011). Similar results were reported in China.[18] In contrast, a cohort study conducted in Thailand concluded that men with tertiary level education had a significantly higher association with type 2 diabetes compared to those with high school or less education.[19] Similarly, a significant association of diabetes was observed

with some behavioral risk factors such as obesity, alcohol consumption, and physical activity. Alcohol consumption was found to be a highly significant factor in prevalence of type 2 diabetes in this study. These findings are similar to other studies done in Nepal.[16] In binary logistic regression model, strong association was found between type 2 diabetes and alcohol consumption (AOR 2.29, 95% CI 1.37-3.83, p-value<0.01). Similar findings were reported in other studies conducted in Kathmandu, Nepal and Thailand.[20,21] In most of the communities of Nepal, drinking alcohol is like social customs and traditions. People find various reasons and excuses often to drink. Some might begin for fun, pose or to relief stress and its consequences to habit. Also, it is seen as customary for daily wage workers and laborers to drink alcohol after a hard day's work saying it gives them energy after a hard day's work. Thus, drinking alcohol in daily basis in huge amount eventually results to obesity and pancreatic dysfunction which ultimately progresses to type 2 diabetes.

Additionally, type 2 diabetes showed a significant association with biological risk factors like a family history of diabetes and hypertension in this study. There was a significant association between a family history of diabetes and the prevalence of type 2 diabetes. This finding is consistent with other studies conducted in Pokhara, Nepal, and reports from previous studies done in Pune, India, and Saudi Arabia.[22,23] People with a positive family history residing with their family sharing the same genetic factors along with similar environmental factors, dietary habits, and biological factors might be the reason for increasing the prevalence of type 2 diabetes among siblings, and their offspring. This present study showed a strong association between the prevalence of type 2 diabetes and known cases of hypertension. The increase in the prevalence of type 2 diabetes was observed with the increase in known hypertensive cases, as seen in other studies as well.[24,25] In binary logistic regression analysis, the study demonstrated a higher prevalence of type 2 diabetes among known hypertensive cases (AOR 2.607, 95% CI 1.594-4.264, p-value<0.001). Similar findings were reported in other studies done in Pakistan and Kathmandu.[26,27] As BMI increases, the risk of developing diabetes also increases. Inverse associations were observed between the prevalence of type 2 diabetes and normal weight in this study. A significant association was observed between the prevalence of type 2 diabetes and overweight and obesity. Some other studies also reported similar results to this study done in Pakistan and Sri Lanka.[24,28] The binary logistic regression model of this study showed a rise in diabetes with a rise in obesity (AOR 2.103, 95% CI 1.162-3.806, p-value<0.05). These findings are similar to other studies conducted in Southern Ethiopia, Sri Lanka and Thailand.[26,27] In this study, a greater number of sedentary workers were found to be diabetic compared to moderate and heavy workers. A strong positive association was observed between the prevalence of type 2 diabetes and low physical activity (X2 = 11.916, df = 2, p-value=0.003), consistent with other studies.[28] In this study, participants with lower vegetable consumption were found to suffer more from diabetes. A significant association was recorded between the prevalence of type 2 diabetes and vegetable consumption. In another study conducted in China, similar findings were found, indicating that the prevalence of diabetes was negatively associated with a healthy diet.[29]

Because the study was cross-sectional, we could not establish temporal relationships between diabetes and the associated factors. By including adults from both urban and rural areas, we can better understand the distribution of the problem within the general population. Participants from different ethnicities, educational levels, and occupations did not have equal representation in the study. While an oral glucose tolerance test (OGTT) would have been more accurate for detecting the true prevalence of glucose metabolism issues, it was not conducted due to resource limitations. Additionally, physical activity, exercise, alcohol consumption, and smoking habits were assessed only through interviews, which may have introduced recall bias. Due to limited resources (money and time), the study was confined to a few wards, and fasting blood glucose levels were measured on-site using a glucometer. Consequently, the results may not be generalizable. However, the findings may provide valuable insights for further research and intervention.

CONCLUSIONS

The study reported a relatively higher prevalence of type 2 diabetes i.e. 18.20%, which exceeded the projected national prevalence of diabetes (14.6%) by the Nepal Diabetic Association.[13] Out of 112 diabetic participants, 54(48.2%) were new cases of diabetes and 58 (51.8%) were already known cases of diabetes. Older age, illiteracy, physical inactivity, having a family history of diabetes, known cases of hypertension, alcohol consumption, and obesity were significantly associated with type 2 diabetes.

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AUTHORS' CONTRIBUTION

NP designed the research, collected data, analyzed the data, and prepared the first draft of the manuscript. GV entered the data and interpreted the results. All authors read and approved the manuscript.

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