Introduction

Majority (69%) of the Bhutanese are rural agrarian who lead a physically active life. About 31% population are urban dwellers. Apart from a small labour population, most urban dwellers lead an increasingly sedentary lifestyle because most of them are office goers, business men, clergy and housewives who spend their time mostly in offices, place of work or at their homes.

Bhutanese population is young with only 14% older than 50 years of age. Bhutan has made significant strides in controlling infectious diseases. Universal child immunization has been achieved since 1991 following which vaccine coverage is maintained at a very high level.

Acute respiratory infection accounts for 21% of outpatient morbidity, followed by skin diseases and diarrhoea. Hypertension and diabetes feature low in the morbidity list. Cardiovascular and cerebrovascular diseases account for 14.9%, alcohol liver disease 14.5% and cancers 9.3% and pneumonia 8% of total mortality. Non communicable diseases related deaths contribute to more than 50% inpatient mortality.

This study was the first of its kind, conducted in the capital city of Bhutan in March 2008 with an objective to determine the prevalence of diabetes, impaired fasting glucose (IFG), impaired glucose tolerance (IGT) and hypertension in urban Bhutanese population aged 25 to 74 years.

Materials and Methods

Stratified two-stage sampling was adopted to include 2474 respondents (Males: 1132, Females: 1342) equally distributed among different age and sex groups. A questionnaire containing demographic, educational and social details and history of diabetes and hypertension was administered on the sampled population the previous evening and blood pressure measured the next morning in nearby camp where fasting blood samples were collected and an oral glucose tolerance test done.

Results: Age and sex standardized prevalence of diabetes, IGT and IFG were 8.2, 21.6 and 4%, respectively. Only 66.5% of the population had normal blood sugar. Prevalence of diabetes and IGT increased progressively with increasing age. Prevalence of hypertension was 26% (Males: 28.3%, Females: 23.2%). It was observed that 54.1% of diabetes population had hypertension.

Conclusion: The study shows that not only is prevalence of diabetes and hypertension high in the urban Bhutanese but also there is a high diagnosis and treatment gap in these disorders.

Keywords: Diabetes, hypertension, impaired fasting glucose, impaired glucose tolerance, oral glucose tolerance test
which recommends a minimum of 250 subjects in each age/sex stratum. Healthy Bhutanese subjects residing in Thimphu at the time of study between 25 to 74 years, both male and female, were included in the study. The total sample size worked out to 2800 persons with an additional 12% sample for non-response.

A stratified two-stage sampling was adopted. Primary and secondary sampling units were blocks and persons respectively. Population and housing census of 2005 was used to develop sample frame. Probability proportional to size (PPS) was adopted for the selection of blocks. Out of a total of 46 blocks, 19 were selected randomly. Listing and numbering of households and Bhutanese persons aged 25 to 74 years residing in those households was prepared for every sampled block to serve as sampling frame. The population in each block was listed in the age groups 25-34, 35-44, 45-54, 55-64, and 65-74 years for both sexes separately. A skip interval was ascertained for each age and sex category and required number of study individuals sampled out from each age and sex stratum for all 19 blocks separately. This included any Bhutanese individual irrespective of presence or absence of diabetes or hypertension.

The study population was informed of the study through mass media. On the specified date, research assistants visited the house hold and contacted the randomly sampled individual, took informed consent and administered a part of the questionnaire. The individual was asked to attend the camp the next morning, fasting for at least 10 hrs. Blood pressure and other anthropometric measures were recorded and fasting blood sample collected at the camp in the subsequent morning. Every subject was provided with 75 grams anhydrous sugar in 250 ml water to be swallowed over five minutes. Second blood sample was collected exactly 120 minutes after ingestion of glucose solution. Blood sample was appropriately stored and transferred to the laboratory at the Jigme Dorji Wangchuck National Referral Hospital for subsequent analysis. Individuals who were on antidiabetes and antihypertensive medicines were recorded as known diabetic and hypertensive.

Sodium vaccutainer tubes were used to collect blood for glucose estimation. Hitachi 912 bio-analyzer was used for the purpose.

The data were entered simultaneously in the computer. Post stratification adjustment weights were calculated prior to the analysis to correct for differences between age-sex structures of the sample against target projected population for 2008. Epi Info program provided by the WHO, Geneva was used to produce descriptive analysis. Diabetes, Impaired Fasting Glucose and Impaired Glucose Tolerance were calculated using the 1997 ADA fasting glucose criteria (FPG) and the WHO oral glucose tolerance test criteria.\(^6\) Thus by the FPG criteria, values of ≥ 7.0 mmol/l (126 mg%) and 6.1-6.9 mmol/l (111-125 mg%) were considered diabetes and IFG respectively, and by the 2 hrs postglucose criteria, values > 11.1 mmol/l (>200 mg%) and 7.8-11.0 mmol/l (140-199 mg%) were considered diabetes and IGT, respectively.

Clinical hypertension was defined as a mean of at least two readings of 140 mmHg systolic blood pressure (SBP) and/or 90 mmHg diastolic Phase V blood pressures or greater.

Abnormal blood sugar was defined as accrual of diabetes, Impaired Glucose Tolerance and Impaired Fasting Glucose.

Results

A total of 2800 eligible subjects 25-74 years were included in the study with a response rate of 88.4%. Table 1 shows prevalence of known diabetes, population prevalence of diabetes, prevalence of IFG and IGT in different age and sex groups as well as in the whole population.

It was observed that 2.5% of the population (Male: 2.8%, Females: 2.1%) were known diabetics. All known diabetics were on some form of medication for diabetes. The prevalence of diabetes was 8.6% in males, 7.7% in females and 8.2% (CI 9.1-9.3) in both sexes. There was a progressive increase in diabetes prevalence with increasing age for 25 to 34 years at 3.5%, 35 to 44 years at 6.5%, 45 to 54 years at 13%, 55-64 years at 14.3% and 65 to 74 years 17.2%. Since 2.5% population knew of their diabetes status, the diagnostic gap was 69.5%.

Impaired fasting glucose (IFG) was observed to be 21.6%, similar in both sexes. It was more common in females in the age range 25 to 34 years (19 vs. 13.9%) and 35 to 44 years (24.4 vs. 19.3%) which reversed for higher age groups at 28 vs. 30.6% for 45-54 years, 23 vs. 32.5% for 55-64 years and 19.5 vs. 20.1% for 65 to 74 years.

Impaired glucose tolerance was seen in much smaller proportion in each age group of 2.4% in 25-34 years, 4.1% in 35 to 54 years, 5.8% in 55-64 years and 8.9% in 65 to 74 years. The population prevalence of IGT was 4%.

The study revealed that only 66.5% of the population had normal blood sugar. Abnormal blood sugar prevalence defined as collective prevalence of diabetes, IFG and IGT, were seen in 22.1% in 25-34 years, 32.1% in 35 to 44 years 46.5% in 45 to 54 years, 48.3% in 55-64 years and 46% in 65 to 74 years [Figure 1].
Table 2 reveals prevalence of known hypertension as 11.1% in 25-34 years, 15.1% in 35 to 44 years, 15% in 45 to 54 years, 24.7% in 55-64 years and 24.2% in 65 to 74 years and 17.1% for 25 to 74 years whereas hypertension was detected in 12.9% in 25-34 years, 20% in 35 to 44 years, 40.3% in 45 to 54 years, 42% in 55 to 64 years, 56.8% in 65 to 74 years and 26% for 25 to 74 years.

The study revealed that 17.1% adult population reported a diagnosis of hypertension whereas 26% population were detected having high blood pressure. Only 9.4% of the populations were on some form of medication for hypertension. This highlights a lofty diagnosis as well as treatment gap for hypertension in the community.

Hypertension was observed in 54.1% of people having diabetes.

Prevalence of smoking was 6.8%; most who smoked were daily smokers (82.2%). Mean age of initiating smoking was 20.9 years. Up to 19.4% population used smokeless tobacco.

It was observed that 30.8% respondents drank alcohol at least once in 30 day. Mean standard drink on a drinking day was 2.6 drinks. Up to 29.2% males drank more than four standard drinks on a drinking day as opposed to 11.1% females.

Two third of the population did not eat enough fruits and vegetables (less than five combined servings a day). Daily consumption of fruit was particularly low of 1.2 serving and vegetables of 3.2 serving.

Majority of population (58.6%) did not attain a minimum requirement of health enhancing physical activity and the prevalence of obesity (BMI > 30) was 12.1% while 52.5% population were overweight (BMI > 24.9).

**Discussion**

This study is compared with similar studies in the neighboring countries like India, Nepal and Bangladesh. Population prevalence of diabetes in urban Bhutanese was 8.2% (Male: 8.6%, Female: 7.7%) against that in urban Indians aged 20 years and more of 12.1%, Nepalese urbanites 15.7 to 16.6% and Dhaka of 11.2%, which is observed to be lesser than in the neighboring countries.

It is a matter of great concern that 69.5% of diabetics remain undiagnosed; however everyone diagnosed were on some form of treatment.
A very high IFG rate of 21.6% was observed, similar in both sexes, more often seen in younger women than men. This was much higher than in the Indian urban population of 5.3%,\textsuperscript{(15)} Nepalese of 9.1%\textsuperscript{(16)} and that in Bangladesh of 5.2%.\textsuperscript{(14)}

On the other hand, IGT was observed as 4%, with highest rate at 8.6% for 64 to 75 years age. The IGT rate is lesser than in Indians (20‑69 years: 11.5 to 12.8%)\textsuperscript{(17)} and Nepalese studies (40 to 74 years: 8.1‑12.6%).\textsuperscript{(13,15)}

Bhutan is possibly at its early phase of diabetes epidemic that its prevalence is lesser than in the neighboring countries. The rates are similar to population prevalence of diabetes in the USA three decades back.\textsuperscript{(18)} However, pre-diabetes population prevalence is higher than in the neighboring countries, which places Bhutan at a high risk of an impending diabetes epidemic in the decades to follow.

Our study revealed that only 30.5% of diabetics knew that they had diabetes. Ratio of known to actual diabetics is a predictor of impending diabetes complication rate in any population. Since 69.5% of the urban diabetics did not know of their diabetes status, a large number of whom would remain undiagnosed for long period and present with complications. It is even more so as diagnosis gap is higher in the younger diabetic population. However, all those who knew that they had diabetes were on some form of treatment which signifies early detection of prime importance.

Hyperglycemia increases the risk of micro and macrovascular complications and premature death in any population. This in turn results in a huge economic burden for society.\textsuperscript{(19‑21)} Interventions involving diet and life style modification reduce the risk of diabetes among people with prediabetes.\textsuperscript{(22,23)}

The study revealed hypertension prevalence of 26% with 40.3% for 45 to 54 years age, 42% for 55 to 64 years and 56.8% for 65 to 74 years against that in the Nepalese population\textsuperscript{(13)} of 14.2% in 40 to 49 years age, 25.9% in 50 to 59 years and 34% in 60 to 74 years.

Sixty five percent of hypertensive population knew of their status whereas only 36% were on medications for high blood pressure.

Population prevalence of hypertension in urban area is high. It is even more among the older age groups. It is appalling that a diagnosis gap for hypertension of 35% and a treatment gap of 64% exist. Since hypertension is a silent killer, the need of advocacy, early detection and adequate management is much desired.

Our study revealed that 54.1% of diabetics had concomitant hypertension as against 36.7% in the Nepalese population (>40 years).\textsuperscript{(13)}

Hyper tension prevalence is higher in the diabetics compared to the general population and as a large proportion of diabetes remain undiagnosed, the
population is at greater risk of complications of diabetes and hypertension.

Majority (93.1%) of the population was exposed to at least one risk factor of non communicable disease, 56.5% had two risk factors and 34.8% had three to five risk factors. Women (38.4%) were more likely to be exposed to multiple risk factors than men (31.9%). The risk of developing non communicable disease multiplies with multiple risk factors that a large urban Bhutanese population is at an elevated risk of developing an array of non-communicable diseases.

The Ministry of Health, Royal Government of Bhutan has developed the “National Policy and strategic framework for prevention and control of Diabetes and Non Communicable Diseases” in partnership with all stakeholders. A systematic approach of enhancing capacity of health workers, surveillance of risk factors, health promotion and a multi-sectoral approach to its containment and prevention are some strategic approaches that are being followed.

Conclusion

The result of our study reveals that diabetes is less prevalent in urban Bhutanese than in similar population in other countries in the region. However, pre-diabetes is highly prevalent and there is a high risk that prevalence of diabetes will increase in the decades to follow. Pre-diabetes, diabetes and hypertension rates are much higher in the older age group. As population age, one would foresee an increasing population prevalence of these conditions. Equally disturbing is the finding that majority of the diabetics are undiagnosed, thereby posing a risk of increased burden due to its complications, disability and premature death. Our results further indicate a high population prevalence of hypertension and a very high diagnosis and treatment gap. Since hypertension prevalence double in the diabetic population, complications due to diabetes and hypertension in these population is envisaged to be high. The study also reveals that a large proportion of population are exposed to multiple risk factors of non communicable diseases, thereby living with a looming risk of developing one of the many non-communicable diseases. The Royal government has realized the need of a diabetes and NCD policy and has undertaken to develop it. However, much remains to be done to deter an impending tsunami of diabetes and other NCDs and its consequences. The tsunami will remain for long taking its toll on the Bhutanese population.

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