Prevalence of Cardiovascular Risk Factors among Diabetic Population and Awareness of Diabetes among Diabetic Patients: A Population Based Himalayan Study

Jatinder Mokta\textsuperscript{1}, Kiran Mokta\textsuperscript{2}, Asha Ranjan\textsuperscript{3}, Mehak Garg\textsuperscript{4}

\textbf{Abstract}

\textbf{Background:} To determine the prevalence of modifiable cardiovascular risk factors among adults with diabetes in the remote Himalayan areas, at elevation range from 350 meters (1,148ft) to 6900 meters (22,966ft) above sea level, in the Indian state of Himachal Pradesh.

\textbf{Material and Methods:} Study was conducted in 21 rural areas of Himachal Pradesh situated at 2200 to 10,000 feet altitude. Non-pregnant diabetic adults (>18years) were surveyed, through 32 diabetic camps. The date and place of the camp was decided one month in advance and advertised. Detailed history including smoking status, weight, height, waist circumference, body mass index recorded. Fasting or random blood glucose, glycated hemoglobin, lipid profile measured and blood pressure recorded.

\textbf{Results:} Total 909 eligible adult diabetics were surveyed (59.73\% male) with a mean duration of disease 38.14±4.56 months. 35.54\% adults were smoker and 67.55\% were either overweight or obese 54.04\% males and 77.53\% females had waist circumference above Indian standards. 78.35\% had A1C >7\% and 61.50\% had blood pressure measurements above target (>140/80mmhg). 56.74\% had elevated LDL and only 6.32\% had all blood glucose, blood pressure and cholesterol at recommended levels.

\textbf{Conclusion:} High prevalence of modifiable cardiovascular risk factors in addition to uncontrolled blood glucose is widespread, placing diabetics at higher risk for cardiovascular disease. Improved disease management system in addition to public awareness campaign is needed for people with diabetes in this region of the country.

\textbf{Editorial Viewpoint}

- Diabetics are at higher risk for cardiovascular disease.
- Improved diabetes management with public awareness is needed to reduce this risk.

\textbf{Introduction}

Type 2 diabetes mellitus (T2DM) has emerged as a pandemic and is associated with increased cardiovascular morbidity and mortality. India, with >60 million people with diabetes, has the second largest diabetic population of the world. The projection shows that this number will increase to 100 million by 2030 (>90\% T2DM).\textsuperscript{1} Although diabetes rates are lower in rural than urban India, the overall diabetes burden is higher in rural India as 68\% of India lives in “Villages”. Nonetheless, the prevalence of diabetes in rural areas is increasing rapidly.\textsuperscript{2} Increased insulin resistance and abdominal obesity in conjunction with unique genes, make Indians more susceptible to develop diabetes at younger age and at lower body mass index (BMI) compared with Caucasians.\textsuperscript{3,4} The mean life expectancy in India is 67.3 years for males and 69.6 years for females. The mean age of death is 56.5 years in diabetics, a decade earlier than non-diabetic population in India and coronary artery disease (CAD) is the most common cause of death.\textsuperscript{5} T2DM patients, who die early have significantly higher glycated Hb (A1C), LDL cholesterol(LDL-C) and blood pressure(BP).\textsuperscript{6} Better control of glycemia, LDL-C and BP (all three parameters) are needed for better long-term survival in T2DM patients.\textsuperscript{6} Himachal Pradesh situated in the western...
Himalayas is a mountainous state with elevation ranging from 350 meters (1,148 ft) to 7,000 meters (22,966 ft) above sea level. 90% of its population lives in the rural areas and agriculture is the main source of income. However, there is a fast shift from agriculture to commercial fruit crops in the past decade. Because of the rapid socio-economic change and consequent change in lifestyle, this population has shown a marked rise in lifestyle related diseases including T2DM. Despite of this alarming rise in T2DM, management provided to patients is not comprehensive and consequently mortality is high. This study was conducted with the aim to assess the CV risk factors and awareness among rural diabetic population of this mountainous state of Himachal Pradesh.

### Material and Method

This study was done in 21 rural areas of the state, located 35 to 400 kilometers from the capital, at 2200 to 10,000 feet altitude. 32 diabetic camps were organized between April 2008 to August 2013. The dates and places of camps were decided one month in advance and people were informed through newspapers, pamphlets, banners, local social workers, local public representatives and local health providers. All known and newly diagnosed T2DM diabetic adults (males and non-pregnant females) more than 18 years of age who attended the camp were included in the study. Non-diabetic participants, T1DM patients, and diabetic patients with age <18 years were excluded. Detailed history (including treatment details, smoking status, history of CAD and pre-mature CAD in family), age, gender, weight, height, waist circumference (WC), body mass index (BMI) was and BP recorded. Fasting (FBS) and/or random blood glucose (RBS) level, lipid profile (done by KONELAB-30 automatic analyzer of Thermo Fisher Scientific Company, United States of America) and A1C (Nycocard HbA1C kit) were measured. Modified ATP III criteria given by IDF for South Asians were used to define obesity (BMI>23Kg/m² and WC>90cm males and >80cm for females). All these patients were also surveyed for diabetes awareness through pre-structured questionnaires (translated for some patients in Hindi and local language by interviewer). Questionnaire was based to assess the awareness of patients including diabetic risk factors, complications, healthy life style, dietary and pharmacologic management of diabetes, their personal preferences for diabetes management and personal practices, follow up and disease associated with diabetes.

### Results

Total 909 diabetic patients were surveyed out of which 59.73% were males and 40.27% females. Mean duration of disease was 38.14±4.56 months (range: 0 days-288 month). Demographic profile of the patients has been tabulated in Table 1. The mean BMI was 24.26± 5.26 Kg/m² (range: 14-40). 32.42% participants had BMI <23 Kg/m². 63.36% males were either overweight (34.74%) or obese (29.78%) and 72.05% females were either overweight (28.22%) or obese (43.83%). 54.04% males had WC >90cm where as 77.53% females had >80 cm. In the present study, 35.53% were smoker (54% male and 8% female) (Figure 1).

<table>
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<th>Table 1: Demographic profile of 909 patients</th>
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<td>Mean duration of disease</td>
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<td>Mean waist circumference for male</td>
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<td>Mean waist circumference for female</td>
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<td>% of male patients with WC&gt;90cm</td>
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<td>% of female patients with WC&gt;80cm</td>
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<td>Mean A1C</td>
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Fig. 1: Percentage of diabetic patients with CAD risk factors
and females spent more time than males by an hour.

64.36% patients were on oral hypoglycemic agents (OHAs), 2.31% on insulin and 32.78% on alternative approaches (herbal, yoga, ayurvedic drugs and local indigenous remedies) for diabetes control. Mean FBS was 153±32.06mg/dl (70-220) and mean RBS was 266±19.07mg/dl (110-500). Mean A1C, estimated in 559 patients, was 8.71±2.034%. A1C above ADA target of 7% was found in 78.35%. Hypertension (including patients on anti-hypertensive drugs) was present in 66.33%. The average systolic BP was 136.41±61.29mmHg (100-250 mmHg) and average diastolic BP was 88.35±23.54 mmHg (60-140). BP above ADA target (140/80 mmHg) was present in 61.50% (559) patients (Figure 1).

Of 711 eligible patients for lipid lowering therapy (age>40years plus one risk factor for CAD) only 10.54% (75) were on statin therapy. Lipids were measured in 430 patients with a mean LDL-C level of 99.69±32.47 mg/dl. LDL-C was above ADA target (100mg) in 60.74%. Only 6.32% achieved all three ABC goals for diabetes management (Figure 2). Of total 894 patients, only 12.50% were aware that changing life style (physical inactivity and changed food habits) was responsible for the surge of diabetic epidemic in this country and were aware that diabetes affects kidney, eyes and heart. Only 4% diabetic patients were aware that insulin deficiency leads to diabetes. 60% had heard that excess sugar (sweets) intake leads to diabetes. 78% of were not aware that diabetes runs in the family and changing family environment (healthy food habits and increased physical activity) is important in preventing diabetes. 33.01% of patients were on non-pharmacological measures for diabetes control as they believed allopathic medicines were hot and have many side effects. Ayurvedic medicines, yoga and other herbal medicines were preferred as they had no side effects. More than 2/3 (67.94%) of patients believed that there was no need of continuing oral hypoglycemic agents once blood glucose is under control and used to stop OHAs once blood glucose normalized. 84% of patients took two big meals (morning and evening) with tea 0-2 to 3 times/day and avoided taking table sugar and sweets. (They would avoid sugar in tea but take samosa, pakoras and salty biscuits with tea as they believed these didn’t contain sugar). Rice, potatoes and kidney beans were avoided particularly as they had heard those to contain sugar. For the fear of high sugar content, they avoided taking fruits except papaya. On asking if taking three meals and 2-3 snacks in between is good for diabetic patients, all believed it to be unpractical in the rural settings. 29% believed that exercise has role in diabetic control but do not take it regularly. All, except 55 patients who were on treatment from higher institutions, had not undergone eye check up, foot examination, lipid profile, microalbuminuria testing because neither their care providers advised nor they were aware. They did not know that hypertension and dyslipidemia are two co-morbidities associated with diabetes and their management is crucial in diabetes management. They were not aware that CAD is the most common cause of death in diabetes and it is common cause of renal failure, blindness and lower limb amputations and were not knowing how to prevent them. All diabetic patients were reluctant to use insulin for its potential of habit formation, they believed.

**Discussion**

Although each component of the metabolic syndrome brings an individual increased CVD risk, the effect is enhanced when in combination. Coronary artery atherosclerosis in diabetic subjects is more diffuse and severe than in non-diabetic subjects. Acute MI in diabetes carries twice the mortality of that in the general population and contributing factors may include coexistent diabetic cardiomyopathy, autonomic neuropathy, and adverse cardiac and metabolic effects of increased nonesterified fatty acid levels. The symptoms of angina may be masked by autonomic neuropathy. T2DM patients have a proatherogenic cardiovascular risk profile which includes impaired glucose regulation, abdominal obesity, hypertension, atherogenic dyslipidemia, microalbuminuria, and specific proinflammatory and prothrombotic abnormalities.

![Fig. 2: Percentage of patients who achieved diabetic management goals](image-url)
of endothelial cell and vascular functions.\textsuperscript{6,8} The dyslipidemia associated with T2DM is more complex than simple elevation of LDL-C levels. The high atherogenicity associated with diabetic dyslipidemia is due to disproportionate amounts of small, dense LDL particles and small HDL particles due to their high susceptibility to oxidation. In addition there is dysfunctional adipose tissue or adiposopathy. DM predisposes individuals to hypertension by promoting sodium retention, increasing vascular tone and by contributing to nephropathy. Hypertension in T2DM can be partly a consequence of insulin resistance and of hyperinsulinemia. There are significant differences in the age-related increase in vascular stiffness in the elastic arteries of people without diabetes, compared to those with diabetes. Their blood vessels age at an accelerated pace, starting at an earlier age. There is also vascular endothelial dysfunction and, impaired synthesis of NO which play important role in the development and progression of subclinical atherosclerosis. The relationship between micro- or macroalbuminuria in DM and CVD mortality is also related to its association with endothelial dysfunction. There is increasing evidence that low-grade inflammation is involved in the pathogenesis of T2DM, dyslipidemia and atherosclerosis. In DM there is also high TLC, low serum albumin, low glomerular filtration rate, high plasma fibrinogen and elevated CRP which contribute to premature atherosclerosis. Hyperglycemia induce protein glycation, oxidation, glycoxidation and lipoxidation, and may mediate vascular damage in DM.\textsuperscript{6,8,9} 

This study documents a high prevalence of modifiable CV risk factors (66% HTN, 60% dyslipidemia, 78.23% A1C>7% and 35% smokers) among rural adult diabetic patients of this Himalayan state. The high prevalence of these risk factors places them at an elevated risk for CV diseases and higher all cause mortality and CV disease mortality.\textsuperscript{5,10} The similar high prevalence of these risk factors has documented in several other studies.\textsuperscript{11,12} Moreover, poor control of modifiable CV risk factors in our study suggest poor diabetic management and this sub-optimal control of CV risk factors has consistently seen in many studies.\textsuperscript{13,14} Several recent studies have shown multiple CV risk reduction strategy better in reducing CV related morbidity and mortality compare to single risk factor control.\textsuperscript{15,16} Therefore, emphasis should be on multiple CV risk reduction rather than glucentric approach in the diabetes management. However, the benefit of aggressive control of BP and cholesterol may exceed than the aggressive control of blood sugar in reducing diabetes related deaths due to CAD and stroke and is cost-effective.\textsuperscript{12,16} Therefore, equal if not greater focus should be in controlling these risk factors in addition to glycemic control by improving the routine use of anti-hypertensive and lipid lowering medicines.\textsuperscript{15,16} The proportion of persons who met all three ABC goals (6.32%) was much lower than the proportion that met each individual ABC goals (21%, 38% and 39% for A1C, BP and LDL-C respectively) in our study. The greatest potential to reduce T2DM, related complications may lie in focusing on controlling ABC goals collectively.\textsuperscript{13} Attaining ABC target will require improved methods to increase adherence to prescribed medications, physical activity, healthy dietary choices and behavior changes.

By using modified criteria for obesity for South Asian population, 68% rural adult diabetic patients are overweight or obese\textsuperscript{17} similar to our study. As more than 2/3, diabetic patients were obese in this study, it is better to use “diabetes” as synonym for diabetes in this hilly state. The high prevalence of obesity (68%) in the rural diabetic population in this agriculturist state was contrary to normal belief of less obesity because of healthy life style and simple nutrition. The high prevalence of obesity found was expected from changed life style of physical inactivity and more consumption of unhealthy food due to rapid socioeconomic development. Both males and females were found obese, surprisingly, more females were found to be obese (72% with respect to BMI and 77% with respect to WC) than male diabetic patient (63% and 54% respectively). Excess of truncal obesity is independently associated with development of diabetes in Indian women compared to Indian men\textsuperscript{3} and is further supported in our study as average WC in women was 87.5cm(normal<80cm) compare to men with average WC of 90.8cm (normal<90cms). The effect of reduced physical activity and increased leisure activity (TV watching: female > male by one hour) was more pronounced in female compare to male in this state, as female used to contribute 60-70% of agriculture fieldwork in the past and sudden increase in physical inactivity due to industrialization and increased television ownership in last one decade leads to more obesity in this gender. Moreover, cultural shift of consuming excess fat dense food for one-year post delivery (average4-6Kg cow ghee) and physical inactivity for one-year post-delivery contribute further for increased obesity in females in this state. In Indians, WC is slightly better indicator than body mass index (BMI) in detecting obesity and insulin resistance and directly corresponds with diabetes rates.\textsuperscript{17} As Indians are more prone to have central obesity and have more body fat at comparatively less body weight,\textsuperscript{3,4,17} use of WC by Modified ATP III criteria is the best parameter to be used to detect obesity in Indian diabetics.\textsuperscript{17} This
is further supported in our study as 1/3 of diabetic patients had BMI <23kg/m² and substantiate the high risk of diabetes in Indians at lower BMI levels than Caucasians in whom 80% of diabetic are either overweight or obese (BMI>25 and >30). 18,19

Individuals with diabetes may lack self-management skills and lifestyle change due to lack of knowledge and awareness. People with diabetes should take steps to improve lifestyle and behavior to lose weight, increase physical activity and reduce the number of calories and fat in the diet and has positive effect on CV risk factors reduction. 20 The lower level of awareness and knowledge about diabetes and its complications documented in this study was also documented in other studies from India. 21,22

Conclusion

Diabetes prevalence is increasing because of ageing population, urbanization and industrialization. Most of the burden of diabetes is due to micro and macro vascular complications. In order to reduce diabetes related complications, it becomes urgent to find ways to overcome barriers to good diabetic management and deliver affordable quality care. Access to care, diabetes education and self management skills, knowledge, behavior and healthy environment, and adherence to therapy and above all removing myths which are big hurdles in diabetes management play important roles in achieving management goals. Control of all three ABC goals collectively is needed for reduction in the diabetes related complications which requires not only skilled clinicians but also receptive patients and their family members. This can be achieved through dissemination of knowledge from pivotal studies and international guidelines recommendations down to primary care providers and to community level through public health campaign. No doubt, our data show sub-optimal management of diabetes in this hilly state of India, but there is always room for improvement.

References

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