ORIGINAL RESEARCH

High prevalence of diabetes in young people in Bangalore, India

SATYAN M RAJBHANDARI,[1,2] K VIJAY KUMAR,[2] RAJA SELVARAJAN,[2] TARA MURALI[2]

Abstract

Background and aims: **The burden of diabetes in India is increasing, especially in cities. We conducted a cross-sectional survey of the prevalence of diabetes and a measure of prediabetes in an urban population in Bangalore, India.**
Methods: **Screening was conducted free of charge and without need for a prior appointment in 32 screening sites throughout Bangalore. Diabetes was defined either on the basis of a self-reported prior diagnosis or as undiagnosed diabetes on the basis of a random blood glucose measurement of >11.1 mmol/L (200 mg/dL). A second index of dysglycaemia, termed prediabetes, was defined as a random blood glucose measurement of >7.8 mmol/L (140 mg/dL) but less than 11.1 mmol/L.**
Results: **The study population comprised 3,691 subjects, screened over a period of 15 months. Previously diagnosed diabetes was present in 818 patients (22.2%), previously undiagnosed diabetes in 67 patients (1.8%) and the additional measure of prediabetes in 221 patients (6%). Accordingly, almost one-third of subjects (30%) had diabetes or prediabetes by our criteria. Diabetes (diagnosed or undiagnosed) and prediabetes were more common in older subjects than younger subjects, as would be expected.**
Conclusions: **We observed high rates of dysglycaemia in a large urban population in Bangalore. Our data add to previous reports of a substantial burden of abnormal glucose regulation in this setting. Additional public health initiatives are required to protect the citizens of Bangalore from diabetes and its future complications.**

Introduction

India bears a heavy burden of type 2 diabetes. Recent data from the Global Burden of Disease Study showed that the overall adult (>20 years) prevalence of diabetes increased from 5.5% in 1990 to 7.7% in 2016.[1] A large increase in population, from about 0.9 billion to about 1.3 billion during this period,[2] masks the impact of this increase in prevalence on the healthcare system and society, as the number of adults with diabetes more than doubled from 26 million to 65 million.

Factors other than an increasing population have fuelled the growth in diabetes prevalence in India, however. People of South Asian heritage appear to have a distinct metabolic phenotype, characterised by a tendency towards abdominal obesity, higher insulin levels and a greater degree of insulin resistance compared with people of Caucasian heritage.[3,4] These factors increase the susceptibility of people from (or descended from people from) the India subcontinent to developing type 2 diabetes and at a lower level of body mass index compared with Caucasian people.[3,4] Urbanisation of the population has been a major feature of India's rapid economic development in recent years.[5] This phenomenon is well known to contribute to a growth in the prevalence of diabetes and its complications, driven by increased access to high energy diets and reduced levels of physical activity,[6] including in India.[7-9] Increasing age is another risk factor for type 2 diabetes,[10] and the average age of the population of India is increasing; the number of people aged >65 years increased from about 60 million in 2010 to about 90 million in 2020 and is projected to reach about 230 million by 2050.[11]

Data on the prevalence of dysglycaemia in defined regions of India are lacking, however, particularly with regard to its urban populations. We conducted a cross-sectional survey of the prevalence of diabetes and a measure of prediabetes in an urban population in Bangalore, India.

Methods

Screening was conducted free of charge and without need for a prior appointment on subjects who attended one of 32 screening sites throughout Bangalore, following local publicity in and around the sites conducted several days before screening took place. Demographic details, anthropometric measurements, blood pressure and information on dietary habits were collected in addition to measurements of capillary blood glucose. Diabetes was defined either on the basis of a self-reported prior diagnosis or as undiagnosed diabetes on the basis of a random blood glucose measurement >11.1 mmol/L (200 mg/dL).[12] A second index of dysglycaemia ('prediabetes') was defined as a random blood glucose measurement >7.8 mmol/L (140 mg/dL) but less than 11.1 mmol/L.[12] Subjects who did not meet these criteria were considered to have normal glucose regulation.

[1] Lancashire Teaching Hospital, UK
[2] Diabetacare, India

Address for correspondence: Dr Satyan M Rajbhandari
Consultant Physician, Lancashire Teaching Hospital, Honorary Clinical Professor, University of Central Lancashire, Chorley & South Ribble Hospital, Preston Road, Chorley PR7 1PP, UK
E-mail: satyan.rajbhandari@lthtr.nhs.uk

Table 1 Proportions of subjects with different categories of glycaemic regulation

	Age category (years)					
	20–29 (n=724)	30–39 (n=869)	40–49 (n=763)	50–59 (n=683)	60–69 (n=496)	≥70 (n=156)
Previous diabetes diagnosis (self-reported)	14 (1.9%)	80 (9.2%)	182 (23.9%)	251 (36.8%)	215 (43.3%)	76 (48.7%)
Previously undiagnosed diabetes*	2 (0.3%)	9 (1.0%)	22 (2.9%)	18 (2.6%)	11 (2.2%)	5 (3.2%)
Impaired glycaemia[†]	18 (2.5%)	50 (5.8%)	55 (7.2%)	58 (8.5%)	32 (6.5%)	8 (5.1%)
No evidence of dysglycaemia[‡]	69 (95.3%)	730 (84.0%)	504 (66.0%)	356 (52.1%)	238 (48%)	67 (43%)

Data are n (%). *Random glucose >11.1 mmol/L. [†]Random glucose >7.8 mmol/L. [‡]Random glucose <7.8 mmol/L and no previous diabetes diagnosis.

Table 2 Dietary pattern and metabolic parameters of subjects taking a vegetarian and a non-vegetarian diet

Parameters	Vegetarian Mean (SD)	Non-vegetarian Mean (SD)
Number	744	943
Female, %	39.8%	36.8%
Age (years)*	42.4 (13.6)	48.2 (14.1)
BMI (kg/m²)*	26 (4.4)	26.6 (4.3)
Systolic BP (mmHg)	128 (19.4)	132.5 (21.2)
Diastolic BP (mmHg)	78 (35.2)	77.7 (12.3)
RBG (mmol/L)*	6.3 (2.0)	7.8 (4.1)

*$P<0.05$. BMI, body mass index; RBG, random capillary blood glucose.

Results

A total of 3,882 subjects were screened over a period of 15 months. Subjects aged <20 years (n=31) and subjects with missing blood glucose data (n=160) were excluded from analyses, leaving a final study population of 3,691 subjects.

About one-quarter of the population (22.1%) reported a previous diagnosis of diabetes. Undiagnosed diabetes (random glucose >11.1 mmol/L) was found in 1.8%, suggesting an overall diabetes prevalence of 23.9%. The additional measure of prediabetes was found in 6%. Overall, 30% had some form of diagnosed or undiagnosed abnormal glucose regulation. The remainder (70%) had normal glycaemia by these criteria. Diabetes (diagnosed or undiagnosed) and prediabetes were more common in older subjects than in younger subjects (Table 1).

Dietary habits were available for 1,687 subjects; 744 were vegetarian and 943 were non-vegetarian. There were no significant differences between vegetarian and non-vegetarian subjects in mean blood pressure; however, non-vegetarians were older, had a higher body mass index and higher random capillary blood glucose (Table 2).

Discussion

Our findings suggest that diagnosed or undiagnosed diabetes is present in about one-quarter of urban residents of Bangalore and some form of abnormal glucose regulation is present in nearly one-third. Previous estimates of the prevalence of diabetes and prediabetes (defined as impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT)) in different regions of India have ranged from 2% to 16% and from 2% to 25%, respectively.[13-19] The high variation in these estimates likely results from differences in methodology, definitions and the nature of the populations studied (eg, urban vs rural), and it is difficult to compare these prevalence rates between studies. Nevertheless, our data appear to lie towards the higher end of these estimates and suggest the presence of a major burden of dysglycaemia among our urban Indian population.

The prevalence of any form of abnormal glucose regulation was higher in urban than in rural populations, consistent with the results of our study.[15,19,20] We found evidence of undiagnosed diabetes among our population (1.8%), but at a much lower rate than that seen in other studies, which have detected a case of undiagnosed diabetes for about every two cases of diagnosed diabetes in India.[15] This is likely due to the limited ability of our study to detect undiagnosed diabetes, as we had access to only a single random glucose measurement from subjects who attended our clinic spontaneously and without notice. Access to HbA$_{1c}$ or fasting glucose measurements may have resulted in a higher prevalence of undiagnosed diabetes.

We found a significant association between non-vegetarian diet and raised body mass index. This is similar to other published studies.[21] Subjects on a non-vegetarian diet were slightly older and had raised capillary blood glucose. The increasing popularity of a vegetarian diet in the younger generation could possibly explain this. The prevalence of abnormal glucose regulation increased with age, as would be expected.[10] In our study, almost 50% of subjects above the age of 50 years had dysglycemia.

Our limited access to diagnostic measurements of blood glucose, as described above, was a major limitation of our study, as we were unable to measure HbA$_{1c}$ or blood glucose either in the fasting state or after an oral glucose tolerance test in order to formally diagnose the classical diabetes or prediabetic states of IFG or IGT. This limitation reflects the practical difficulty faced in conducting a large survey in a developing country. The elevated levels of blood glucose seen in our ambulatory subjects with prediabetes probably indicated that this subpopulation was enriched with people with IGT. In addition, we were unable to exclude people with IFG from our 'normoglycaemic' population.

Key messages

- Diabetes and prediabetes are present in about a third of the urban adult (>20 years) population of Bangalore, a major city in India
- One in 12 of the adult population have glucose abnormalities of which they are not aware
- Regular screening for diabetes and associated non-communicable diseases in urban areas should be considered by policy makers

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Finally, our subjects volunteered to attend and were essentially a self-selected population. Our substantial survey population was the strength of this study.

In conclusion, we observed high rates of dysglycaemia in a large urban population in Bangalore. Our data add to previous reports of a substantial burden of abnormal glucose regulation in this setting. Weight loss is associated with biochemical remission and extended life expectancy for people with type 2 diabetes.[22] This also prevents the development of diabetes in subjects with dysglycaemia.[23] Additional public health initiatives are required to protect the citizens of Bangalore from diabetes and its future complications by making policy to discourage high sugar-containing foods and drinks and adapting the environment to enable weight loss in an urban population. A vegetarian diet could be encouraged by religious leaders to help this, but further studies are needed.

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