Original Article

# Prevalence of Diabetes and Impaired Fasting Glucose in A Selected Population with Special Reference to Influence of Family History and Anthropometric Measurements - The Kolkata Policeman Study

S Kumar*, Sarmistha Mukherjee**, P Mukhopadhyay***, K Pandit****, Moutusi Raychaudhuri+, N Sengupta++, S Ghosh+++, S Sarkar++++, S Mukherjee#, Subhankar Chowdhury##

## Abstract

Aims and Objectives: The aim of this study was to estimate the prevalence of diabetes as well as IFG in a population of policemen and to evaluate the possible influence of some risk factors.

Material and Methods: It was an epidemiological study on a group of policemen in Kolkata. Diagnosis of diabetes was based on history and fasting plasma glucose. The study population was divided in three categories: normoglycaemic, IFG and diabetes. BMI, waist circumference, WHR and waist-to-height ratio were estimated.

Results: Out of 2160 subjects with a mean age of 36.4 yrs (between 20 and 60 yrs), diabetes was found in 11.5% (10.4% known and 1.1 % newly diagnosed) and 6.2 % had IFG. Prevalence of diabetes was found to be increasing with age ($p<0.001$). There was no statistically significant difference in BMI when compared between groups (normoglycaemic, IFG and diabetes). Waist circumference, waist-to-height ratio and WHR of normoglycaemic group were significantly less than those with IFG and diabetes; however there was no statistically significant difference between the diabetes and IFG groups. Parental history had significant influence on the prevalence of diabetes; a 37.5% prevalence was found in persons with history of biparental diabetes and 20.8% with uniparental diabetes, whereas it was only 9.9% without any family history ($p<0.01$ and $p<0.05$, respectively.)

Conclusion: The prevalence of diabetes in the study population was high and was strongly influenced by family history, age and abdominal adiposity, without having any appreciable impact of BMI. ©

## Introduction

Diabetes is increasing in an alarming proportion especially in South East Asia.[1,2] The state of prediabetes confers a risk of development of diabetes as well as cardiovascular disease. A significant proportion of people with type 2 diabetes presents with complications (both macrovascular and microvascular), usually subclinical and asymptomatic at the time of diagnosis. Early diagnosis of diabetes offers the chance of intervention and curbs the onward progression of complications. Hence it is imperative that to curtail the menace of complications, an early diagnosis of diabetes and prediabetes is important. This also presents an opportunity to gauge the prevalence of risk factors for development of diabetes in the said population and the opportunity to intervene in the high risk cases to prevent the development of diabetes in an individual level.

*Professor and Ex-Head; ***RMO cum Clinical Tutor; ****Research Scientist; +Senior Resident; #Associate Professor; ##Professor & Head, Dept. of Endocrinology, IPGME&R and SSKM Hospital, Kolkata. **Consultant Endocrinologist, BR Singh Hospital, Eastern Railway, Kolkata. ++Assistant Professor, Dept of Endocrinology, NRS Medical College and Hospital, Kolkata. +++Clinical Teaching & Clinical Research Fellow, The Ayr Hospital, Dalmellington Road, Ayr, Scotland, United Kingdom. ++++Lecturer, Department of Anthropology Vivekananda College for Women, Barisha, Kolkata.
Received : 14.9.2007; Revised : 19.6.2008 Accepted : 28.9.2008

## Material And Methods

The study was performed on a group of policemen, from Kolkata with different ranks (monthly income between Rs.6000-15000), age (range between 20 and 60 years), socioeconomic status and family background. This particular study group was chosen for having access to a large number of subjects with the facility of follow up and prospective

studies in future. Taking into account an allowable error of 10% and assuming the prevalence of diabetes to be around 15% in the population under study, an initial sample size of around 2200 was aimed at. Individuals were selected by systematic random sampling.

The aim of the study was to determine the prevalence of diabetes (both previously diagnosed and newly diagnosed) and IFG and evaluation of its relation with family history and various markers of adiposity.

It was a cross-sectional study in which age, parental history of diabetes, history of previous diagnosis of diabetes of the subjects were obtained. Heights and weights were measured by standard methods and BMI was calculated. Waist and hip circumferences were measured by standard techniques and the mean of two readings was noted. Waist hip ratio (WHR) and waist to height ratio (WHtR) were also calculated. Obesity and abdominal obesity were defined using the revised criteria for Asian Indians.[3] Blood pressure was recorded in sitting position in right arm with standard methods with mercury sphygmomanometer. Fasting blood glucose was measured by measuring capillary blood after an overnight fast.

Glucose was measured in capillary blood using Accuchek meter and compatible strips (Roche Diagnostics, USA). Quality control check on blood glucose measurement was done by the fasting plasma glucose values with Hexokinase method in every tenth case, in a reference laboratory which adopted regular quality control measures. The regression equation between two methods of glucose measurements was as follows: venous plasma glucose = 0.98 x glucometer reading – 8, r= 0.93, p < 0.01. Family history of diabetes was considered positive when either or both the parents were having a history of diabetes.

The total number of patients was categorized into 3 groups according to glycaemic status: normoglycaemic group, IFG group and diabetes group. IFG and diabetes were defined as FBG level 100- 125 mg/dl and ≥ 126 mg/dl respectively according to the current ADA criteria. FBG level <100 mg/dl was considered as normoglycaemic. Subjects with known diabetes were also included in the diabetes group. Prevalence of diabetes (both known and newly diagnosed) and IFG in the study population was determined. Age stratification was done (≤ 30, 31-40, 41-50 & >50 yrs.) and prevalence of diabetes was estimated in each group. Prevalence of family history of diabetes (both uniparental and biparental) was determined in each group separately and compared with each other. Statistical analysis was done by Student's unpaired t test, Chi square test and regression analysis as needed, with the help of SPSS software, version 10 (Release 10.0.0).

## Results

The study population consists of 2160 subjects, all males. Diabetes was found to be present in 249 subjects (11.5%). Amongst them 225 subjects (10.4%) were known to have diabetes and 24 (1.1%) were not known to have diabetes earlier. Impaired Fasting Glucose was found in 133 subjects (6.2%). Rest of the study subjects i.e. 1778 persons (82.3%) were found to be normoglycaemic.

Prevalence of diabetes at the age group of ≤ 30 years was 4.2%, at the age group >30 and ≤ 40 years was 6.9%, at the age group >40 and ≤ 50 years was 20.7% and at the age group of > 50 years was 31.4%. The prevalence of diabetes was increasing with age, which was statistically significant (p<0.001) (Table 1, Fig. 1).

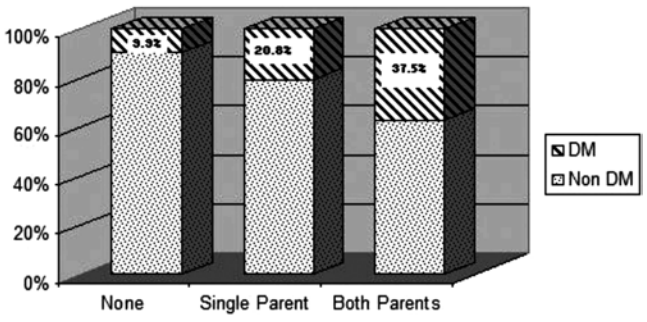
All the four parameters (BMI, waist circumference, WHR and waist to height ratio) were compared among the groups. There was no statistically significant difference in BMI when compared between groups (p>0.05). Waist circumference, waist hip ratio and waist to height ratio of normoglycaemic group was significantly less from both IFG and diabetes group (p<0.001). But there was no statistically significant difference between IFG and Diabetes groups.

There was a positive family history of diabetes in 274 subjects, which was uniparental in 250 and biparental in 24. Of the 24 subjects, 9 persons (37.5%) were found to have diabetes which was significantly higher than the prevalence of diabetes in subjects without any family history (9.9 %, p<0.01). Similarly, out of the 250 subjects with history of uniparental diabetes 52 persons (20.8%) were detected to have diabetes which again was significantly higher than the prevalence of diabetes in patients without any family history (p<0.05).

Table 3 represents the results of the regression analysis was using glucose intolerance as dependent variable. Age (OR-1.081, p<0.0001), waist circumference (OR-1.035, p<0.01), body mass index (OR-0.942, p>0.05), waist hip ratio (OR - 1.267, p< 0.0001), waist to height ratio (OR – 1.314, p<0.01), systolic blood pressure (OR-1.012, p<0.05), diastolic blood pressure (OR-0.995, p>0.05), family history of diabetes (OR-1.637, p<0.05), were found to be significantly associated

Table 1 : Prevalence of diabetes in different age groups

| Age group | DM | NGT+IFG |
|---|---|---|
| ≤30 yrs. (n= 962) | 40 (4.2%) | 922 |
| 31-40 yrs. (n= 467) | 32 (6.9%) | 435 |
| 41-50 yrs. (n= 492) | 102 (20.7%) | 390 |
| >50 yrs. (n= 239) | 75 (31.4%) | 164 |




Fig, 1 : Relationship between parental history and prevalence of diabetes.

Table 2 : Biochemical profile of study groups

| Variable | NGT (N=1778) | IFG (N=133) | DM (N=249) | p value |
|---|---|---|---|---|
| Age (years) | 34.95 ± 9.69 | 43.04 ± 9.71 | 47.73 ± 7.66 | * p<0.05, ♣ p<0.05, ♦ p<0.05 |
| BMI | 23.51 ± 2.52 | 23.87 ± 2.83 | 23.65 ± 3.05 | * p>0.05, ♣ p>0.05, ♦ p>0.05 |
| Waist circumference | 82.74 ± 7.80 | 87.46 ± 7.81 | 86.05 ± 8.47 | * p<0.001, ♣ p<0.001, ♦ p>0.05 |
| WHR | 0.89 ± 0.06 | 0.93 ± 0.06 | 0.94 ± 0.06 | * p<0.001, ♣ p<0.001, ♦ p>0.05 |
| Waist to height ratio | 0.48 ± 0.04 | 0.50 ± 0.04 | 0.50 ± 0.05 | * p<0.001, ♣ p<0.001, ♦ p>0.05 |
| SBP (mm Hg) | 120.24 14.19 | 126.51 ± 17.19 | 130.04 ± 21.93 | * p<0.05, ♣ p<0.05, ♦ p>0.05 |
| DBP (mm Hg) | 78.46 9.02 | 81.72 ± 10.29 | 80.89 ± 10.27 | * p>0.05, ♣ p>0.05, ♦ p>0.05 |

* between NGT and Diabetes, ♣ between NGT and IFG, ♦ between IFG and Diabetes

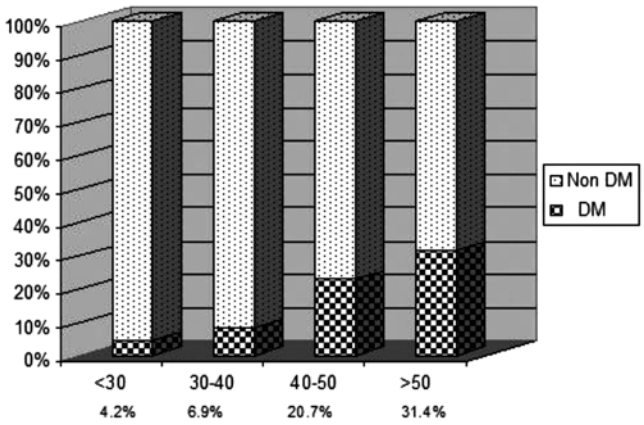



Fig. 2 : Influence of age on prevalence of diabetes.

with glucose intolerance.

The study was done in a monoethnic and unisexual population, hence influence of ethnicity and sex could not be estimated from this study.

## Discussion

Diabetes has reached an epidemic proportion in many populations, especially in this country.[1,2,4] Studies from India revealed a prevalence of diabetes in the age group of > 20 years increased by 39.8% (8.3–11.6%) from 1989 to 1995; by 16.3% (11.6–13.5%) between 1995 and 2000; and by 6.0% (13.5–14.3%) between 2000 and 2004.[5] Thus within a span of 14 years, the prevalence of diabetes increased by 72.3%. The prevalence of IGT increased by 9.6% from 1989 to 1995 and by 84.6% between 1995 and 2000[5]. Similar secular trend was noted in US population as well. Prevalence of diabetes in 1988-1994 was estimated to be 5.1% for US adults ≥ 20 years of age.[3] Using the then American Diabetes Association criteria, the prevalence of undiagnosed diabetes (FBG ≥126 mg/dl) was 2.7%, and the prevalence of IFG (110 - 125 mg/dl) was 24.7%. The crude prevalence of total diabetes in 1999–2002 was 9.3%, consisting of 6.5% diagnosed and 2.8% undiagnosed. An additional 26.0% had IFG, totalling 35.3%, with either diabetes or IFG. The crude prevalence of diagnosed diabetes rose significantly from 5.1% in 1988–1994 to 6.5% in 1999–2002, but the crude prevalence were stable for undiagnosed diabetes (from 2.7 to 2.8%) and IFG (from 24.7 to 26.0%). Results were similar after adjustment for age and sex.[7]

We estimated BMI, waist circumference, WHR and waist to height ratio as markers of obesity and evaluated their influence on glycaemic status. Though BMI was higher in the diabetes group in comparison to normoglycaemic group, there was no statistically significant difference in BMI between groups. Waist circumference and WHR as well as WHtR had got definite impact on the influence on the prevalence of diabetes, suggesting that central obesity was of paramount importance in our population. In a recent publication, WHtR was seen to be an important predictor, better than BMI or WHR for cardiovascular disease.[8]

Table 3 : Regression analysis of determinants of glucose intolerance

| Variable | β | S.E. | p value | OR (95% CI) |
|---|---|---|---|---|
| Age | 0.078 | 0.008 | 0.000 | 1.081 (1.065 – 1.098) |
| WC | 0.034 | 0.012 | 0.006 | 1.035 (1.010 – 1.061) |
| WHR | 0.234 | 0.127 | 0.000 | 1.425 (1.175 – 1.167) |
| WHtR | 0.184 | 0.170 | 0.000 | 1.483 (1.150 – 1.817) |
| BMI | 0.059 | 0.036 | 0.096 | 0.942 (0.879 – 1.011) |
| SBP | 0.012 | 0.006 | 0.050 | 1.012 (1.000 – 1.024) |
| DBP | 0.005 | 0.011 | 0.630 | 0.995 (0.975 – 1.016) |
| Family history | 0.493 | 0.158 | 0.002 | 1.637 (1.202 – 2.230) |

Waist circumference was the strongest independent predictor of insulin resistance in one study.[9] However, neither BMI nor percent fat retained its association with insulin resistance once waist circumference was adjusted in that population. In the study done in Chennai[4] waist circumference was found to be a useful predictor of both diabetes and IGT. We found Waist, WHR and WHtR to be important indicators of diabetes and IFG.

Age dependent increase in the prevalence of diabetes was noted to be similar to the CUPS[4], but the prevalence of diabetes in the young age (30 yrs.) was noted to be much higher in our study population (4.2% vs. 0.6%). Family history also had a significant relationship with diabetes. Diabetes was found in 37.5% in persons with history of biparental and in 20.8% with uniparental diabetes.

In summary, high prevalence of diabetes and IFG was recorded among a population of middle-income group of policemen in Kolkata, and abdominal obesity had a strong influence on the prevalence of diabetes while BMI showed poor correlation. History of parental diabetes was found to be a strong predictor of prevalence of diabetes.

Acknowledgement

The study was on behalf of Diabetic Association of India, West Bengal. The study was possible because of generous support from the Nicholas Piramal Ltd. We gratefully acknowledge the contributions by Dr. K.S. Chhajer, Dr. A.K. Sinha, Dr. K.A. Kabir and Dr. Bibek Roychowdhury without whose help this study would not have been conceptualized and seen the light of the day. We are also immensely indebted to Dr. Susmita Mukhopadhyay and Dr. Barun Mukhopadhyay of Biological Anthropology Unit of Indian Statistical Institute, Kolkata for their active help in statistical analysis.

Abbreviations : [IFG: Impaired Fasting Glucose; BMI: Body Mass Index; WHR: Waist to Hip Ratio; WC: Waist circumference; Waist to height ratio: WHtR; ADA: American Diabetes Association, FBG: Fasting Blood Glucose; NGT: Normal Glucose Tolerance; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure].

## References

1. Amos AF, McCarty DJ, Zimmet P. The rising global burden of diabetes and its complications: estimates and projections to the year 2010. Diabet Med 1997;14:S1–S85.
2. King H, Aubert R, Herman W. Global burden of diabetes, 1995–2025: prevalence, numerical estimates and projections. Diabetes Care 1998;21:1414–31.
3. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004;363:157-63.
4. Mohan V, Shanthirani CS, Deepa R. Glucose intolerance (Diabetes & IGT) in a selected South Indian population with special reference to family history, obesity and life style factors- Chennai Urban Population Study (CUPS 14). J Assoc Phys Ind 2003;51:771-77.
5. Mohan V, Deepa M, Deepa R, Shanthirani CS, Farooq S, Ganesan A, Datta M. Secular trends in the prevalence of diabetes and impaired glucose tolerance in urban South India—the Chennai Urban Rural Epidemiology Study (CURES-17). Diabetologia 2006;49:1175–78.
6. Harris MI, Goldstein DE, Flegal KM, Cowie CC, et al. Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in U.S. adults. The Third National Health and Nutrition Examination Survey, 1988-1994. Diabetes Care 1998;21:518-524.
7. Cowie CC, Rust KF, Byrd-Holt DD, et al. Prevalence of Diabetes and Impaired Fasting Glucose in Adults in the U.S. Population. National Health and Nutrition Examination Survey 1999–2002. Diabetes Care 2006;29:1263–68.
8. Schneider HJ, Glaesmer H, Klotsche J, et al. For DETECT Study Group. Accuracy of Anthropometric Indicators of Obesity to Predict Cardiovascular Risk. J Clin Endocrinol Metab 2007;92:589–94.
9. Racette SB, Evans EM, Weiss EP, Hagberg JM, Holloszy JO. Abdominal Adiposity is a Stronger Predictor of Insulin Resistance Than Fitness Among 50–95 Year Olds. Diabetes Care 2006;29:673-78.