Short Communication

Glucose Indices, Frank and Undetected Diabetes in Relation to Hypertension and Anthropometry in a South Indian Rural Population

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Summary

Diabetes has emerged as one of the world's biggest health problems and its prevalence is increasing at an alarming rate. This study was conducted to find out the magnitude of frank and undetected diabetes mellitus, including impaired glucose tolerance (IGT) among persons in rural Karnataka, and its relationship with associated risk factors like hypertension and anthropometry. This was a population-based, cross-sectional study on 1370 participants in the field practice area of KBN Medical College, conducted from April 2009 to March, 2010. Diabetes mellitus was noted among 19.78% of the participants, with an additional 12.04% with impaired glucose tolerance. Hypertension observed among participants with diabetes and impaired glucose tolerance was 65.13 and 53.94%, respectively. Effective primary prevention strategies have to be intensified among high-risk population groups, to promote awareness through behavior change communication.

Key words: Body mass index, Diabetes mellitus, Hypertension, Impaired glucose tolerance

Diabetes has emerged as one of the world's biggest health problems and its prevalence is increasing at an alarming rate. The World Health Organization (WHO) has declared that people living with diabetes are increasing rapidly worldwide, and this has become a major public health concern.[1] All age global diabetes prevalence of diabetes has been estimated to be 2.8% in 2000 and is predicted to be 4.4% in 2030. Currently 190 million people around the world suffer from diabetes mellitus, with 366 million by the year 2030.[2] Diabetes in urban Indians is reaching an epidemic scale. The prevalence of Type 2 Diabetes Mellitus in Asian Indians ranges from 2.7% in rural India to 14% in urban India.[3,4] Diabetes mellitus is a multifactorial disease with both genetic and environmental factors contributing to its development. Diabetes has noteworthy involvement with hypertension, overweight, and obesity, and other long-term vascular complications as the main causes of morbidity and mortality. Recognizing the magnitude of the growing problem, a study was undertaken to assess the magnitude of the problem of diabetes and its association with hypertension, obesity, and positive family history.

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Access this article online	
Website: www.ijph.in	Quick Response Code:
DOI: 10.4103/0019-557X.82545	

This cross-sectional study was carried out among the participants from the population in the field practice area of KBN Medical College and Hospital from April 2009 to March 2010. The prevalence rate of diabetes in India (Urban and Rural) among adults (20 years and above), 62.47 per thousand, was calculated by the experts at the World Health Organization for use in the national levels in India.[5] Considering this prevalence of diabetes with 5% alpha error and 20% absolute allowable error, a 1370 sample size (male = 685, female = 685) was included in the study.

All eligible individuals were identified from the electoral roll of the election commission of India in the population of the field practice area. Subsequently, the sample was selected from all participants aged 20 years and above, using the simple random sampling. Participants with co-morbidities, namely, febrile illness, suffering from any other hormonal disorders, benign or malignant disorders, diabetic ketoacidosis, renal failure, transplant rejection, central nervous system disorders, and other chronic diseases, were excluded from the study.

The data collection tool used for the study was an interview schedule. This pre-designed and pre-tested questionnaire contained questions relating to the socio-demographic information of the participants. The pilot study was carried out among a comparable population, following which some of the questions from the interview schedule were modified.

The study conformed to the Helsinki Declaration. The Institution Ethical Committee (IEC) approved the study. All the participants were explained about the purpose of the study and were ensured strict confidentiality and that it would be used only for academic purpose. Then informed consent was taken from each participant. A maximum of five visits were done for those who could not be contacted during the first visit. The data on family and personal characteristics were recorded by personal interview, for age, sex, personal past history of diabetes mellitus, and hypertension. Venous blood samples were taken after a 10 – 12 hour fast, and were examined in the biochemistry laboratory of the institute by using the Star Plus 21 semi-auto analyzer. The diagnosis of diabetes mellitus was based on the World Health Organization (WHO) criteria: A fasting plasma glucose (FPG) level = 7.0 mmol/l or = 126 mg/dl after a minimum 12-hour fast, or a two-hour postprandial glucose level (oral glucose tolerance test (OGTT) or two-hour OGTT) = 11.1 mmol/l or = 200 mg/dl on more than one occasion, with symptoms of diabetes. An impaired glucose tolerance (IGT) was defined as an FPG level of 100 mg/dl (5.6 mmol/l) but < 126 mg/dl (7.0 mmol/l).[5]

For estimation of BP, an average of three readings measured thrice at an interval of 15 minutes was taken, with the participants in a sitting position, using a mercury sphygmomanometer. Hypertension was defined according to the new criteria (systolic blood pressure of 140 mm Hg or over, or a diastolic of 90 mm Hg or over).[6]

Body weight was measured (to the nearest 0.5 kg) in the standing motionless position on the bathroom scale, without shoes and using minimum clothing. Height was recorded (to the nearest 0.5 cm) by a stadiometer in bare-footed standing position, back and heels against the upright bar of the height scale, head upright in Frankfort horizontal plane 'look straight ahead' position. Waist circumference was measured by flexible non-stretchable measuring tape, in the standing position. Old cases of diabetes were considered on the basis of being under treatment as per their previous reports and prescriptions. The results were expressed in percentages represented by tables and statistically analyzed using the Chi-square test.

Out of a total of 1370 study participants in our study population, a higher-than-normal blood glucose level was found among 13.28% previously diagnosed cases; in males it was 10.51% and in females 16.06%. The newly diagnosed cases of diabetes were found to be 5.77%, out of which the occurrence in males was 5.55% and in females 5.98%. Therefore, the total percentage of new and old cases of Diabetes Mellitus was 19.78%; 16.06% in males and 22.04% in females. It was observed that the frequency of diabetic cases was the highest in the 50 – 59 years age group, that is, 32.10%. The magnitude of the problem of IGT was 12.04%, constituting 10.51% males and 13.58% females [Table 1].

A higher-than-normal body mass index (BMI0 was found in participants with both diabetes and IGT. A significantly higher BMI was observed in male diabetics with IGT compared to non-diabetics. ($P < 0.001$); in male participants this difference of BMI was not significant between diabetics and IGT. In case of female diabetics the difference of BMI was observed to be extremely significant compared to non-diabetics ($P < 0.001$). A significantly higher waist circumference was observed in male diabetics and IGT compared to non-diabetics ($P < 0.001$); in male participants this difference of waist was not significant between diabetics and IGT. In case of female participants with diabetes and IGT, the difference of waist circumference was observed to be extremely significant compared to non-diabetics ($P < 0.001$). It was seen that people having a family history of diabetes were more affected [54.02% diabetics had a family history of diabetes, while 42.42% of IGT had the same] than non-diabetic people, who have lesser (2.33%) family history of diabetes. This difference was extremely significant ($P < 0.0001$). The frequency of hypertension was 65.13% among all diabetic participants and 53.94% among

Table 1: Distribution of diabetics and subjects with impaired glucose tolerance

Age Years	Sex	Previously diagnosed No. (%)	Newly diagnosed No. (%)	Total diabetic No. (%)	Impaired Glucose tolerance No. (%)	Non-diabetic No. (%)
20 – 29	Male (n = 72)	0(0.00)	4(5.56)	4(5.56)	12(16.67)	56(77.77)
	Female (n = 58)	5(8.62)	4(6.90)	9(15.51)	9(15.51)	39(67.24)
30 – 39	Male (n = 106)	8(7.55)	7(6.60)	15(14.15)	23(21.70)	68(64.15)
	Female (n = 143)	9(6.29)	4(2.80)	13(9.09)	25(17.48)	105(73.43)
40 – 49	Male (n = 205)	14(6.83)	7(3.41)	21(10.24)	10(4.88)	174(84.88)
	Female (n = 208)	17(8.17)	11(5.29)	28(13.46)	21(10.10)	159(76.44)
50 – 59	Male (n = 118)	19(16.10)	9(7.63)	28(23.73)	12(10.17)	78(66.10)
	Female (n = 95)	48(50.53)	11(11.58)	59(61.54)	22(23.16)	14(14.74)
60 – 69	Male (n = 123)	29(23.58)	6(4.88)	35(28.45)	6(4.88)	82(66.67)
	Female (n = 105)	13(12.38)	7(6.25)	20(19.05)	8(7.62)	79(75.24)
70+	Male (n = 61)	12(19.67)	5(8.20)	17(27.87)	9(14.75)	35(57.38)
	Female (n = 76)	18(23.68)	4(5.26)	22(28.95)	8(10.53)	46(60.53)
Total	Male (n = 685)	72(10.51)	38(5.55)	110(16.06)	72(10.51)	503(73.43)
	Female (n = 685)	110(16.06)	41(5.98)	151(22.04)	93(13.58)	441(64.58)

those with impaired glucose tolerance; this difference was statistically significant ($P = 0.0275$). In our study population, only 23.43% of the non-diabetic persons had hypertension. Compared with participants having abnormal glucose the difference of hypertension was found to be extremely significant. ($P < 0.0001$) [Table 2].

A population-based study, on the magnitude of the problem of diabetes was carried out in the KBN Medical College and Hospital, Gulbarga, during the period of April, 2009 to March, 2010. The result revealed that there was 19.78% prevalence of diabetes among the study participants. It was observed that men and women were almost equally affected with diabetes and it was similar to the results from other surveys,[1] It was also seen that there was a high association of diabetes with the risk factors of diabetes, such as, age, obesity, family history, and hypertension, as revealed in other studies.[7] It was observed that there was a sharp increase in the overall prevalence of known diabetes after 40 years of age, which appeared to be more or less similar to the findings of other studies.[8]

The results of this study showed that increasing of waist circumference has a significant association with diabetes mellitus. These findings are consistent with the previous studies where it was found that abdominal fat distribution is also associated with diabetes mellitus, independent of overall adiposity.[9] Studies have shown that central obesity was more strongly associated with glucose intolerance than generalized obesity. Further, Asian Indians have a higher degree of central adiposity for a given BMI, that is, Asian Indians have a greater amount of intra-abdominal fat and thicker truncal skinfolds.[10] Participants having a

Table 2: Anthropometric measurements, hypertension, and family history of the participants

Variables		Normal (Non-Diabetic)	Impaired Glucose tolerance (IGT)	Total Diabetics (Newly and Previously diagnosed)
Total participants		944	165	261
Body mass Index [Kg/m^2]	Total	25.28 ± 4.97*	27.44 ± 5.12*	27.68 ± 5.34*
	Male	21.78 ± 3.03*	26.94 ± 4.92*	26.82 ± 4.80*
	Female	26.90 ± 6.81*	27.25 ± 4.19*	28.91 ± 5.71*
Waist [inches]	Total	37 ± 5.25*	42 ± 4.54*	43 ± 6.16*
	Male	39 ± 4.29*	43 ± 3.94*	44 ± 6.57*
	Female	36 ± 5.67*	41 ± 3.59*	43 ± 4.78*
Family history of diabetes n = 233	Total	22[2.33%]	70[42.42%]	141[54.02%]
	Male	12[1.75]	32[4.67]	68[9.93]
	Female	10[1.46]	38[5.55]	73[10.66]
Hypertension n = 484	Total	225 (23.83)	89 (53.94)	170 (65.13)
	Male	108 (11.44)	35 (21.21)	65 (24.90)
	Female	117 (12.39)	54 (32.73)	105 (40.23)

*Values are expressed as mean ± S.D. [Standard Deviation]

family history of diabetes were at a highest risk in their productive years of life. It was seen that people having a family history of diabetes were more affected [54.02% diabetics had a family history of diabetes, while 42.42% of IGT had the same] than people who did not have a family history of diabetes.

Rural population particularly in southern peninsular India can no longer be ignored as a traditionally low-risk group as non-communicable diseases like diabetes are almost as much prevalent in rural India as in their urban counterpart, because of the change in lifestyle. The National Non-Communicable Disease Control Program in general and the National Diabetes Control Program in particular, should be seriously implemented by the

Government of India, by promoting awareness of the disease, particularly in rural areas with the same priority as given to the other National Programs for control of Communicable diseases.

References

1. Alwan A. The WHO Eastern Mediterranean programme on diabetes prevention and control. The Bulletin of the Arab Group of the study of Diabeties, 1993,2(1):38-40.
2. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes estimates for the year 2000 and projections for 2030. Diabetes Care 2004;27:1047-53.
3. Gupta A, Gupta R, Sarna M, Rastogi S, GuptaVP, Kothari K. Prevalence of diabetes, impaired fasting glucose and insulin resistance syndrome in an urban Indian population. Diabetes Res Clin Pract 2003;61:69-76.
4. Ramachandran A, Snehalatha C, Kapur A, Vijay V, Mohan V, Das AK, *et al*. Diabetes Epidemiology Study Group in India (DESI): High prevalence of diabetes and impaired glucose tolerance in India-National Urban Diabetes Survey (NUDS). Diabetologia 2001;44:1094-101.
5. Available from: http://www.whoindia.org/SCN/AssBOD/06-Diabetes.pdf. [Last accessed on 2009 April 2].
6. American Diabetes Association: Report of the Expert committee on diagnosis and classification of Diabetes Mellitus. Diabetes Care 2004;27 Suppl 1:S5-10.
7. Fuller H, Stevens LK. Diabetes Hypertension study Group, Prevalence of hypertension among diabetic patients and it relation to vascular risk. J Hum Hypertens 1991;5:237-43.
8. King H, Rewers M. Global estimates for prevalence of diabetes mellitus and impaired glucose tolerance in adults. Diabetes care 1993;16:157-77.
9. Zurba FI. Characteristics and pattern of care of diabetes in primary health care centres in Bahrain. Bull Arab Group Study Diabetes 1994;3:9-18.
10. Shelgikar KM, Hockaday TD, Yajnik CS. Central rather than generalized obesity is related to hyperglycaemia in Asian Indian participants. Diabet Med 1991;8:712-7.

Cite this article as: Zaman FA, Pal R, Zaman GS, Swati IA, Kayyum A. Glucose indices, frank and undetected diabetes in relation to hypertension and anthropometry in a South Indian rural population. Indian J Public Health 2011;55:34-7.

Source of Support: Nil. **Conflict of Interest:** None declared.

FORM IV

Statement about ownership and other particulars about newspaper ***(Indian Journal of Public Health)*** *to be published in the first issue every year after the last day of February*

1. Place of publication	:	Mumbai
2. Periodicity of its publication	:	4 Issues (January, April, July and October)
3. Printer and Distributor	:	Medknow Publications & Media Pvt. Ltd.
Nationality	:	Indian
Address	:	B5-12, Kanara Business Center, Off Link Rd, Ghatkopar (E), Mumbai - 400075, India Phone: 91-22-6649 1818
4. Publisher's Name	:	Dr. S. K. Ray Chief Editor, Indian Journal of Public Health on behalf of Editorial Board of Indian Public Health Association
Nationality	:	Indian
Address	:	110, C. R. Avenue, Kolkata-700073, India. Phone: 91-33-32913895
5. Chief Editor's Name	:	Dr. Sandip K. Ray
Nationality	:	Indian
Address	:	Chief Editor, Indian Journal of Public Health 110, Chittaranjan Avenue, Kolkata – 700073, West Bengal, India.
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I, **Dr. Sandip K. Ray**, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Date: 20th May 2011 **Dr. Sandip K. Ray**