Vulnerability toward the development of diabetes mellitus type 2 among adults from a rural community of West Bengal, India

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Abstract

Purpose – India has over half a million diabetics, with many others at risk. The Indian Diabetes Risk Score (IDRS) is a simple and validated tool used for mass screening of diabetes mellitus type 2 at the community level. This study assessed the vulnerability of developing diabetes in adults of a rural community of West Bengal using the IDRS and finds out the relationship of the risk of developing diabetes with socioclinical variables.

Design/methodology/approach – Multi-stage sampling was employed to select one eligible nondiabetic adult from selected families residing in the rural field practice area of a medical college in West Bengal. They were interviewed with a predesigned and pretested data collection schedule and examined.

Findings – Among 197 participants, 83.8% were female, 51.8% were illiterate and 57.4% came from Class IV of Prasad's socioeconomic scale. Of participants, 22.8% had existing known morbidities, and 23.9% had some form of substance addiction. In total, 46.8% of the participants on whom the IDRS could be applied ($n = 175$) were at high risk of developing diabetes (Score = 60). Gender and existing comorbidities significantly predicted a high risk of diabetes.

Originality/value – A large proportion of the Indian population yet to be diagnosed with diabetes are at a high risk of having the disease. Early detection of the disease can help curtail its complications and reduce its clinical, social and economic burden. Mass screening tools like the IDRS thus become a very important tool in India's attempts to fight diabetes.

Keywords Community based, Diabetes, Indian diabetes risk score, India

Paper type Research paper

Introduction

The number of diabetics around the world is expected to increase from 366 million cases in 2011 to 552 million cases by 2030 as per the International Diabetes Federation (IDF) if no suitable urgent action is taken [1].

India is often quoted as the Diabetes Capital of the World, besides China. Every fifth diabetic across the globe is an Indian, and the total burden of morbidity in India is expected to reach 100 million cases by 2030. Added to this increasing burden, the problem is compounded by the fact that 66% of Indians who are diabetic go undiagnosed compared to 50% in Europe and 33% in the USA [2].

Responding to the alarming rise in diabetics, the Government of India has laid special emphasis on this noncommunicable disease in its National Health Policy, and the National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) has been designed to address such concerns [3].

Most diabetics are aged between 30–40 years, which has a significant impact on the social and economic cost of the country [4]. Early detection of diabetes by screening methods with a special focus on the population at higher risk of developing the disease can help delay or intercept its complications and thereby reduce the clinical, social and economic burden due to diabetes [5].

The present study aimed to assess the vulnerability among adults of a rural community of West Bengal toward developing diabetes mellitus type 2, using the Indian Diabetes Risk Score (IDRS). The IDRS, developed by V Mohan, one of India's leading diabetologists, from the Madras Diabetes Research Foundation, is a validated, simple, low cost, feasible tool for mass screening of diabetes mellitus type 2 at the community level, which has been used by many studies across India [2, 6–9].

Methods

The present descriptive, epidemiological study with a cross-sectional design was conducted in the rural field practice area of a medical college of West Bengal over a period of three months (May–July 2019).

A predesigned and pretested schedule was used to collect data, which had questions on socioclinical details and questions based on the IDRS. Waist circumference was measured in centimeters at the level of the umbilicus, using a nonstretchable measuring tape with the nearest calibration of 1 mm.

The IDRS used is given below [2]:

Risk factor	Category	Score
Age (years)	<35	0
	35–49	20
	>49	30
Abdominal obesity (in cm)	<80 (f); 90 (m)	0
(f) = female	80-89 (f); 90–99 (m)	10
(m) = male	>=90 (f); >=100 (m)	20
Physical activity	Vigorous exercise or strenuous at work	0
	Moderate exercise at work/home	10
	Mild exercise at work/home	20
	No exercise and sedentary at work/home	30
Family history of diabetes	Nondiabetic	0
	One parent diabetic	10
	Both parents' diabetic	20
Total		*100*

Note(s): Total score: >=60: high risk, 30–50: medium risk, <30: low risk

A total of 227 line-listed families were residing in the defined area. A similar Indian study completed on the rural population found that 12.1% of its participants had a high risk of diabetes [10]. The sample size was calculated using the formula $n_0 = z^2pq/e^2$ and was further corrected, since the population was finite, using the formula $n = n_0/[1+\{(n_0-1)/N\}][11]$. Here, n_0 = sample size before correction, $z^2 = 3.84 \approx 4$ (at 95% confidence interval), prevalence $(p) = 12.1\%$, N = total number of line listed families = 227, $q = 1 - p$ and $e = 20\%$ of p, sample size (n) was calculated to be 173. Assuming a nonresponse rate of 20%, considering

the fact that some families would either be unwilling to participate or were unavailable and some respondents would not be aware of the status of diabetes in their parents, the sample size was finally calculated to be 208. Hence, 208 families were randomly selected from the list of all available families. In total, 197 families were finally included in the study, as the rest were either unwilling to participate or were unavailable after three visits on three consecutive days of data collection. Nonseriously ill adult members (aged more than 18 years) present at the time of data collection, not known to be diabetic, and willing to participate in the study, were considered eligible. One eligible member from each of these families was selected by simple random sampling for interview and waist circumference measurement.

Data were entered and analyzed using Statistical Packages for Social Science (SPSS)® (SPSS Inc, Chicago, IL, USA) version 16.0. Results were obtained based on the predefined objectives as ratios and proportions. Sociodemographic variables found to be showing significant statistical predictability toward a high risk of diabetes mellitus type 2 (as per IDRS score) by univariate logistic regression analysis were further assessed using multivariable logistic regression.

Ethical consideration
The study proposal was placed before the Institute's Ethics Committee of the concerned medical college, and permission was obtained (Ref. No. MC/Kol/IEC/Non-spon/364/04/19 dated 27.4.2019). The participants were included only after informed consent, and their identities were not disclosed. The waist circumference of the female subjects was measured in the presence of the local Accredited Social Health Activist (ASHA) worker or another female of the household if the study subject was female.

Results
A total of 197 participants were included in the present study, with a mean age of 42.10 ($\pm$22.86) years, out of whom 83.8% ($n = 165$) were female and 53.8% ($n = 106$) were Hindus. The majority of the study subjects were illiterate (51.8%; $n = 102$) and presently married (76.6%; $n = 151$). Of participants, 57.4% ($n = 113$) belonged to socioeconomic Class IV as per the BG Prasad scale of socioeconomic status, modified in July 2018 – the BG Prasad scale classifies a family based on monthly per capita income into one of five socioeconomic classes (Class I to V) – with Class I denoting the highest and Class V denoting the lowest socioeconomic class [12]. In total, 22.8% ($n = 45$) had known comorbidities like hypertension, hypothyroidism, gout; 23.9% ($n = 47$) were addicted to at least one substance of addiction such as tobacco smoking, smokeless tobacco or alcohol. The sociodemographic characteristics of the study participants are given in Table 1.

Participants aware of the status of diabetes in their parents ($n = 175$) were evaluated based on the IDRS. Of them, most of the participants (49.7%; $n = 87$) were aged between 35–49 years with a score of 20; 54.3% ($n = 95$) of whose parents were nondiabetic, scoring zero (0). For physical activity, most (41.7%; $n = 73$) were classified in the category of "mild exercise at work/home" with a score of 20, while 46.9% ($n = 82$) had a waist circumference of more than 90 cm (for females) and 100 cm (for males), scoring 20 points. In total, 46.8% ($n = 82$) of the participants were at high risk (score: >=60), 38.8% ($n = 68$) were at medium risk (score: 30–50) and the rest (14.4%; $n = 25$) were at low risk of developing diabetes mellitus type 2 (score: <30), as per their corresponding IDRS (Table 2).

Gender ($p = 0.007$), addiction ($p = 0.060$) and presence of known comorbidities ($p = 0.002$) individually predicted significantly for high risk of developing diabetes mellitus type 2 in univariate logistic regression, while the results with other sociodemographic variables under consideration were not found significant. These three variables were subjected to multivariable logistic regression, and gender [adjusted odds ratio, i.e. AOR = 2.737

Socio-clinical characteristics	Category/Group	No. (%)
Gender	Male	32 (16.2)
	Female	165 (83.8)
Religion	Hinduism	106 (53.8)
	Islam	91 (46.2)
Educational qualification	Illiterate	102 (51.8)
	Primary	27 (13.7)
	Middle	47 (23.9)
	Secondary and above	21 (10.6)
Marital status	Presently married	151 (76.6)
	Unmarried	6 (3.1)
	Widowed	28 (14.2)
	Separated	12 (6.1)
Socioeconomic status* with per capita monthly income (INR)	Class I (7008 or more)	0 (0.0)
	Class II (3504–7007)	0 (0.0)
	Class III (2102–3503)	5 (2.5)
	Class IV (1051–2101)	113 (57.4)
	Class V (1050 or less)	79 (40.1)
Known existing morbidity	Present	45 (22.8)
	Absent	152 (77.2)
Addiction	Present	47 (23.9)
	Absent	150 (76.1)

Note(s): *classified as per modified B.G. Prasad scale, January 2019 [12]

Table 1.
Distribution of the study subjects according to their socioclinical characteristics ($n = 197$)

Risk factor	Category	No. (%)
Age (years)	<35	47 (26.9)
	35–49	87 (49.7)
	>49	41 (23.4)
Abdominal obesity (in cm)	<80 (f); 90 (m)	49 (28.0)
(f) = for females	80–89 (f); 90–99 (m)	44 (25.1)
(m) = for males	>=90 (f); >=100 (m)	82 (46.9)
Physical activity	Vigorous exercise or strenuous at work	3 (1.7)
	Moderate exercise at work/home	62 (35.5)
	Mild exercise at work/home	73 (41.7)
	No exercise and sedentary at work/home	37 (21.1)
Family history of diabetes	Both parents nondiabetic	95 (54.3)
	One parent diabetic	64 (36.6)
	Both parents diabetic	16 (9.1)

Table 2.
Distribution of study participants according to risk factors of diabetes mellitus type 2 as per the IDRS ($n = 175$)

(1.129–6.638); $p = 0.026$] and existing known morbidities [AOR = 3.234 (1.453–7.195); $p = 0.004$] were found to be significantly predicting a high risk of developing diabetes mellitus type 2, placing males and those with comorbidities at higher risk. For this model, the Omnibus test for model coefficient was significant ($p = 0.000$), and the Hosmer–Lemeshow test result was insignificant ($p = 0.694$). Nagelkerke's R^2 and Cox & Snell R^2 for the model were 0.134 and 0.101, respectively. The model could predict correctly in 66.9% of cases (Table 3).

Discussion
Apart from India and China, countries like the USA, Germany, Italy, Indonesia, Pakistan, Bangladesh, Brazil and Mexico contribute significantly to the worldwide burden of diabetes [4, 13]. A number of diabetes risk scores have been derived from around the world to detect

diabetes cases that have remained undiagnosed, and most of these rely on anthropometric, behavioral and demographic factors [14–17]. Ethnic differences contributing to the risk of developing diabetes make no scoring tool generalizable across the world. The IDRS, derived specifically for the purpose of screening the Indian population, thus becomes a necessary and useful tool in the Indian perspective.

We found a large proportion (46.8%; $n = 82$) of the participants to be at high risk of developing diabetes mellitus type 2, based on their score obtained with the help of the IDRS; 38.8% ($n = 68$) were found to be at medium risk, and 14.4% ($n = 25$) were at low risk of developing the disease. A study from Chennai had 37% and 45% of its participants at high risk and moderate risk, respectively [18]. Another similar study from North India revealed 43.3% of its respondents at moderate risk, while 51.4% at high risk; a Karnataka-based study found 57.2% of its participants to be at moderate risk and 33.8% at high risk [1, 19]. A similar study in rural Karnataka showed 14.84% to be at high risk and 73.19% to be at moderate risk; a study from rural Tamil Nadu showed 74.7% of its study subjects to be at moderate risk and 12.1% to be at high risk [10, 20]. The low proportion of high-risk individuals in these two studies could have been because they were performed on a relatively younger population.

Our study and similar other studies as referred above have found that a large proportion of the Indian population, yet to be diagnosed with diabetes, are at a high risk of having the disease. Like in India, nearly two-thirds of total diabetics in most developing countries, have been shown to go undiagnosed, due to lack of awareness, restricted access to healthcare services and inadequately trained healthcare workers; the developed nations have a smaller proportion of their citizens going undiagnosed [2, 13]. With cases of diabetes on the constant rise, leading to increasing health expenditure and an ever-growing sick population, early detection of diabetes is a much necessary step. This in turn could help avert the dreaded complications of the disease and thereby reduce the clinical, social and economic burden due to diabetes. Mass screening tools like the IDRS thus become a very important part of India's efforts to fight diabetes, which may be targeted on the vulnerable sections of the population in community-based screening camps. The IDRS offers the scope of providing a cost-effective screening mechanism, which is also practically feasible, something much needed in the Indian scenario.

This study found gender and the presence of existing known comorbidities to be significantly predicting the risk of diabetes. A similar study also found gender to be significantly associated with the risk of diabetes [19]. Males are generally more predisposed towards developing diabetes, as is evident from existing scientific records [21–23]. Comorbidities like hypertension and obesity often go hand in hand with diabetes and the presence of one predisposes an individual to the other [24–26].

Therefore, along with these widespread screening initiatives using tools like the IDRS, extensive campaigns may be undertaken to educate people on the risk factors of diabetes and to encourage people to adopt healthy behaviors in order to curb the risk of developing the

| Variable | | Risk of diabetes | | Total | AOR (95% CI)* | p |
		High risk	Medium and low risk			
Gender	Female	61	84	145	*Ref*	
	Male	21	9	30	*0.026 (1.129–6.638)*	*0.026*
Addiction	Absent	58	77	135	Ref	
	Present	24	16	40	1.581 (0.735–3.403)	0.241
Co-morbidity	Absent	56	82	138	*Ref*	
	Present	26	11	37	*3.234 (1.453–7.195)*	*0.004*

Note(s): *Adjusted odds Ratio (95% Confidence Interval)

Table 3.
Predictability of risk of diabetes mellitus type 2 with sociodemographic variables by multivariable logistic regression analysis ($n = 175$)

disease that can ultimately result in a positive change in the scenario. The need for sidestepping the avoidable risk factors of diabetes may be stressed to people in their growing years at school and college by designing a curriculum focussed on health education. As recommended by the World Health Organization (WHO), in order to discourage people from indulging in harmful practices that predispose them to diabetes, higher taxes may be imposed on sweets and sweetened beverages; detailed labels may be placed on food packaging to educate and motivate them against these [13]. Grassroot health workers [like the ASHAs, who work in villages in India], should be trained to identify symptoms of diabetes, along with the training to perform and interpret basic diagnostic tests. A dedicated diabetes detection kit may be designed and supplied to them for use so that the diabetic status of the person identified to be at risk can be ascertained without delay. The primary health centers may be made fully competent to treat diabetes, ensuring the availability of basic and advanced laboratory tests, along with adequate variety and quantity of antidiabetic medications [13]. The power of mass media like television and radio, which are commonly found in households may be utilized, by design and dissemination of diabetes-related health education communications. Medical colleges may be encouraged to perform high-quality research on diabetes through readily available funds from either the governments or other funding agencies. A dedicated database on diabetes that gets updated real-time, to keep track of the rising number of cases, is also urgently needed.

A strength of this study is that it was field-based. With regards to the limitation of the present study, recall bias could be seen as a limitation as participants who had lost their parents a while back would not be able to recall details of their parents' diabetic status.

Conclusion
A large number among the Indian population either have diabetes and are yet to be diagnosed or are at a high risk of having the disease. Early detection of the disease can help curtail its complications and reduce its clinical, social and economic burden. Identifying those vulnerable to developing the disease can be useful in order to implement timely primary prevention. A simple mass screening tool like the IDRS, which can be used at the grassroots level by health care and social workers to fight diabetes even in rural and hard to reach areas, thus becomes a very important instrument, especially in a country like India, which is also the second most populous country in the world.

Conflict of Interest: None

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