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Original Research Article

Indian diabetes risk profile of employees in a tertiary care facility in north Maharashtra: a cross sectional study

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ABSTRACT

Background: The rising prevalence of type 2 diabetes (T_2D) in India calls for screening of at-risk adults. Objectives were to assess IDRS (Indian diabetes risk score) of T_2D in staff in tertiary care hospital, and to assess covariates random blood sugar (RBS), BMI, skinfold thickness (SFT), pre-existing T_2D in the employees.
Methods: In this cross sectional study, IDRS was used to assess all staff in a tertiary care institute. Anthropometric measurements, BP and RBS were done. Information on parental T_2D, cereal intake and weekly physical activity (PA) was obtained in interview.
Results: 370 subjects (F-117, M-273) with mean age 30.81 (7.99), BMI 22.89 (14.13) years were screened. Subjects in moderate and sedentary work were 185 each, 15% women and 39% men had higher waist size. Total 5.4% subjects had T_2D including known diabetics. RBS in women and men was 113.1 (27.87), 114.7 (27.66), with IDRS score high in 29 (7.84%) and moderate in 144 (38.92%). Parental T_2D was present in 19.5% subjects. IDRS risk was strongly associated with type of work (Chi-square 79.0283, df=4, p=0.00). Multiple logistic regression for IDRS risk outcome showed association of age (OR 1.4), BMI (OR1.3), parental T_2D (OR 9.6) with highly significant p values. Multiple linear regression for RBS outcome was associated with age (OR 1.3) and BMI (OR 1.4) but the results were statistically not significant.
Conclusions: Pooled IDRS risk was present in 47% subjects despite younger age of study population. Improvements in physical activity and reduction in waist size is the need of the hour.

Keywords: BMI, Diabetes, IDRS, Random blood sugar, Sedentary

INTRODUCTION

India is facing an epidemic of diabetes. Prevalence of diabetes in ICMR-INDIAB study in 15 states of India was 7.3% and prediabetes 10.3%.[1] A study based on $NFHS_4$ data suggests a diabetes prevalence of 6.65% and pre-diabetes 5.57%. An ICMR study in 1970 reported a prevalence of 1% in rural areas; which has now increased to 4-10% by 2000.[2] Type 2 diabetes (T_2D) has affected urban as well as rural population due to lifestyle transition to less physical activity (PA). A meta-analysis estimates prevalence of diabetes in tribal population at 5.9%.[3]

The Madras diabetes research foundation developed IDRS as a simple screening tool for detecting and educating at-risk people in the community.[4] This study was planned with the objective of (a) identifying high risk individuals for T_2D and (b) assessing covariates such as random blood sugar (RBS), BMI, skinfold thickness (SFT), blood pressure and pre-existing T_2D in the employees.

METHODS

Prior IEC certification was obtained. This cross-sectional study of IDRS in a teaching medical institute employees was conducted from December 2019 to February 2020 when the COVID pandemic halted the work.

Non-probability purposive sampling was used. All employees aged 28 to 65 years who volunteered for screening were included in the study. Informed consent was taken from all subjects. A pre-tested form was used with Marathi version of IDRS.

Exclusion criteria

Unwilling staff members and known diabetic patients.

Equipment used

For height- stadiometer (height 200 cm, No. 26 SM), body weight - digital bathroom scale (Ideal Industries, Pune), skin fold thickness- skin caliper (instrument model: Beachbody, FBA_ACCBODFAT2101, 23.6×18.5×4.8 cm ASIN B003 JU3G4A), mid arm circumference, measure waist and hip circumference-tailoring tape, RBS- glucometer, Accu Check Active (GB14121675).

The sub step of each anthropometric measurement was as described in NHANES anthropometry manual.[5]

RBS was measured with a point-of-care-glucometer on capillary blood, with plasma reader strip (Viva-Check 2019 POCG). Only one reading was taken, pricking the left ring finger. The categorization of RBS as normal, pre-diabetic and diabetic was done on guidelines of International Diabetic Association.[6] BP was taken with subject sitting in chair, using a digital BP machine (Model of BP machine), taking average of three readings. Consumption of Kcal from cereal-millet-based food intake was made after obtaining average count of chapatis, bhakaris and rice in 24 hours, without accounting for other energy sources like sugar, pulses, oils etc. The average daily intake of chapatti, bhakari and rice bowl was assessed through interview. A sample of 10 chapatis and five bhakris taken on first day of survey was weighed and averaged after drying for 2 days, estimated and rounded to 40 gm and 70 gm respectively. Rice bowl was estimated to have 40 gm of dry rice from home weighment before cooking. Energy intake in Kcal was estimated by multiplying dry cereal weight intake with a factor of 3.5 Kcal per gram. This energy intake was assumed to be roughly 50% of total energy intakes in Maharashtra (urban 45%, Rural 62%) based on ICMR-NIN studies.[7] Hence the cereal-millet energy estimate was then doubled to get total energy intakes from all foods.

The IDRS score banks on two modifiable (physical activity and waist circumference) and two non-modifiable risk factors (age and parental history of diabetes) in 50:50 measure.[4] Age and activity have higher weightage (30 each) than other two of waist-circumference and family history of T2D (20 each). IDRS is calculated using the following criteria:[4] 1) age in years (<35 = 0 score; 35-49 = 20 score; ≥50 = 30 score); 2) abdominal obesity [waist <80 cm in women and <90 cm in men = 0 score; 80-89 cm (women) 90-100 cm (men) = 10 score and ≥90 cm (women) and ≥100 cm (men) = 20 score]; 3) PA (heavy exercise + strenuous work =0; mild exercise or light work = 20; no exercise and totally sedentary = 30); 4) family history of diabetes (no family history = 0; either parent diabetic = 10 and both parents diabetic = 20) .

A maximum score of 100 was assigned for these categories and a score of <30 was categorized as low risk, 30-50 as medium risk and those with ≥60 were at a high risk for diabetes.

A case sheet was made and tested before use, with necessary information and four major questions (a) do any of your parents have diabetes? The parental history of T_2D (PHT_2D) was entered as 0, 1, 2 depending upon number of parents having T2D (b) do you exercise regularly? Here weekly exercise of at least ≥120 minutes was taken as minimum for qualifying, (c) does your work include manual labour? Here only two categories were made: sedentary or moderate work, (d) the average daily count of chapattis and/or bhakris and rice-bowls in meals.

Sample size estimation

Assuming 20% prevalence of IDRS>60 in adults above 20 years, and using a formula of $n=4pq/r^2$ (where p is 20 from a Pune study, q=80, r is allowable error of 5%, with z=1.96 or 2) sample size of 226 was taken to achieve 95% confidence in the results.[8] However, all eligible employees were included beyond the required sample size to extend the health benefits. Data processing and analysis was done with Excel and Epi-Info.

RESULTS

Table 1 offers summary information about study population.

The IDRS risk as shown in Figure 1 is similar in men and women, (with Chi-square 0.752, df2 P 0.6866). Table 2 offers IDRS outcome by staff category. The association of IDRS category with staff type (sedentary or moderate) was statistically highly significant.

Table 1: Summary information about study population.

Description	Women	Men	Pooled
1. Study population by gender	117 (31.6%)	273 (68.4%)	370 (100%)
2. Education Graduate + PG	91 (22.2%)	139 (77.8%)	230
3. Education at or below HSC/SSC	26 (45.1%)	114 (54.9%)	140
4. Moderate work (technicians + manual workers+nurses)	42 (22.7%)	143 (77.3%)	185
5. Sedentary work (teaching staff+ office staff)	75 (40.5%)	110 (59.5%)	185
6. Age (mean±SD) years	30.14 (7.73)	31.13 (8.10)	30.81 (7.99)
7. Weight (mean±SD)	55.04 (11.19)	64.60 (12.76)	61.58 (13.05)
8. Waist size (mean±SD) cm	80.70 (12.35)	90.80 (9.28)	
9. Subjects with waist size above threshold of 80 (women) and 90 (men) cm	57 (15%)	143 (39%)	200 (54%)
10. Hip size (mean±SD) cm	92.16 (10.60)	98.00 (8.19)	
11. BMI (mean±SD)	22.97 (4.63)	22.85 (3.89)	22.89 (14.13)
12. Estimated average Kcal intake/24 hours	1396 (388)	1997 (733)	
13. TFST(mean±SD) mm	15.18 (5.55)	11.13 (3.93)	
14. Systolic BP (mean±SD)	108.52 (14.97)	115.23 (15.19)	
15. Diastolic BP (mean±SD)	74.21 (11.96)	76.89 (12.33)	
16. Random BSL (mean± SD)	113.1 (27.87)	114.7 (27.66)	
17. Known diabetics (excluded later from analysis) + (detected in survey by RBS>200 mg/dl)	3+4	5+1	8+5 (=13, 3.5% of study population)
18. Persons doing aerobics >2 hours any week	1	15	72 (19.5%)
19. T_2D in either parents (% of total 370 subjects)	28 (7.5%)	44 (12%)	

Table 2: IDRS category by staff work type.

Staff type	High risk	Mod risk	No current risk	Total
Office staff	12 (13.33%)	49 (54.44%)	29 (32.22%)	90 (100.00%)
Teaching faculty	9 (21.95%)	29 (70.73%)	3 (7.32%)	41 (100.00%)
Manual workers	8 (3.35%)	66 (27.62%)	165 (69.04%)	239 (100.00%)
Total	29 (7.84%)	144 (38.92%)	197 (53.24%)	370 (100.00%)

Chi-square 79.0283, df=4, Probability=0

Table 3: Multiple linear regression analysis of RBS outcome) against risk factors.

Variable	Coefficient	95% confidence	Limits	Std. error	F-test	P value
Age in years	0.371	-0.004	0.746	0.191	3.7804	0.052624
BMI	0.885	0.155	1.615	0.371	5.6839	0.017631
Parental hypertension (0, 1)	-1.856	-7.997	4.286	3.123	0.3530	0.552770
Work-type sedentary work or moderate work (0, 1)	0.512	-5.289	6.312	2.950	0.0301	0.862342
Constant	84.973	66.725	103.221	9.279	83.8540	0.000000
Correlation coefficient: $r^2 = 0.03$						
Source	**df**	**Sum of squares**	**Mean square**		**F-statistic**	**P value**
Regression	4	10043.2375	2510.8094		3.2285	0.0127
Residuals	365	283857.2598	777.6911			
Total	369	293900.4973				

Table 3 summarizes multiple linear regression analysis of RBS outcome wherein age and BMI have small values as predictors though statistically significant p values while parental T_2D had high values but larger p values, hence unimportant in the study population.

Table 4 shows logistic regression analysis of IDRS risk (no risk versus some risk) in this study population against exposure of constituent risk factors of age, BMI, work type and PHT_2D. All factors but work type had OR>1 and all results having significant p values.

Table 4: Analysis of IDRS risk (no risk/some risk) outcome by multiple logistic regression.

Term	Odds ratio	95%	C.I.	Coefficient	S.E.	Z-statistic	P value
Age in years	1.3587	1.2585	1.4668	0.3065	0.0391	7.8452	0.0000
BMI	1.4230	1.2765	1.5863	0.3527	0.0554	6.3639	0.0000
Parental T_2D-1 (0, 1)	9.6097	4.2681	21.6364	2.2628	0.4141	5.4644	0.0000
Sedentary work (0, 1)	0.1746	0.0794	0.3840	-1.7451	0.4021	-4.3401	0.0000
Constant	*	*	*	-18.4471	2.1132	-8.7296	0.0000
Convergence			Converged				
Iterations			6				
Final-2*Log-likelihood			199.1754				
Cases included			370				
Test				**Statistic**		**D.F.**	**P value**
Score				198.8081		4	0.0000
Likelihood ratio				279.3131		4	0.0000

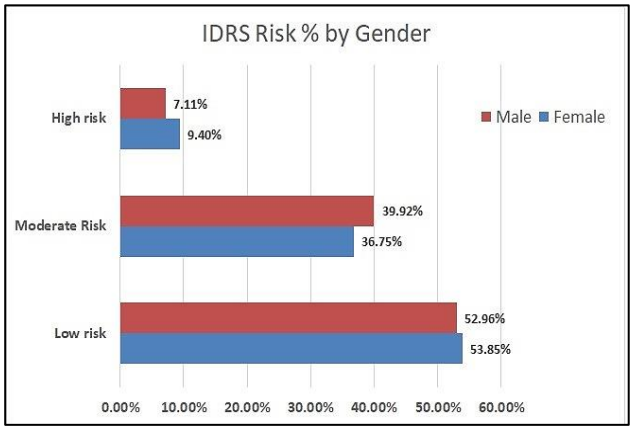

Figure 1: IDRS risk percent by gender.

The International Diabetic Association criteria on RBS were used for deciding categories.[6] With this, 86% subjects were normal (<140 mg/dl), 12% prediabetic (141-199 mg/dl) and 1.6% diabetic (≥200 mg/dl) excluding those who were already known diabetics.

DISCUSSION

The rise of T_2D India in urban-rural communities is a cause of concern from various reports.[1-3] This implies importance of prevention tools as well as timely diagnosis and treatment. The sustainable development goals call for PA and its inclusion in NPCDCS (National program for prevention and control of cancer, diabetes, cardiovascular diseases and stroke) was overdue.

IDRS is a simple tool based easy-to-check criteria and helps to categorize subjects into low, moderate and high-risk categories for developing T_2D. IDRS has been used in India across states.[2,9-12] A note of caution about its limitations as a predictive tool in comparison of the Finnish diabetes risk score (FINDRISC) was reported by a Miraj-based study.[9] Another study (Shimla) suggests that IDRS is a user-friendly screening tool but has a moderate diagnostic accuracy at 57%.

In this study eight subjects had previously known diabetes, hence excluded from subsequent analysis. The five more T_2D subjects detected by RBS criterion of ≥200 mg/dl, were retained in the analysis since diagnosis with HbA_1C was not done. T_2D prevalence of 3.5% was observed, for the rather younger age group of this study population (30.8 years).[13] Of the subjects, 46% were at high and moderate risk. Looking at the large proportion of high and moderate IDRS risk in this population (46.6%), the prevalence could be higher with advancing age of the cohort. This is the real value of screening for IDRS risk, especially for younger age groups. A study from Puducherry reported 50.32% subjects at moderate risk for diabetes and 31.20% in high risk IDRS group, out of the latter 76% were diabetics already. The Puducherry study population was older (68% above 35 years) than our study population. A Pune AFMC study in 2017 with mean age 49 years reported strong association of high IDRS scores and being diabetic and surprisingly large percentage of undiagnosed population. The same study reported high sensitivity of IDRS tool (100-95%) as age advances from 20 to 60 years and poor specificity (2-28%) from age 20 to 60 years.[8] In our study we have not estimated sensitivity and specificity as definitive diagnosis of diabetes was not done with HBA_1C test. A Lucknow IDRS study (56% above 50 years age) reported that 67% subjects had high risk for T_2D, and 30% had moderate risk.[11] Hence our study population has currently mainly an age-advantage for keeping T_2D at bay.

The study population is equally divided in moderate and sedentary work category, with contract workers from ancillary services making most of the moderately active people. The energy intakes between sedentary and moderate workers don't vary significantly and the 'moderate' nature of work involves many energy-saving gadgets. Also, there is scant physical workout as only 15

men and 1 woman had any reportable aerobic weekly activity >120 minutes/week to mention, which is already a compromised level compared to the mandatory 150 minutes/week. The mandatory 150 minutes/week aerobics was reported by only 6 subjects.

PHT_2D in any parent was present in 19.5% cases could be underreported.

On waist size criterion, 15% women and 39% men had waist above 80 and 90 cm respectively. Waist size and BMI correlated closely (0.7390, 21.0423, p<0.0001). Hence waist size is a good tool for health education and monitoring rather than the intangible BMI that needs to be calculated.

By using the International Diabetic Association criteria on RBS, 86% subjects were normal (<140 mg/dl), 12% pre-diabetic (141-199 mg/dl) and 1.6% diabetic (>200 mg/dl) excluding those who were already known diabetics. The conversion of pre-diabetic to diabetic status is rather quick in Indian population, there is need to take specific steps regarding timely prevention.[14]

Results of multiple regression for RBS (Table 3) with significant p values for coefficients for BMI and age but not PHT2D and type of work (sedentary or moderate) are noteworthy. The strength of association of PHT_2D and work type (sedentary or moderate) is seen clearly in IDRS risk category (Table 4).

The Finnish risk score for predicting diabetes (FINDRISC) has 11 points to consider against the four points in IDRS.[15] IDRS is a much simple screening tool and can be done even by laypersons with simple measurements and information. IDRS can also serve well as a health awareness and action tool for waist size and PA even for health care workers and subjects. Waist size, as compared to BMI, is a more direct measure of corpulence and central obesity that matters for causing diabetes.

The enormous challenge of motivating people for control of food intakes and better PA levels to achieve healthy waist-size outcomes on a perennial basis is however daunting, looking at the low PA level in this study population. Families and institutional managers need to find ways to achieve this as a lifestyle change. Thanks to the IT gadgets the super-sedentary job is a new occupational health problem adding to the NCD burden. Sedentary behaviour is now widely recognized for its adverse metabolic effects.[16] Some examples of sedentary behaviour include television viewing, playing video games, using a computer, sitting at school or work, and sitting while commuting.[17] Hence recent studies argue about (a) personal awareness and measures to enhance PA and (b) workplace interventions like doing things standing rather than do them sitting.[18,19] Indian work establishments need to wake up to this challenge.

This study has some limitations. Purposive sampling limits the external validity of the IDRS risk profile. PA was assessed broadly on job type and not on PA scale. RBS has a limited value in diagnosis of diabetes. We could not cover the entire staff because of COVID pandemic halting the work in March 2020.

CONCLUSION

Pooled IDRS risk was present in 47% subjects despite younger age of study population. Improvements in physical activity and reduction in waist size is the need of the hour.

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