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ASSESSMENT OF PREVALENCE OF TYPE-2 DIABETES MELLITUS AMONG UNDERGRADUATE STUDENTS IN WEST BENGAL, INDIA

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ABSTRACT
Diabetes mellitus is a public health problem with increasing prevalence worldwide. Type2 diabetes mellitus (T2DM) is now alarmingly high among young and causes rapid progression of chronic vascular, myocardial, neuronal, nephrogenic and retinal complication. This suggests the need for screening programs to detect diabetes at an early stage. Thus objective of this study was to assess the prevalence of T2DM among under graduate students in West Bengal, India using sensitive and cost effective tools. A cross sectional study was done among 1869 (male-732, female 1137) undergraduate students in West Bengal, India using Indian Diabetic Risk Score (IDRS) and American Diabetic Association proposed Risk Score (ADARS). A predesigned questionnaire was developed and was used to data collection. IDRS shows that 5.3% of male and 11.0% female students were in high risk group, 65.6% male and 67.0% female students were under medium risk group. According to ADARS prevalence of type2 diabetes risk for male and female was 9.7% and 13.7% respectively. According to obesity classification for Asians more than 30% (33.9% for male and29.2% for female) students were either overweight or obese. 28.6% students were centrally obese. More than 20% students were hypertensive.76.1% students had no exercise and sedentary work. This study reveals that young college students are highly vulnerable to T2DM in future. Age, family history of diabetes, BMI and/or central obesity, hypertension and physical inactivity have strong association with diabetic risk scores. Except age and family history of diabetes all others risk factors are modifiable with life style modification and dietary changes. It is recommended that all undergraduate students should be tested to determine the risk of developing T2DM so that proper intervention can be carried out to reduce the burden of diabetes in future.

KEYWORDS: Type2 diabetes, IDRS, ADARS, Waist circumference, hypertension, family history.

INTRODUCTION
Diabetes mellitus (DM) is one of the non-communicable disease characterized by chronic hyperglycemia caused by complete or partial insufficiency of insulin secretion and/or insulin insensitivity. There are two primary type of DM viz. insulin dependent diabetes mellitus (IDDM) or type 1 diabetes mellitus (T1DM) and noninsulin dependent diabetes mellitus (NIDDM) or type 2 diabetes mellitus (T2DM). T2DM is the most common form of DM, which accounts for 90% to 95% of all diabetic patients.[1] DM is now a leading cause of morbidity and mortality. It is now considered as major risk factor for death and nonfatal complications that will form a large burden to the patient's family and health care system.[2] In 2011 there was 366 million people with DM globally and this will increased to 552 million by 2030.[3] In India alone the prevalence of DM is expected to increase from 31.7 million in 2000 to 79.4 million in 2030.[4] Thus prevalence of DM is rapidly rising at an alarming rate. India will be considered as diabetes capital of the world from 2025.[5]

T2DM was considered once as a disease of grandparents and parents but now it is disease children and adolescent.[6,7] Onset of DM in early age causes rapid progression, chronic vascular complication and end organ damage at relatively earlier time.[8] Thus DM is growing cause of disability and premature death. Across the world one person dies in DM every 7 seconds.[9] In spite of its high prevalence DM remains highly undiagnosed and causes increase risk of mortality. It has been found that 66% of Indian, 50% in Europe and 33% in the USA diabetes cases are not diagnosed.[10] Thus it is very important to diagnose the DM at the earliest to unmask hidden burden of this disease.

The causal sequence of T2DM usually started in childhood, particularly in obese individuals.[11] Obesity

particularly central obesity creates T2DM by inducing insulin insensitivity.[12]

Sedentary life style and physical inactivity are contributors of overweight and obesity, are also great importance to the development of T2DM.[13,14] The prevalence of overweight in adolescents is increasing worldwide as well as in India due to urbanization and technological advances.[15] Among the youth of today, college students have a busy academic schedule and they generally do not have much time for physical exercise. Based on this background, present study was undertaken to find out the risk of undergraduate students of developing T2DM in future using Indian Diabetes Risk score (IDRS) and American Diabetes Association Risk Score (ADARS).

METHODS

***Subjects*:** It is a cross sectional institution based observational study done from June2017 to August 2017 among undergraduate students in a college of West Bengal, India. Recruitment of the students as study subjects was done after thoroughly explain the purpose of the study. 1869 students (732 male and 1137 females) give their consent for participation. Data was collected by interviewing each participant with the help of pre-designed questionnaires consisting of demographic details, family history of diabetes, anthropometric measurement and measurement of blood pressure.

Measurement of blood pressure: Blood pressure was measured with a standard mercury sphygmomanometer. Before recording the blood pressure students were allowed to wait in separate room for 10 minutes to relieve their restlessness and anxiety. Each boy was then called one by one and pressure was measured in the sitting posture in the right upper arm. Three readings were taken at 5 minute intervals and their mean was taken as subject's blood pressure. The child cuff was used when upper arm length was 20cm or less and the adult cuff otherwise.[17] Systolic blood pressure was recorded on hearing the first sound (phase I) while diastolic blood pressure was taken on complete disappearance of Korrotkov sounds (phase V).

Anthropometric measurements: Body weight was measured using bathroom scale accurate to 0.5kg. The scale was kept on a fate surface and adjusted with '0' mark. Now the subject was requested to step on it in bare feet. Weights were taken in light cloth. Weight was recorded to the nearest 0.5kg. Height was measured using anthropometric rod. Height of the subject was recorded without footwear and expressed to the nearest 0.1cm. Neck circumference (NC) was measured to the nearest 0.1cm just below the laryngeal prominence (Adam's apple). Waist circumference (WC) was measured mid-way between iliac crest and lowermost margin of the ribs in quiet breathing with the subjects wearing minimal clothing. WC above 90cm for male and above 80 cm for female was considered as abdominally obese. BMI was calculated from the height and weight using following equation: BMI (kg/m^2) = weight (kg) / $height^2$(m). On the basis of Asian classification BMI <18.5 kg/m^2 was considered as underweight, 18.5-22.9 kg/m^2 as normal, 23.0-27.5 kg/m^2 as preobese and > 27.5 kg/m^2 as obese.

***Assessment of diabetes risk*:** IDRS (16) was computed for every participant with four parameters (age, abdominal obesity, family history of diabetes and physical activity). The students were classified as high risk, moderate risk and low risk based on IDRS (up to 30 score as low risk, 30-50 score as moderate risk and > 60 as high risk). Similarly, ADARS (17) was calculated for everyone with seven parameters (age, sex, gestational diabetes, family history of diabetes, hypertension, weight-height ratio and physical activity). The participants were divided as low risk and high risk on the basis of ADARS (< 5 as low risk and > 5 as high risk).

***Statistical analysis*:** Data obtained from the study were given as mean + SD. Risk categories were expressed in percentage. Chi square test was done to find out association between various parameters and IDRS and ADARS. P value of 0.05 or less was considered as statistically significant.

RESULTS

1869 students were screened by the IDRS and ADARS out of which 732 (39.2 %) were male and 1137 (60.8 %) were females. Demographic characteristics of the study participants were represented in table-1.

Table. 1: Demographic characteristics of study subjects.

Parameters	Male	Female
Age (years)	19.32 + 1.39	19.10 + 1.12
Height (cm)	167.09 + 6.62	153.83 + 5.80
Weight (kg)	60.65 + 12.36	80.881 + 10.37
BMI (kg/m^2)	21.66 + 3.89	21.45 + 4.09
Waist circumference (cm)	78.95 + 10.62	76.20 + 10.02
SBP (mmHg)	124.96 + 13.48	114.81 + 13.46
DBP (mmHg)	76.28 + 9.25	73.70 + 9.19

IDRS and ADARS components of study population are given in table-2 and table-3. Mean IDRS 29.33 (ranged from 0 to 70) for male and 33.66 (ranged from 0 to 60) for female. Maximum attainable score was 100.

Maximum attainable score was 11 according to ADARS. Mean score was 2.12 (ranged from 0 to 6) for male and 2.56 (ranged from 0 to 6) for female. Females were found to have more IDRS and ADARS than male counter parts.

Table. 2: IDRS among male and female students.

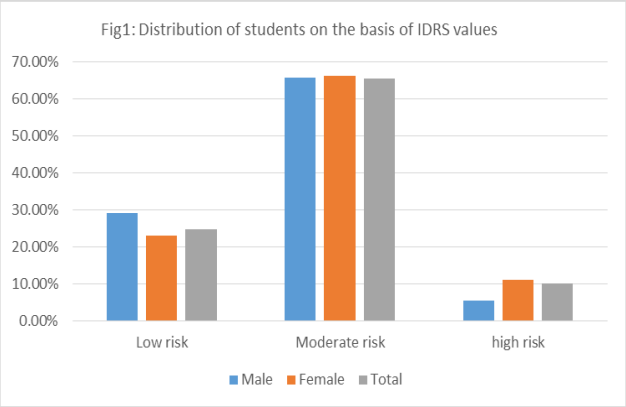
Components	Scores	Male		Female	
		Number	%	Number	%
Age					
<35 year	0	732	100	1137	100
35-49 years	20	0	0	0	0
> 50 years	30	0	0	0	0
Abdominal obesity (waist circumference):					
<90cm (M); <80cm (F)	0	604	82.5	731	64.3
90-99cm (M); 80-89 cm (F)	10	98	13.4	271	24.3
>100cm (M); >90cm (F)	20	30	4.1	135	11.4
Physical activity:					
Exercise regular + strenuous work	0	65	8.9	46	4.1
Exercise regular or strenuous work	20	148	20.2	188	16.5
No exercise and sedentary work	30	519	70.9	903	79.4
Family History of diabetes:					
No family history	0	610	83.3	860	75.6
Either parents	10	115	15.7	261	23.0
Both parents	20	7	1.0	16	1.4
Scores					
Maximum attainable	100				
Maximum attained		70		60	
Minimum attained		0		0	
Mean		29.33		33.66	

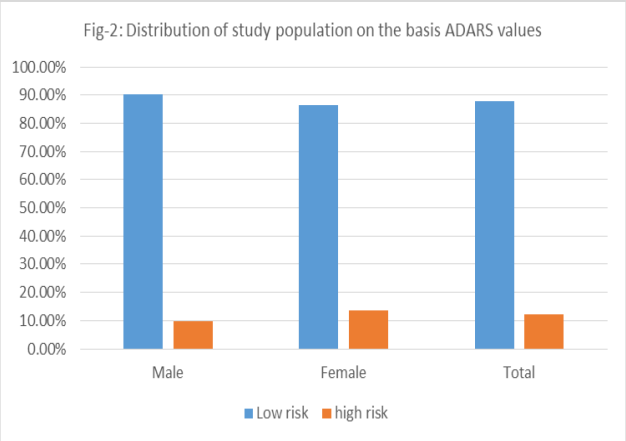
Table. 3: ADARS among male and female students.

Components	Scores	Male		Female	
		Number	%	Number	%
Age					
<40 years	0	732	100	1137	100
40-49 years	1	0	0	0	0
50-59 years	2	0	0	0	0
> 60 years	3	0	0	0	0
Gender					
Male	1	732	100	Not applicable	Not applicable
female	0	Not applicable	Not applicable	1137	100
Gestational Diabetes					
Yes	1	Not applicable	Not applicable	0	0
No	0	732	100	1137	100
Diagnosed with hypertension					
Yes	1	126	17.2	264	23.2
No	0	606	82.8	873	76.8
Physical activity					
Yes	0	213	29.1	248	21.8
No	1	519	70.9	889	78.2
Weight height ratio (BMI)					
<18.5 kg/m2	0	145	19.8	291	24.7
18.5-22.9 kg/m^2	1	349	47.7	514	45.2
23.0-27.4 kg/m^2	2	162	23.5	234	20.6
> 27.5 kg/m^2	3	76	9.0	98	9.5
Mother, father, sister or brother with diabetes					
Yes	1	122	16.7	277	24.4
No	0	610	83.3	860	75.6
Scores					

Maximum attainable	11		
Maximum attained		6	6
Minimum attained		1	1
Mean		2.12	2.56

According to IDRS 25.2% (29.1% for male and 23.0% for female) students were low risk, 66.5% (65.6% for male and 66% for female) were medium risk and 7.8% (5.31% for male and 11.0% for female) were high risk category (fig.1). According to ADARS 12.1% participants (9.7% for male and 13.7% females) were high risk category (fig.2).





There are numbers of factors that increase the risk of developing prediabetes and ultimately type2 diabetes. Some of these factors are beyond a person's control (non-modifiable) and some modifiable. Non-modifiable risk factors include family history of diabetes, age and gestational diabetes. Age limit of students was 18-21 years having mean value 19.2 years. Thus age has no role in this risk assessment. All the participants were unmarried hence gestational diabetes was not consider for risk assessment. 20.1% participants showed a family history of diabetes in any one parents and 1.2% of the students had both parents suffering from diabetes (table-4).

Modifiable risk factors include overweight/ obesity, physical inactivity, hypertension etc. According to obesity classification for Asians more than 30% students were either overweight or obese. 28.6% students were centrally obese. More than 20% students were hypertensive.76.1% students had no exercise and sedentary work (table-4).

Table. 4: Risk factors of type 2 diabetes

Components	**Male**	**Female**	Total (%)
Height weight ratio (BMI)			
Normal/Underweight	494 (67.5)	805 (70.8)	1299 (69.5)
Overweight/Obese	238 (32.5)	332 (29.2)	570(30.5)
Abdominal obesity (waist circumference)			
Normal (<90cm [M]; <80cm [F])	604 (85.8)	731 (64.3)	1335 (71.4)
Obese (>90cm [M]; >80cm [F])	128 (14.2)	406 (35.7)	534 (28.6)
Physical activity:			
Moderate to severe work	213 (29.1)	248 (21.8)	461 (24.7)
No exercise and sedentary work	519 (70.9)	889 (78.2)	1408 (75.3)
Blood pressure			
Normotensive	606 (82.8)	873 (76.8)	1479 (79.1)
hypertensive	126 (17.2)	264 (23.2)	390 (20.9)
Family history of diabetes			
No family history	610 (83.3)	877 (77.1)	1487 (79.6)
Family history	122 (16.7)	260 (22.9)	382 (20.4)

Table-5 shows the association between various risk factors and the IDRS. There is significant association between risk factors like overweight/obesity, family history, physical activity, hypertension and IDRS. There is strong association (p<0.001) between all tested risk factors and ADARS (table-6).

Table. 5: Association between risk factors and IDRS.

Risk factors	Males				Females			
	N	IDRS>30	Chi square	P value	N	IDRS>30	Chi square	P value
BMI								
Overweight/obese	238	226 (99.2%)	18.45	<0.001	332	297 (89.5%)	5.09	<0.05
Normal/underweight	494	306 (59.9%)			805	579 (71.9%)		
Waist circumference								
Centrally Obese	128	121 (94.5%)	5.38	<0.05	406	356 (87.7%)	5.11	<0.05
Normal	604	411 (68.0%)			731	520 (71.1%)		
Blood Pressure								
Hypertensive	126	126 (100%)	8.08	<0.01	264	256 (97.0%)	9.31	<0.01
Normotensive	604	406 (67.0%			873	620 (71.0%)		
Physical activity								
Moderate to severe	213	64 (30.0%)	52.45	<0.001	248	76 (30.6%)	63.22	<0.001
No physical activity	519	468 (90.2%)			889	800 (90.0%)		
Family history of diabetes								
Present	122	120 (98.4%)	6.96	<0.01	277	270 (97.5%)	10.43	<0.01
Absent	610	412 (67.4%)			860	606 (42.1%)		

Table. 6: Association between risk factors and ADARS.

Risk factors	Males				Females			
	N	ADARS > 5	Chi square	P value	N	ADARS > 5	Chi square	P value
BMI								
Overweight/obese	238	68	109.8	<0.001	332	148	253.5	<0.001
Normal/underweight	494	3			805	8		
Waist circumference								
Centrally Obese	128	69	222.3	<0.001	406	145	204.5	<0.001
Normal	604	2			731	11		
Blood pressure								
Hypertensive	126	69	225.1	<0.001	264	141	287.7	<0.001
Normotensive	606	2			873	15		
Physical activity								
Moderate to severe	213	2	22.8	<0.001	248	4	15.5	<0.001
No physical activity	519	69			889	152		
Family history of diabetes								
Present	122	71	231.0	<0.001	277	147	303.8	<0.001
Absent	610	0			860	9		

DISCUSSION

Current study showed that more than 10% (10.1% according to IDRS and 12.1% according to ADARS) of study population are at high risk of getting T2DM in future. Risk of developing diabetes was moderate in 65% and low in more than 24% of undergraduate students as assessed by IDRS.

Abdominal or central obesity is expressed as an increased waist circumference. Several studies have shown that abdominal obesity correlates well with T2DM.[18,19] Recent study suggested that there is significant association between waist circumference and future risk to develop T2DM.[20,21] 28.6% (14.2% for male and 33.7% for female) of study population were under risk group according to central obesity. This finding is similar to early findings.[5,22]

30.5% population (32.5% for male and 29.2% for female) students were either overweight or obese. This finding is similar to previous other studies.[5,23] This study also found significant association between BMI and diabetes risk scores. Overweight and obesity is known to increase the risk of T2DM in future.

This study found 75% participants with no physical activity. Various studies in India found no to minimal physical activity ranging 5-85%.[5,23] Physical activity increases the sensitivity of cells to insulin. Thus physical inactivity is an important risk factor for T2DM. Physical

activity also causes weight reduction and control of blood pressure.[24]

More than 20% (17.2% for male and 23.2% for female) of study students were hypertensive. Hypertension and diabetes were found to share common risk factors and co-occur frequently.[25] Several studies indicated that high blood pressure is a significant predictor of T2DM.[25,26] This study also support that high blood pressure is a predictor of T2DM as significant association was noted between future risk of diabetes and hypertension.

Non-modifiable risk factors for T2DM include family history of diabetes, age and gestational diabetes. Age limit of students was 18-21. Thus age has no role in this risk assessment. All the participants were unmarried hence gestational diabetes was not consider for risk assessment. 20.1% participants showed a family history of diabetes in any one parents and 1.2% of the students had both parents suffering from diabetes (table-4).

CONCLUSION

The present study shows that more than 10% of study population are at high risk of getting T2DM in future. Risk of developing diabetes was moderate in 65% of undergraduate students. Obesity, hypertension, physical inactivity and family history of diabetes are significantly associated with IDRS and ADARS. Except age and family history of diabetes all others risk factors are modifiable with life style modification and dietary changes. Therefore appropriate lifestyle modifications should be implemented by emphasizing on balance diet and regular physical activity. It is recommended that all undergraduate students should be tested to determine the risk of developing T2DM so that proper intervention can be carried out to reduce the burden of diabetes in future.

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