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ORIGINAL ARTICLE

RISK OF DEVELOPING DIABETES MELLITUS AMONG MEDICAL STUDENTS IN SOUTH INDIA

Darshan Arathi[1], Mukhi Naman[2]

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ABSTRACT: BACKGROUND AND OBJECTIVES: Earlier diabetes mellitus (DM) was the disease thought to be the disease of elderly but at present there has been a trend towards shift in the mean age of onset of type 2 diabetes to a much younger age. This rise in prevalence has been attributed to changes towards a western lifestyle, obesity and family history. The Indian diabetic risk score (IDRS) is simple and easily applicable for screening of DM. This study was undertaken to evaluate the risk of DM among medical students likely versus not likely to develop Type 2 DM. **METHODOLOGY:** The present one year cross-sectional study was carried out in the Department of Medicine of a tertiary care centre situated in South India from January 2014 to December 2014 on 200 medical students aged >18 years. Assessment of diabetes risk was based on IDRS a simple questionnaire consisting of four simple parameters i.e. age, obesity status, exercise status, and family history of type 2 DM. **RESULTS:** The fasting blood sugars level were found to be between 100 to 125mg/dL in 24.5% of the students and 16.5% of the students had HbA1c between 5.5 to 6.4 while one student had HbA1c >6.5 suggesting diabetes mellitus. The risk of developing DM was low in 82.5%, moderate in 16.5% and high risk in 1% of the students. There was positive association between diabetes risk based on IDRS score and FBS, HbA1c and body mass index. Among the 35 students with moderate and high risk of DM, 31.43% had raised LDL, 68.57% had abnormal HDL while triglycerides and total cholesterol were raised in 11.43% and 8.57% respectively. **CONCLUSION:** Individuals above 18 years should be screened for the presence of risk factors including physical activity, obesity and family history of diabetes mellitus using IDRS which will not only help to predict the risk of developing DM but also helps in prevention.

KEYWORDS: Diabetes mellitus; Fasting Blood glucose; Indian diabetic risk score; Medical students;

INTRODUCTION: Diabetes mellitus (DM), a metabolic disease is characterized by hyperglycemia which results from defects in either insulin secretion or insulin action or both.[1] Most patients fall into two broad categories that is, patients with little or no endogenous insulin secretory capacity called as Insulin Dependent Diabetes Mellitus (IDDM or type 1) and those who retain endogenous insulin secretory capacity but have a combination of resistance to insulin action and an inadequate compensatory insulin secretory response known as Non-Insulin Dependent Diabetes Mellitus (NIDDM, or type 2).[1,2] Apart from type 1 and type 2 Diabetes Mellitus, there are other forms of diabetes in the young including maturity onset diabetes of the young (MODY), fibrocalculous pancreatic diabetes (FCPD), gestational diabetes mellitus (GDM), endocrine diabetes and rare genetic forms of diabetes.[1]

Diabetes mellitus is a chronic and potentially disabling disease which is reaching an epidemic proportion in many parts of the world and a major growing threat to global public health.[1] Diabetes Mellitus has evolved into a global epidemic and India has the second largest population with diabetes. Diabetes caused 4.9 million deaths in 2014 and every seven second a person dies from diabetes or its complication. Based on the recent statistics of International Diabetes Association it is estimated that

worldwide 387 million people have diabetes and by 2035 this will rise to 592 million.[3] Diabetes is fast gaining the status of a potential epidemic in India with more than 62 million diabetic individuals currently diagnosed with the disease.[4,5] It is predicted that by 2030 diabetes mellitus may afflict up to 79.4 million individuals in India, while China (42.3 million) and the United States (30.3 million) will also see significant increases in those affected by the disease.[6]

Unfortunately, more than 50% of the diabetic patients in India remain unaware of their diabetic status, which increases the risk of development of diabetic complications in them.[7] It has also been found that 66% of the Indian diabetics are not diagnosed, as compared to 50% in Europe and 33% in the USA.[8] India currently faces an uncertain future in relation to the potential burden that diabetes may impose upon the country.[6] The rising prevalence of type 2 DM is closely associated with westernization, industrialization and socioeconomic development.[7]

The chronic hyperglycemia of diabetes results in long term damage, dysfunction and failure of various organs, especially the eyes, kidneys, nerves, heart and blood vessels. Hence, early identification of the risk factors associated with diabetes and appropriate interventions aimed at preventing the onset of diabetes and its complications are urgently required.

Previously, DM was a disease of the middle-aged and elderly. Currently there has been a trend towards shift in the mean age of onset of type 2 diabetes to a much younger age especially in high-risk populations.[9,10] A diabetes risk score helps in devising effective screening strategies to unmask the hidden burden of the disease. The risk factor approach needs aggressive identification for planning prevention strategies and for an early diagnosis. Several diabetes risk scores or risk engines have been devised for prevention programmes in the USA, Scandinavia and in the UK.[11] Mohan et al.,[12] from their Chennai Rural Epidemiology Study (CURES) cohort, have developed a single user friendly Indian diabetic risk score (IDRS) (Table 1). Its advantages are its simplicity and low cost and it is easily applicable for mass screening programmes.

Medical students have a stressful life, sedentary lifestyle and irregular food habits which could predispose them for Diabetes or Pre-Diabetes at a younger age. Also, at our institution a large number of obese medical students have been observed. This indicates that a small percentage of them could have high risk scores which could pre-dispose them for diabetes at a younger age. Medical students being a very important part of the society and can be easily educated regarding the early identification of impaired glucose tolerance and diabetes to prevent the complications that follow in the later life. Hence, study was undertaken to find the differences in risk factors among medical students likely versus not likely to develop Type 2 DM.

METHODOLOGY: This one year cross-sectional study was done in the Department of Medicine of a tertiary care center of North Karnataka from January 2014 to December 2014. A total of 200 medical students aged>18 years studying in our institute were enrolled. Medical student with known diabetes, on corticosteroids and not willing to participate were excluded from the study. The study was approved by the Institutional Ethics Committee. The selected medical students were briefed about the nature of the study and a written informed consent was obtained.

Demographic data like gender and age were collected along with relevant history. Medical students were interviewed for family history (Cardiovascular, hypertensive and diabetic history), type of regular food intake (Vegetarian, non-vegetarian), smoking and alcohol intake and the responses were recorded on predesigned and pretested proforma. A thorough clinical examination was done and the findings were noted. The abdominal obesity was measured by using a measuring

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tape at the mid-point below the lower rib cage and the highest point of the iliac crest. The measurements were taken with the subjects in minimum clothes and when they were breathing quietly at the end of their expirations. Under strict aseptic precautions, fasting blood sample was drawn fasting for the estimation of fasting blood sugar, lipid profile (Total cholesterol, triglycerides, HDL, LDL) and HbA1c.

All subjects were assessed for IDRS which requires answers to three simple questions and a waist measurement. The four parameters are given in Table 1. The students were given scores according to physical activity[13] (Sedentary, mild, moderate, vigorous exercise, or strenuous work).

The anthropometric measurement waist circumference (That indicates both central as well as general obesity) was measured by using a measuring tape. Measurement of the waist was taken directly on the body with light clothing with an accuracy of 0.5cm. The waist circumference was taken at the midpoint between the iliac crest and the lower border of the ribs after a normal expiration.[14]

Assessment of diabetes risk was based on IDRS. Simple, safe, and inexpensive questionnaire consisting of four simple parameters i.e. age, obesity status, exercise status, and family history of type 2 DM. The validated IDRS has been successfully implemented as a practical screening tool to assess the diabetes risk and to detect undiagnosed type 2 diabetes, it also proved suitable in prediction of metabolic syndrome and cardiovascular disease in the South Indian population which takes into consideration the age, abdominal obesity, physical activity and the family history of the patients. The IDRS has a sensitivity of 72.5% and a specificity of 60.1% and it was derived, based on the large population based studies.[12]

Statistical Analysis: The data obtained was coded and entered into Microsoft Excel Worksheet. The categorical data was expressed as rates, ratios and proportions and continuous data was expressed as mean±standard deviation (SD). Categorical data was analysed using chi-square and Fisher's exact test. A p value of ≤ 0.05 was considered as statistically significant.

RESULTS: In this study out of 200 medical students 52.5% were boys and 47.5% were girls with male to female ratio of 1.10:1. Maximum students were aged 19 years (31%) and belonged to third year (60%) As all the students were below 35 years the diabetes risk score was considered as '0'. On physical examination, 42% of the students had body mass index between 18.5 to 22.99Kg/m^2, 3.5% had same between 23.00 to 24.99 and 4% students had body mass index between 25.00 to 29.99 Kg/m^2 (Table 1). On IDRS assessment, maximum students (30%) had mild exercise (IDRS score 20), family history diabetes was present among 53 (26.5%) students and maximum students reported family of diabetes mellitus in father (17.5%). The abdominal circumference was normal in 64% of the students and suggestive of moderate risk in 33.50% (Table 2). The fasting blood sugars level were found to be between 100 to 125 mg/dL in 24.5% of the students and 16.5% of the students had HbA1c between 5.5 to 6.4 while one student had HbA1c >6.5 suggesting diabetes mellitus (Table 3). Based on the IDRS risk scoring, low risk was noted in 82.5%, moderate in 16.5% and high risk in 1% of the students (Table 3).

There was positive association between diabetes risk based on IDRS score and FBS, HbA1c and body mass index (Table 4). Among the students with moderate and high risk of diabetes mellitus based IDRS scores, lipid profile was abnormal in considerable subset of students that is 31.43% of the students had raised LDL, 68.57% had abnormal HDL while triglycerides and total cholesterol were raised (>150mg/dL and >200mg/dL respectively) in 11.43% and 8.57% respectively (Table 5).

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DISCUSSION: In the last decade, the incidence and prevalence of type 2 diabetes in adolescents has increased dramatically, especially in ethnic populations. However, the shift from paediatrics to adulthood is a critical period as the older teen enters the next developmental stage referred to as emerging adulthood and is a period of major life transitions. This is also a period of deterioration in glycemic control among normal individuals and in those individuals diagnosed to have diabetes there may be increased occurrence of acute complications and psychosocial, emotional, and behavioural issues; and emergence of chronic complications. Based on the recently published projections from Centres for Disease Control and Prevention for type 2 diabetes, assuming a 2.3% annual increase, the prevalence of type 2 diabetes in those under 20 years of age will quadruple in 40 years. It is also postulated that, autoantibodies and ketosis may be present in patients with features of type 2 diabetes (Including obesity and acanthosis nigricans).

Significant comorbidities may already be present at the time of a type 2 diabetes diagnosis. Nevertheless, accurate diagnosis is critical as treatment regimens, educational approaches, dietary counsel, and outcomes will differ markedly between the two diagnoses. It is recommended that blood pressure measurement, a fasting lipid panel, assessment for albumin excretion, and dilated eye examination be performed at diagnosis. Thereafter, screening guidelines and treatment recommendations for hypertension, dyslipidemia, albumin excretion, and retinopathy in youth with type 2 diabetes are similar to those for youth with type 1 diabetes. Additional problems that may need to be addressed include polycystic ovary disease and the various comorbidities associated with pediatric obesity, such as sleep apnea, hepatic steatosis, orthopedic complications, and psychosocial concerns.[15]

Hence, the current ADA guidelines (2015) recommend testing to detect type 2 diabetes in children and adolescents who are overweight or obese and who have two or more additional risk factors for diabetes. Further, testing to detect type 2 diabetes in asymptomatic people should be considered in adults of any age who are overweight or obese (BMI ≥25kg/m^2 or ≥23kg/m^2 in Asian Americans) and who have one or more additional risk factors for diabetes. If tests are normal, repeat testing is to be carried out at a minimum of 3 years intervals reasonably.[15] This prompted us to find the differences in risk factors likely versus not likely to develop Type 2 DM in young individuals pursuing medical curriculum using IDRS which is a simple and cost-effective tool for a primary care physician or a health worker to identify at risk individuals for diabetes.

In the present study none of the participant had age as a risk factor as all the participants were medical students (100%) aged between 18 to 24 years. There was slight male preponderance with male to female ratio of 1.10:1 as 52.5% of the students were males and 47.5% were females. Assessment of IDRS components showed maximum risk of lack of physical activity (79.5%) followed by central obesity as measured by abnormal circumference (36%) and family history (27.5%). With regard to physical activity, 30% of the students had mild exercise, 28% had moderate exercise and 21.5% had sedentary lifestyle. The family history of diabetes mellitus was reported by 23.5% of the students in either father or mother and 3% of the students reported same among both the parents. Based on these statistics the IDRS score showed lower risk of developing diabetes in 82.5% of the students while moderate and high risk was found in 16.5% and 1% of the students respectively.

A similar study[8] on 261 medical students (99 female students and 162 male students) in 2011 from Pune, Maharashtra India reported 4%, 76%, and 20% in high, moderate and low risk group, respectively, for developing type 2 DM. Also major contribution to risk score was sedentary lifestyle in 62% students not doing any exercise other than daily routine activities followed by abdominal

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obesity was as a risk factor was found to 38% of students. Another study[11] from India in 2011 on 150 medical students reported 101 students with an IDRS of <30, 42 students with a moderate IDRS (30-50) and 7 who had a high IDRS of ≥60 resulting in nearly one third of the young medical students had moderate to high risk diabetes scores. Although only 5% were in the high risk category, about 28% were in the moderate risk category. The increased risk scores were mainly due to a decreased physical activity (in 22% of the students), a family history of diabetes in about 13% students and an increased abdominal circumference in about 8% of the students.

The proportion of the students with moderate and high risk for developing diabetes observed in the present study was low compared to these Indian studies,[8,11] but the profile of major contributors to the risk factors in the present study was comparable with other Indian studies. The lower proportion of students with higher risk of developing diabetes observed in the present study could be explained by the lower frequency of medical students with sedentary lifestyle compared to other Indian studies which also would have influenced the central obesity. Though, abdominal circumference risk factor in 36% of the students, higher risk was present only in 2.5% of the students. The assessment of body mass index also revealed similar findings that is only 3.5% of the students with BMI at risk of developing obesity (Between 23.00 to 24.99 Kg/m^2) and 4% were overweight (BMI between 25.00 to 29.99 Kg/m^2) and none of the students was found to be obese (BMI ≥ 30 Kg/m^2).

In this study on estimation of FBS, 24.5% of the students revealed RBS levels between 100 to 126mg/dL suggesting prediabetes condition. In 16.5% of the students HbA1c levels were between 5.7 to 6.4 suggesting prediabetes and one students had HbA1c between 6.5 to 7.0 confirming the diagnosis of type 2 DM. Positive association was noted between risk of diabetes based on IDRS with fasting plasma glucose levels ($p=0.002$), HbA1c ($p<0.001$) and body mass index ($p<0.001$). V. Mohan et al.[12] also showed an increase in the IDRS was associated with a worsening of glucose tolerance. The Inter 99 study by Glummer et al. showed a significant correlation between the Danish risk score with BMI and HbA_1C.[16]

The available data as to the long-term complications of type 2 diabetes such as nephropathy micro albuminuria, hypertension, dyslipidemia, atherosclerosis, and polycystic ovarian syndrome, poor blood glucose control[17,18] in young people underscores the severity of the disease. Although the IDRS does not include all the risk factors, it could predict dyslipidaemia also. A study by V. Mohan et al.[19] showed that the mean IDRS increase was associated with hypertriglyceridemia and hypercholesterolemia. The same was true in the present study as 35 sstudents with moderate and high risk of developing diabetes were investigated further for fasting lipid profile in which more two third of the students (68.57%) had low HDL levels and nearly one third (31.43%) had higher LDL levels. The mean HDL and LDL levels were 37.83 ± 9.93 mg/dL and 94.17 ± 23.87 mg/dL respectively.

Overall the present study with other Indian studies pose a big concern for lack of physical activity which strongly poses future risk of developing type 2 diabetes mellitus as without exercise the younger individuals may get more obesity in future with more stress related professions. Further family history of DM is a strong genetic component which predicts risk of developing type 2 diabetes. It is postulated that, the individuals with a parent with type 2 DM have an increased risk of diabetes and if both parents have type 2 DM, the risk approaches 40%.[1] Hence these individuals should be followed up regularly every year for screening of type 2 DM. Also IDRS is a very useful tool which can be used for predicting the risk of developing diabetes. It is also a very useful tool which can be used for predicting dyslipidaemia.

In resource limited settings, where a large population has to be screened for cardiovascular risk factors, calculating the IDRS and selecting high risk people for checking the lipid profile will save time and resources. It could also emerge as a good tool for health education and life style modifications, since the major cause of the high risk score among the young students was physical inactivity, which was easily modifiable. Hence, unnecessary investigations for identification of type 2 DM are avoided and this definitively reduces the economic burden of the nation.

The limitations of the study were that, estimation of fasting lipid profile was not done in all the students due to the cost constraints and study assessed the risk profile of medical students which cannot be applied to the general population. Hence studies on the calculation of IDRS in multiple groups of people with various age and its effect on the lifestyle modifications are needed.

CONCLUSION: Individuals above 18 years should be screened for the presence of risk factors including physical activity, obesity and family history of diabetes mellitus. In resource limited settings, where a large population has to be screened for cardiovascular risk factors, IDRS is a simple screening tool which aids in selecting high risk people for further investigations thereby saving time and resources. This will not only help to predict the risk of developing diabetes but will also help in prevention of future risk of diabetes.

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Variable	Sub-groups	Score
Age	< 35	0
	35-49	20
	≥ 50	30
Abdominal Obesity (Cms)	<80 female; < 90 male	0
(Waist Circumference)	80-89 female; 90-99 male	10
	≥ 90 female; ≥100 male	20
Physical activity	Vigorous exercise or strenuous work	0
	Moderate exercise	10
	Mild exercise	20
	Sedentary lifestyle	30
Family history	No family history	0
	Either parent	10
	Both parents	20
Maximum score		100
Risk stratification	Mild risk	< 30
	Moderate risk	30 – 50
	High risk	≥ 60

Table 1. IDRS scoring system to predict the risk of diabetes mellitus[12]

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Components	Risk (IDRS Score)	Distribution (n=200)	
		Number	Percentage
Physical activity	Strenous work (0)	41	20.50
	Moderate exercise (10)	56	28.00
	Mild exercise (20)	60	30.00
	Sedentary lifestyle (30)	43	21.50
	Total	**200**	**100.00**
Family history	Father (10)	35	17.50
	Mother (10)	12	6.00
	Both (20)	6	3.00
	Absent (0)	147	73.50
	Total	**200**	**100.00**
Abdominal	<90 male; <80 female (0)	128	64.00
circumference	90 to 99 male; 80 to 89 female	67	33.50
(Cms)	Abnormal (≥ 90 male; ≥ 80 female)	5	2.50
	Total	**200**	**100.00**
IDRS score	Low risk (< 30)	165	82.50
	Moderate risk (30 to 50)	33	16.50
	High (≥ 60)	2	1.00
	Total	**200**	**100.00**

Table 2: Distribution of students according to the IDRS component findings

Variables	Sub-groups	Distribution (n=200)	
		Number	Percentage
Fasting blood	< 100	151	75.50
sugar (mg/dL)	100 to 126	49	24.50
	> 126	0	0.00
	Total	**200**	**100.00**
HbA1c levels	< 5.5	166	83.00
	5.5 to 6.4	33	16.50
	6.5 to 7.0	1	0.50
	Total	**200**	**100.00**
BMI (Kg/m^2)	Undernourished (< 18.5)	101	50.50
	Normal (18.5 to 22.99)	84	42.00
	At risk (23.00 to 24.99)	7	3.50
	Overweight (25.00 to 29.99)	8	4.00
	Obese (≥ 30)	0	0.00
	Total	**200**	**100.00**

Table 3: Distribution of students according to the BMI, FBS and HbA1c levels

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Variables	Sub-groups	Risk of diabetes (IDRS score)						'p' value
		Low (<30)		Moderate (30-50)		High (≥60)		
		No	%	No	%	No	%	
Sex	Male	88	83.81	16	15.24	1	0.95	0.851
	Female	77	81.05	17	17.89	1	1.05	
	Total	**165**	**82.50**	**33**	**16.50**	**2**	**1.00**	
FBS	< 100	132	87.42	19	12.58	0	0.00	0.002
(mg/dL)	100 to 125	33	67.35	14	28.57	2	4.08	
	Total	**165**	**82.50**	**33**	**16.50**	**2**	**1.00**	
HbA1c	< 5.5	153	92.17	13	7.83	0	0.00	<0.001
	5.5 to 6.4	12	36.36	19	57.58	2	6.06	
	6.5 to 7.0	0	0.00	1	100.00	0	0.00	
	Total	0	0.00	1	100.00	0	0.00	
BMI	<18.5	101	100.00	0	0.00	0	0.00	<0.001
(Kg/m^2)	18.5 to 22.99	64	76.19	20	23.81	0	0.00	
	23.00 to 24.99	0	0.00	6	85.71	1	14.29	
	25.00 to 29.99	0	0.00	7	87.50	1	12.50	
	Total	**165**	**82.50**	**33**	**16.50**	**2**	**1.00**	

Table 4: Association of IDRS with characteristics of study population

Variables	Sub-groups	Distribution (n=35)	
		Number	Percentage
Total	< 200	32	91.43
Cholesterol	200 or more	3	8.57
(mg/dL)	**Total**	**35**	**100.00**
	Mean ± SD	**152.89**	**27.83**
LDL	< 100	24	68.57
(mg/dL)	100 or more	11	31.43
	Total	**35**	**100.00**
	Mean ± SD	**94.17**	**23.87**
HDL	< 40	24	68.57
(mg/dL)	40 or more	11	31.43
	Total	**35**	**100.00**
	Mean ± SD	**37.83**	**7.93**
Triglycerides	< 150	31	88.57
(mg/dL)	150 or more	4	11.43
	Total	**35**	**100.00**
	Mean ± SD	**101.71**	**34.91**

Table 5: Distribution of students according to lipid profile

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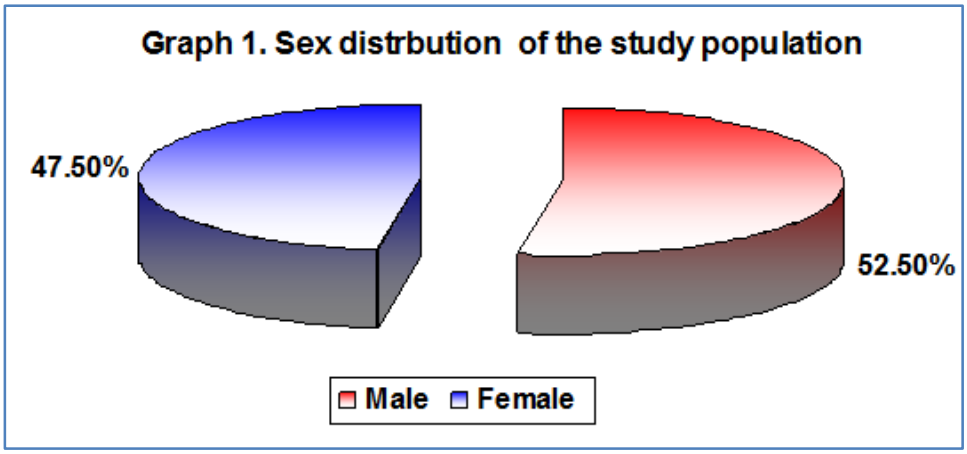

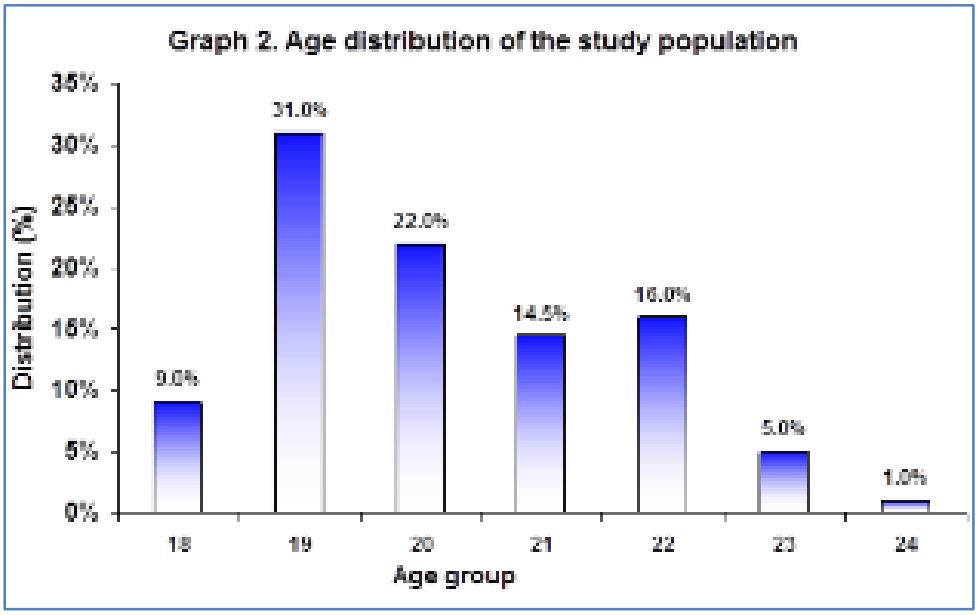

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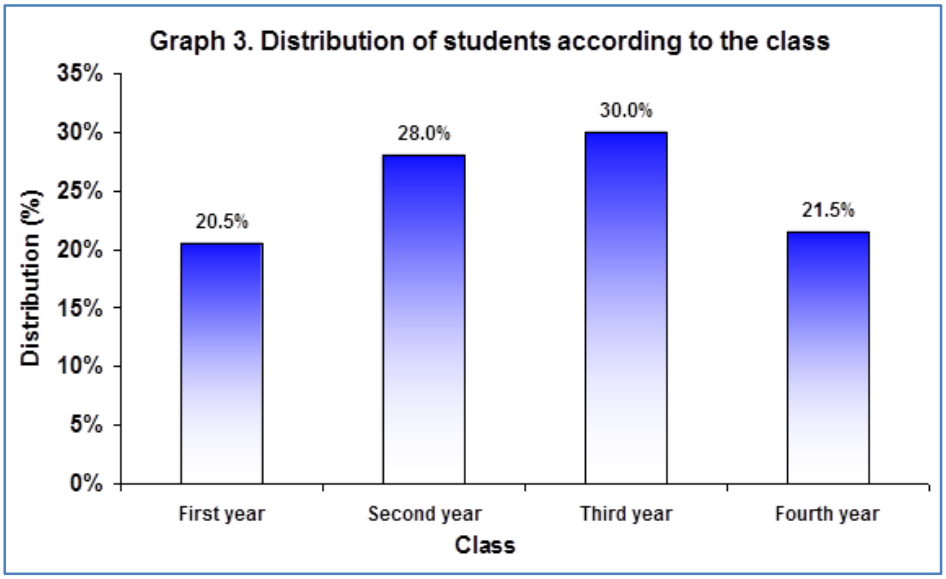

AUTHORS:

1. Darshan Arathi
2. Mukhi Naman

PARTICULARS OF CONTRIBUTORS:

1. Professor, Department of General Medicine, J. N. M. C, Belgaum.
2. Post Graduate, Department of General Medicine, J. N. M. C, Belgaum.

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NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Mukhi Naman,
Plot Number-620, Vinay House, Sector-5,
M. M. Extension, Opposite Sreenagar Garden,
Belgaum, Karnataka.
E-mail: dr.namanmukhi@gmail.com

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