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Demographic and Clinical Characteristics of Diabetes Mellitus among Youth Kashmir, India

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Abstract

Introduction
Diabetes mellitus (DM) is a major public health problem. Objective of current study was to know the demography, clinical characteristics and etiology of youth diabetes mellitus in Kashmir, North India.

Materials and Methods
A prospective hospital based study, carried out in the Department of Endocrinology, SKIMS Srinagar, Kashmir- India, in a two-year period. All the new youth onset diabetes patients whose age were less than twenty five years and were admitted in endocrinology ward for various reasons over the period from July 2008 to September 2010 were enrolled in this study. Variables recorded were demographics, clinical presentation, laboratory tests.

Results
A total of seventy two patients of youth onset diabetes mellitus with a mean age of 16.7 $\pm$ 5.7 years were studied. There were 33 males (45.8%) and 39 females (54.2%). Fifty nine patients (81.9%) presented with osmotic symptoms; hypoglycemic episodes were present in forty one (56.9%) patients. Family history of type 1 diabetes mellitus was present in nineteen (26.4%) patients; fourteen were less than 20 years and five more than 20 years. Sixteen (22.2%) patients had nephropathy. Diabetic ketoacidosis (DKA) at initial presentation was diagnosed in thirteen (18.1%) of the patients and nine (12.5%) had retinopathy.

Conclusion
Osmotic symptoms, hypoglycemic episodes and family history of diabetes were the most common presenting symptom. Family history of type 1 diabetes mellitus is highly prevalent among the studied patients.

Key Words: Type 1 diabetes mellitus (T1DM), Diabetic ketoacidosis (DKA), India, Family history.

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Introduction

The incidence of Type 1 diabetes mellitus (T1DM) is rapidly increasing in specific regions and shows a trend toward early age of onset. T1DM accounts for about 10% of diabetes, affecting 1.4 million in the United States and about 15 million in the world. 40% of the individuals with T1DM are younger than 20 years of age. The incidence of T1DM is highly variable among different groups. The overall age-adjusted incidence of T1DM varies from 0.7/100,000 per year in Karachi (Pakistan) to about 40/100,000 in Finland. This represents more than 400 fold variation in the incidence among 100 populations (1, 2).

Data from Western European diabetes centers suggests that the annual rate of increase in type 1 diabetes mellitus () incidence is 3-4%, where as some central and eastern European countries demonstrate even more rapid increase. The increasing rate is greatest among the youngest children; rates of increase of in T1DM incidence as a function of age of onset are 6.3%, 3.1%, and 2.4% in age groups of children 0-4 yr, 5-9 yr and 10-14 yr, respectively (2).

In the United States, the overall prevalence of diabetes among school aged-children is about 1.9/1000. The frequency, however is roughly correlated with increasing age; the range is 1/1430 children at 5 years of age to 1/360 children at 16 years. Among African Americans, the occurrence of (T1D) is 30-60% of that seen in American Whites. The annual incidence of new cases in the United States is about 14.9/100.000 of the child population. It is estimated that 30,000 new cases occur each year in the United States, affecting 1 in 300 children and 1 in 100 adults during the life span. Girls and boys are almost equally affected; there is no apparent correlation with socio economic status. Peaks of presentation occurs socio economic; at 5-7 yr of age and the time of puberty. A growing number of cases are presenting between 1 and 2 years of age (2).

Diabetes mellitus coming at young age is a big challenge for parents and treating clinicians. Type 1 diabetes being the commonest etiology in this age group but type 2 is also coming parallel to its increase in adults especially in last two decades (3). Patients with type 1 diabetes are predisposed to acute complications in the form of diabetic ketoacidosis and hypoglycemia, if insulin is either omitted or overused. Goals of treatment in young children are individualized depending on their age. At very early age, the main goal of treatment is to keep child free from acute complications and undesired symptoms at the same time ensuring a normal sleep, growth and development and a relative restriction free food habits (4). Chronic complications of diabetes are less often seen up to five years of age or the initial five years of onset of diabetes in type 1 diabetes (5). In type 2 diabetes macro vascular complications because of insulin resistance could be an issue. There have been many studies across the world on the prevalence of diabetes in young (6-8).

In our population etiology of diabetes at very early age in the first three decades is not known. And the clinical behavior is not defined. So the present study will be undertaken to study the etiology and clinical behavior and complication status in children aged less than 25 years. The etiology of diabetes in youth is changing because of increasing prevalence of Type 2 diabetes (T2DM) in this age group. Goswami et al. presented the data on the etiology of youth onset diabetes and found that T1DM is the commonest followed by ketosis resistant diabetes, type 2 diabetes and fibrocalculous pancreatic diabetes (FCPD) at diabetes of young clinic at All India Institute of Medical Sciences (AIIMS) (9).

A previous study from Kashmir valley has documented a high prevalence of diagnosed (1.8%) and undiagnosed (4.2%) diabetes mellitus and impaired glucose tolerance (8%) in non-pregnant Kashmiri adults aged 40 years or more. In a recent study published from this place 2.5 % of youth in the age group of 20-40 years had type 2 diabetes mellitus and 0.3 % had known Type 2 diabetes(T2D) (10). There is paucity of literature on the cause of youth onset diabetes, their subsequent clinical behavior and long term metabolic control and complication status. The aim of the present study was to study the demographic and clinical profile of youth onset diabetes in Sher-I-Kashmir Institute of Medical Sciences (SKIMS), a tertiary care centre in Kashmir north of India.

Materials and Methods

The present clinical study aimed define the demographic, clinical and etiological profile in young diabetes patients (age < 25 years) over a period of 2 years. The patient will be screened for age, gender, duration of symptoms related to diabetes or its complications, adherence to treatment and diabetic education, socioeconomic status, family history of diabetes, episodes of DKA.

All the new youth onset diabetes patient whose age were less than 25 years and were admitted in Endocrinology Ward for various reasons over the period from July 2008 to September 2010, were participated at this study. All these patients during their evaluation and management in the ward were subjected to detailed clinical and biochemical assessment as per a pre defined proforma including:

History

1. Recoding of age as per the best authentic records available with the parents;
2. Details of residence;
3. The socio economic status as per Kuppuswamy scale;
4. Symptoms of presentation including- osmotic symptoms, presentation as ketoacidosis.

Examination

Anthropometry:

1. Weight taken while the patient would stand on the weighing machine with minimum clothing, weight would be measured to the accuracy of one Kg;
2. Height was taken while the subject would stand against the wall having a measuring scale. Patient would keep his feet together with occipital, back and heels touching the wall and neck slightly extended and face in the Frankfort plane;
3. Body mass index (BMI) measured as weight in Kg ÷ Height in M^2 ;
4. Waist measurement was performed with a flexible measuring tape and measurement taken at midpoint between the costal margin and iliac crest with patient standing and measurements to the nearest 0.1 cm. taken at mid respiration;
5. Hip measurements were taken at the maximum circumference of the hip;
6. Waist hip ratio (WHR) taken as the ratio of waist and hip measurements.

Clinical Examination

A detailed clinical examination was performed especially looking for possible complications of diabetes. These included:

1. Vitals include heart rate and blood pressure. Pulse was recorded for a period of one minute for rate, rhythm and any special character in addition to looking for consistency of the vessel wall. Blood pressure was measured in the lying down position with patient relaxed. A sphygmomanometer was used after an appropriate cuff size. Systolic pressure was taken at the time of the appearance of korotkoff sounds and diastolic pressure at the time of muffling of the sounds;

2. Detailed neurological examination to look for signs of peripheral neuropathy including presence of hypo or anesthesia of a part or whole of the limb together with presence of muscle wasting if any and presence or absence of deep tendon jerks;
3. Vasculopathy including either feebleness or absence of peripheral pulses;
4. Fundus examination to look for signs of cataract, retinopathy including presence of microaneurysms, exudates, hemorrhages and maculopathy;
5. Signs of malnutrition included measurement of BMI;
6. Signs of insulin resistance like acanthosis nigricans;
7. Signs of puberty were looked for and it's staging was done;
8. Foot examination was performed to look for presence of high risk feet or any other sign of foot involvement in diabetes and accordingly graded.

Investigation:

All the subjects were subjected to a set of baseline investigations like Complete blood count (CBC), routine urine examination, liver, kidney and bone function tests and estimation of lipid profile. Sample for all these investigations were taken in the fasting state.

Definitions:

1. Type 1 diabetes: defined as subjects with an episode of ketoacidosis and requiring insulin for survival, whom requires insulin with first year of diagnosis for control of hyperglycemia;
2. Type 2 diabetes: defined as individuals without an episode of ketoacidosis, controlled on oral anti diabetic drugs for more than a year after diagnosis;
3. Fibrocalculous pancreatopathy: diabetes mellitus with or without pain abdomen with pancreatic calcification either on plain X-ray, ultrasonography or CT abdomen;
4. Others: diabetes not fitting into the above categories.

Data Analysis:

Statistical analysis was done by using the statistical package for social sciences (SPSS), version 16. Results were expressed as mean± SD. An independent samples t- test was used to compare mean± SD values between cases from various groups. P-value of less than 0.05 was taken as significant.

Results

A total of seventy two patients of youth onset diabetes mellitus were studied with a mean age of 16.7 $\pm$ 5.7 years. Forty six (twenty males and twenty six females) were less than 20 years and twenty six (Males:13, Females:13) were more than 20 years of age. There were 33 males (45.8%) and 39 females (54.2%) (Table.1). A total seventy two patients were selected for the study. These included thirty three males (45.8%) and thirty nine (54.2%) females (Table.1).

Table 1: Age distribution of youth onset diabetes in studied group

Age (year)	Male		Female		Total		P value
	N	%	N	%	N	%	
< 20	20	60.6	26	66.7	46	63.9	
≥ 20	13	39.4	13	33.3	26	36.1	0.596
Total	33	45.8	39	54.2	72	100	
Mean$\pm$ SD	17.7 ± 5.0		15.9 ± 6.2		16.7 ± 5.7		

Seventeen patients (Male eight and Female nine) were studying in primary classes, eighteen (Male eight and Female ten) were studying in middle classes, fourteen (Male seven and Female seven) were in secondary classes, seven (Male two Female five) were in higher secondary, five (Male two and Female three) were doing graduation and one female was doing post graduation (PG) (Table.2). The income of majority of the patients were in the range of 2936-4893, only four had income of > 19575 Indian rupees per month. The majority of the patient's socioeconomic status according to Kuppuswamy modified scale was upper lower 48 (66.7%), and among these thirty (65.2%) were age less than 20 yrs and eighteen (69.2%) were age more than 20 years.

Table 2: Education status of the studied patients

Literacy Status	< 20yrs		≥ 20yrs		P value
	N	%	N	%	
Primary	16	34.8	1	3.8	
Middle	13	28.3	5	19.2	
Secondary	9	19.6	5	19.2	0.000
Higher secondary	2	4.3	3	11.5	
Graduation	0	0.0	3	11.5	
PG (post graduation)	1	2.2	0	0.0	
Nil	5	10.9	9	34.6	

Family history of diabetes was present in nineteen (26.4%), fourteen were less than 20 yrs and five more than 20 years. Fifty nine (81.9%) presented with osmotic symptoms, of those thirteen were less than 20 years and twenty two were more than 20 years. Thirteen (18.1%) presented with DKA, nine were less than 20 years and four were more than 20yrs. The mean Body Mass Index (BMI) of the patients age less than 20 was 16.7±1.7 kg/msq and age more than 20 yrs was 17.9±2.6kg/msq. Mean Waist-Hip ratio less than 20yrs as well as more than 20 yes was 0.9±.1. Puberty grading less than 20 yrs was 3.3±1.4 and more than 20yrs was 4.9±.3 (Table.3).

Table 3: Presenting Characteristics across Age (yr) of the Studied Subjects.

Variables		< 20 yrs		≥ 20 yrs		P value
		N	%	N	%	
First PR	Osmotic symptoms	37	80.4	22	84.6	0.660
	DKA	9	19.6	4	15.4	
*BMI	Mean ± SD	16.7 ± 1.7		17.9 ± 2.6		0.021
Waist- Hip Ratio	Mean ± SD	0.9 ± 0.1		0.9 ± 0.1		0.391
Puberty	Mean ± SD	3.3 ± 1.4		4.9 ± 0.3		0.000

*BMI: Body Mass Index

Hypoglycemic episodes were present in forty one patients. One (less than20 yrs) had daily episodes, six had biweekly (five less than 20and one more than 20yrs), five had weekly all less than 20 yrs, nine had fortnight (three less than 20and six more than 20 yrs), eleven had monthly (five less than 20 and six 20 yrs) and nine had occasional (six less than 20 and three more than 20 yrs). All of them had mild hypoglycemia relieved by food intake. Sixteen patients had nephropathy, ten were less than 20 yrs and six more than 20 yrs. Retinopathy was found in nine patients, seven had bilateral cataract (four less than 20 and three more than 20 yrs), one had bilateral optic atrophy (less 20yrs) and one had NPDR (>20 yrs). Neuropathy was present in ten patients, five were less than 20 yrs and five more than 20 yrs. None was found to have PAD (Table.4).

Table 4: Complication Profile across Age (yr) of the Studied Subjects.

Variables		< 20yrs		≥ 20yrs		P value
		N	%	N	%	
Hypoglycemic Episodes	Daily	1	4.0	0	0	0.234
	Biweekly	5	20.0	1	6.3	
	Weekly	5	20.0	0	0	
	Fortnight	3	12.0	6	37.5	
	Monthly	5	20.0	6	37.5	
	Occasionally	6	24.0	3	18.8	
Ur Pr. 24 h	Nil	36	78.3	20	76.9	0.896
	Present	10	21.7	6	23.1	
Fundus. Exam	Normal	41	89.1	22	84.6	0.638
	NPDR	0	0	1	3.8	
	Bilateral Cataract	4	8.7	3	11.5	
	Bilateral optic atrophy	1	2.2	0	0	
*CNS.Exam	Normal	41	89.1	21	80.8	0.328
	Abnormal	5	10.9	5	19.2	
Peripheral Pulse	Posterior Tibial Artery	46	100.0	26	100.0	1.000
	Dorsalis Pedis Artery	46	100.0	26	100.0	1.000

*CNS: Central nervous system.

Discussion

Children with diabetes differ from adults in many respects, including change in insulin sensitivity related to sexual maturity and physical growth, ability to provide self care, supervision in child care and school and unique neurological vulnerability to

hypoglycemia and DKA, so diabetes at young age is a big challenge for parents and treating physicians. Three-fourth of all cases of type 1 diabetes are diagnosed in individuals < 15 years of age; although type 2 is also coming parallel to increase in adults especially in last two decades (11). Over the last few decades, many studies have demonstrated an increase in incidence of type 1 diabetes (12-14). Worldwide epidemiological investigation of type 1 diabetes as a non communicable disease indicate a 4% to 6% annual increase in incidence rate in Scandinavia and similar data rate collected from other countries (14).

India is currently experiencing an epidemic of diabetes mellitus. According to World Health Organization (WHO), India has the unique distinction of being the country with largest number of diabetic patients in the world.

Present study was conducted to evaluate the clinical profile including etiology and clinical behavior of youth onset diabetes in Kashmir valley in north India. In our study a total of 72 patients were studied with mean age 16.7 years. Males were 33 (45.8%) and females were 39 (54.2%). The patients were classified into different types of diabetes on the basis of onset of osmotic symptoms, presence or absence of ketosis and pancreatic calcification on abdominal imaging. Thirteen (18.1%) patients were type 1, 58 (80.6%) were type 2. One patient had FCPP on abdominal X-ray.

One of our previous study revealed that type 1 diabetes as the commonest form of DM seen in age group < 40 years accounting for 48% followed by 40% of type 2 diabetes (3). Until recently most children and adolescents with diabetes were diagnosed with type 1 diabetes, however, type 2 diabetes mellitus is being increasingly reported in children from several parts of world, including the children of Indian origin living in other countries (15). This may indicate an increasing prevalence of diabetes in children in India who may then join the pool of diabetes with complications. T2D in children is probably under diagnosed because it can exist without symptoms and can be misclassified.

Present study revealed that there is an increasing incidence of type 2 diabetes in youth and this may be concomitant with food patterns and increasing obesity rates. The present study highlights the fact that, type 2 diabetes is the commonest form of diabetes in young diabetic patients; and the underlying cause of type 2 diabetes in children is likely related to the epidemic of childhood obesity (16). Our study is accordance to study of Japan, where type 2 diabetes mellitus is seven times common than type 1 diabetes mellitus, and its incidence has increased more than 30 fold over past 20 years (17). However there may be bias in our study as we did not measure their C peptide and islet cell antibodies characteristic of (T1D) as the said facilities are not available at our place.

Fibrocalculous pancreatic diabetes is a complication of tropical calcific pancreatitis mostly seen in tropical areas. The highest prevalence is probably found in southern India. In these regions FCPD currently accounts for about 1-5% of all cases of diabetes. We have previously described its presence in Sub tropical area with a temperate climate (18, 19). All the patients had a lean body mass, required insulin for control. Although ketoacidosis was not seen, other chronic complications were very well seen (20). In our present study we documented one patient of FCPP (1.35%), who presented with diabetes at the age of 18 years and had features of pancreatic malabsorption.

Until recently (T1D) was thought to occur almost exclusively in children and adolescents, however that the clinical aspect of T1DM can occur at any age.

There are two peak age groups of presentation for boys and girls, at 5-7 years of age and at the time of puberty. Present study reveals that mean age presentation of T1D in our community is 16.7±5.7 yrs; boys presented 16.7±5.7 and girls presented earlier 15.9.±6.2.

It has been reported that the peak incidence occurs earlier in girls than boys, if the clinical onset of T1D is linked to pubertal growth, then this difference in incidence rate can be explained by the fact that pubertal growth occurs early in girls than boys. Type 1 diabetes usually has a stormy acute onset while as T2D usually has a long asymptomatic period. Findings in our study also confirm that T1D has a florid onset of symptoms; ketoacidosis was their presentation, while as in T2 D, polyuria, polyphagia and polydypsia were the predominant symptoms. The mean presenting HbA1c of type 1 DM in our study was 9.96±2.6 while in case of type 2 DM, the mean presenting HbA1c was 11.23±3.14. This is because type 1 DM have florid onset of symptoms and come to medical attention early, while in case of type 2 DM they have slow onset osmotic symptoms.

The disease burden of diabetes mellitus is primarily due to the burden of its complications. Retinopathy was found in 13.51% of patients. All the complications were seen in more often in type 2 DM than type 1 DM. this may be long duration of type 2 DM as compared to type 1 DM. We also noticed that there is a direct relationship between the degree of hyperglycemia and various complication of diabetes. All seven patients who had bilateral cataract had HbA1c > 8. Similarly in case of nephropathy 13 patients out of 16 who had diabetic nephropathy HbA1c was > 8. Many studies have demonstrated that the level of diabetic exposure is the strongest risk factor for progression from normoalbuminuria to microalbuminuria the threshold level of HbA1c >8.1 (20). However the effect of hyperglycemia on the progression of microalbuminuria to overt proteinuria and then ESRD is not clear.

A number of factors other than hyperglycemia have been shown to increase the risk of diabetic kidney-predisposition of hypertension elevated blood pressure, high LDL cholesterol and genetic predisposition to diabetic kidney disease may promote development of overt proteinuria (xxx). The dyslipidemia in diabetes is characterized by moderately elevated cholesterol and triglyceride level, depressed HDL-cholesterol. Mean total cholesterol in our patients with type 1 DM was 131 mg/dl and in case of type 2 DM was 141 mg/dl, while as mean triglyceride in our patients with type 1 DM was 148 mg/dl and type 2 DM was 152 mg/dl. Lipid disorders are not uncommon in diabetes whatever the mechanism; they contribute importantly to increase the risk of atherosclerosis and mortality in diabetes. Dyslipidemia is more common with type 2 diabetes and is the major contributor to the high of CHD.

Conclusion

Type 2 diabetes mellitus is emerging as the form of diabetes in young diabetic patients, due to epidemic of childhood obesity. Type 2 diabetes is already associated with several metabolic and cardiovascular complications in this age group. Daily exercises, blanket ban on junk foods in all schools and healthy diet are ways to prevent its onset in young age.

Conflict of interest: None.

References

1. Rosenbloom A, Young RS, Winter WE. Emerging epidemic of Type 2 diabetes in youth. Diabetes Care 1999; 22(2):345-54.
2. Karvonen M, Viik-Kajander M, Moltchanova E, Libman I, LaPorte R, Tuomilehto J. I Incidence of childhood

type 1 diabetes worldwide. Diabetes Mondiale (DiaMond) Project Group. Diabetes Care. 2000; 23(10):1516-26.
3. Zargar AH, Bhat MH, Laway BA, Masoodi SR. Clinical and aetiological profile of early onset diabetes mellitus: Data from a tertiary care center in the Indian subcontinent. J Postgrad Med 2001;47(1):27-9.
4. Stephen A Green, Ray W Newton. Diabetes mellitus in childhood and adolescence. In John Pickup and Gareth Williams. Textbook of diabetes. 2nd edition; Blackwellscience; Germany: 1997. pp 73.1-73.16.
5. American Diabetes Association (ADA). Diagnosis and Classification of DM. Diabetes Care 2010;33(suppl. 1):s62-9.
6. Green A, Patterson CC; Eurodiab Tiger Study Group. Trends in the incidence of childhood- onset diabetes in Europe 1989-1998. Diabetologia. 2001 Oct;44 Suppl 3:B3-8.
7. Vikram NK, Tandon N, Misra A, Srivastava MC, Pandey RM, Mithal A, et al. Correlates of Type 2 diabetes mellitus in children, adolescents and young adults in north India: a multisite collaborative case-control study. Diabet Med 2006;23(3):293-8.
8. Scott CR, Smith JM, Cradock MM, Pihoker C. Characteristics of youth onset non-insulin-dependent diabetes mellitus and insulin-dependent diabetes mellitus at diagnosis. Pediatrics 1999;100(1):84-91.
9. Goswami R, Kochupillai N, Gupta N, Kukreja A, Lan M, Maclaren NK. Islet cell autoimmunity in youth onset diabetes mellitus in Northern India. Diabetes Res Clin Pract 2001;53(1):47-54.
10. Zargar AH, Wani AA, Laway BA, Masoodi SR, Wani AI, Bashir MI, et al. Prevalence of diabetes mellitus and other abnormalities of glucose tolerance in young adults aged 20 to 40 years in north India (Kashmir Valley). Diabetes Res Clin Pract. 2008; 82(2): 276-81.
11. Ramachandran A, Snehalatha C, Satyavani S, Vijay V. Type 2 diabetes in Asia-Indian urban children. Diabetes Care 2003; 26(4):1022-5.
12. Onkamo P, Vaananen S, Karvonen M, Toumilehto J. Worldwide increase in incidence of T1DM- the analysis of the data on published incidence trends. Diabetologia 1999 Dec;42(12):1395-403.
13. Raymond NT, Jones JR, Swift PG, Davis MJ, Lawarence G, McNally PG, et al. Comperative incidence of Type 1 diabetes in children aged under 15 years from South Asian and White or other ethnic backgrounds in Leicestershire UK 1989-98; Diabetology. 2001; 44 Suppl 3: B32-6.
14. Marjattu K. Incidence of type 1 diabetes worldwide. Diabetic Care. 23(10):1516-26.
15. Nandkeoliar MK, Dharmalingam M, Marcus SR. Diabetes mellitus in Asian Indian children and adolescents. J Pediatr Endocrinol Metab2008; 21 (1): 98-9.
16. Ehtisham S, Barrett TG, Shaw NJ. Type 2 diabetes mellitus in UK children-an emerging problem: Diabet Med 2000; 17(12):867-71.
17. Kitagawa T, Owada M, Urakami T, Yamauchi K. Increased incidence of non insulin dependent diabetes mellitus among Japanese school children correlates with an increased intake of animal protein and fat. Clin Pediatr (Phila) 1998;37(2):111-5.
18. Zarger AH, Laway BA, Masoodi SR, Shah NA, Shas JA. Fibrocalculous pancreatic diabetes from the Kashmir valley. Ann Saud Med 1996; 16:144-147.
19. Samal KK, Kar CR, Naik SK, Samal SC, Hota D, Sahu CS, et al . Fibrocalculous pancreatic diabetes in western Orissa. J Indian Med Assoc 1992;90(11):287-9.
20. Lawson ML, Sochett EB, Chait PG, Balfe JW, Daneman D. Effect of puberty on markers of glomerular hypertrophy and hypertension in IDDM. Diabetes 1996;45(1):51-5.