

Declining Age of Onset of Type 2 Diabetes Mellitus in the North-West Punjabi Population

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ABSTRACT

Context: Diabetes mellitus, an inherited metabolic disorder which is associated with devastating complications, is one of the biggest burdens on the society, in terms of the expenditure of money on health care and wastage of the prime years of life. The increasing prevalence of diabetes mellitus is attributed to adverse lifestyles like obesity and physical inactivity and this is prevalent even among school going children, thus making them vulnerable to the disease at an earlier age.

Aim: The present study was designed to decipher the prevalence of type 2 diabetes mellitus in various age groups of the north west Punjabi population.

Settings and design: The subjects were selected by conducting a door to door survey of a few villages of the border belt of Amritsar and the Tarn Taran district. One patient of diabetes

mellitus was considered as one family unit and the offsprings of these diabetic patients, who were siblings amongst themselves, were recruited for the study.

Material and Method: All the selected families were required to fill up a consent form by the head of the family. Fasting samples of the participating families were collected and analyzed for fasting plasma glucose, glycated haemoglobin, complete lipid profile, serum insulin and C-peptide. Statistical analysis was done by using the Student's t test. **Results and conclusions** The prevalence of diabetes mellitus in the north-west Punjabi population was found to be 25%. IFG was more prevalent in females as compared to the males and the age of onset of diabetes mellitus was observed to decline both in males and females, as was evident from its occurrence in the age group of 19-24 years. .

Key Words: Diabetes mellitus, Age of onset, North-west Punjabi population

KEY MESSAGE

- Diabetes mellitus has devastating complications
- Childhood obesity and environmental factors play a role
- The age of onset of type 2 diabetes mellitus is declining

INTRODUCTION

Diabetes mellitus is one of the most common, non-communicable, inherited metabolic disorders. It is associated with devastating micro-vascular and macro-vascular complications. In the year 1995, about 19 million of Indians were suffering from type 2 diabetes and it has been projected that the number will increase and may reach up to 57 million by the year 2025, out of the total 300 million diabetic individuals of the world, thus making India the diabetic capital of the world. The increasing prevalence of type 2 diabetes mellitus which occurs globally is attributed mainly to adverse lifestyle factors [1]. Obesity and decreased physical activity are the key components in the causation of the adverse effects which lead to diabetes, coronary heart disease and many other related disorders; however, in the recent decades, the world is facing a threat from the early onset of type 2 diabetes mellitus, as is evident from the increasing incidence of this disease in children and adolescents [2-4]. This has great implications for the health care burden in any country. Within a few decades, type 2 diabetes has changed from being a disease of the elderly and the affluent to being a disease of the young and poor [5,6]. Indians are more

prone to develop type 2 diabetes than many other groups. Only limited information is available on the genetic factors, but a number of other predisposing risk factors are present at a much higher level in Indians. As far as the genetics of the disease is concerned, the HLA-DQ genes are the strongest risk markers for type 1 diabetes [7], although their influence may be modified by other MHC genes. Research is going on with regards to some candidate genes as the markers of risk for type 2 diabetes mellitus. These include peroxisome proliferator-activated gamma (PPAR- γ) and transcription factor 7 like 2 (TCF7L2) [8-13]. Keeping in view the magnitude of the disease, its expression at an early age and its status as an inherited disorder, the present study was conducted in the north-west Punjabi population to study the prevalence of type 2 diabetes mellitus in a young age group i.e. the age group of 19 to 24 years.

MATERIAL AND METHOD

The present study was conducted in the Department of Biochemistry, Government Medical College, Amritsar (Punjab). The subjects were recruited by conducting a door to door survey of a few villages of

the border belt of Amritsar and the Tarn Taran district. Each diabetic individual was considered as one family unit and the offsprings of these individuals, who were siblings amongst themselves, were recruited for the study. Written consent was taken from these diabetic individuals for the inclusion of their families in the study and the individuals were free to leave the study at any point. Only the individuals who gave their consent were included in the study. These individuals were advocated about the consequences of diabetes mellitus i.e. micro and macro vascular complications. The diabetic individuals were given dietary and lifestyle modifications. The blood samples of the families who were willing to participate in the study were collected by conducting community camps on a fixed date, at a fixed common place, such as a gurudwara or the Panchayat Bhawan of the village. The patients were advised to observe an overnight fast. To comply with the instructions, the samples were collected early in the morning. Seven ml of venous blood was collected under aseptic conditions and was divided into three vials. The vial containing the anti coagulant was used for the estimation of plasma glucose [14], the second vial containing the sample along with EDTA was used for the estimation of glycated Hb¹⁵ and the blood sample in the third vial was allowed to clot and serum was separated from it for the estimation of the lipid profile [15], serum insulin [16] and the c-peptide levels [17]. The

S.No	Criteria	Number	Percentage
1	Total families surveyed	1000	100%
2	Normal	750	75%
3	Diabetic	250	25%

[Table/Fig-1]: Percentage prevalence of type 2 Diabetes mellitus in a few villages of border belt of Amritsar and Tarn Taran

S.No	Age Group	Number of siblings		
		Total	Male	Female
1	≤18 years	124	73	51
2	>18 to 35 years	407	220	187
3	>35 to 45 years	74	38	36
4	>45 years	8	4	4
	Total	613	335	278

[Table/Fig-2]: Distribution of siblings from various families according to age and sex .

S. No	Age Group	Total number of Siblings n=613					
		Males n=335			Females=278		
		Normal	IFG	Diabetic	Normal	IFG	Diabetic
1	upto18 years Total=124 Males=73 Females=51	68 (93.15%)	4 (5.47%)	1 (1.36%)	40 (78.43%)	8 (15.68%)	3 (5.88%)
2	19-35 years Total=407 Males=220 Females=187	162 (73.63%)	30 (13.63%)	28 (12.72%)	129 (68.98%)	34 (18.18%)	24 (12.83%)
3	36-45 years Total=74 Males=38 Females=36	17 (44.73%)	11 (28.94%)	10 (26.31%)	11 (30.55%)	12 (33.33%)	13 (36.11%)
4	46-55 years Total=8 Males=4 Females=4	-	-	4 (100%)		3 (75%)	1 (25%)

[Table/Fig-3]: Age and sex wise distribution of siblings in terms of fasting plasma glucose levels

results which were obtained were statistically analyzed by using the Student's 't' test.

RESULTS AND DISCUSSION

It was observed that every fourth family had a history of type 2 diabetes mellitus [Table/Fig 1], either in the present or in the past generation. Out of 250 families who had a family history of type 2 diabetes mellitus, 47 families refused to join the study, while the remaining 203 families were enrolled for the present study. The offsprings of these families (n=203) who were siblings amongst themselves and belonged to the 10 to 50 years age group were included in the present study. Out of a total number of 613 siblings, 335 were males and 278 were females. The siblings were further subdivided into 4 groups according to their ages i.e. group I- ≤18 years, group II- 19 to 35 years, group III- 36 to 45 years and group IV- more than 45 years of age. The maximum number of siblings belonged to the age group II i.e.19 to 35 years (n=407) [Table/ Fig 2].While all the siblings were subdivided on the basis of the fasting plasma glucose levels as normal, IFG and diabetic [Table/ Fig 3], it was observed that a higher percentage (5.8%) of females were suffering from diabetes mellitus at a younger age i.e. up to 18 years, as compared to age matched males (1.36%). Likewise, the percentage of females having IFG (15.68%) was much higher as compared to the males (5.47%) in the same age group, thereby suggesting the need for extensively educating the females about lifestyle modifications, especially those who fell in the IFG range, to prevent the rate of conversion of these individuals to the diagnosed cases of diabetes mellitus. Almost an equal proportion of males (n=28, 12.72%) and female siblings (n=24, 12.83%) in this age group were diabetic. This finding was suggestive of the occurrence of diabetes at an early age in the north- west Punjabi population. Also, it was observed that both the male and female siblings were equally likely to get the disease in the 19-35 years age group. A similar trend was observed in other age groups as well, with regards to the fact that more female siblings were suffering from IFG than the male siblings. More females were diabetic in the age group of <19 years (n=3, 5.88%) and more than 35 years (n=13, 36.11%) than the males.

A comparison of various parameters such as glycated Hb, serum insulin and c-peptide in these individuals showed a statistically significant increase in the siblings with IFG and diabetes as compared to the normal individuals [Table/Fig 4]. However, a comparison of these parameters between the male and female siblings of each age group, who were either normal or who had IFG or diabetes, did not reveal any statistically significant variation. The changes in the fasting glucose, glycated Hb, serum insulin and c-peptide values were of great help in diagnosing the siblings with IFG, as per the ADA guidelines. All these individuals were found to be normolipidaemic [Table/Fig 5].

The siblings in the age group of 19-35 years were further subdivided into three sub groups of 19-24 years, 24-30 years and >30 -35 years. In the age group of 19-24 years, it was observed that 7.14% males and 9.09% females were diabetic, thus suggesting the occurrence of diabetes before 24 years of age. 16.27% males and 11.90% females in the age group of 24-30 years age range and 16% males and 21.62% females in the 30-35 years age range were found to be diabetic. From the data which were collected, it was very clear that the females were more prone to this disease as compared to the males and that the percent of individuals suffering from this disease increased with advancing age [Table/Fig 6]. Twelve percent of the siblings (both males and females) had an IFG in the

S.No.	Age group	Sex	Glucose mg%			Glycated Hb%			S.Insulin μ IU/ml			S.C-peptide μ IU/ml		
			Normal	IFG	Diabetic	Normal	IFG	Diabetic	Normal	IFG	Diabetic	Normal	IFG	Diabetic
1	\leq 18 years	Male	80.02 \pm 1.2	109.5 \pm 4.9*	158 \pm 4.1*	4.3 \pm 0.60	5.05 \pm 0.91*	6.2 \pm 1.2*	9.35 \pm 1.8	19.09 \pm 1.01*	26.2 \pm 2.1*	16.45 \pm 2.4	37.68 \pm 1.69*	19.8 \pm 2.5*
		Female	94.05 \pm 3.2	118.37 \pm 3.6*	169.3 \pm 3.1*	4.3 \pm 0.57	5.75 \pm 0.69*	6.2 \pm 0.72*	8.42 \pm 2.0	22.9 \pm 0.04*	21.23 \pm 6.7*	15.42 \pm 1.6	76 \pm 1.08*	46.27 \pm 1.5*
2	>18-35 years	Male	96.97 \pm 2.4	116.4 \pm 6.12*	175.9 \pm 3.2*	4.4 \pm 0.71	5.62 \pm 0.44*	6.81 \pm 1.18*	8.94 \pm 1.6	14.36 \pm 8.25*	25.35 \pm 5.6*	20.42 \pm 1.54	29.16 \pm 13.7*	36.88 \pm 2.3*
		Female	100.64 \pm 2.8	114.47 \pm 6.0*	216.23 \pm 10.0*	4.4 \pm 0.64	5.5 \pm 0.54*	6.15 \pm 1.22*	9.42 \pm 2.4	15.67 \pm 4.4*	19.28 \pm 6.6*	20.8 \pm 2.8	32.82 \pm 1.42*	46.14 \pm 2.4*
3	>35-45 years	Male	107.9 \pm 3.67	118.72 \pm 8.3*	242 \pm 12.3*	4.5 \pm 0.73	5.9 \pm 0.5*	6.9 \pm 0.81*	9.43 \pm 1.7	13.14 \pm 2.3*	22.59 \pm 6.2*	22.3 \pm 2.4	45.9 \pm 3.4*	27.33 \pm 13.3*
		Female	104.9 \pm 3.77	114.33 \pm 6.7*	190 \pm 3.7*	4.6 \pm 0.97	5.64 \pm 0.66*	6.39 \pm 0.84*	11.0 \pm 1.8	16.55 \pm 5.4*	26.04 \pm 2.01*	17.0 \pm 2.4	35.15 \pm 18.4*	47.64 \pm 5.1*
4	>45 years	Male	-	-	187 \pm 3.05*	-	-	5.45 \pm 1.82*	-	-	24.6 \pm 4.8*	-	-	72.15 \pm 9.6*
		Female	-	116 \pm 7.9*	130 \pm 7.4*	-	5.6 \pm 0.65*	6.4 \pm 1.95*	-	20.45 \pm 5.7*	21.3 \pm 4.8*	-	32.8 \pm 6.3*	78.6 \pm 5.9*

Table/Fig-4]: Comparison of fasting blood glucose, glycated Hb, Insulin and C-peptide in various age groups of individuals of North-west Punjabi population. *p<0.001 when IFG and Diabetic individuals were compared with normal individuals.

S.No.	Age group	Sex	Cholesterol mg%			Triglycerides mg%			LDL-C mg%			VLDL-C mg%			HDL-C mg%		
			Normal	IFG	Diabetic	Normal	IFG	Diabetic	Normal	IFG	Diabetic	Normal	IFG	Diabetic	Normal	IFG	Diabetic
1	\leq 18 years	Male	154.2 \pm 4.0	182.5 \pm 4.0*	229 \pm 2.1*	139 \pm 10.9	188 \pm 2.5*	106 \pm 2.4*	77.17 \pm 3.72	111.4 \pm 4.08*	150.8 \pm 2.0*	30.5 \pm 2.45	17.6 \pm 5.12	21.2 \pm 1.78	46.7 \pm 7.8	53.25 \pm 4.99*	57 \pm 4.67*
		Female	157.8 \pm 5.1	197.12 \pm 4.0*	222 \pm 2.4*	99.16 \pm 3.2	102.5 \pm 2.5	110.33 \pm 1.7	85.4 \pm 5.13	124.95 \pm 3.95*	149.2 \pm 2.1*	19.8 \pm 6.3	20.5 \pm 5.1	18.06 \pm 3.4	52.6 \pm 8.0	51.62 \pm 9.3	54.69 \pm 5.8*
2	>18-35 years	Male	166.2 \pm 3.3	178.4 \pm 4.2*	201.5 \pm 4.8*	113.8 \pm 5.9	143.7 \pm 6.4*	166.85 \pm 9.6*	93.6 \pm 3.3	94.48 \pm 4.2	116.8 \pm 4.9*	22.5 \pm 11.9	30.92 \pm 1.8	33.87 \pm 1.9	50.71 \pm 7.9	50.13 \pm 7.5	49.12 \pm 7.4
		Female	164.6 \pm 3.4	183.8 \pm 2.8*	202 \pm 4.07*	107.2 \pm 5.6	136.9 \pm 5.5*	192.3 \pm 1.34*	92.6 \pm 3.2	110.6 \pm 3.0*	113.1 \pm 3.7	21.15 \pm 11.2	29.74 \pm 2.04	36.9 \pm 2.3	50.08 \pm 6.2	48.85 \pm 6.5	48.3 \pm 7.2
3	>35-45 years	Male	168.1 \pm 3.2	186.54 \pm 2.9*	225 \pm 3.6*	142.6 \pm 8.9	173.72 \pm 7.2*	199 \pm 10.1*	89.1 \pm 3.7	100.89 \pm 3.3*	127.7 \pm 3.5*	28.7 \pm 1.76	37.38 \pm 1.6	40.8 \pm 2.1	50.5 \pm 7.8	48.63 \pm 4.9	48 \pm 4.6
		Female	172.9 \pm 3.4	202.33 \pm 3.3*	295.8 \pm 3.7*	140.2 \pm 9.1	163.91 \pm 5.5*	193 \pm 07 \pm 9.7*	95.16 \pm 3.2	123.88 \pm 3.2*	127.2 \pm 4.5	27.17 \pm 1.62	32.78 \pm 11.0	41.93 \pm 2.1	50.3 \pm 7.4	47.41 \pm 8.06	48.23 \pm 5.3
4	>45 years	Male	-	-	376.5 \pm 2.2	-	-	247 \pm 12.8	-	-	96.25 \pm 8.4	-	-	29.4 \pm 2.41	-	-	51 \pm 9.5
		Female	-	235 \pm 4.3	384 \pm 5.8	-	187 \pm 7.8	236 \pm 11.92	-	98.45 \pm 4.6	118.8 \pm 1.94	-	34.5 \pm 3.67	27.2 \pm 2.86	-	47.8 \pm 4.24	38 \pm 3.9

Table/Fig-5]: Comparison of complete lipid profile in various age groups of individuals of North-west Punjabi population. *p<0.001 when IFG and Diabetic individuals were compared with normal individuals.

S. No	Age Group 19-35 years	Total number of Siblings n=407					
		Males n=220			Females=187		
		Normal	IFG	Diabetic	Normal	IFG	Diabetic
1	19-24 years Total=150 Males=84 Females=66	68 (80.95%)	10 (11.90%)	6 (7.14%)	52 (78.78%)	8 (12.12%)	6 (9.09%)
2	>24-30 years Total=170 Males=86 Females=84	60 (69.76%)	12 (13.95%)	14 (16.27%)	52 (61.90%)	22 (26.19%)	10 (11.90%)
3	>30-35 years Total=87 Males=50 Females=37	34 (68%)	8 (16%)	8 (16%)	25 (67.56%)	4 (10.81%)	8 (21.62%)

[Table/Fig-6]: Age and sexwise distribution of siblings in the age group of 19-35 years in terms of fasting plasma glucose levels

age range of 19-24 years and the very existence of the individuals with IFG at an early age (<24 years) [Table/Fig 6] was a matter of concern in the present study. The levels of fasting plasma glucose, glycated Hb, serum insulin and c-peptide showed a statistically significant increase in these individuals with IFG, as compared to the normal individuals and hence were of diagnostic value as per the ADA guidelines. The raised insulin and c-peptide levels in these individuals were suggestive of the increased synthesis and secretion of insulin, maybe in response to the increased fasting plasma glucose levels. [Table/Fig 7]. All these individuals were normolipidaemic [Table/Fig 8]. All the individuals with IFG were suggested to make life style modifications. The diabetic individuals were also advised to make life style modifications along with pharmacological intervention. Work is in progress to evaluate the impact of lifestyle modifications on the regulation of the blood sugar levels.

CONCLUSIONS

The data of the north-west Punjabi population which were analyzed till date is suggestive of the fact that in this population, the age of onset of diabetes mellitus is declining (19-24 years), both in males and females. It was observed in the present study, that the females were more prone to the disease as compared to the males.

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S No	Age Group	Sex	Fasting Plasma Glucose mg%			Glycated Hb %			S. Insulin µU/ml			S. C-peptide µU/ml		
			Normal	IFG	Diabetic	Normal	IFG	Diabetic	Normal	IFG	Diabetic	Normal	IFG	Diabetic
1	I 19-24 years	Male	78.02±1.2	115.16±9.3*	163±4.1*	4.5±0.60	5.9±0.3*	5.8±0.28*	9.35±1.8	18.4±2.04*	25.11±0.4*	16.45±2.4	25.4±2.03*	50.21±2.0*
		Female	84.05±3.2	111.75±2.9*	164.6±2.7*	4.5±0.57	5.85±0.99*	6.4±1.2*	8.42±2.0	22.90±4.03*	27.65±3.1*	15.42±1.6	26.0±5.79*	46.08±10.1*
2	II >24-30 years	Male	86.97±2.4	112.2±2.4*	203±9.4*	4.0±0.71	5.8±0.5*	6.8±1.01*	8.94±1.6	17.20±1.03*	21.3±8.10*	20.42±1.54	37.26±1.25*	44.10±2.1*
		Female	90.64±2.8	112.85±4.8*	181.8±3.4*	4.3±0.64	6.2±0.62*	6.46±0.9*	9.42±2.4	19.52±3.87*	23.18±6.4*	20.8±2.8	39.59±2.46*	52.78±3.3*
3	III >30-35 years	Male	87.9±3.67	116.2±6.3*	221.4±10.3*	4.9±0.73	6.23±0.42*	7.37±1.2*	9.43±1.7	13.98±7.2	26.56±4.5*	22.3±2.4	26.09±1.4*	46.55±2.6*
		Female	84.9±3.77	115.15±6.7*	242±12.3*	4.4±0.97	6.43±0.41*	7.9±0.81*	11.0±1.8	15.67±4.4*	22.59±6.2*	17.0±2.4	32.82±14.2*	27.33±13.3*

[Table/Fig-7]: Comparison of fasting plasma glucose, glycated Hb, insulin and c-peptide in various sub age groups of 19-35 years. *p<0.001 when normal individuals were compared with IFG and Diabetics

S No.	Age group	Sex	Cholesterol mg%			Triglycerides mg%			LDL-C mg%			VLDL-C mg%			HDL-C mg%		
			Normal	IFG	Diabetic	Normal	IFG	Diabetic	Normal	IFG	Diabetic	Normal	IFG	Diabetic	Normal	IFG	Diabetic
1	I 19-24 years	Male	161.3±2.08	200.5±5.87	226.5±3.3	77.30±1.06	111.50±27.5	94±2.2	85.6±2.3	126.7±5.4	149.7±3.0	23.06±2.20	22.3±5.5	18.8±4.5	48.7±7.8	51.5±13.4	58±1.4
		Female	165.5±55.87	200.2±3.9	221±4.6	68.50±27.5	105.8±3.0	164.27±10.4	126.7±5.4	90.22±4.1	138.8±4.3	138.8±4.3	22.3±5.5	19.85±5.7	32.85±2.09	50.6±8.0	51.9±6.4
2	II >24-30 years	Male	165.2±3.9	186.2±3.10	211.24±4.7	95.8±3.0	121.4±3.4	163.5±13.1	90.22±4.1	113.8±3.0	117.04±3.7	19.85±5.7	28.51±2.3	32.51±2.6	56.71±7.9	49.84±6.9	50.7±8.8
		Female	186.2±3.10	189.68±4.1	190.7±4.5	93.4±3.4	161.84±7.2	165.05±9.2	113.8±3.0	101.4±4.3	150.3±4.8	28.51±2.3	36.85±2.0	33.7±1.9	54.08±6.2	49.36±7.91	49.13±7.4
3	III >30-35 years	Male	183.68±4.1	189.57±2.5	197.3±3.5	86.84±7.2	143.26±6.8	201.7±13.7	101.4±4.3	110.13±3.0	113.08±3.8	36.85±2.0	28.6±1.3	38.16±2.2	49.5±7.8	48.47±5.9	46.9±5.7
		Female	183.57±2.5	186.54±2.9	225±3.6	95.26±6.8	173.72±7.2	199±10.1	110.13±3.0	100.89±3.3	127.7±3.5	28.6±1.3	37.38±1.6	40.8±2.1	57.3±7.4	48.63±4.9	48±4.6

[Table/Fig-8]: Comparison of Complete lipid profile in various sub age groups of 19-35 years.
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