Original Article

Demographic, breast-feeding, and nutritional trends among children with type 1 diabetes mellitus

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ABSTRACT

Background: The pathogenesis of type 1 diabetes mellitus (T1DM) requires a genetic predisposition to particular environmental triggers that may activate mechanisms leading to progressive loss of pancreatic beta cells. **Aims:** We tried to compare the impact of some demographic and environmental factors and breast-feeding on children (aged < 18 years) with recent onset diabetes mellitus (≤1 year) with that on age, sex, and socioeconomic status-matched controls. **Material and Methods:** A total of 43 consecutive patients (male, 24, mean age ± SD = 12.58 ± 9.6 years) and equal number of controls without diabetes mellitus or dysglycemia were included in this hospital-based case–control study. **Results and Conclusions:** A distinct peak in the incidence noted in the early adolescence with segregation in the winter months. Our patients did not differ significantly from the controls with regard to birth order, mode of delivery, parental age, parental education, dietary practices, breast-feeding, and migration in the family. Growth characteristics and nutritional status were also similar. A population study with more power will be better equipped to answer such queries.

Key words: Type 1 diabetes mellitus demography, type 1 diabetes mellitus etiology, breast-feeding, diabetes

Introduction

The pathogenesis of type 1 diabetes mellitus (T1DM) requires a genetic predisposition to particular environmental triggers that may activate mechanisms leading to progressive loss of pancreatic beta cells. The polygenic nature T1DM and the influence of nongenetically determined factors in its causation are supported by data from studies using animal models and also from human studies.[1]

Among the various socioeconomic denominators, a tendency toward shorter education and more practical type of employment was seen among parents of diabetic children from Europe; however, a South Indian study found that higher rather than lower socioeconomic status had influenced the absolute incidence and early onset of T1DM.[2-4] Strong clustering of T1DM in young children is thought to be an indication of in utero exposure to infection or other environmental agents.[5] The precise impacts of migration on the incidence of T1DM still not clear. Some early reports showed a different childhood T1DM incidence in France (4.6/100,000/year) and Canada (8.2/100,000/year), suggesting that those moving from low-risk areas to a high-risk area tend to adopt the incidence rate of that community.[6] Similarly, the incidence among Asian communities living in Bradford, Yorkshire, UK, during 1978–1981 was 4 times lower than non-Asians. However, it rose steadily during the 1981–1990 period finally leading to similar incidence among the children of non-Asian parents and the first generation of Asian children born in the UK.[7] Studies conducted in various European countries have found a strong association of advanced maternal or paternal age at birth to the risk of

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T1DM in the later life of the offspring.[3,8-9] A South Indian study, however, found evidence to the contrary.[10] Etiologic importance of breast-feeding and pattern of weaning in T1DM has been studied extensively. The protective effect of breast-feeding in T1DM has been reported in number of studies. Diabetogenic effect of cow's milk in genetically susceptible animals, such as biobreeding rats and nonobese diabetic mouse have been observed by different workers.[11] A molecular mimicry between bovine -casein and glucose transport (GLUT2) peptide has been suggested. It is believed that early exposure to an ABBOS peptide present in bovine serum was responsible for autoimmune response directed against islet cells due to sequence homology to the islet antigen (ICA69) peptide.[12] Studies conducted among English and Scottish children showed that higher number of diabetic children discontinued breast-feeding earlier compared with normal children[3]; however, an epidemiologic study from Sweden found that the population of children who were breast-fed was similar in diabetic and nondiabetic referral group.[2] The German BABYDIAB[13] and diabetes autoimmunity study in the young (DAISY),[14] both well designed for risk evaluation, did not find any association.

Seasonal onset of T1DM has also been highlighted in many studies indicating a link of etiopathogenesis of the disease with some environmental or even viral trigger. However, the findings are inconsistent regarding the dominance of a particular season over another.[15-19] There are insufficient data as regards the preponderance of a particular sex among T1DM patients.[2,4,15-16]

Thus a review of literature available worldwide reveals conflicting data with regard to the influence of the different demographic, socioeconomic, and environmental issues on the etiopathogenesis of T1DM. Although there are only few studies from South India, there is no data on north Indian population in the available literature. Hence we planned to carry out this preliminary study among hospitalized T1DM patients at least to gather the basic demographic and socioeconomic data and analyze whether such factors actually influence the etiopathogenesis of T1DM.

Material and Methods

This was a tertiary care hospital-based, noninterventional, case–control study, spreading over a period of 20 months starting from May 2000. Consecutive diabetic patients were included who fulfilled the following criteria: (i) aged 18 years or less, (ii) diagnosed with diabetes mellitus within preceding 12 months, (iii) had unequivocal history of diabetic keto-acidosis or documentation of spontaneous ketonuria, and (iv) were treated in Endocrinology ward of the institute. Control group comprised children who were not found to have diabetes mellitus or any other metabolic, endocrine, or autoimmune disease. They were recruited in equal proportion to cases (1:1) from (i) different wards of the institute and (ii) among family members of medical and paramedical professionals. The subjects in both the groups were matched for age, sex, and socioeconomic class.

The reference subject (patient or control) and family member(s) inclusive of at least one parent were interviewed extensively. Special emphasis was put on information regarding antenatal and perinatal events, birth order, parental age, breast-feeding, weaning, animal milk exposure, feeding habits of the family (milk, sugar, fats, processed food, and others), family history of diabetes and other autoimmune disease, history of migration, including previous three generations, parents' educational, professional, and economic backgrounds and categorization using standard criteria.[20] Specific questions were asked with regard to age and season of onset of diabetes, type of presentation, episodes of keto-acidosis, and presence/absence of any precipitating factors, type of treatment received, additional problems, such as exocrine pancreatic defects and others. Baseline laboratory investigations, such as fasting blood glucose, glycated hemoglobin, triglycerides, and cholesterol were performed. Pancreatic imaging included a plain skiagram and ultrasound to rule out calcifications. The study was approved by the institutional ethics committee.

Descriptive statistics, that is, mean, standard deviation, and frequency distribution were calculated for each and every variable wherever applicable. To see the significant difference between the two groups for the continuous variable, we had applied Student's *t* test (unpaired). To see the association between the two groups for the categorical variables we had applied Chi-square test. *P* value of 0.05 or less was considered as statistically significant.

Results

Forty-three subjects were enrolled in each group. The study group consisted of 24 males and 19 females and the control group had 25 males and 18 females. Baseline characteristics, such as age, body mass index, and socioeconomic status were similar in both the groups [Table 1].

No significant difference existed between the patients and control ($P = 0.326$) with regard to the history of migration in the family [Table 1]. Similarly, place of residence also did not differ ($P = 0.329$) significantly between the two groups [Table 1]. There appeared to be a slight positive association of urban dwelling and previous migration (mostly rural

Table 1: Baseline demographic and socioeconomic characteristics of patients and control subjects

Parameters	Patients (n=43)	Controls (n=43)	*P* value
Age, years (mean ± SD)	12.58±9.6	12.05±4.23	NS
Median age, years	12	12	NS
Male:female	24:19	25:18	NS
Age range in years	3–18	3–18	NS
BMI, kg/m2 (mean ± SD)	16.8±3.9	16.7±3.5	NS
Socioeconomic status (%)			
Upper	11.6	9.3	NS
Upper middle	20.9	13.9	NS
Upper lower	23.2	34.9	NS
Lower middle	32.6	32.6	NS
Lower	11.5	9.3	NS
History of migration			
Any migration	22	27	NS
Rural to urban	13	19	NS
Place of residence			
Rural	9	14	NS
Urban	34	29	NS
Parental education (%)			
Illiterate	20.9	13.9	NS
Primary	16.3	9.3	NS
High school	27.9	44.2	NS
College	23.3	18.6	NS
University	11.6	11.6	NS
Parental age (years)			
Maternal (mean ± SD)	25 ± 4.9	23.5 ± 3.4	NS
Paternal (mean ± SD)	30 ± 5.2	27.5 ± 4.1	NS
Mode of delivery (%)			
Home	37.2	41.9	NS
Institutional	62.8	58.1	NS
Family history of DM (%)			
1° relative	20.9	11.6	NS
2° and beyond	30.9	55.8	0.45

BMI: Body mass index, SD: Standard deviation, DM: Diabetes mellitus

to urban), which however was not significant due to small sample sizes.

Subjects were divided into 5 groups depending on the level of education received by at least one parent, namely, illiterate, primary, high school, college, and university. No significant difference was observed in the distribution of patient or control subjects at any level ($P = 0.579$) [Table 1]. Children born to illiterate parents were at an equal risk of developing diabetes mellitus compared with those who were born to highly educated parents.

Age of either parent at of the time of birth of the studied patients did not differ significantly from that of the control subjects [Table 1]. Mothers in either group were mostly between 21 and 25 years of age at the birth of the reference subjects. Children born to mothers above 35 years of age were slightly more at risk of developing diabetes in the later age.

Majority of children in both the groups belonged to either first or second order of birth. However, there was slight preponderance of early birth order in the control group, which was of borderline significance only ($P = 0.06$). Children belonging to the first birth order were relatively at a lower risk of developing diabetes compared with those belonging to the fifth birth order. There was insignificant ($P = 0.825$) difference between the 2 groups with regard to the mode of delivery, that is, institutional vs noninstitutional.

Duration (mean ± SD) of exclusive breast-feeding was comparable between the patients (5 ± 4 months) and control (6.6 ± 4 months). However, the duration (mean ± SD) of total breast-feeding (breast milk plus top feed) of the control group (18.6 ± 10.2 months) was significantly more ($P < 0.05$) than that of the patients (13 ± 7.5 months) [Table 2]. There was no significant difference between the 2 groups with regard to the age of initiation and duration of weaning [Table 2]. Both the groups underwent a rather prolonged course of weaning, 9 ± 4.7 months in patient group and 8.3 ± 3.2 months in the control group. The age at which the subject was fed with animal milk for the first time did not differ significantly between the 2 groups. Mean age of such exposure in the patient group was 6 ± 5 months and that for controls was 6.7 ± 6 months. Those children who were exposed to any type of animal milk prior to the age of 6 months were 1.6 times more at risk of developing diabetes compared with those who were not. The consumption of sugar, fats, and processed food in the families of patients did not significantly differ from that of the families of control subjects [Table 2].

Table 2: Details of breast-feeding and consumption of processed food among the patients and control subjects

Parameters	Patients (n=43)	Controls (n=43)	*P* value
Duration of breast-feeding (months)			
Only breast milk (mean ± SD)	5 ± 4	6.6 ± 4	NS
Breast milk + top feed (mean ± SD)	18.6 ± 10.02	13 ± 7.5	<0.05
Age (months) of weaning (mean ± SD)	8.7 ± 4.7	8.3 ± 3.2	NS
Consumption/person/month‡			
Sugar, kg (mean ± SD)	1 ± 0.7	0.8 ± 0.5	NS
Milk, L (mean ± SD)	12 ± 8.1	8.7 ± 5.1	NS
Fat, kg (mean ± SD)	0.94 ± 0.52	0.91 ± 0.46	NS
Processed food consumption (% of subjects)			
Minimum (<5 days/month)	51.2	50	NS
Moderate (5–15 days/month)	39.5	26	NS
Significant (>15 days/month)	9.3	23.8	NS

SD: Standard deviation, ‡Calculated by dividing total volume consumed per family by number of family members

The prevalence across different age groups showed a distinct peak at early adolescence (around 12 years of age), irrespective of sex [Figure 1]. Reliable data were obtained regarding the exact month of onset of symptoms in 33 patients. Frequency distribution analysis did not show a significant increase of incidence in any particular month or season of the year; however, most of the cases occurred during autumn and winter [Figure 2].

Discussion

The educational background of parents has been shown to be an important determinant in the etiology of diabetes in young in some studies. Bloom *et al*[2] observed a tendency toward shorter, more practical type of education among parents of diabetic children compared with control subjects. In the present study, parents' educational background did not vary significantly between patients and control subjects. Most parents in either group were educated up to high school level, which might have reflected the prevailing situation in the population. Children of both illiterate and highly educated parents were equally at risk of having diabetes. Unlike others, our findings did not support the notion that higher socioeconomic status positively influences diabetes incidence in children.[3,4] Although a higher number of study children came from urban background, it could be a referral bias as comparable number of control were also from a similar background. Migration has been shown to be influential in the etiologic and clinical course of both type 1 and type 2 diabetes.[6,7] No significant difference in history and type of migration between the study and control groups was observed. All previous studies included large populations. Hence it is difficult to draw a conclusion from a hospital-based study, such as the current one.

Advanced maternal age has been shown to be associated with diabetes in young.[3,4,8] Such a correlation was not observed in the current study. Mean age of either parent at birth of the subject from both the group did not differ significantly. Data with regard to the mode of delivery, birth order, and total number of children in the referent family were comparable between 2 groups. Others have found increased risk of diabetes among lower birth order children.[3,4]

Mean period of total breast-feeding in the current study was significantly longer in controls ($P < 0.05$). However, the duration of total breast-feeding among the patients ranged from birth till 2.5 years of age (mean ± SD = 13 ± 7.5 months). As such no conclusion can be drawn regarding the protective nature of breast-feeding on diabetes. Different researchers[3] earlier reported the protective nature of breast-feeding, whereas others found evidence to the contrary.[2,13-14] The diabetogenic effect of animal milk is also a matter of debate.[14] The consumption of processed food, sugar, milk, and fat did not differ between families of patients and controls.

A slight male preponderance (56%) found among diabetic children is similar to that of a large epidemiologic study among Swedish[2] and Swiss[18] children. One German study[21] did not find significant difference among either sex, whereas the Hawaiian IDDM registry [18] showed a higher incidence among girls. Influence of sex in etiology of diabetes is not clear. Peak incidence of diabetes was seen at 11–12 years of age, that is, early adolescence in this study, a finding which is similar to that of the EURODIAB-ACE (10–14 years) and a South Indian hospital-based study (11 years).[15,22]

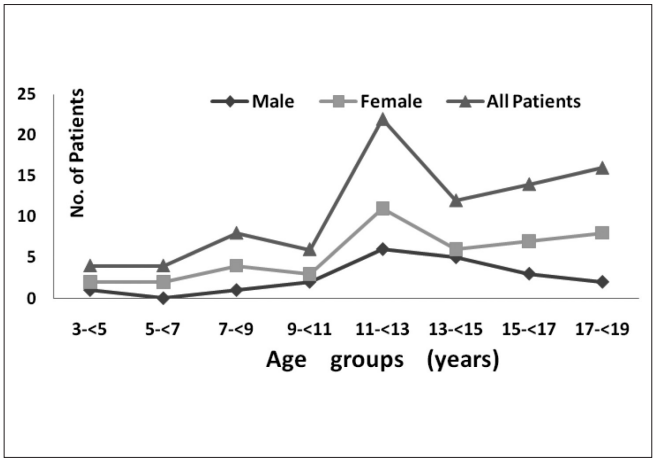

Figure 1: Agewise distribution of patients showing a peak incidence around 11–12 years (the trend is similar in both sexes)

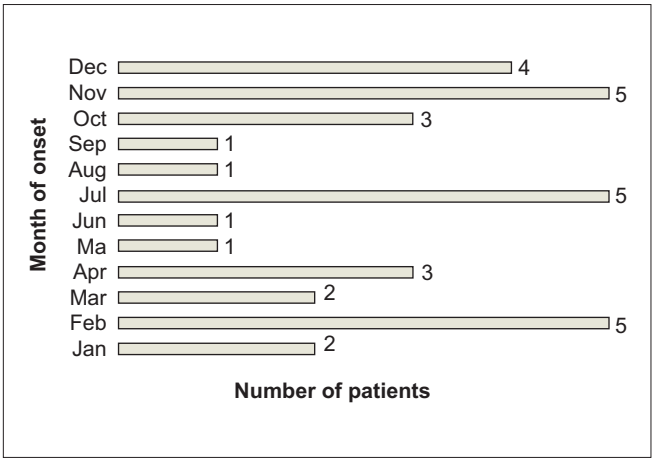

Figure 2: Distribution of patients according to the month of onset showing slight preponderance in winter months

Various studies have indicated a high incidence of diabetes during winter and early spring[18] A Japanese study[17] reported highest occurrence (40%) during January–March. A higher incidence was observed during autumn and winter months in the current study also. Such variations at timing of onset suggest possible environmental triggers, such as viral infection, eating pattern, and so on.

In conclusion, children and adolescents with diabetes mellitus do not differ significantly from their normal healthy peers in nutritional status, growth characteristics, and socioeconomic, educational, and demographic characteristics of the family. The possible role of environmental socioeconomic, and environmental factors in triggering the onset and progression of T1DM has always generated great interest among scientists across the globe, leading to significant number of publications on this subject. Ideally, epidemiologic studies with large cohorts are required to address such issues. Unfortunately, such studies have rarely been performed in our country. Our study, despite being hospital based, and including a relatively smaller cohort of patients and controls is a humble initiation to generating some indigenous data on some hitherto unresolved issues. In many instances, data accumulation is completely dependent on the recalling power of parents or other relatives of the subject that is not entirely without bias. A long-term prospective study can overcome these limitations.

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