Original Article

Demographic details, clinical features, and nutritional characteristics of young adults with Type 1 diabetes mellitus - A South Indian tertiary center experience

Mini Joseph, Asha H. Shyamasunder, Riddhi D. Gupta, Vijayalakshmi Anand, Nihal Thomas

Department of Endocrinology, Diabetes and Metabolism, Christian Medical College and Hospital, Vellore, Tamil Nadu, India

ABSTRACT

Context: Type 1 diabetes mellitus (T1DM) accounts for 5–10% of all diagnosed diabetes and the highest incidence is found in India. **Aims:** The main objectives were to study the demographic, clinical, and nutritional characteristics of young adults with T1DM and its effect glycosylated hemoglobin levels. **Subjects and Methods:** This cross-sectional study was conducted among young adults with T1DM (18–45 years of age) in a tertiary hospital in South India. Data were obtained from updated medical records. The dietary data were assessed from food diaries and 24 h recall method. Anthropometry was determined. **Results:** The analysis revealed that socio-economic variables did not affect the glycosylated hemoglobin levels. The mean glycosylated hemoglobin value was 8.81 ± 2.38%. Nearly, half the patients were malnourished. The overall dietary intake was inadequate. The multivariate regression model, adjusted for confounding factors such as gender, age, and body mass index, revealed that only duration of diabetes and protein intake were significant predictors of glycosylated hemoglobin status ($P < 0.005$). **Conclusion:** Integrated care provided at subsidized cost has been pivotal in effective diabetes management. However, there is an urgent need to educate our patients on nutrition therapy. T1DM patients need specialized advice to ensure appropriately balanced nutrition that has a significant impact on their long-term glycemic control.

Key words: Clinical features, demography, glycemic control, nutritional data, Type 1 diabetes mellitus

Introduction

There are 415 million adults with diabetes mellitus (DM) worldwide according to the latest report of the diabetes atlas (7th edition), and this is equivalent to approximately one in every 11 persons. According to the data that have been released by the International Diabetes Federation (IDF) 2015, USA has the highest prevalence of diabetes among developed nations (11%). However, China and India have the highest total numbers of people with diabetes — 110 million and 69 million, respectively.[1]

Type 1 DM accounts for 5–10% of all diagnosed diabetes.[2] DM is one of the most common metabolic disorders of childhood. T1DM occurs due to the autoimmune destruction of insulin-producing islet beta cells predisposed by genetic and precipitated by environmental determinants.[3]

The TIDM worldwide registry of the World Health Organization Multinational Project for childhood diabetes

Corresponding Author: Dr. Mini Joseph,
Department of Endocrinology, Diabetes and Metabolism, Christian Medical College and Hospital, Vellore, Tamil Nadu, India.
E-mail: minijoseph 66@yahoo.in

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reported an annual increase in the incidence of T1DM in Europe (3.2%) and North America (5.3%) with a fall in incidence in Central America and the West Indies (−3.6%).[4]

In 2013, the South-East Asia Region (SEAR) estimated that 77,900 children were affected with T1DM, with the Indian population having the largest incidence.[5] A study from Karnal district of Haryana in Northern India in 2008, reported a prevalence of 18.3/100,000 in the 0–14 years age group.[6] A lower incidence was seen in South India (10.5/100,000/year) amongst children below 15 years of age in the 4-year period from 1991 to 1994.[7]

Patients with T1DM are largely diagnosed in their childhood or adolescence and with proper diabetes management, they can attain their maximum potential in terms of quality of life and academic success.[8] Appropriate nutrition therapy is essential to ensure sustained optimum growth and avoid hypoglycemia. The pivotal components of diet are the provision of adequate calorie intake distributed at regular intervals throughout the day, in suitable proportions of carbohydrate, proteins, and fat along with avoidance of high glycemic index foods. It is imperative that the patients with T1DM comprehend their condition so that they are in control of their lives.[9]

Various factors such as poor socio-economic conditions and faulty understanding of the diabetes care can upset the glycemic control. Adolescents and the youth are particularly prone to put themselves at risk. Poor control of diabetes predisposes them to complication.[9]

This is a cross-sectional study of T1DM patients being managed in the Department of Endocrinology, Diabetes and Metabolism of Christian Medical College, Vellore, Tamil Nadu, India. This hospital is 2600 bedded tertiary care teaching hospital catering to the medical needs of patients from all over India and its neighboring countries. The main objectives of this study were to look at the demographic, clinical, and nutritional characteristics of T1DM patients and to study the association of these factors with glycosylated hemoglobin levels (HbA_1C).

Subjects and Methods

Data were obtained (over a 6 month period) from patients aged between 18 and 45 years who had T1DM for the duration of at least 6 months and were managed at the Adult Young Diabetes Clinic of the Department of Endocrinology, Diabetes and Metabolism of Christian Medical College and Hospital, Vellore, India. Patients with chronic conditions that interfere with food intake, known psychiatric illnesses, pregnant or lactating mothers, patients with malignancies, congenital diseases, and prevailing syndromes were excluded from the study. The study sample consisted of 115 patients who met the inclusion criteria and provided informed consent. The study protocol conformed to the ethical guidelines of the 1975 declaration of Helsinki (and revised in 2000), and approval was obtained by the Institutional Review Board of Christian Medical College and Hospital, Vellore, India (IRB Min. No. 9547 dated 22.07.2015). The demographic details were obtained from their updated medical records. The medical data were noted by the examining physician during routine visits to the clinic. A log book was given to each patient to record their blood glucose levels, insulin dose, food intake, including portion sizes at each meal and physical activity. Patients were advised to note down their details in the log book at least 3 days/week and bring it during each hospital visit. The weight and height of the patients were measured using standard procedures ($n = 109$). Their body mass index (BMI) was interpreted according to Asia-Pacific guidelines[10] Nutritional data of the patients were recorded by 24 h recall along with their log books, by the dietitian. The nutrient composition of diet was computed from the book-Nutritive Value of Indian Foods.[11] Patients were provided individualized advice on diet modification for optimal nutrient intake and better glycemic control.

The Dietitian (MJ) also provided group education to the patients on appropriate nutrition using power point presentations, pictures and standardized tools. The topics discussed in these sessions concentrated on healthy eating patterns for better management of diabetes. During the same sessions, a diabetes nurse educator trained in the care of patients with T1DM provided group education on several aspects of diabetes management such as a correct technique of insulin injection, rotation of sites, appropriate insulin dose adjustments based on planned food intake and activity and sick day management.

Statistical analysis

The data were statistically analyzed using SPSS version 19 for Windows (IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY). Percentage analysis was done to represent the data. Independent sample *t*-test was used to compare the HbA_1C, nutrient intake and insulin dose of males and female patients. Chi-square test was used to study the association between HbA_1C and demographic, clinical, and dietary factors. Univariate and multivariate regression analysis was used to find the relationship between HbA_1C and the independent variables. $P < 0.05$ was considered significant.

Results

Demographic and clinical characteristics: A total of 115 Type 1 diabetes patients out of 135 met the

inclusion criteria (13 did not come for follow-up, three had developmental problems, and four had chronic psychiatric illnesses). Their demographic and clinical details are presented in Table 1. This study included 65 males and 50 females with a mean age of 25.08 ± 7.03 years and 26.47 ± 5.8 years, respectively. The male:female ratio was 1.3:1. More than 50% of them hailed from rural areas and were employed in daily labor, earning less than INR ₹5000 per month. Majority of female patients were non-income generating. More than one-third of them were graduates or postgraduates. There was no significant difference between the males and females with regard to their level of education.

Table 1: Demographic and clinical characteristics of patients with type 1 diabetes mellitus (*n*=115)

Variables	Frequency (*n*)	Percentage (%)
Gender		
Male	65	56.5
Female	50	43.5
Place of residence		
Rural	57	49.5
Urban	46	40
Remote	4	3.5
NA	8	7
Occupational level		
Student	15	13.2
Homemaker	32	28.1
Office/factory	22	19.3
Daily wage worker	31	27.2
Self-employed	3	2.6
NA	12	9.6
Educational level		
Illiterate	4	3.4
High school	11	9.6
Up to 10th class	24	20.9
Higher secondary	16	13.9
Degree/diploma	43	37.4
Post-graduation	11	9.6
NA	16	5.2
Family income		
1500-5000	46	43.3
5001-10,000	30	28.8
10,001-20,000	16	15.4
>20,001	13	12.5
Individual income		
Not earning	63	54.4
1000-5000	31	27.1
5001-10,000	14	12.3
10,001-20,000	5	4.4
>20,000	2	1.8
Insulin administration device		
Pen	16	13.9
Syringe	92	80
Pen and syringe	7	6.1
Insulin storage device		
Refrigerator	16	13.9
Mud pot	85	73.9
Flask	7	6.1
NA	7	6.1
Insulin regime		
Basal-bolus regime	22	19.3
Split-mix regime	92	80.7

NA: Not available

Disposable syringes and mud-pots were the popular devices used to administer and store the insulin, respectively. The average duration of diabetes was 9.20 ± 6.31 years, ranging from 1 year to 24 years. The average insulin dose was 0.77 ± 0.27 units/kg/day (range 0.09–1.31 units/kg/day). Nearly, 80% of them were on the split-mix regime with regular and NPH insulin administered twice daily. The mean HbA_1C values (determined by high performance liquid chromatography) for the T1DM patients were 8.81 ± 2.38% (males: 8.86 ± 2.41%, ranging between 6.1% and 19%; females: 8.75 ± 2.37%, ranging between 5.5% and 15.7%; $P = 0.520$).

The average weight of the male and female population was 56.8 ± 10.6 kg and 50.9 ± 8.4 kg, respectively. The patients were classified based on their BMI.[10] Half the male patients and 65% of the females were malnourished. More than one-fourth of all the patients were underweight (BMI <18.5). A small proportion of males and females were overweight and obese (BMI ≥23 and ≥25, respectively). This gender wise distribution of the patients based on body mass index according to Asia-Pacific perspectives[10] is illustrated in Figure 1.

Nutritional characteristics

The nutritional data of the patients are tabulated in Table 2. There was a deficit of approximately 300 and 250 calories in the daily diet of male and female patients respectively when compared to RDA according to Indian Council for Medical Research 2010.[11] The percent intake of macronutrients was not in line with the RDA for those with diabetes (carbohydrates 50–60%; proteins 15–20%; fats 25–30%).[9] The consumption of carbohydrates was 10% higher coupled with an inadequate intake of proteins. The overall daily protein intake per kg body weight was 0.79 ± 0.3 g/kg body weight with males having a significantly higher intake (0.84 ± 0.3 g/kg body weight) than their female counterparts (0.74 ± 0.2 g/kg body weight) ($P = 0.047$). The fat intake was satisfactory. The majority of the patients consumed food at least six times a day which included three meals and three snacks. The intake of dietary fiber was poor in more than 50% of the male and female patient population.

Exercise duration

More than three-fourth of the patient population (males - 75%; females - 78.8%) exercised adequately, at least 30 min/day. Walking was the most common form of exercise; cycling and skipping were also popular.

Factors affecting the glycosylated hemoglobin levels of patients

Univariate and multivariate regression analysis were used to study the association of HbA_1C with gender,

Table 2: Nutritional data of type 1 diabetes mellitus patients

Nutrients/day	Males (*n*=47)	Females (*n*=31)
Calories (kcal)	1647.4±357.3	1360.4±264.9
Carbohydrates (g)	284.5±58.0	237.7±44.5
Proteins (g)	45.7±18.3	36.5±10.5
Proteins/body weight (g/kg)*	0.84±0.3	0.74±0.2
Fat (g)	36.6±13.0	29.2±11.8
Meal composition		
% Intake of carbohydrates	69.5	70.3
% Intake of proteins	10.8	10.6
% Intake of fats	19.7	19.1
Meal frequency (%)		
3 meals	7.8	4
3 meals + 1 snack	7.8	14
3 meals + 2 snacks	14.1	18
3 meals + ≥3 snacks	70.3	64
Daily servings of fiber rich foods†		
Poor (<2 servings)	60.9	58
Fair (3-4 servings)	23.5	28
Adequate (≥5 servings)	15.6	14

†Fruits/vegetables, 1 serving=100 g, *P=0.047

socio-economic factors, duration of diabetes, total insulin dose per day, type of insulin regime, exercise, nutrient intake, and meal pattern.

Univariate regression analysis indicated that a longer duration of diabetes (P = 0.002; CI = 0.011, 0.048), higher per cent of carbohydrates in diet (P = 0.046; CI = 0.000, 0.157), with a low protein intake (P = 0.045; CI = −1.664,-0.018) lower meal frequency (P = 0.004; CI = −0.876, −0.170), with inadequate exercise (P = 0.047; CI = 0.018, 2.715) were significantly associated with higher HbA_1C levels.

In the multivariate regression model, adjusted for confounding factors such as gender, age and BMI, only longer duration of diabetes (P = 0.000; CI = 0.300, 0.083) and lower protein intake (P = 0.022; CI = −2.344; −0.186) showed significant association with HbA_1C.

Discussion

This study of young adults with T1DM showed a higher prevalence of diabetes condition in the male gender. This could also be a bias in India due to better health care-seeking behaviors for males leading to their treatment at tertiary care centers. The worldwide DIAMOND project also indicated a statistically significant male-to-female excess incidence in three centers, with no populations reporting a female excess.[4] Similar findings have been reported from Swedish studies where the male to female ratio was 1.8:1.[12] Treatment of diabetes is expensive, and the overall costs can be a strain on the family income.[13,14] Interestingly, our study indicated that socio-economic variables did not affect the HbA_1C status of our patients. Most of our patients are supported by the IDF-Life for a Child program and Marjorie's fund

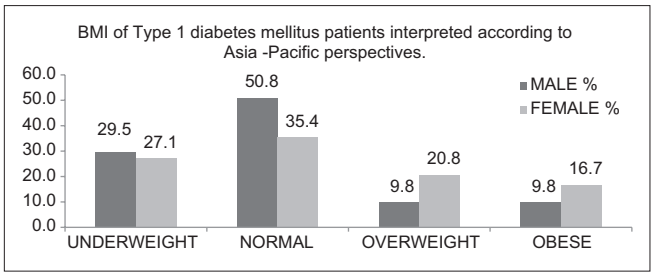

Figure 1: Gender-wise distribution of Type 1 diabetes mellitus patients based on body mass index according to Asia-Pacific perspectives

which provided glucometers and strips free of cost for monitoring. This takes off a major financial burden and might have resulted in the observed lack of association between socioeconomic status and HbA_1C. In contrast, a study from the rural communities of Mthatha, South Africa indicated that poverty and inaccessibility to doctors were the major hurdles faced by patients to attain good glycemic control.[15]

It was interesting to note that the HbA_1C did not seem to be related to the patient's level of education. This probably reflects the fact that academic knowledge does not always translate into disease awareness; however, the numbers studied were small. This assumes greater significance for patients with DM across all sections of the society. Similar findings have been reported among Northern Indian T1DM patients, where knowledge, attitude, and practices with respect to diabetes management were found to be unsatisfactory.[16] A South African study reported that a major negative factor in glycemic control for the patients from rural communities was a lack of knowledge.[15] It must be remembered that each visit to the clinic is an opportunity to educate the patients on various aspects of diabetes. The group education sessions at our center are a reliable point for sharing, disseminating, and updating knowledge.

As expected, the HbA_1C levels were significantly higher in patients with a longer duration of the disease condition.

Regular physical exercise of at least a 30 min duration helps in achieving good glycemic control. In our study, only three-fourths of them complied with the exercise regime. Lack of a proper social support and encouragement from the peer-group remain major obstacles to Type 1 diabetes management in our country. Interestingly, a South American study reported adequate physical activity (4.5 ± 2.7 h per week) in the T1DM Chilean adolescents.[17] In our society, diabetes continues to be a stigmatized condition, and patients often conceal their condition due to the fear of being ostracized. There is an urgent need to sensitize our community about the benefits of exercise to control as well as prevent T2DM.

Medical nutrition therapy is an important arm in diabetes care management. The dietary data revealed that the overall dietary intake of the patients was poor. The meal composition was inappropriate; there was a deficit in calories, fiber, and proteins with a proportionally high carbohydrate intake. Nearly, one-fourth of the patients did not have a satisfactory eating pattern. The high percentage of carbohydrates (70%) in their diet had a negative effect on the HbA_1C levels. The cheap and easy accessibility of polished rice (refined cereal) in the public distribution system has replaced millets (small coarse grains with high fiber) from the daily diet of South Indians.

It was interesting to note that a higher protein intake was protective as indicated by a significantly lower HbA_1C level. The major source of protein in the diet of Indians is pulses. The protective effect of pulses is due to its low glycemic response and high satiety index.[9] Other sources of protein such as flesh foods and dairy products are consumed less frequently due to their higher cost. However, the high price of pulses has resulted in a deficient intake in our study population (11%). The intake of fat was within the acceptable range of 20% of the total calories. The major source of fat in the diet was the oil used for cooking.

Fiber has a protective effect as it lowers the postprandial glycemic peak and prolongs the gastric emptying time, resulting in delayed release, and absorption of carbohydrate.[9] The fiber intake of our patients was poor. This is due to the low vegetable intake, inadequate intake of whole gram pulses and high intake of refined cereals. Similar findings were reported among Chilean T1DM children.[17] The intake of vegetables can be enhanced by promoting kitchen gardens and encouraging the use of locally available seasonal vegetables.

It was found that as the meal frequency increased, the HbA_1C levels were significantly lower. Only 60–75% of the patient population followed three meals with small snacks in between.

Chinese investigators have recommended a need for an increased frequency of nutrition education in conjunction with intensified self-monitoring of blood glucose.[18] However, their T1DM patients were more sensitized to carbohydrate intake in the diet when compared to their non-T1DM populations.[19] A review paper which looked at the dietary intake of T1DM children from Western countries (US and EU) also indicated a deficit in their nutrient intake. These authors suggest that behavioral changes should be incorporated to offer potential efficacy in promoting healthful dietary change.[20]

A Chilean study reported a higher protein (21.4% of total energy), adequate fat (31.2%), and low carbohydrate intake (48%) in the diets of young T1DM children (15.2 ± 4.0 years). The HbA_1C values significantly correlated with fat intake in grams per day ($r = 0.363$, $P < 0.05$).[17]

The nutrient deficit in our study is reflected in their anthropometric data. Malnourishment was prevalent in half the males and one-third of the females, clearly indicating that they are a vulnerable group who required frequent contact with the medical team. An underweight status was more common, and this could be explained by their inadequate calorie intake due to fear of hyperglycemia. This is in contrast to Italian reports on T1DM patients (3–19 years) where the prevalence of obesity and overweight (34.5%) overrides underweight (11.5%).[21]

To our knowledge, this is the first study from Southern India that looked at the dietary pattern of T1DM patients. The limitation of the study was that the dietary data was obtained by the 24 h recall method and self-reported food diaries, the accuracy of which is questionable. This output tends to over or underestimate the actual intakes.[22,23] Our patients did not practice carbohydrate counting to decide on their type and quantity of food. Studies with more objective measures of dietary intake and of longer duration are necessary to get the complete picture.

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Conflicts of interest

There are no conflicts of interest.

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