Original Article

Improvement of knowledge following diabetes self-management education with respect to socioeconomic status: A retrospective cohort study among type 2 diabetes in Eastern India

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Abstract

Introduction: We assessed the baseline knowledge and the improvement and retention of knowledge after attending diabetes self-management education (DSME) programs with respect to different socioeconomic status (SES). We also looked into the change in body mass index (BMI), blood pressure, and glycemic parameters after attending the DSME sessions. **Materials and Methods:** This was a retrospective, cohort study carried out via chart review based on data collected from manual or electronic medical records (EMR) and questionnaire responses of 160 adult patients with type 2 diabetes (T2D) who attended two DSME sessions with a gap of at least six months. **Results:** Baseline knowledge on diabetes was uniform (P = 0.06), irrespective of differences in SES, and DSME sessions significantly improved the knowledge in all socioeconomic classes (P value < 0.05 in each SES group). However, SES did have a significant influence on the finally acquired knowledge of diabetes as was evident from the final score after attending two DSME sessions. A significant number of patients (48.1%) from our cohort either improved or retained their knowledge of diabetes over a mean follow-up of 15.5 months. The BMI of our cohort was significantly reduced from baseline to final follow-up (P = 0.016). **Conclusion:** DSME sessions were effective in improving knowledge and awareness among T2D patients, irrespective of socioeconomic classes in Eastern India. The acquired knowledge from DSME sessions was retained over a long time.

Keywords: Diabetes self-management education program, improvement, knowledge, retention, socioeconomic status, type 2 diabetes

Introduction

Type 2 diabetes (T2D) has been represented a substantial burden in terms of mortality, morbidity, and health-system costs.[1] Patient-centered, structured diabetes self-management education (DSME) facilitates the knowledge, attitudes, and abilities necessary for self-management.[2] DSME is associated

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with improved diabetes knowledge, and self-care behaviors, reduced glycemic parameters, and body weight, improved quality of life, reduced all-cause mortality, and reduced health care costs.[3] American Diabetes Association (ADA) suggests that all people with diabetes should receive DSME following an initial comprehensive medical evaluation and annually thereafter.[3]

The knowledge and awareness of diabetes is suboptimal in India.[4] A structured diabetes educational program was found to be effective in improving self-care behavior among T2D patients in the Indian subpopulation.[5] Low health literacy negatively impacts disease self-management and individual self-care behavior.[6] Conventionally low socioeconomic position is strongly associated with inadequate health literacy.[7,8] The baseline knowledge on diabetes among T2D patients was independent of the socioeconomic status (SES) even when analyzed separately for income levels and educational qualification, and was reported in our previous presentation.[9]

There is limited published research that evaluates the impact of DSME among T2D in different SES.[10-12] Although the three studies evaluated the effectiveness of DSME[5,13,14] on self-care behavior and glycemic variability, the retention of acquired knowledge after attending the DSME program on long-term was not addressed.

In the present study, we assessed the baseline knowledge on diabetes before attending the DSME session and the improvement of knowledge and retention of knowledge after attending two DSME sessions with respect to different SES. Conventional education results in short-term improvements in glycosylated hemoglobin (HbA1c), sustained improvements in self-efficacy, and reduces diabetes distress in the Western world.[15] However, it needs ongoing reinforcement to achieve lasting behavioral change and glucose control.[15] In the present study, we evaluated the long-term (15.5 months) influence of DSME program on the changes in clinical (weight, blood pressure) and glycemic parameters in the hitherto unknown among the Indian subset, especially in consideration of educational status.

Materials and Methods

This study was a single-centered, nonrandomized, cross-sectional, and retrospective chart review, done in an urban setting of a tertiary diabetic clinic of Kolkata, where DSME training along with evaluation of knowledge on diabetes was regularly offered to all T2D patients. The adult patients (aged between 30 and 70 years) with T2D attended two DSME sessions (DSME 1 and DSME 2) between January 2016 and November 2019, with a gap of at least six months, and were either on oral antidiabetic drugs (OADs) and/or insulin included in the study.

The data were reviewed for the patients who had relevant sociodemographic information and had completed their responses in the questionnaires. Patients with type 1 diabetes, gestational diabetes, and diagnosed late-onset diabetes in young and other specific varieties or who were mentally unfit to comprehend questions and respond were excluded from the study.

Sample size calculation

Considering an awareness level of 11.9% as reported in a previous community-based study among the South Indian population,[16] α of 0.05%, and absolute precision of 5%, the sample size was calculated as 161 by using the equation 4PQ/D2. The power of the study was taken as 80%.

We obtained the written informed consent before initiating the chart review. The data on demographic characteristics (age and sex), clinical characteristics [height in centimeter, weight in kilogram, body mass index (BMI) in kg/m^2, blood pressure in mmHg], and socioeconomic characteristics (education of the head of the family, occupation of the head of the family, and total monthly income of the family) were collected in a structured proforma either from manual or from electronic medical records (EMR) of the patients during the first DSME session (DSME 1). The data on clinical characteristics (weight, BMI, blood pressure) were collected again after the second DSME session (DSME 2). The data of 160 T2D patients who fulfilled the inclusion and exclusion criteria were statistically analyzed and represented in the tables [Annexure 1].

Ethical considerations

Approval for exemption from the review was obtained from Independent Ethics Committee [IEC] [OIEC/12/01/2023]. Confidentiality and anonymity were meticulously maintained as per the Helsinki Declaration and related bioethics policies were strictly adhered to during consent processing.

DSME training

Well-structured and locally contextualized DSME sessions were conducted every weekend by a team of certified diabetes educators, with a 6-h intensive and interactive group discussion consisting of 8–12 patients. The sessions consisted of three main elements: (a) eight educational sessions each lasting for 30–45 min on average, focused on basic diabetic knowledge on diet; physical activity, lifestyle modification, insulin administration, self-monitoring of blood glucose (SMBG), foot care, management of hypoglycemia and sick days; (b) a colorful, well-illustrated educational booklet distribution; and (c) extensive interactive discussions with take-home messages. The educational sessions were carried out using proprietary PowerPoint slides of the ADA: 20–25 slides each session. The sessions were discussed in mixed language (English and Bengali), keeping the technical terminology intact by the certified diabetes educators. Knowledge gaps in the different areas of the disease management were discussed at the end of each session. The curriculum of the program was consistent with the requirement of the National Standards for Diabetes Self-Management Education and Support.[2]

Diabetes knowledge questionnaire and scoring

The diabetes knowledge questionnaire was a set of semistructured questionnaire with 15 multiple-choice questions [Annexure 2] addressing different sections of diabetes. Same questionnaire was handed over to the patients before attending DSME sessions (pretest of DSME 1 and pretest of DSME 2) and also after completing the DSME sessions (posttest of DSME 1 and posttest of DSME 2). We used the questionnaire in English as well as local language (Bengali) after back translation. The questionnaire covered the area of etiology of diabetes, diet, monitoring of blood glucose, lifestyle, foot care, insulin administration, and complications. Score "one" was awarded for each correct answer and "zero" for each incorrect or unattempted answer. Scores of all the 15 questions are summed up for the pretest of DSME 1 and posttest of DSME 1 and pretest of DSME 2 and posttest of DSME 2. A maximum obtainable mark was 15 and a minimum obtainable mark was 0 in each of the pre/post DSME evaluation.

The baseline diabetes knowledge was obtained from the score of the pretest questionnaire of DSME 1 (Pretest 1 score). The improvement of knowledge was calculated by subtracting the score of the pretest of DSME 1 from the score of the posttest of DSME 2 (Posttest 2 score minus Pretest 1 score) after attending two DSME sessions. Final diabetes knowledge was obtained from the score of the posttest questionnaire of DSME 2 (Posttest 2 score) after attending two DSME sessions.

The retention of knowledge was calculated by subtracting the score of the posttest of DSME 1 from the score of the pretest of DSME 2 (Pretest 2 score minus Posttest 1 score).

Scoring of SES

The modified Kuppuswamy SES scale (KSS) score of 2016 was used in this study as the initial assessment and DSME 1 was conducted in 2016.[17] The scale is based on three variables—occupation of the head of the family, education of the head of the family, and total monthly income of the family. The sociodemographic characteristics were classified as upper (I) class, upper middle (II) class, lower middle (III) class, upper lower (IV) class, and lower (V) class.

The data of laboratory investigations on glycemic parameters fasting plasma glucose (FPG), postprandial plasma glucose (PPPG), and HbA1c were compared to the biochemical parameters between baseline and follow-up. The laboratory evaluation before attending the DSME 1 session was considered as a baseline investigation and the same before attending the DSME 2 session was considered as a follow-up investigation.

Data were analyzed by using SPSS 23.0 statistical software with different methods to interpret the result. Relationships were considered significant at the P value < 0.05 level.

Results

The demographic, anthropometric, and SES of the patients during DSME 1 are shown in [Annexure 1 and Table 1]. Thirty-nine patients (24.4%) of the cohort belong to the upper (I), 89 patients (55.6%) to the upper middle (II), 21 patients (13.1%) to the lower middle (III), and 11 patients (6.9%) to the upper lower (IV) SES [Annexure 1 and Table 1].

The pretest and posttest score variables of the two DSME sessions were tested for normality of distribution by Kolmogorov–Smirnov test which showed the variables were not normally distributed. Hence, we conducted a nonparametric analysis of the test scores. The median pretest and interquartile range (IQR) and median posttest and IQR of the DSME 1 were 8 (5) and 10 (3), respectively. A Kruskal–Wallis test showed that there was no significant difference in Pretest 1 scores between patients of different SES, χ^2 (3) =7.41, P = 0.06 [Annexure 1 and Table 2] at baseline.

Improvement of knowledge score (Posttest 2 score minus Pretest 1 score) was assessed with respect to different SES after attending two DSME sessions. There was a significant improvement in diabetic knowledge score, irrespective of SES (P value < 0.05 in each SES groups) [Annexure 1 and Table 3].

Final diabetes knowledge score (Posttest 2score) after attending two DSME sessions with respect to different SES represented [Annexure 1 and Table 4]. The overall median and IQR of the posttest score was 12 (3). There was a significant difference in posttest 2 scores between patients of different SES, χ^2 (3) =10.003, P = 0.019. *Post hoc* test showed that compared to the lower middle class (III), posttest scores were significantly higher (P = 0.022) in the upper (I) SES.

Retention of knowledge of the DSME 1 was assessed with respect to different SES. The median and IQR of retention score was − 1 (4), which showed that irrespective of overall SES, 48.1% of the patients either improved or retained the acquired knowledge after DSME 1. About 36.2% showed improvement, 11.9% of patients retained the acquired knowledge, and 51.9% showed a deterioration of knowledge score.

The time interval between DSME 1 and DSME 2 was in a range of 7 to 31 months (mean 15.5 months). No significant difference was observed in improvement, retention, and deterioration of knowledge score among the cohort between mean time intervals (P = 0.545**)** of DSME 1 and DSME 2.

The changes in BMI, blood pressure, and glycemic parameters from baseline to final follow-up during DSME 2 were tabulated in [Annexure 1 and Table 5]. BMI was significantly reduced from baseline to final follow-up (P = 0.016). The correlation between the impact of DSME sessions (improvement or retention of knowledge after attending DSME 1) with BMI was analyzed. BMI was noted to fall with improvement or retention of knowledge

following the DSME 1 (correlation coefficient—0.116), but it failed to reach any statistical significance ($P = 0.143$).

Discussion

Health literacy is the capacity to obtain process and understand basic health information. DSME provides the knowledge, skills, and confidence to accept responsibility for self-management to people with diabetes. The relevance of DSME was scarcely tested in resource poor and highly unequal socioeconomic country like India. KSS,[17] BG Prasad scale,[18] and Udai Pareekh scale[19] are the widely accepted scales for evaluation of SES in India. Among these three, the KSS scale is the most extensively used for people residing in urban areas.[17]

Baseline knowledge scores, though poor among the different SES of our cohort, were not different ($P = 0.06$) between the classes. Uniform baseline knowledge scores, independent of SES, were observed in our previous study as well.[9] The baseline knowledge about diabetes was poor among the Indian population, particularly in rural areas.[4] The prevalence of inadequate health literacy was high even in the European region despite a relatively high educated population.[7] Imparting knowledge of diabetes is the first step in the prevention of disease progression and the reduction in all-cause mortality risk.[3] These findings underscore the need for intensifying DSME among T2D in India.

Significant improvement in knowledge score after attending two DSME sessions (with mean time intervals of 15.5 months) was observed in all the SES (P value < 0.05 in each SES group). The use of patient-friendly educational sessions, well-illustrated educational booklets, and interactive group discussions as part of the intervention most likely contributed to the rise in knowledge score across all SES compared to baseline score. In other words, DSME sessions were effective in improving the knowledge of diabetes in all social classes. In line with this observation, the structured DSME has been reported to make major contributions in the areas of health promotion not only in high-income countries but also in low- and middle-income countries with limited resources.[20] However, the final diabetes knowledge score (Posttest 2 score) after attending two DSME sessions was significantly higher ($P = 0.022$) in the upper (I) SES compared to the lower middle (III) SES, indicating the importance of the socioeconomic position. The interclass difference of the posttest 2 score of DSME 2 was also significant ($P = 0.019$). This finding was reflected in many other studies, where a better knowledge score was observed among the professionals and/or the upper class.[10,11,19] Background education perhaps contributed to the significant difference in the final acquired knowledge score among the upper (I) SES.

Fifty-eight patients (36.2%) had an improvement in knowledge score and another 19 patients (11.9%) had retained the acquired knowledge even with mean time intervals of 15.5 months from the DSME 1 session. On the other hand, eighty-three patients (51.9%) showed deterioration of knowledge score with mean time intervals of 15.5 months. The mean time difference between DSME 1 and DSME 2 sessions was statistically insignificant (ANOVA, $P = 0.545$) and hence did not contribute toward improvement, deterioration, or retention of the knowledge score. The retention of information after diabetes education program or medication instructions was poor irrespective of the literacy levels, even after a very short period of 2 weeks.[21,22] In this backdrop, this positive result (48.1% patients of in our cohort either improved or retained in knowledge score) was the most significant impetus to continue the DSME session further in our center. In this line, knowledge and self-care skills gained during the intensive DSME program were retained for at least six months to one year in another study.[23]

DSME intervention in our cohort led to a significant ($P = 0.016$) reduction in BMI from baseline to follow-up. Reduction in weight was one of the key clinical benefits of the DSME program.[3,20,24] Several factors may help explain the positive results obtained in the present study: First, the program was culturally tailored for the patients and the educators helped the patient to acquire the knowledge. Secondly, the education was effectively conducted with group discussion. Thirdly, the learning emphasized behavioral changes, unlike a more traditional didactic approach, including handouts to meet specific needs. The patient had the possibility to modify the lifestyle practices: nutrition, physical activity, and addiction, leading to the benefit of BMI. However, we could not exclude the other confounding factors, most importantly the change in OADs which included sodium–glucose linked transporter-2 (SGLT-2) inhibitors or glucagon-like peptide-1 receptor agonists (GLP-1RAs).

We did not observe any change in blood pressure from baseline to follow-up. Though a reduction in blood pressure after the DSME program was observed in some of the studies,[25] it was not an expected clinical benefit of the DSME program.[3] None of the Indian studies had evaluated the benefit of the DSME program on change in blood pressure.[5,13,14]

Reduction in HbA1c levels after DSME was commonly observed in many studies[9,13,14,20,24] and reduction in HbA1c was one of the key clinical benefits of the DSME program.[3] However, we did not observe any change in FPG, PPPG, and HbA1c levels from baseline to follow-up. Despite improvement in knowledge, glycemic control might not improve always.[23] The mean HbA1c of our cohort remains statistically unchanged (7.88 at baseline to 7.95 in the final) over a mean follow-up of 15.5 months. This level was superior compared to the national average of 9%[26] and almost at the target necessary to prevent microvascular and macrovascular events in diabetes.[27] Many other unaccounted confounding factors, especially OADs / insulin, had a significant influence on HbA1c.

The present study has limitations. First, the study was conducted in a single center, randomization was not done, and there was no control arm. Clinic-based retrospective record analysis is associated with bias. Second, variables, like

the duration of diabetes, the distribution of age groups, and gender differences, were not evaluated with the knowledge score. Third, there were a few shortcomings in the use and application of the KSS. Identification of the head of the family was often challenging in Hindu undivided families, where retired or unemployed and poorly educated eldest member in the family was considered as head. Choosing the head of the family as a surrogate measure for the education and the occupation level of the total family might wrongly yield a low score in these situations.[28] Fourth, comorbidities and treatment modalities were not considered during the evaluation. Fifth, the study was conducted in an urban metro city setting of India that markedly differs from the country's rural and remote areas. Both the literacy rate and economic standards of the cohort were higher than the average Indian population, and thus, the results cannot be extrapolated to the Indian community as a whole.

Conclusion

The structured DSME program is beneficial and effective in imparting diabetes knowledge, irrespective of SES, and it has an impact on both improvement and retention of diabetes knowledge among T2D patients in an urban tertiary care setting of Kolkata.

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Conflicts of interest

There are no conflicts of interest.

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Annexure 1

Table 1: Baseline characteristics of the patients at the DSME 1

Demographic (*n*=160)	Mean (±SD)
Age (years)	57.65 (±9.28)
Gender	80 males (50%), 80 females (50%)
Anthropometric	
Height (cm)	159.39 (±9.72)
Weight (kg)	66.64 (±11.22)
BMI (kg/m^2)	26.27 (±3.65)
SES as per modified KSS 2016	
Upper (I)	39 (24.4%)
Upper Middle (II)	89 (55.6%)
Lower Middle (III)	21 (13.1%)
Upper Lower (IV)	11 (6.9%)
Lower (V)	0 (0%)

Table 2: Pretest 1 score before attending DSME 1 with respect to different SES

SES	Pretest score before DSME 1		
	Median (IQR)	Chi-square (χ^2)	*P*[ǂ]
Upper (I)	8 (7)	7.41	0.06
Upper Middle (II)	8 (3)		
Lower Middle (III)	8 (4)		
Upper Lower (IV)	6 (6)		

Table 3: Improvement of diabetes knowledge score from baseline (Pretest 1) to final follow-up (Posttest 2) in different SES

SES (*n*=160)	Median (IQR)		*Z*	*P*[©]
	Pretest score 1	Posttest score 2		
Upper (I) *n*=39	8 (7)	12 (2)	−4.527	0.000
Upper middle (II) *n*=89	8 (3)	12 (2.5)	−6.522	0.000
Lower middle (III) *n*=21	8 (4)	10 (4.5)	−3.138	0.002
Upper Lower (IV) *n*=11	6 (6)	10 (5)	−2.627	0.009

[©]*P* computed by Wilcoxon signed-ranks test; *P*<0.05 considered as statistically significant

Table 4: The final diabetes knowledge score (Posttest 2 score) after attending two DSME sessions with respect to different SES

SES	Post-test score after DSME 2			
	Mean rank	Chi-square (χ^2)	*P*[ǂ]	*Post hoc* test
Upper (I)	95.09	10.003	0.019	a—0.693
				b—0.273
Upper middle (II)	81.22			c—1.0
Lower middle (III)	59.10			d—0.022
Upper lower (IV)	63.77			e—0.28
				f—1.0

[ǂ]*P* computed by Kruskal–Wallis test; *post hoc* test performed by Dunn's test. a—difference between Group II and Group I, b—difference between Group IV and Group I, c—difference between Group IV and Group II, d—difference between Group III and Group I, e—difference between Group III and Group II, f—difference between Group III and Group IV; *P*<0.05 considered as statistically significant

Table 5: Summary of changes in BMI, blood pressure, and glycemic parameters from baseline to final follow-up

Parameter (n=160)	Baseline		Final follow-up		t	$P^{\S}$
	Mean	SD	Mean	SD		
BMI	26.27	3.65	26.04	3.61	2.43	0.016
SBP	130.56	14.01	132.13	13.72	−1.54	0.125
DBP	79.86	7.56	80.63	7.84	−1.19	0.236
FPG	130.36	36.13	131.13	38.83	−0.23	0.821
PPBG	173.75	55.87	172.15	63.76	0.31	0.760
HbA1C	7.88	1.40	7.95	1.52	−0.63	0.530

§P computed by paired sample t-test, P<0.05 considered as statistically significant

Annexure 2

Name:
Total score: 15
ID:

1. Diabetes Mellitus is a
- Kidney disease
- Liver disease
- Stomach disease
- Pancreatic disease ①

2. Uncontrolled blood sugar will affect
- Eye
- Nerve
- Heart
- Kidney
- All of the above ①

3. Diabetes mellitus leads to different health problems. We need to control
- Blood pressure
- Body weight
- Blood sugar
- Lipids
- All of the above ①

4. In case of insulin use—which option is true?
- Once insulin starts it will be continued for life long
- Insulin should always be stored at refrigerator
- Arm is the best site for insulin injection
- Insulin can be taken in different devices ①

5. Which food a diabetic should consume in large quantity?
- Protein
- Nuts and oil seeds
- Ghee, butter, oily food
- Vegetables ①

6. Which food a diabetic should consume in small quantity?
- Protein
- Nuts and oil seeds
- Ghee, butter, oily food
- Vegetables ①

7. Which one is the best when your blood sugar is below 70 mg/dl?
- Fish, meat
- Curd
- Rice & Chapatti
- Glucose ①

8. Diabetic people need to follow a healthy lifestyle—what are they?
- Maintaining proper diet
- Taking medicines regularly
- Exercise routinely
- Monitoring blood glucose
- Avoid tobacco use
- All of the above ①

9. A diabetic should check HbA1c
- Daily
- Every week
- Quarterly
- 6 months ①

10. While traveling—a diabetic patient should carry—
- Glucometer
- Glucose
- Diabetic card
- All of the above ①

11. For a person in good blood sugar control, what effect does exercise have on blood glucose?
- Lowers it
- Raises it
- Has no effect ①

12. Which statement is true for vaccine?
- It is applicable only for children
- It is applicable only for adults
- Aged persons above 65 years should take vaccines
- Diabetic patient at any age, vaccines are mandatory ①

13. What kind of shoe a diabetic should wear?
- Shoes with small toe box
- Shoes which are hard with a heel guard
- Shoes with large toe box that fits properly
- Sandals ①

14. Which of the following should a diabetic patient avoid?
- Cleaning foot regularly
- Examining foot regularly
- Wearing covered shoes
- Walking in barefoot ①

15. Which one is true for monitoring of blood glucose?
- Urine examination
- Blood examination
- Both are true
- None is true ①