

## Impact of Structured Diabetes Education on Achieving Glycemic Control in Patient with Uncontrolled Diabetes Mellitus Admitted in Tertiary Care Hospital of Bangladesh

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**Abstract:** Diabetes education and lifestyle modification are critical components in controlling blood glucose levels of people with diabetes mellitus. Despite abundant study focused diabetic epidemiology and its complications, very few studies in Bangladesh emphasis the role of structured diabetic education and its effect on glycemic control. To observe the impact of structured diabetic education on achieving glycemic control in patient with uncontrolled Diabetes Mellitus admitted in tertiary care hospital. The interventional study was carried out from September 2017 to August 2018, following ethical approval at the in-patient department of Endocrinology, BIRDEM General Hospital, Dhaka. Total 100 adult diabetic population of all socioeconomic strata admitted in the study sit. The study population was subdivided into 'Case or intervention group (GI)' and 'Control (GC)' by purposive sampling. Status of diabetic education were evaluated by pretest (questionnaire) and scored out of 10. Structured diabetic education was provided to interventional group by investigator with interactive elaborate discussion. Post-test evaluation was done and after 3 months glycemic status was evaluated for all the patients. Among the participants, mean age of GI and GC were 50.10±12.26 and 53.44±8.59 respectively, with slight predominance of female in both group (GI: 54% female vs. 46% male and GC: 60% female vs. 40% male). Educational qualifications, occupations, and monthly income were similar across the group (P>0.05). Mean duration of DM in GI and GC were 10.31±5.77 and 10.44± 5.04 years. Base line value of (Mean) FBS, 2HABF, 2HAL, 2HAD and HbA1c in GI were 15.89±4.04, 19.73±4.18, 17.65±3.92, 16.14±3.74 and 11.17±2.56& in GC were 16.17±2.91, 20.70±3.73, 16.54±3.97, 17.02±3.28 and 12.01±2.33 respectively with no significant difference across the group ( p>0.05 in all cases). At the end of 3 months follow up, significant improvement were seen in FBS, 2HABF, 2HAL, 2HAD and HbA1c in interventional group than control group (p<0.05 in all cases). Besides this, in intervention group the baseline diabetes self-management evaluation score was improved than control group (1.40±0.94 vs. 7.74±1.52, p<0.001). There is a significant positive impact of structured diabetes education on achieving glycemic control in patient with uncontrolled diabetes mellitus.

**Keywords:** Diabetes education, epidemiology, intervention group, self-management

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### I. Introduction

Diabetes is a metabolic disorder of multiple etiologies, characterized by chronic hyperglycemia together with disturbance of carbohydrate, fat and protein metabolism resulting from defects of insulin secretion, insulin action or both.<sup>1</sup> The slow progression and lack of symptoms in the early stages of disease often delays people seeking a glucose test, preventive care, and/or medical attention. In 2015, the International Diabetes Federation (IDF) estimated that 415 million people worldwide had diabetes, of which 75% live in low and middle-income countries. Among those aged 20–79 years, about 8.8% had diabetes globally, of whom an estimated 46.5% remain undiagnosed. The number of people with diabetes is expected to reach 642 million by 2040, an increase of 55% (International diabetes federation, 2016). With the increasing consumption of high-energy food, increasing adoption of sedentary lifestyles and urbanization, increasing numbers of individuals are developing T2DM, and the age at which individuals are diagnosed is decreasing.<sup>2</sup> In the South Asian region

diabetes has become the seventh leading attributable risk factor for burden of disease putting an enormous pressure on fragile health systems in low-economic countries.<sup>3</sup> In Bangladesh total number of people with diabetes will projected to raise 3.2 million in 2000 to 11.1 million in 2030.<sup>4</sup> In a study by American association of clinical Endocrinologist showed that there is higher rate of uncontrolled diabetes in American people which showed 41% patients have HbA1c >7% (AAACE, 2014). In Bangladesh among the people with diabetes roughly 1 in 13 achieves treatment targets.<sup>5</sup> One of the reason may be lack of knowledge of proper education of self-management. So diabetes education and psychosocial support are critical elements of care for all people with diabetes to achieve glycemic target and prevent complication. Education helps people to initiate effective management and cope with diabetes when they are first diagnosed. The expected outcome of diabetes education is effective self-management; hence the preferred term is *diabetes self-management education*. One of the most significant advances in diabetes care has been the recognition that the most important person in the diabetes care team is the patient himself<sup>6</sup>, who needs to be empowered to take the responsibility for his/her own health care rather than relying on others. The recent second Diabetes, Attitudes, Wishes and Needs (DAWN2) study, conducted in 17 countries across four continents, revealed that, on average, only 49% of people with diabetes reported having ever participated in a diabetes education program. Of those who participated, 81% found the diabetes education helpful<sup>7</sup>. And participation was associated with more positive quality of life and well-being outcomes. The process of education must be based on the needs, goals and life experiences of the person with diabetes and is preferably guided by evidence-based standards.<sup>8</sup> Persons with diabetes must be placed at the center and active involvement in their own health care must be prioritized over educator-dominated involvement.<sup>9</sup> This is referred to as patient-centered or person-centered care. This is reflected in the recent promotion by the American Association of Diabetes Educators of the AADE7 Self-Care Behaviors. Within this framework professional services are oriented around the behaviors of healthy eating, being active, glucose monitoring, medication adherence, problem-solving, reducing risk, and healthy coping (AADE, 2014). The value of patient education is evident from research demonstrating that patients who never received diabetes education showed a striking four-fold increased risk of a major complication. The basic objectives in the handling of type-2 diabetes mellitus patients are reaching normal metabolic control and preventing complications.<sup>10</sup> The expected outcomes would go beyond knowledge and glycemic control to include prevention of diabetes, improved quality of life and delaying of complications. This study was conducted to see impact of structured diabetic education on achieving glycemic control in patient admitted in Tertiary Care Hospital with uncontrolled DM.

## **II. Methods**

It was an interventional study done the Endocrinology departments of BIRDEM General Hospital. Adult diabetic population age of all socioeconomic strata admitted in Endocrinology department of BIRDEM General Hospital, Dhaka were the study population and it was carried out from September 2017 to August 2018. Sampling technique was purposive type. DiabCare Bangladesh study showed that 76.9 % diabetic patient have uncontrolled diabetes. From that minimal sample size is 38 were calculated but as a large number of patient admitted in this hospital, total sample size was considered 100. Patient admitted in Endocrinology department of BIRDEM General Hospital with uncontrolled Diabetes Mellitus with age above 18 years were included in the study and patients unwilling to participate in this study, end stage chronic illness where self-management is not feasible. (e.g.: Stroke, advanced CKD) were excluded before commence of the study, formal ethical approval was taken from the Institutional Review Board (IRB) of BIRDEM. Adults patients admitted in department of Endocrinology were approached for enrollment. In this study, the population was divided into two groups: intervention group (GI) and control group (GC). Detailed clinical history was taken regarding age, sex, dietary pattern, lifestyle, drug history, co-morbidities, and complications. Biochemical data were collected from hospital records. A pre-test were taken to check the status of diabetic education and were scored out of 10. Structured diabetic education were provided to interventional group regarding the disease, dietary intervention, exercise management, medication adjustment and glucose monitoring, hypoglycemia, complications, sick day management, foot care by the investigator with interactive elaborate discussion. It was done by one to one education delivering each patient and duration was 3 hours, divided in 4 sessions, 45 minutes each in separate days. They were frequently followed up by the investigator to assess the progression of diabetes self-management education. After education post-test evaluation and scoring was done. During hospital stay their medications and insulin was intensified according to need. Both the groups, regular session for diabetic education was also provided by inpatient diabetes education department. All patients were followed up after 3 months for clinical and biochemical data. In interventional group, adherence to diabetic education also evaluated. Collected data were kept recorded into case record form and all were summarized and analyzed by statistical methods. Data analysis was carried out by using SPSS version 22. Exploratory data analysis were carried out to describe the study population where categorical variables were summarized using frequency tables while continuous variables were summarized using measures of central tendency and dispersion such as mean,

median, percentiles and standard deviation. Distribution of treatment among patients was assessed by chi-square test. Independent test were used to comparison of baseline weight, blood pressure and glycemic values between intervention and control group. Paired sample *t* test was used to comparison of baseline and end of intervention BMI and Blood pressure in both groups. While, to compare the baseline and end of treatment with Glycemic variables, Paired sample *t* test and to compare the intervention outcome between the groups were estimated by independent sample *t* test. Values of  $p < 0.05$  were considered statistically significant in all cases.

### III. Results

**Table-1:** Socioeconomic variables in the intervention and control group at baseline (n=100)

Demographic Variables	Intervention n (%)	Control n (%)	Total n (%)	P-value
<b>Educational Qualification</b>				
Graduation & post-graduation	13 (26)	06 (12)	19 (19)	
HSC	09 (18)	15 (30)	24 (24)	0.14
SSC	13 (26)	18 (36)	31 (31)	
Primary or below	15 (30)	11 (22)	26 (26)	
<b>Occupation</b>				
Govt. & Non-govt. job	08 (16)	07 (14)	15 (15)	
Self-employed	11 (22)	13 (26)	24 (24)	0.34
Housewife	24 (48)	28 (56)	52 (52)	
Others	07 (14)	02 (04)	09 (09)	
<b>Monthly Income</b>				
Below 30000 tk	20 (40)	18 (36)	38 (38)	
(30000 to 50000) tk	28 (56)	30 (60)	58 (58)	0.92
Above 50000 tk	02 (04)	02 (04)	04 (04)	

**\*p-value is determined by chi-square test**

Majority 55% patients were from SSC or HSC certificate holder. The percentage of higher educated person was 19%. Illiterate patients were 26% overall. Almost 52% patients were housewife, 15% patients were service holder, 24% were self-employed and only 9% others. Maximum patients earned in between 30000 taka to 50000 taka monthly. Only 4% patients had income more than 50000 taka. The percentage of income less than 30000 taka was 38%.

**Table-2:** Comparison of baseline glycemic values between intervention and control group (n=100)

Variables	Intervention (n=50) (mean±SD)	Control (n=50) (mean±SD)	P-value
FBS (mmol/L)	15.89±4.04	16.17±2.91	0.07
Blood glucose 2HABF (mmol/L)	19.73±4.18	20.70±3.73	0.05
Blood glucose 2HAL (mmol/L)	17.65±3.92	16.54±3.97	0.09
Blood glucose 2HAD (mmol/L)	16.14±3.74	17.02±3.28	0.21
HbA1c (%)	11.17±2.56	12.01±2.33	0.09

**p-value is determined by Independent-samples t test**

Comparison of baseline parameters between intervention and control group showed that glycemic values were similar across groups ( $p>0.05$ ). Mean HbA1c level was  $11.17\pm 2.56\%$  in intervention group and  $12.01\pm 2.33\%$  in control group at baseline.

**Table-3:** Comparison of baseline and end of treatment with Glycemic variables (n=82)

Variables	Groups	Baseline (mean±SD)	Follow-up after 3 month (mean±SD)	P-value
FBS	Intervention (n=42)	15.89±4.05	8.13±1.14	<0.0001
	Control (n=40)	16.27±2.50	9.71±1.23	<0.0001
Blood glucose 2HABF (mmol/L)	Intervention (n=42)	19.73±4.18	11.18±2.42	<0.0001
	Control (n=40)	20.64±3.73	12.19±1.96	<0.0001
Blood glucose 2HAL (mmol/L)	Intervention (n=42)	17.65±3.92	10.94±2.12	<0.0001
	Control (n=40)	16.54±3.38	12.78±2.53	<0.0001
Blood glucose 2HAD (mmol/L)	Intervention (n=42)	16.14±3.74	9.90±1.72	<0.0001
	Control (n=40)	17.02±3.11	11.03±2.05	<0.0001
HbA1c (%)	Intervention (n=42)	11.17±2.56	7.55±0.58	<0.0001
	Control (n=40)	12.20±2.44	8.23±0.62	<0.0001

**p-value is determined by paired samples t test; AL=After lunch; AD=After dinner**

In both group of patients FBS, blood glucose 2HABF, blood glucose 2HAL, blood glucose 2HAD and HbA1c was measured at baseline and at follow-up. Significant improvement was noted in these parameters in both groups of patients.

**Table-4:** Comparison of change in glycemic, weight and blood pressure values between intervention and control group (n=82)

Variables	Intervention (n=42) (mean±SD)	Control (n=40) (mean±SD)	P-value
FBS (mmol/L)	9.16±2.16	1.99±5.06	0.05
Blood glucose 2HABF (mmol/L)	7.05±4.59	4.29±5.24	0.01
Blood glucose 2HAL (mmol/L)	6.55±3.57	3.66±5.26	0.0045
Blood glucose 2HAD (mmol/L)	6.50±3.80	4.12±3.80	0.0058
HbA1c (%)	3.34±1.83	1.09±4.36	0.0029
BMI (kg/m <sup>2</sup> )	0.33±1.68	2.65±11.14	0.18
Systolic Blood Pressure (mmHg)	11.40±13.12	6.70±8.51	0.04
Diastolic Blood Pressure (mmHg)	3.49±7.20	5.16±8.28	0.34

**p-value is determined by Independent-samples T test**

Comparison of mean change from baseline to follow-up in weight, BP and glycaemic values in both groups shows that improvement of systolic blood pressure, FBS, blood sugar two hour after breakfast, after lunch, and after dinner, and HbA1c were significantly higher in patients who were given structured diabetic education than that of control ( $p < 0.05$ ). Only change in BMI and diastolic blood pressure did not differ significantly between groups.

**Table-5:** Comparison of baseline and after intervention (structured diabetes Education) diabetes self-management evaluation scores in intervention group (n=42)

	Baseline (mean±SD)	After Intervention (mean±SD)	P-value
Diabetes self-management evaluation scores	1.40±0.94	7.74±1.52	<0.0001

**p-value is determined by paired samples t test**

In intervention group the baseline diabetes self-management evaluation score was 1.40±0.94 and after structured diabetic education the score increased to 7.74±1.52. The improvement in score was statistically significant ( $p < 0.001$ ).

**Table-6:** Effect of diabetic education in frequency of physical activity (n=42)

Exercise (one hour per day)	At admission (n=42) N (%)	During follow-up (n=42) N(%)	p-value
Ye	23 (54.8)	36 (85.7)	< 0.0002
No	19 (45.2)	06 (14.3)	

**p-value is determined by McNemar's test**

Significant change was noted in daily physical activity in intervention group after diabetic education. Initially 54.8% patients did daily one hour exercise. After intervention 85.7% patients did daily one hour exercise. P value ( $< 0.001$ ) was significant.

**Table-7:** Effect of diabetic education in dietary habit (n=42)

Dietary habit (Meals 6 times/day)	At admission (n=42) N (%)	During follow-up (n=42) N(%)	p-value
Yes	09 (21.4)	27 (64.3)	.008
No	33 (78.5)	15 (35.7)	

**p-value is determined by McNemar's test**

Dietary habits changed significantly after diabetes education ( $p < 0.05$ ). At admission 21.4% patients took 6 daily small meals and after intervention the number raised to 64.3%.

**Table-8:** Effect of diabetic education in adherence to drug (n=42)

Drug adherence	At admission (n=42) N (%)	During follow-up (n=42) N(%)	p-value
Yes	01 (2.4)	25 (59.5)	< 0.0001
No	41 (97.6)	17 (40.5)	

**p-value is determined by McNemar’s test**

Only 2.4% patients in the intervention group adhered to drugs initially. After education on the importance of drug adherence, 59.5% patients maintained that learning in their life. The change was significant (p<0.001).

**Table-9:** Effect of diabetic education in self-monitoring activity of blood glucose (n=42)

Self-monitoring of blood glucose	At admission (n=42) N (%)	During follow-up (n=42) N(%)	p-value
Yes < 0.0001	00 (0)	16 (38.1)	
No	42 (100)	26 (61.9)	

**p-value is determined by chi-square test**

At admission no patients were doing self-monitoring of blood glucose. But with intervention self-monitoring activity improved significantly (p<0.001).

#### IV. Discussion

Structured diabetes education is an important component in maintaining glycemic control in addition with medication and insulin intensification in a patient with uncontrolled diabetes mellitus. Diabetes education has been found to be important in raising knowledge and awareness regarding diabetes control as well as improved self-care. In a study Norris showed the effectiveness of self-management training in type 2 diabetes, particularly in the short term<sup>11</sup>. Therefore this study was designed to assess the effect of structured diabetes education on self-management and glycemic control of diabetes patients. In both intervention and control group majority patients were from urban area. This findings corroborates with that of othe.<sup>12</sup> A large study conducted in the neighboring country Myanmar<sup>13</sup> entitled “Urban–rural differences in the prevalence of diabetes mellitus among 25–74 year-old adults of the Yangon Region, Myanmar” explored this particular urban–rural difference and found higher prevalence in the urban area. The reason for this is manifold which can be related to the total way of life of both rural and urban people. Majority of the patients were educated up to SSC (31%), followed in second and third by primary education or below (26%) and HSC (24%). This is contrary to the findings of Islam<sup>3</sup> and Imam.<sup>12</sup> They found that diabetes prevalence was higher with higher level of education. Majority patients (52%) were leading a sedentary life and 43% patients did moderate physical activity. No highly active patients were found. Sedentary lifestyle can be associated with obesity and thereby with higher prevalence of diabetes in this group. The risk sedentary lifestyle poses for development of diabetes has been tested by Joseph et al (Joseph *et al.*, 2016) in their multiethnic study entitled “Physical activity, sedentary behaviors and the incidence of type 2 diabetes mellitus: the Multi-Ethnic Study of Atherosclerosis (MESA)” and was found to be true. Mean duration of diabetes was 10.44±5.04 years in intervention group and 10.31±5.77 years in control group. This was similar to that reported by Yang et al (Yang *et al.*, 2015) in their study. They found duration of diabetes 10.28±6.94 years in structured education group and 10.28±8.43 years in routine usual care education group. A lower mean duration was reported by Eissen et al<sup>14</sup> who found duration of diabetes being 6.9±4.7 years in the intensive education group and 6.1±3.8 years in the conventional education group. Majority patients were using both oral anti-diabetic drug and insulin (59%) in this study. The most commonly used oral agent for

diabetes was metformin which was found in 47% patients. Among insulin premixed form was the most common (87.7%). On the other hand in another study 84.7% patients were on oral hypoglycemic agent and 14.4% patients were on insulin.<sup>14</sup> Ahmed and colleagues found<sup>15</sup> that 62.9% of diabetic patients in Bangladesh are prescribed oral agents for diabetes and among metformin alone predominated 41% prescription. This is concordant with the findings of this study. Mean HbA1c level was 11.17±2.56% in intervention group and 12.01±2.33% in control group at baseline. This was very high in comparison to the study by Bloomgarden et al<sup>16</sup>. They reported 6.8±2.1% and 6.6±2.0% in education and control groups respectively. Comparison of other baseline parameters between intervention and control group showed that values were similar across groups (p>0.05). But, slightly higher report at baseline was noted by Fan et al (Fan *et al.*, 2016) who found 9.61±1.92% and 9.80±1.98% HbA1c in respectively case and control group. Total 18 patients were lost from follow-up. Eighty two patients completed the study. When baseline and follow-up data were compared of those who completed the study significant reduction was noted in glycemic values (FBS, 2HABF, 2HAL and 2HAD glucose values) and blood pressure in both groups. Deakin noted that instructing patients what to do can often lead to patients making changes to please the health professional, but because those changes may not be intuitive for that patient, they may not be continued in the long term.<sup>17</sup> But, a mean improvement in values was checked to assess the impact of intervention in those variables. Significantly higher change was found in education group than that of control group in relation to blood glucose and systolic blood pressure values as well as HbA1c percentage (p<0.05). This implies that diabetic education had significant impact on glycemic and blood pressure control in the intervention group. Similar findings were reported by many other studies.<sup>16,17</sup> A significant improvement was noted in diabetes self-management evaluation scores in the intervention group (p<0.001). In intervention group the baseline diabetes self-management evaluation score was 1.40±0.94 and after structured diabetic education the score increased to 7.74±1.52. Intervention group showed significant improvement in frequency of physical activity, dietary habit, adherence to drugs and self-monitoring of glucose (p<0.001) with structured education. In the X-PERT study<sup>17</sup> noted that X-PERT patients had increased self-monitoring of blood glucose levels at 4 months. Norris et al<sup>11</sup> conducted a systematic review of the randomized controlled trials testing effect of structured diabetes education in different parameters and found that positive effects of self-management training on knowledge, frequency and accuracy of self-monitoring of blood glucose, self-reported dietary habits, and glycemic control were demonstrated in studies with short follow-up (<6 months). Effects of interventions on lipids, physical activity, weight, and blood pressure were variable. With longer follow-up, interventions that used regular reinforcement throughout follow-up were sometimes effective in improving glycemic control. They found that educational interventions that involved patient collaboration may be more effective than didactic interventions in improving glycemic control, weight, and lipid profiles. Therefore, from this study it can be deduced that structured diabetic education is effective in diabetes, particularly in the short term.

Patients with diabetes in Bangladesh have limited knowledge in lifestyle modification and management strategies of diabetes. It was observed that structured diabetes education significantly improves the glycemic status of the patients. Moreover, it will enrich the knowledge of the patients regarding their disease and further care. However, further study is recommended to get the original picture of the country.

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