

## **The Role of Educational Level in Glycemic Control among Patients with Type II Diabetes Mellitus**

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### **Abstract:**

**Objectives:** To evaluate the impact of the educational level on glycemic control among patients with type II diabetes mellitus.

**Methods:** A disproportional systematic stratified sample of 384 patients, based on educational level, was selected from patients of type II diabetes attending the Primary Care Clinic of King Khalid University Hospital, over a period of 6 months in 2012-2013. A questionnaire sought information about socio-demographic factors, clinical characteristics, awareness of diabetic complications and self-care management behaviors. Weight and height were measured. Poor glycemic control was defined as HbA1c  $\geq 7\%$ .

**Result:** The rate of patients who had poor glycemic control is 67.7%. The educational level had no impact on glycemic control, but the patients of high educational level had better awareness of the complications and a high rate of adherence to diet. About 70.5% of patients were aware of two or more diabetic complications. The factors associated with poor control included increased duration of diabetes, use of insulin and oral hypoglycemic agents combination, being obese or overweight, poor adherence to diet, poor adherence to exercise and poor compliance with follow up. This study found a high rate of poor adherence to diet (68%) and poor adherence to exercise (79.4%).

**Conclusion:** The proportion of patients with poor glycemic control was high in this study. This study showed that educational level may not be a good predictor of better therapeutic compliance. In spite of the significant importance of appropriate diet and exercise in the control of diabetes, there was a high rate of poor adherence to diet and to exercise, especially among females. Educational programs that emphasize adherence to treatment regimens as a whole, especially to diet, to exercise and to regular follow up are of greater benefit in glycemic control as compared to compliance of medications alone.

**Key Words:** Primary care clinic, diabetes mellitus type 2, educational level, awareness of diabetic complications, glycemic control.

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## Introduction:

Diabetes mellitus (DM) is a major public health problem worldwide, that requires continuing medical care and ongoing patient self-management education and support to prevent acute complications and to reduce the risk of long-term complications. The prevalence of type II diabetes mellitus is rapidly increasing all over the world in which the number of adults with diabetes in the world will rise from 135 million in 1995 to 300 million in the year 2025. <sup>(1)</sup> As the global average prevalence is around 10% (WHO, 2012). However the Arab region appears to have a higher prevalence of diabetes than the global average. Based on a study in 2009, the overall prevalence of type II DM in the Kingdom of Saudi Arabia (KSA) was 30%. <sup>(2)</sup> In the studies in Arab region, the overall prevalence rates of DM in the United Arab Emirates, Bahrain, Jordan and Kuwait were 20.1%, 20.1%, 17.1%, and 14.8% respectively. <sup>(3, 4)</sup>

American Diabetes Association (ADA) regards glycemic control as one of the important strategies for the management of DM, and glycosylated hemoglobin (A1C) is the best measure of glycemic level over the previous 3 months. Lowering hemoglobin A1C to below or around 7% has been shown to reduce microvascular complications of diabetes and if implemented soon after the diagnosis of diabetes, is associated with long-term reduction in macrovascular disease. The ADA recommends a goal of A1C, less than 7% for people with DM. <sup>(5)</sup> Despite the availability of evidence-based guidelines and vast knowledge about microvascular and macrovascular complications due to this disease, clinical goals for diabetes outcomes are not being routinely achieved in practice. <sup>(6)</sup> In almost all surveys, only a small fraction of individuals with diabetes met treatment targets. In a recent study, the prevalence of poor glycemic control (A1C  $\geq 7$ ) was 67.9% and 65.1% in KSA and Jordan, respectively. <sup>(7, 3)</sup>

Many factors are shown to affect the health of individuals and communities. One of these factors is low education level, which is linked with poor health, more stress and lower self-confidence. <sup>(10)</sup> It was documented in some studies that low educational status had been associated with negative effect on glycemic control, <sup>(3, 7, 9)</sup> while others have shown that educational status had no effect on glycemic control. <sup>(4, 5, 8)</sup> Adherence of diabetic patients to diabetic medications, to dietary advice and to physical exercise has been found to have a

large effect on the degree of diabetic control, <sup>(3, 5, 7)</sup> however little is known about the impact of the educational status on these factors among such patients attending the Primary Care Clinic (PCC) of King Khalid University Hospital (KKUH) in Riyadh, capital of KSA. In addition, to the best of our knowledge, little is known about the level of awareness among these patients about DM complications and its importance in glycemic control.

The current study was conducted to evaluate the effect of the educational level on glycemic control among patients with type II DM, who attended the PCC of KKUH. In addition, the impact of educational level on the intermediate factors was evaluated. The intermediate factors here included awareness of DM complications and self-care management behaviors (adherence to diabetic medications, to healthy diet as advised by the treating health care team, to regular exercise and to regular follow up).

## Methods:

### Participants

This cross-sectional study was conducted at the PCC of KKUH between November 2012 and April 2013. The study population included patients with type II DM aged 18 years or above, who had A1C done over the past 6 months and attended the clinic at least twice per year on regular follow up. The exclusion criteria included patients with any handicap, inherited anemia or pregnant women. We used a disproportional systematic stratified sampling technique. A list of all diabetic patients enrolled was taken and then stratification was done in which the patients in the study were classified into two strata, based on the educational level. The first stratum included patients of less than high secondary school educational level, while the second one included patients holding high secondary school or higher qualification. For the whole study period, every third patient was selected to participate in the study.

The sample size was calculated, based on the prevalence of poor glycemic control among diabetic patients of low educational level and those with high educational level that was found to be 69% and 55%, respectively, in a previous study done in KSA<sup>7</sup>, with power 80% and confidence interval 95%. Using the equation for the difference between two proportions (Epi Info 6.04), we needed 188 participants for each group. We assumed that non response rate

would be 10%, so the total number of 414 participants was estimated to be the requirement for conducting this study.

### Data collection

The data were collected using a questionnaire. The questionnaire was developed based on study variables with the help of experts. The study variables included age, gender, marital status, educational level, occupation, duration of DM, treatment used for DM (diet alone, oral hypoglycemic agents, insulin or both insulin and oral hypoglycemic agents), frequency of visits to PCC, co-morbidities, awareness of diabetic complications and self-care management behavior. The self-care management behavior included adherence to diabetic treatment, to healthy diet, to exercise and compliance with follow up. A pilot study was carried out on a limited number of patients (40) to modify the questionnaire. Weight and height were measured with light clothes and taking the shoes off. Weight was taken to the nearest 0.5 kilogram and height was taken to the nearest centimeter. Available last readings of A1C were extracted from the computer by using file number of the patients. The questionnaires were distributed to the participants, using a self-administered method, during their attendance at the PCC for follow up during the entire study period. The participants were asked to carefully read the consent form, before they verbally agreed to participate in the study. Confidentiality of the participants was ensured. The study was approved by the Institutional Review Board on 7/10/2012.

### Operational definition

The diagnosis of DM was reached according to the ADA criteria (American Diabetes Association, 2012). Glycemic status was categorized as good glycemic control, if A1C < 7% and poor glycemic control if A1C ≥ 7%<sup>(5)</sup> Body mass index (BMI) was calculated as the ratio of weight in kilograms to the square of height in meters. BMI was categorized as normal if it was <25 kg/m<sup>2</sup>, overweight if it was 25–29.9 kg/m<sup>2</sup>, and obese if it was ≥30 kg/m<sup>2</sup><sup>(5)</sup> Patients were considered to be adherent to prescribed medications, if they took medications every day or only missed them one day over the past 7 days. Adherence to healthy diet, as recommended by the dietitian indicated that patients were following the eating plan 5 days or more in the previous 7 days. Adherence to

physical exercise (walking), if they walked for at least 30 minutes 5 days or more in the previous 7 days.<sup>(5)</sup> Regarding adherence to follow up with the treating physician, patients were classified as those who never missed any single appointment, missed 1-2 appointments or missed more than 2 appointments at the PCC of KCUH over the past two years. Regarding awareness to diabetic complications, patients were asked whether they were aware of it or not, if yes, they were requested to answer open-ended follow-up questions that required them to list the body organs or complications they felt were affected or caused by diabetes. Depending on their answers, we classified them as not aware at all or aware to 1, 2, 3 complications or more than 3 complications.

### Statistical analysis

Statistical analysis was carried out using Statistical Package for Social Sciences (SPSS, version 17). Data were described using mean with standard deviation (SD) for continuous variables and proportions for categorical variables. Chi-square test was used to assess statistical significance of the difference in the percentages of glycemic control according to independent categorical variables. Chi-square test was also used to evaluate statistical significance of the difference in the percentages of the intermediate factors according to the educational level and according to the gender. Multiple logistic regression was conducted to determine factors that are associated with poor glycemic control. A P value < 0.05 was considered statistically significant.

## Results

### Participants characteristics

A total of 384 patients participated in this study, while 29 disagreed, giving non-response rate of 7%. The average age of participants was 56 years (SD ± 10.91), ranging from 24 to 85 years and the females constituted 52.1%. The median duration of DM was 11 years. About 68.5% of patients were on oral hypoglycemic agents, 20.6% were on a combination of oral hypoglycemic agents and insulin and only 8.1% of patients were on insulin alone. Only 11.5% of patients had normal body weight, while 50.5% were obese. Nearly 48.7% and 46.1% of diabetic patients had hypertension and dyslipidemia respectively, while 23.4% had no comorbidity. Table 1 shows the frequency of all study variables.

**Table 1.** The frequency of the study variables:

Study variables	Frequency	(%)
<b>Age years:</b>		
< 55 years	180	46.9
55-64 years	121	31.5
≥ 65 years	83	21.6
<b>Gender:</b>		
Male	184	47.9
Female	200	52.1
<b>Marital status:</b>		
Single	7	1.8
Married	309	80.5
Divorced	20	5.2
Widow	48	12.5
<b>Educational level:</b>		
Illiterate	68	17.7
Primary or intermediate	124	32.3
High school	81	21.1
Diploma	35	9.1
Bachelor	64	16.7
Master or high	12	3.1
<b>Occupation:</b>		
Employed	103	27.1
Non-employed	164	43.2
Retired	113	29.7
<b>BMI:</b>		
Normal	44	11.5
Overweight	146	38
Obese	194	50.5
<b>Duration of DM:</b>		
≤ 7 years	154	40.1
8– 14 years	108	28.1
≥15 years	122	31.8
<b>Medications:</b>		
Diet only	11	2.9
OHA	263	68.5
OHA+ Insulin	79	20.6
Insulin	31	8.1
<b>Co morbidities</b>		
None	90	23.4
1-2 diseases	248	64.6
≥3 diseases	46	12
<b>Awareness of DM complications</b>		
Not aware	60	15.6
Aware of 1 complication	53	13.8
Aware of 2 complications	130	33.9
Aware of 3 complications	107	27.9
Aware of 4 or more	34	8.9
<b>Adherence to Rx:</b>		
Yes	338	88
<b>Adherence to exercise</b>		
Yes	77	20.1
<b>Adherence to Diet:</b>		
Yes	123	32
<b>Adherence to F/U:</b>		

Yes	275	71.6
Missed 1-2 appointments	83	21.6
Missed >2 appointments	26	6.8

### The intermediate Factors

Most patients (88%) were adherent to their diabetic medications, but 79.9% of patients did not perform regular physical exercise and only 32% of patients were adherent to dietary advice. 71.6% of patients never missed any appointment at the PCC, while 28.4% of participants missed 1-2 appointments over the last two years. With respect to DM

complications, 15.6% of patients were not aware, while 70.5% were aware of two or more complications. Among those who knew that diabetes could affect body organs, awareness to eye complications was the highest (68%), followed by awareness to kidney problems (61.7%). The least awareness of complication reported by the patients was of neuropathy (10.7%), Table 2.

**Table 2**

Frequency of complications, the patients were aware of:

Complication	Frequency	Percentage
Eye complication	261	68%
Renal complication	237	61.7%
Cardiovascular	119	31%
Foot and wound	65	16.9%
None	60	15.6%
Sexual dysfunction	49	12.8%
Neuropathy	41	10.7%

### Glycemic control and diabetes related variable

Of the total 384 patients, 67.7% had poor glycemic control. Table 3 shows the proportion of the glycemic control according to the study variables. Diabetes was significantly more likely to be poorly controlled with increased duration of DM, overweight and obesity, poor adherence to dietary advice, poor adherence to exercise and poor adherence to regular follow up. The highest level of poor glycemic controlled was among

patients on the combination of insulin and oral hypoglycemic agents (92.5%). The educational level had no impact on the glycemic control as shown in Table 3. The evaluation of intermediate factors according to the educational level is shown in Table 4, which shows that adherence to diet and awareness to DM complications were better among those of high educational level. Educational level had no significant association with adherence to medications, to exercise or regular follow up. Table 5 shows evaluation of

the intermediate factors according to the gender, demonstrating that adherence to diet and the adherence to exercise were significantly higher among males, while compliance to regular follow

up was better among females. Male patients were more aware of the complications of diabetes, as compared to female patients.

**Table 3.** The proportion of the glycemetic control according to the study variables\*:

Study variables	Good glycemetic control A1C < 7 (%)	Poor glycemetic control A1C ≥ 7 (%)	P value <sup>x</sup>
<b>Age years:</b>			
< 55 years	60 (33.3)	120 (66.7)	0.758
55-64 years	40 (33.1)	81 (66.9)	
≥ 65 years	24 (28.9)	59 (71.1)	
<b>Gender:</b>			
Male	54 (29.3)	130 ( 70.7)	0.141
Female	70 (35)	130 (65)	
<b>Marital status:</b>			
Single	5 (71.4)	2 (28.6)	0.010
Married	89 (28.8)	220 (71.2)	
Divorced	10 (50)	10 (50)	
Widow	20 (41.7)	28 (58.3)	
<b>Educational level:</b>			
Illiterate	24 (35.3)	44 (64.7)	0.921
Primary or intermediate	36 (29)	88 (71)	
High school	28 (34.6)	53 (65.4)	
Diploma	10 (28.6)	25 (71.4)	
Bachelor	22 (34.4)	42 (65.6)	
Master or high	4 (33.3)	8 (66.7)	
Low educational level	60 (31.3)	132 (68.8)	0.662
High educational level	64 (33.3)	128 (66.7)	
<b>Occupation:</b>			
Employed	31 (30.1)	72 (69.9)	0.294
Non-employed	59 (36)	105 (64)	
Retired	31 (27.4)	82 (72.6)	
<b>BMI:</b>			
Normal	22 (50)	22 (50)	0.019
Overweight	40 (27.4)	106 (72.6)	
Obese	62 (32)	132 (68)	
<b>Duration of DM:</b>			
≤ 7 years	76 (49.4)	78 (50.6)	<0.05
8– 14 years	30 (27.8)	78 (72.2)	
≥15 years	18 (14.8)	104 (85.2)	
<b>Medications:</b>			
Diet only	9 (81.8)	2 (18.2)	<0.05
OHA	105 (39.9)	158 (60.1)	
OHA+ Insulin	6 (7.6)	73 (92.4)	
Insulin	4 (12.9)	27 (87.1)	
<b>Co morbidities</b>			
None	26 (28.9)	64 (71.1)	0.714
1-2 diseases	82 (33.1)	166 (66.9)	
≥3 diseases	16 (34.8)	30 (65.2)	
<b>Awareness of DM complications</b>			
Not aware			0.577
Aware of 1 complication	25 (41.7)	35 (58.3)	
Aware of 2 complications	16 (30.2)	37 (69.8)	
Aware of 3 complications	40 (30.8)	90 (69.2)	

Aware of 4 or more	33 (30.8) 10 (29.4)	74 (69.2) 24 (70.6)	
<b>Adherence to Rx:</b> Yes	112 (33.1)	226 (66.9)	0.337
<b>Adherence to exercise</b> Yes	33 (42.9)	44 (57.1)	0.027
<b>Adherence to Diet:</b> Yes	49 (39.8)	74 (60.2)	0.030
<b>Adherence to F/U:</b> Yes Missed 1-2 appointments Missed >2 appointments	97 (35.3) 24 (28.9) 3 (11.5)	178 (64.7) 59 (71.1) 23 (88.5)	0.036

\* Chi-square test was used to assess statistical significance of the difference in the percentages of glycemic control according to independent categorical variables  
 × *P* value < 0.05 was considered statistically significant.

**Table 4.** Evaluation of the intermediate factors according to the educational level\*:

Intermediate factors	high educational level	Low educational level	P value <sup>×</sup>
<b>Awareness of DM complications</b>			
Not aware			<0.05
Aware of 1 complication	7 (11.7)	53 (88.3)	
Aware of 2 complications	18 (34)	35 (66)	
Aware of 3 complications	67 (51.5)	63 (48.5)	
Aware of 4 or more	69 (64.5) 31 (91.2)	38 (35.5) 3 (8.8)	
<b>Adherence to Rx:</b> Yes	173 (51.2)	165 (48.8)	0.209
<b>Adherence to exercise</b> Yes	43 (55.8)	34 (44.2)	0.251
<b>Adherence to Diet:</b> Yes	73 (59.3)	50 (40.7)	0.012
<b>Adherence to F/U:</b> Yes Missed 1-2 appointments Missed >2 appointments	135 (49.1) 45 (54.2) 12 (46.2)	140 (50.9) 38 (45.8) 14 (53.8)	0.659

\* Chi-square test was used to assess statistical significance of the difference in the percentages of glycemic control according to independent categorical variables  
 × *P* value < 0.05 was considered statistically significant.

**Table 5.** Evaluation of the intermediate factors according to the gender\*:

Intermediate factors	Males (%)	Females (%)	P value <sup>×</sup>
<b>Awareness of DM complications</b>			
Not aware	29 (48.3)	31 (51.7)	0.008
Aware of 1 complication	20 (37.7)	33 (62.3)	
Aware of 2 complications	51 (39.2)	79 (60.8)	
Aware of 3 complications	63 (58.9)	44 (41.1)	
Aware of 4 or more	21 (61.8)	13 (38.2)	
<b>Adherence to Rx:</b> Yes	158 (46.7)	180 (53.3)	0.213
<b>Adherence to exercise</b> Yes	48 (62.3)	29 (37.7)	0.005
<b>Adherence to Diet:</b>			

Yes	72 (58.5)	51 (41.5)	0.004
<b>Adherence to F/U:</b>			
Yes	120 (43.6)	155 (56.4)	0.021
Missed 1-2 appointments	47 (56.6)	36 (43.4)	
Missed >2 appointments	17 (65.4)	9 (34.6)	

\* Chi-square test was used to assess statistical significance of the difference in the percentages of glycemic control according to independent categorical variables

× P value < 0.05 was considered statistically significant.

### Multivariate Analysis

In the multivariate analysis (Table 6), the only variables that were significantly associated with poor glycemic control were duration of diabetes, BMI and treatment used. Patients with duration of diabetes of 8-14 years and ≥15 years had higher odds of poor glycemic control (8-14 years and ≥15 years vs. ≤7years: OR=2.27, P≤.0005 and OR=4.49, P≤.0005, respectively).

Use of combination of OHA and insulin (OR=6.20 P≤.0005) were significantly associated with increased odds of being poorly controlled, while patients on diet only were associated with decreased odds of being poorly controlled as compared to patients on OHA alone. Overweight and obesity also increased odds of poor glycemic control, Table 6.

**Table 6.** Logistic regression analysis of factors associated with poor glycemic control among patients with Type 2 diabetes:

Variable	Odd Ratio (95% confidence interval)	P value <sup>×</sup>
Duration of diabetes		
≤ 7 years	1	
8– 14 years	2.27 (1.26-4.07)	0.006
≥15 years	4.49 (2.27-8.86)	<0.001
Treatment used:		
OHA**	1	
Diet only	.147 (0.03-0.72)	0.018
OHA+ Insulin	6.20 (2.49-15.43)	<0.0001
Insulin		0.082
BMI:		
Normal Weight	1	
Overweight	3.64 (1.67-7.94)	0.001
Obesity	3.25 (1.51-6.95)	0.002

\*\* OHA= Oral Hypoglycemic Agents

× P value < 0.05 considered statistically significant

### Discussion

Successfully managing diabetes requires a lifelong commitment to self-care. As patients are the most important decision-makers, they should receive enough instructions to make informed decisions about their treatment. This study showed that poor glycemic control (A1C ≥7%) was present in 67.7% of patients attending the PCC of KCUH. This rate is almost similar to the study done in Al Hasa district of KSA (67.9%)<sup>(7)</sup> and is slightly higher than that reported by a study in Jordan (65.1%).<sup>(3)</sup> In a study in Kuwait, 66.7% of the studied population had HbA1c ≥8%.<sup>(12)</sup> In the Canadian primary care setting, 49% of diabetic patients had A1C ≥7%.<sup>(13)</sup> In UK,

69% had A1C ≥7.5%.<sup>(14)</sup> Nevertheless, the current percentage of glycemic control had improved slightly at the PCC of KCUH. As the percent of good glycemic control had improved from around 25% to 32% when compared to the situation at 2006.<sup>(15)</sup>

The current study showed that the educational level had no impact on glycemic control, which is consistent with some studies<sup>(5, 6, 11)</sup> but not with others<sup>(3, 7, 9)</sup> However, the high educational level was significantly associated with better awareness of diabetes complications, which is similar to a study done in Pakistan,<sup>(16)</sup> and high rate of adherence to dietary advice. This high rate of adherence to diet among patients of high educational is consistent with some studies.<sup>(17, 18)</sup> In contrast, studies done in



the United Kingdom have shown that patients with low educational level had better compliance.<sup>(19, 20)</sup> It may presume that patients with low educational level have more trust in the physicians' advice.

With regard to awareness of diabetic complications, 15.6% of patients were not aware of it at all and 13.8% were aware of one complication. Awareness to two complications or more was 70.5%. In comparison to other studies (considering the awareness, if patient was aware of two complications or more), the awareness was higher (70.5%) in our study as compared to a study (55.6%) in Pakistan.<sup>(16)</sup> The awareness was higher among males which is consistent with some studies.<sup>(16)</sup> Only one female reported sexual dysfunction as a complication, while 48 males were aware of sexual complication. The most frequent complications reported by the patients were eye problems (68%) which is consistent with a study conducted in Ireland,<sup>(21)</sup> followed by nephropathy. This higher rate (as compared to awareness to other complications) can be explained by the annual screening for retinopathy and proteinuria. The awareness of complications had no effect on glycemic control.

Among the intermediate factors, poor compliance of appropriate diet, poor adherence to exercise and poor adherence to regular follow up were significantly associated with poor control. These findings are consistent with those observed in some similar studies.<sup>(3, 7)</sup> In spite of the known significant importance of diet and exercise in control of diabetes, only a small percentage of patients with Type 2 diabetes attending the PCC of KCUH were adherent to diet regimen (32%) and physical activity (20.1%). The adherence to diet in this study is higher than that observed in the study in Jordan (18.6%),<sup>(3)</sup> while it is lower than the study carried out in Al Hasa (64.7%).<sup>(7)</sup> The adherence to exercise is lower than what was seen in other research studies.<sup>(3, 7)</sup> The compliance of exercise and adherence to diet were significantly higher among males, which are similar to other study.<sup>(17)</sup> The poor adherence to exercise among female could be due to more sedentary lifestyle of Saudi women, because of cultural constraints. Nearly 71.6% of the total patients never missed a single appointment at PCC of KCUH. This rate is considerably higher than what was recorded in Al Hasa study (7.9%)<sup>(7)</sup> and it could be explained by the fact that the appointments at PCC of KCUH are usually given every 3-6

months and if the patient misses any appointment, getting another appointment may take another 3 months. The compliance with follow up was high among females. Fortunately, adherence to the diabetic medications among our patients was about 88%, which is almost near to that seen in Jordan (91.9%) and higher than what was observed in Al Hasa (42.5%).<sup>(7)</sup> This higher rate of adherence to medications in comparison to the other intermediate factors might be due to the reason that, taking medications is the easiest regimen to follow.

To the best of the author's knowledge, this study was the first study conducted to assess the level of awareness of diabetic complications among patients with type II DM and its impact on glycemic control at the PCC of KCUH and probably in KSA. However, this study is cross sectional, where causal relationship between the independent and dependent variables cannot be established, so a longitudinal study is needed to assess the relationship between those variables over time. At the same time, adherence to diabetic medications, to healthy diet, to regular exercise and to regular follow up were obtained by self-report and may be limited by recall bias.

In conclusion, the proportion of patients with poor glycemic control was high in this study. This study showed that educational level may not a good predictor of better therapeutic compliance. In spite of the significant importance of appropriate diet and exercise in the control of diabetes, there was a high rate of poor adherence to diet and to exercise, especially among females. Educational programs that emphasize adherence to treatment regimens as a whole, especially to diet, to exercise and to regular follow up are of greater benefit in glycemic control as compared to compliance of medications alone.

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