

**EFFECTIVENESS OF METFORMIN PLUS DIABETIC EDUCATION IN CASE OF  
EARLY DIAGNOSED TYPE 2 DIABETES MELLITUS IN BANGLADESH**

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**ABSTRACT**

Diabetes mellitus requires lifelong pharmacological and non pharmacological treatment to prevent complications. Many persons with diabetes do not achieve optimal control due to lack of knowledge about diabetes self management education. A prospective randomized comparative study measured glycosylated haemoglobin (HbA1c) at base line, 3 months, 6 months and after 1 year and other outcomes at the same time to determine the effectiveness of diabetic education. Out of 105 early diagnosed type 2 diabetic patients, 56 were found suitable based on exclusion, inclusion criteria and turned up for participation to the study. Metformin monotherapy (n=29) termed as usual care and metformin plus diabetic education (n=27) termed as intervention group. Intervention group received diabetic education according to ADA and AADE approved guide line in four sequential sessions delivered at consistent time of intervals over a period of 06 months. For instance, in case of control group, HbA1c was changed from 8.80±0.10% at base line to 7.35±0.26% (p<0.05) after 1 year while this change in case of intervention group was from 9.0±0.36% at base line to 6.5±0.24% (p<0.001) after 1 year. Results showed that the main outcome, glycosylated haemoglobin (HbA1c), was decreased from baseline tests to the tests after 1 year for both the control and intervention groups but the decrease was much higher and more significant in case of intervention group. The study confirms the effectiveness of diabetic education on improving health outcomes.

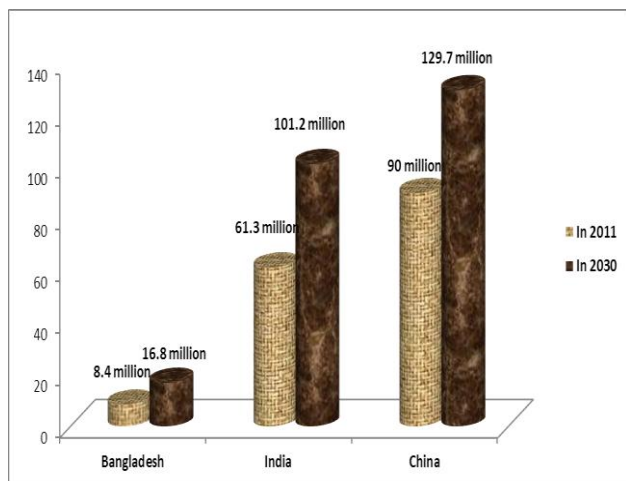
**KEYWORDS:** Type 2 diabetes, Metformin, Diabetes self management education, Glycosylated haemoglobin (HbA1c).

**INTRODUCTION**

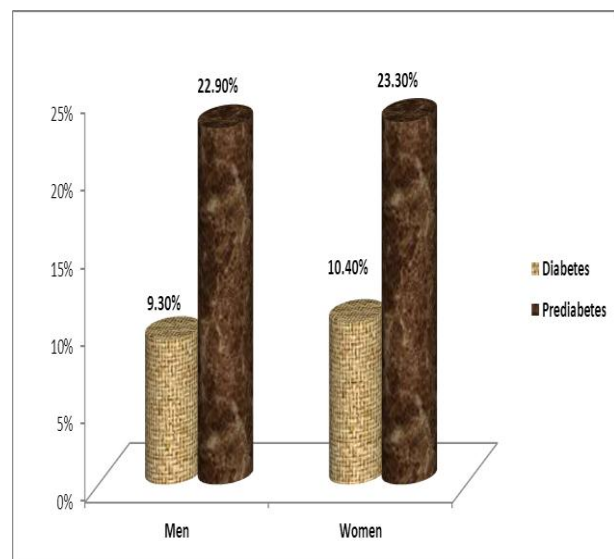
Diabetes was first recognized 3500 years ago by the ancient Egyptians.<sup>[1]</sup> First known description of diabetes Symptoms, found on Egyptian papyrus by physician Hesy-Ra in 1552 BC. Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood sugar. Mortality from diabetes has declined since the discovery of insulin. Diabetes is a metabolic disease characterized by hyperglycemia (raised blood sugar), glycosuria (sugar in urine), polydipsia (increased thirst), polyuria (increased urination), polyphagia (increase appetite), even these acute and chronic complications may lead to coma and eventually death if left untreated. Type 2 diabetes mellitus is a progressing epidemic and a major cause of mortality and morbidity worldwide.<sup>[2]</sup> Type 2 diabetes is a global public health crisis that threatens the economies of all nations, particularly developing countries like Bangladesh. The number of people with diabetes is

increasing due to population growth, aging, urbanization and increasing prevalence of obesity and physical inactivity. The incidence of diabetes has doubled every 20 years since 1945. 80% diabetic will be prevalent in the developing countries in 2030 and the urban population become double in developing countries.<sup>[1]</sup> The international diabetes federation reported an estimate of 382 million (8.3%) of total population with diabetes in 2013 and predicted that this will increase to 592 million (10.1%) of total population in 2035 and similar projection have been made by the WHO. More than 80% of diabetes deaths occur in low and middle income countries. The cost burden to the nation due to diabetes is not exactly known but the morbidity and mortality due to diabetes is increasing. Higher risk of developing diabetes-related complications such as blindness, kidney damage, or depression, impacting both quality of life and mortality rates.<sup>[3][4]</sup> The prevalence of diabetes in rural Bangladesh is growing rapidly. Diabetes mellitus in people of all ages is reaching epidemic proportions in Bangladesh. In 2011, the IDF estimated

that 8.4 million people in Bangladesh are suffering from diabetes and by 2030 it will be 16.8 million. This rapid increase in diabetes prevalence will place Bangladesh among the top seven countries in terms of the number of people living with diabetes in 2030. Lack of physical activity is the significant predisposing factor of diabetes in Bangladesh.<sup>[5]</sup> Available transport facility is one of the important causes of lack of physical activity and over all knowledge about diabetes is poor. Low birth weight is the another risk factor for diabetes in Bangladesh.<sup>[6]</sup> Obesity is increasingly becoming a developing world problem.



**Figure 1. Number of People with diabetes aged (20-79 years), Top three country of south east Asia.**



**Figure 2. Prevalence of Diabetes in Bangladesh in 2011 (Shamima *et al.*, 2014)**

Current guidelines from the American Diabetes Association/European Association for the Study of Diabetes (ADA/EASD) and the American Association of Clinical Endocrinologists/American College of Endocrinology (AAACE/ACE) recommend early initiation of metformin as a first-line drug for monotherapy and combination therapy for patients with Type 2 diabetes

mellitus.<sup>[7]</sup> This recommendation is based primarily on metformin's glucose-lowering effects, relatively low cost and generally low level of side effects, including the absence of weight gain.<sup>[8]</sup> According to ADA and ESAD algorithm metformin and life style measure is the first line of treatment in case of early diagnosed type 2 diabetes.<sup>[9]</sup>

Though multiple demographic, socio-economic and social support factors can be considered as positive contributors in facilitating self-care activities in diabetic patients, role of clinicians in promoting self-care is vital and has to be emphasized.<sup>[10]</sup> Diabetes is a chronic illness 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 patient's own role in diabetes treatment and recognition of the need to educate patients in diabetes self-management has long been considered to be important. Controlling blood glucose levels for people with type 2 diabetes requires continuing clinical care and intensive self care. Diet, exercise and weight reduction are the most important non pharmacological intervention of diabetes management.<sup>[11]</sup> Diabetes education helps people with diabetes learn how to manage their disease and be as healthy as possible by focusing on seven self-care behaviors: healthy eating (how to eat, how much to eat, when to eat), being active e.g. exercise (frequency, intensity, type & time), monitoring of self blood glucose, taking medication, problem solving (high and low blood glucose levels and sick days), healthy coping e.g. living with diabetes (psychosocial adaptation) and reducing risks of diabetes complications.<sup>[12]</sup> Diabetes education is a critical component of the clinical management of diabetes mellitus and DSME should always be considered as part of the treatment plan even if a patient is reported to have excellent metabolic control.<sup>[13]</sup> All people with diabetes and those at risk of diabetes, no matter where they live, have the right to learn about diabetes, how it can be prevented, how it can be managed effectively and how to access educational and clinical resources.<sup>[14]</sup> Education program is an effective intervention for helping individuals with diabetes to understand the disease, delay its progression and reduce associated complications.<sup>[11]</sup> Several review studies have assessed the effect of DSME programs on the general population. Those studies have established that DSME programs can improve glycemic control<sup>[15]</sup> and identified the key characteristics for improving glycemic control, including face-to-face delivery, teaching methods based on cognitive reframing<sup>[16]</sup> and higher contact time between participant and educator.<sup>[17]</sup> Diabetes educators are primary care physician (general practitioner), nurse, registered pharmacist, dietitian, exercise physiologist etc. A new study has found that patients benefit from diabetes education about the same whether the education is provided in a group or individual setting.<sup>[18]</sup> Individual diabetes self management education (DSME) is the best non-pharmacological way of management of diabetes. Comprehensive group diabetes education programs or

individualized education sessions have reported HbA1C decreases of 0.5–2% for Type 2 DM.<sup>[19]</sup>

Type 2 diabetes mellitus is a progressing epidemic and a major cause of mortality and morbidity across the globe in developed and developing countries.<sup>[20]</sup> Diabetes requires continuing medical care and patient self-management education to prevent complications. Many persons with diabetes do not achieve optimal control due to lack of knowledge about diabetes self management education. Diabetic education can be given in two ways: Individual education and group education. Individual education is face to face education. For both cases diabetic education was found to be very promising. Group education is a large gathering. It requires hall room and multimedia. Initial establishment cost for group education is very high for country like Bangladesh. In case of group education participants need to attend the classes at specific time. But in case of individual education participant can arrange suitable time consulting with diabetic educator<sup>[21]</sup> found that the vast majority of people were interested in individual-appointment basis (n = 55,761), with fewer attending group classes (n = 12,234) and some getting a mixture of both (n = 9829). Every patient is an individual.<sup>[22]</sup> One participant's life style differs from another participant's. In case of individual education participant can learn about which foods to eat and exercise work according to his life style. Thus it is important for everyone on the diabetes care team to take time to listen to the patient's needs and desires. The physician along with the team, should provide patients with the necessary information to build a realistic care plan, patients need to be informed. So they can make informed decision about their own care. Primary care physicians working in both urban and rural environment. They usually share ethnicity, language, socioeconomic status, life experiences with patients, they serve. It is essential that physicians and everyone on the diabetes care team work together to support patients self management by developing patients centered goals that will be more likely to be achieved. Implementing diabetic education in primary care is cost effective. So primary care physician based face to face individual diabetic education may be very helpful in case of type 2 diabetic patients. According to American Diabetes Association and European Association for the Study of Diabetes algorithm metformin and life style measure is the first line of treatment in case of newly diagnosed type 2 diabetes. Metformin is a cost effective drug.<sup>[23]</sup> There were no trials available with metformin along with diabetic education. Most of the research was done as metformin monotherapy, metformin plus other drugs or metformin versus other drugs<sup>[24]</sup> and metformin plus life style measure. Unfortunately, there has not been any study on such intervention with diabetic patients in Bangladesh. Therefore, it was aimed to see the effectiveness of primary care physician based individual diabetic education along with metformin in case of low income

people of Bangladesh. However, the specific objectives of the study are as follows:

1. To assess the role of pharmacological and non pharmacological intervention in diabetes patient management.
2. To implement diabetes self-management education in primary care to provide evidence base intervention to improve processes and measure outcomes.
3. To evaluate the effects of individual face to face education with active collaboration with the primary care physician.

## MATERIALS AND METHODS

### Subjects selection

The study subjects were chosen from one multidisciplinary medical center and two private clinics located in Dhaka, Bangladesh. The subjects were Bengali speaking adults, who have been recently diagnosed with type 2 diabetes mellitus.

#### a) Inclusion criteria of subjects

Non insulin treated newly diagnosed type 2 diabetes. Age greater than 35 years and less than 60 years. HbA1c >7% and <9%. Blood sugar > 140mg/dl.

#### b) Exclusion criteria of subjects

Having type 1 diabetes, pregnant woman, Malabsorption or GI disturbance, Low BMI, marked weight loss. Impaired renal function (S.creatinine) male-1.5mg/dl, female 1.4mg/dl, hepatic impairment: acute/chronic, cardiac failure hypotension/sepsis, vitamin B12 deficiency, GI intolerance, haemoglobinopathy.

#### c) Informed consent

Informed consent in the prescribed form was obtained from all patients in the process of selection of subjects for the study.

### Method used in the study

Out of 105 early diagnosed type 2 diabetic patients, 56 were found suitable based on exclusion, inclusion criteria and turned up for participation to the study. Metformin monotherapy (n=29) termed as usual care and metformin plus diabetic education (n=27) termed as intervention group. One year diabetic education was given in four sessions at different time intervals in case of intervention group and usual advice was given to the usual care group at same time interval. Intervention group subjects received individual education in four sequential sessions delivered at base line, 02 weeks, 03 months and 6 months period. All sessions were face to face. The four sessions were designed to meet the needs of the adult learner and consisted of 5-7 hours of education in total. For individual education initial session was 2 hour and each follow-up session was 1 hour period. It is important to mention here that at the end of last session each subject was instructed to continue his/her metformin and follow diabetic education guide line (diet, exercise etc.) until one year.

### Data collection procedure

Main outcome HbA1c was measured at base line, 3months, 6months and after one year and FPG, PPG at the same time.

### RESULTS AND DISCUSSIONS

HbA1c was considered as the main outcome of the given education session. HbA1c measured at base line, after 3months, after 6 months and after 1year. Few samples of HbA1c and fasting blood sugar (FBS) were cross checked to verify the data. Fasting is defined as no caloric intake for at least 8 hour and fasting plasma glucose (FPG)  $\geq 7.0$  mmol/ L<sup>[25]</sup> is one of the diagnostic criteria of diabetes. The target FPG (mmol/L) for people with diabetes is  $<6.1$  mmol/L. Fasting plasma glucose decreased from  $9.60\pm 1.88$  at base line to  $7.15\pm 1.10$

( $p<0.05$ ) after 1 year in case of control group Whereas in case of intervention group fasting plasma glucose decreased from  $9.70\pm 1.80$  at base line to  $5.96\pm 1.34$  ( $p<0.001$ ) after 1 year (Table 1). A 2-hour postprandial blood glucose (PPG) test measures blood glucose exactly 2 hours after eating a meal. Note that time should be counted just from the start of the meal.  $PPG\geq 11.1.0$  mmol/ L<sup>[25]</sup> is termed as diabetic level. In case of control group postprandial glucose decreased from  $14.20\pm 2.40$  at base line to  $8.56 \pm 1.30$  ( $p<0.05$ ) after 1 year (Table 1). Whereas in case of intervention group postprandial glucose decreased from  $14.30\pm 2.53$  at base line to  $7.12\pm 1.10$  ( $p<0.001$ ) at the end of 1 year (Table 1). The European association for the Study of Diabetes have a postprandial target of  $<7.5$  mmol/L.

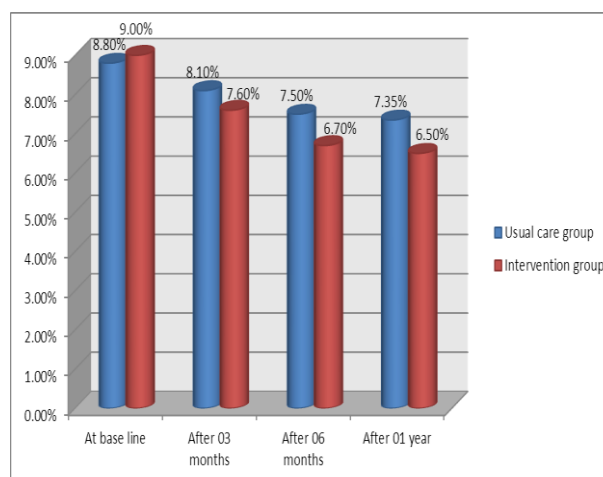
**Table 1: Effect of metformin and usual advice (n=29) and metformin plus diabetic education on glycemic control (n=27).**

| Parameter    | Period                | Control group (Mean $\pm$ SD) | P value | Intervention Group (Mean $\pm$ S) | P value  |
|--------------|-----------------------|-------------------------------|---------|-----------------------------------|----------|
| FPG (mmol/L) | At base line (0 days) | 9.60 $\pm$ 1.88               | –       | 9.70 $\pm$ 1.80                   | –        |
|              | After 3months         | 7.30 $\pm$ 1.76               | $<0.10$ | 6.54 $\pm$ 1.66                   | $<0.01$  |
|              | After 6 months        | 7.10 $\pm$ 1.24               | $<0.05$ | 6.20 $\pm$ 0.80                   | $<0.01$  |
|              | After 1year           | 7.15 $\pm$ 1.10               | $<0.05$ | 5.96 $\pm$ 1.34                   | $<0.001$ |
| PPG(mmol/L)  | At base line (0 days) | 14.20 $\pm$ 2.4               | –       | 14.30 $\pm$ 2.53                  | –        |
|              | After 3months         | 10.32 $\pm$ 2.56              | $<0.10$ | 8.9 $\pm$ 2.10                    | $<0.05$  |
|              | After 6 months        | 9.20 $\pm$ 1.80               | $<0.05$ | 7.26 $\pm$ 1.30                   | $<0.01$  |
|              | After 1year           | 8.56 $\pm$ 1.30               | $<0.05$ | 7.12 $\pm$ 1.10                   | $<0.001$ |

A 2-hour postprandial blood glucose (PPG) test measures blood glucose exactly 2 hours after eating a meal. Note that time should be counted just from the start of the meal.  $PPG\geq 11.1.0$  mmol/ L<sup>[25]</sup> is termed as diabetic level. In case of control group PPG was found  $14.20\pm 2.4$ ,  $10.32\pm 2.56$  ( $p<0.10$ ),  $9.20\pm 1.80$  ( $p<0.05$ ),  $8.56\pm 1.30$  ( $p<0.05$ ) at base line, after 3 months, 6 months & 1 year, respectively (Table 2). Whereas in case of intervention group PPG was found  $14.30\pm 2.53$ ,  $8.9\pm 2.10$  ( $p<0.05$ ),  $7.26\pm 1.30$  ( $p<0.01$ ),  $7.12\pm 1.10$  ( $p<0.001$ ) at base line, after 3 months, 6 months & 1 year (Table 2). The European association for the Study of Diabetes have a postprandial target of  $<7.5$  mmol/L.

The hemoglobinA1c (HbA1c), which reflects the mean plasma glucose, in the last 8 to 12 weeks.<sup>[26]</sup> The test was performed in a laboratory (ISO certified) using a method that is National Glycohemoglobin Standardization Program certified and standardized to the Diabetes Control and Complications Trial assay. The normal level of HbA1c is  $<6.5\%$ . In case of control group glycosylated haemoglobin decreased from  $8.80\pm 0.10$  at base line to  $7.35\pm 0.26$  ( $p<0.05$ ) after 1year. Whereas in case of intervention group glycosylated haemoglobin

decreased from  $9.0\pm 0.36$  at base line to  $6.5\pm 0.24$  ( $p<0.001$ ) after 1 year. (Figure 3). The target of HbA1c is  $6.5-7\%$ .<sup>[27]</sup>



**Fig. 3: Primary outcomes HbA1c (at base line, after 03 months, 06 months and after 01 year).**

From the result (FPG, PPG & HbA1c) it is clear that people with diabetes that attended the diabetes self



management education had better clinical outcomes compare to those who had not participated in diabetic education. The blood sugar level and HbA1c in case of intervention group is less than or within target level but control group did not achieve target level. P value in case of intervention group is highly significant ( $p < 0.001$ ) than control group ( $p < 0.05$ ). In case of control group decreased blood sugar and HbA1c level was due to metformin therapy and standard advice. Since metformin was common in case of control group and intervention group, the improvement in case of intervention group was solely due to diabetic education and it was statistically highly significant ( $p < 0.001$ ). In the present study HbA1c was reduced by 2.5% in case of intervention group. And it could be possible for the combination of various strategies (diet, exercise, monitoring, psychosocial adaptation etc). Diet restriction and physical activity has cumulative benefits when it comes to managing type 2 diabetes. Mean HbA1c was significantly reduced by 1.02% among patients who had contact with a diabetes educator and dietitian compared with a 0.59% decrease among patients who did not. Exercise decreases both FPG and PPG by several mechanism.<sup>[28]</sup>

## CONCLUSION

Diabetes self-management education (DSME) is a critical element of care for all people with diabetes and is necessary in order to improve patient outcomes.<sup>[29]</sup> It is evident from prior research that behavior and ultimately clinical outcomes are unlikely to change unless there is knowledge together with an understanding of the need to change, what to change and how to change it. The results of this study found that the diabetic people attended the diabetes self-management education achieved better learning, behavioral and clinical outcomes compared to those who had not participated. For example, HbA1c level was significantly improved in case of intervention group in comparison to control group. Not only that, diabetic education found to improve HbA1c levels at immediate follow up and this improvement was increasing with the increment of patient-diabetes educators contact time due to the gradual development of the effective diabetic education. In case of intervention group, self care knowledge and health related quality parameters of life such as self-monitoring of blood glucose (SMBG) skills, dietary habits, physical activities, smoking cessation were more readily improved. The study confirms the effectiveness of metformin and diabetic education on improving health outcomes of early diagnosed type 2 diabetic patients in terms of knowledge on diabetes, life style and various clinical parameters. It indicates diabetic education helps not only to improve clinical outcomes but also to improve quality of life. In Bangladesh, no structured national diabetes education and awareness programs are in place, high quality structured diabetic education should be provided for all people with diabetes at the primary care level with active collaboration of the primary care physician, it will be cost effective and mass people can participate in

diabetic education and long term goal can be achieved then.

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