Jour of Diab and Endo Assoc of Nepal Vol. 6, No. 1, January-June 2022
ISSN Print 2594-3367 ISSN Online 2631-2107

Journal of Diabetes and Endocrinology Association of Nepal

ORIGINAL ARTICLE OPEN ACCESS

Assessment of factors associated with poor glycemic control among patients with Type 2 diabetes mellitus

[1] Pratap Kumar Roy, [2] Sanjay Kumar Jha
[1]Lecturer Department of Medicine, Endocrine unit, [2]Assistant professor, Department of Biochemistry, Nobel Medical College and Teaching Hospital, Biratnagar, Nepal

Abstract

Background: Diabetes Mellitus type 2 (DM) is a metabolic syndrome with multiple complications. All of those complications are directly related to glycemic control status.. Adequate glycemic control leads to less complications, morbidity and mortality.

Aims and objective: The aim of this study is to access the factors associated with poor glycemic control in DM subjects. **Materials and methods:** This is a OPD based cross-sectional descriptive study conducted in Nobel Medical College and Teaching Hospital among adult DM subjects over the period of one year. A total of 105 cases with DM aged ≥18 years were included and clinical profile, laboratory reports were documented. **Results:** We found that out of 103 population 60 people (58.2%) had poor glycemic control i.e Hba1c >7% and only 43 (41.8) had good glycemic control i.e Hba1c <7%. FBS and PP glucose was found to be higher in poor control group compared to good control and was statistically significant ($p<0.001$). Smilarly duration of DM was also found to be associated with poor glycemic control. **Conclusion:** FBS, PP and duration of DM was associated with higher Hba1c leading to higher prevalence of poor glycemic control. Age, sex, dyslipidemia, BMI,WHR were not found to be associated with poor glycemic control.

Key Words: Hyperglycemia, Prediabetes, Thyroid dysfunction, Screening

Introduction

Diabetes is a medical condition characterized by chronic hyperglycemia in which the glucose metabolism is impaired because insulin secreted by pancreas gland is either inadequate or does not function properly [(1)]. Global prevalence of diabetes was 422 million (8.5%) among adults aged over 18 years in 2014 and is rapidly increasing in low and middle income countries . South East Asia has covered second largest prevalence of diabetes comprising 96 million (8.6%) [(2)]. A meta-analysis done for prevalence of diabetes in Nepal from 2000 to 2014 found the pooled prevalence of type 2 diabetes as 8.5% (ranging from 1.4% to 19%) in both urban and rural settings [(3)].. The primary goal in the management of diabetes mellitus is to attend near-normal glycaemia. Poor glycemic control is risk for both macrovascular and microvascular complications . All these complications contribute to the high morbidity and mortality associated with diabetes mellitus [4,5]. Poor glycemic control among patients with diabetes mellitus is common in many countries including Indonesia (83%) [6], Bangladesh (81.2%) [selim 7, Saudi Arabia (74.9%) [8]. in spite of well-defined treatment for type 2 diabetes, in majority of the people, disease is poorly controlled with existing therapies.[9,10]. Therefore, recognizing the determinants of poor glycemic control will contribute to a clearer understanding of modifiable

Correspondence Author
Dr. Pratap K Roy
Department of Clinical Biochemistry,
Kathmandu University School of Medical Sciences,
Dhulikhel, Nepal, Mobile No.: +977-9841276674,
Email: drsarojthapa@gmail.com

antecedents of diabetes-related complications and help to achieve improved diabetic control.

Aims and objective

This aim of this study was to assess factors associated with poor glycemic control among patients with DM and to shed light on reversible factor with regards to glucose control and to understand the barriers to achieving good glucose control .

Methods

The study is a prospective observational study conducted on adult aged ≥18 years with DM in endocrine OPD of Nobel Medical College during 12 months period from July 1, 2020 to June 30, 2021. The study was approved by the Institutional Review Committee of the hospital (NMCTH IRC reference number 472/2021). Written consent was acquired after the patient or patients attendant was explained about the study, its advantages, procedures and disadvantages. Inclusion criteria was all known DM patients of ≥ 6 months duration and if ready to give consent, irrespective of their DM complication were included in this study. Exclusion criteria were all new case of Diabetes Mellitus < 6months duration, type-1 dm, secondary DM, age below 18 years and those not ready to give consent were excluded from this study. Blood glucose was performed in the laboratory (Glucose oxidase and peroxidase method). Detailed history, demographic and clinical variables like age, sex, duration of DM was recorded. Height, weight, waist circumference (WC) , hip circumference (HC) and blood pressure were measured using standard procedure. Besides, Body Mass Index (BMI) was calculated by formula, BMI = kg/m2 where kg is a person's weight in kilograms and m2 is their height in meter squared. Asian criteria-based BMI was used as follows: <18.5 for underweight, 18.5-22.9 for normal-weight, 23.0-27.5 for overweight, and >27.5 for obese. Waist hip ratio (WHR) was calculated by dividing WC (in cm) by HC (cm). HC was measured at a level parallel to floor, at the largest circumference of the buttocks. WC was measured at the end of several consecutive natural breaths, at the level parallel to the floor, midpoint between the top of the iliac crest and the lower margin of the last palpable rib in mid-axillary line. WHR cutoffs points for Asians used (0.95 in men and 0.80 in women) denote abdominal obesity.

Blood samples were collected and glycated Hemoglobin, lipid profile was analyzed using the automated spectrophotometer. Fasting blood sugar (FBS) and postprandial blood sugar (PP) were performed in the laboratory by Glucose oxidase and peroxidase method. Glycemic control definition by ADA, (2021): HBA1C ≤ 7.0%, Preprandial capillary plasma glucose 80–130 mg/dL, Peak postprandial capillary plasma glucose† , ≤ 180 mg/dL. Hypercholesterolemia refers to a total cholesterol level ≥200 mg/dl, HDL was considered low when the level is below 40 mg/dl in males and below 50 mg/dl in females. LDL was considered high when the level was ≥100 mg/dl. Hypertriglyceridemia refers to a level ≥150 mg/ dl. Dyslipidemia was defined as the presence of one or more of the previous abnormalities in serum lipids. Glycemic control was considered good if Hba1c was <7%, satisfactory if Hba1c between 7-8% and unsatisfactory if >8%.

Statistical analysis

Using n=z2× p (1-p) / e2with 5 % margin of error, and pooled prevalence of DM in nepal 8.1% taken as 8% (Gyawalil B, et.al. 2008) 3, sample size was calculated to be 113 but we took 105 subjects as 8 subjects withdrew themselves from the study. Descriptive statistics was used for summarizing patient's demographics and survey responses. Differences in HbA1c goal was evaluated by chi-square tests (categorical variables). After finding significant differences in chi-square tests, the Bonferroni function was used to assess individual differences. Independent t test (measurement data) was used to assess the relationship between inadequate glycemic control and potential influencing factors where P <0.05 was considered as statistically significant. The software package used for calculations was SPSS (version 25.0). All data was tabulated and statistically analysed using SPSS 25.

Results

Jour of Diab and Endo Assoc of Nepal Vol. 6, No. 1, January-June 2022
ISSN Print 2594-3367 ISSN Online 2631-2107
Journal of Diabetes and Endocrinology Association of Nepal
ORIGINAL ARTICLE OPEN ACCESS

Table 1. Socio demographic parameters between Good and Poor glycemic control in Type II Diabetic Patient

Characteristics	Good Glycemic Control HbA1c < 7		Poor glycemic Control HbA1c >7%		P- values
Gender*	N	%	N	%	
Male = 1	25	41.7	35	58.3	0.984
Female = 2	18	41.9	25	58.1	

*Chi square test

Table 2. Anthropometric and Biochemical parameters between Good and Poor glycemic control in Type II Diabetic Patient

Characteristics	Good Glycemic Control HbA1c < 7		Poor glycemic Control HbA1c >7%		P- values
Parametric**	Mean	SD	Mean	SD	
Age	55.07	11.00	56.68	9.21	0.421
BMI	26.21	3.40	25.31	4.46	0.267
W/H Ratio	1.02	0.06	1.07	0.23	0.246
SBP	129.77	14.56	125.00	10.81	0.059
DBP	81.86	9.32	79.00	5.43	0.053
FBS	114.02	18.59	182.42	63.62	<0.001*
PPBS	197.49	58.52	327.22	90.98	<0.001*
TC	166.51	47.56	185.82	49.70	0.051
TG	188.21	94.31	198.27	82.80	0.568
LDL	94.79	26.76	100.10	23.70	0.291
HDL	41.21	6.65	42.05	6.96	0.539

** Independent t test *Highly Significant

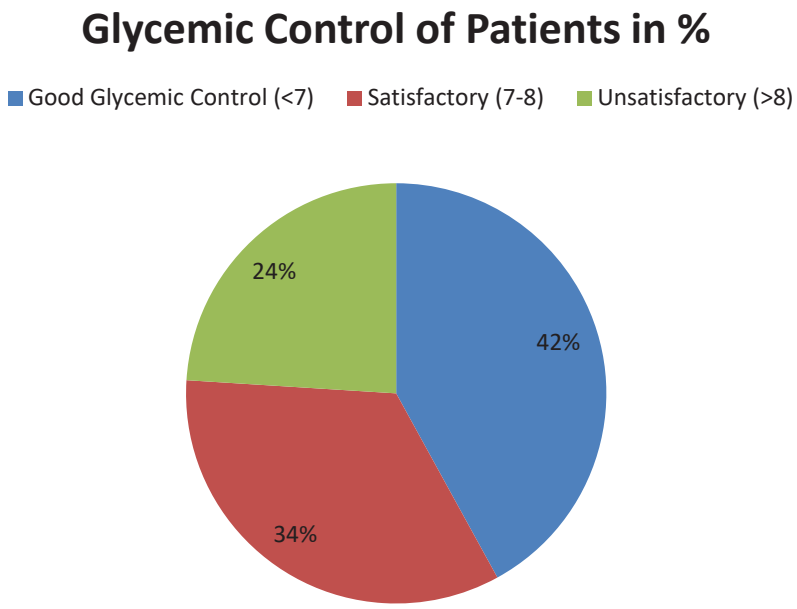
Jour of Diab and Endo Assoc of Nepal Vol. 6, No. 1, January-June 2022
ISSN Print 2594-3367 ISSN Online 2631-2107
Journal of Diabetes and Endocrinology Association of Nepal
ORIGINAL ARTICLE OPEN ACCESS

Table 3. Anthropometric and Biochemical parameters between Good and Poor glycemic control in Type II Diabetic Patient

Characteristics	Good Glycemic Control HbA1c < 7		Poor glycemic Control HbA1c >7%		P- values
Non parametric***	Median	IQR	Median	IQR	
DM duration in years	4.00	2.00 – 7.00	8.00	3.625 – 13.75	0.010*
Serum Creatinine	0.80	0.70 – 1.00	0.80	0.70 – 0.975	0.743
Serum Urea	26.00	23.00 – 30.00	26.00	24.00 – 30.75	0.720

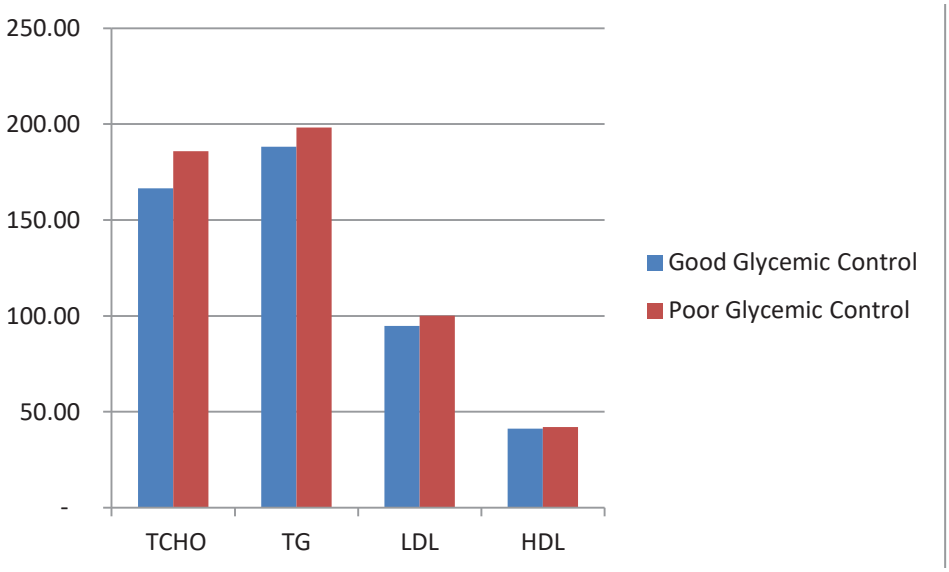
*** Mann-Whitney U test * Highly Significant

Figure 1. Degree of glycemic control among Type II Diabetic patients. HbA1c < 7% is good glycemic control. HbA1c >7% poor glycemic control which includes satisfactory and unsatisfactory glycemic control



Jour of Diab and Endo Assoc of Nepal Vol. 6, No. 1, January-June 2022
ISSN Print 2594-3367 ISSN Online 2631-2107
Journal of Diabetes and Endocrinology Association of Nepal
ORIGINAL ARTICLE OPEN ACCESS

Figure 2 Lipid profile among Good and Poor glycemic control among Type II Diabetic patients.



In this study we found that out of 103 population 60 people (58.2%) had poor glycemic control i.e Hba1c >7% and only 43 had good glycemic control i.e Hba1c <7%. Total 35 male patients (58.3%) had poor glycemic control compared to 25 male patients(41.7%) who had good glycemic control. Among female patients 25 (58.1%) had poor control and only 18 (41.9%) had poor control.

Mean age in good glycemic control was 55.07±11years and in poor control group it was 56.68±9.21years which was almost similar in both group. BMI was slightly higher in good control group 26.21±3.40 then poor control group 25.31±4.46. Waist hip ratio (WHR) were comparable in both group. Mean blood pressure was SBP 129.77±14.56 mmhg vs 125±10.81mmhg and DBP was 81.86±9.32 mmhg vs 79 ±5.43 mmhg in good control vs poor control group. Both fasting blood sugar (FBS) 114. ±18.59 mg/dl vs 182.42±63.62 mg/dl and prandial blood sugar (PP) 197.49±58.52 mg/dl vs 327.22±90.98 mg/dl was higher in poor control group. Considering lipid parameter total cholesterol was higher in poor control group i.e 185.82±49.70 mg/dl compared to good control 166.51±47.56mg/dl. Triglyceride level was 188.21±94.31mg/dl in good control group and 198.27±82.80mg/dl in poor control group. LDL level was slightly higher in poor control group then good control group 100.10±23.70 mg/dl vs 94.79±26.76mg/dl. However HDL level as seen higher in poor control group compared to good control 42.05±6.96mg/dl vs 41.21±6.65mg/dl. Mean duration of diabetes was 8 years in poor control group and 4 years in good control group. Prevalence of good glycemic control was only 42% i.e Hba1c<7% and poor glycemic was 58%. Among poor control 34% of subjects had satisfactory glucose control Hba1c 7-8% and 24% had unsatisfactory glucose control Hba1c >8%.

Correlating glycemic control with different variables FBS value was more among poor control group and was statistically significant($p<0.001$), likewise PP glucose value was also found to be higher in poor control group compared to good control and was statistically significant ($p<0.001$). Smilarly duration of DM was also found to be associated with poor glycemic control. Poor glycemic control was seen more in subjects who had longer duration of DM and it was statistically significant($p=0.010$). no other statistically significant association of variables were found between good and poor glycemic control group though few degree of differences were noted.

Jour of Diab and Endo Assoc of Nepal Vol. 6, No. 1, January-June 2022
ISSN Print 2594-3367 ISSN Online 2631-2107
Journal of Diabetes and Endocrinology Association of Nepal
ORIGINAL ARTICLE OPEN ACCESS

DISCUSSION

Our study was a observational study conducted in Nobel Medical College which is a tertiary centre. Study was conducted in 103 subjects after taking consent from the patients. In this study gender was not a associated factor for poor glycemic control, finding similar to a study done by Jyoti et al. [11] where as other studies shows female gender a association for poor glycemic control(Kirk et al [12] and Zhao et al [13]). In some studies, female sex was found to be a risk factor for poor glycemic control. It is being said that being an inferior sex specially in developing countries females are deprived for diabetes care, busy in providing more care to family and that is how neglect their own health. Hence females needs more attention during management of diabetes considering their nutritional, psychological and puberty issues also [14].

We did not find any significant association between age and poor glycemic control similar to some studies done in other countries.[15], whereas a couple of studies has shown their association Huang et al [16] and Woldu et al [17].

BMI and WHR did not show statistically significant association for poor glycemic control in this study. Similar finding was found in a study done by Louis et.al, 2014 where no association was found between poor glycemic control and BMI.[18]. The reason could be the number of subjects in our study was small. Couple of studies found the opposite of our finding stating association of poor glycemic control with higher BMI[11]. Obesity, especially abdominal adiposity is an important risk factor for the development of type 2 diabetes and also impact glycemic control. Association of obesity with other comorbidities like dyslipidemia, hypertension, Insulin resistance might also be contributing in nonattainment of good glycemic control in obese subjects.

FBS and PP was significantly higher in poor control group compared to good control group and the difference was statistically significant. Its obvious to have higer blood sugar in poor control group compared to good control group as Hba1c is an average of FBS and PP. Dyslipidemia was not associated with poor glycemic control in our study. Both the group had almost similar mean lipid levels though slightly higer in poor control group but difference was not statistically significant finding similar to jyoti et.al[11].

Duration of diabetes was significantly associated with poor glycemic control. Longer the duration more poor glycemic control. In good control group mean duration of DM was 4 years whereas in poor glycemic group duration of DM was 8 years. Similar finding was seen by a study done by Tania et.al 2018. That study found that individuals with longer duration of diabetes had 1.83 times higher odds of having poor glycaemic control.[19]. This could be because with increasing duration of DM the insulin secretary capacity of beta cells decrease over time and other comorbities may increase leading to further poor glycemic control.

HbA1C was used as a indicator for glucose control, as its a gold standard parameter for measuring glycemic control. Hba1c <7% was considered good control and above 7% was considered poor glycemic control. Poor glycemic control was observed in 58.2% of subject which seem to be alarmingly high. Similar finding was seen in other studies. In a study population of the Asian patients treated at diabetes centers, more than 50% were not well controlled leading to higher microvascular complications in the group of patients with higher HbA1c. [20]. Likewise other studies done in other countries had similar finding like Souliotis in Greece (57.1%) [21]. There are studies which shows much higher prevalence of poor glycemic control as compared to ours studies done by Tekalegn in Ethiopia (80%) [22], Hai in Pakistan (81.6%) [23] and Rahman in Bangladesh (82%) [24] which found a higher prevalence. This higher prevalence could be because of poor drug adherence, poor education about diabetes and high cost of medicine for consumption in low economic countries like ours.

Limitation of study

This study has low number of subjects, so if higher number of subjects could have been enrolled result could be more efficient. As this is a hospital based study and includes subject from few areas of our

country only this study as such cannot represent the whole scenario of this country

CONCLUSION

This observation study was a hospital based study. we found prevalence of poor glycemic control was high 58%. FBS, PP and duration of DM was associated with higher Hba1c leading to higher prevalence of poor glycemic control. Age, sex, dyslipidemia, BMI,WHR were not found to be associated with poor glycemic control. There are couple of limitation of this study as this is a hospital based study and includes local patients it may not represent the whole country prevalence of poor glycemic control. The sample size was very low so may be this could have altered the result. Further larger study would be of great impoetance to see actual association of factors for poor control.

References

1. Definition, diagnosis and classification of diabetes mellitus and its complications : report of a WHO consultation. Part 1, Diagnosis and classification of diabetes mellitus Access on 15 Nov. 2022

2. WHO. Global report on diabetes. France: 2016. Access on internet 15 Nov. 2022 https://www.who.int/publications/i/item/9789241565257

3. Gyawali B, Sharma R, Neupane D, Mishra SR. Prevalence of type 2 diabetes in Nepal: a systematic review and meta-analysis from 2000 to 2014. Glob Helth Acti. 2015; 8:1, DOI: 10.3402/gha.v8.29088.

4. Iorio A, Ylli D, Polimanti R, Picconi F, Maggio P, et al. (2018) Effect of the GSTM1 gene deletion on glycemic variability, sympathovagal balance and arterial stiffness in patients with metabolic syndrome, but without diabetes. Diabetes Research and Clinical Practice. 138: 158-168.

5. Association AD (2018) Cardiovascular disease and risk management: standards of medical care in diabetes-2018. Diabetes Care. 41: S86-S104.

6. Pamungkas RA, Mayasari A, Nusdin N (2017) Factors associated with poor glycemic control among type 2 diabetes mellitus in indonesia. Belitung Nursing Journal. 3: 272-280.

7. Selim S, Pathan F, Saifuddin M, Latif ZA, Karim N (2016) The challenge of proper glycaemic control among patients with type 2 diabetes in Bangladesh. Sri Lanka Journal of Diabetes Endocrinology and Metabolism. 6: 16.

8. Alzaheb RA, Altemani AH (2018) The prevalence and determinants of poor glycemic control among adults with type 2 diabetes mellitus in Saudi Arabia. Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy. 11: 15.

9. Sarah W, Gojka R, Anders G, Richard S, Hilary K. Global prevalence of diabetes. Diabetes care. 2004;27:1047-53.

10. Home P. The challenge of poorly controlled diabetes mellitus. Diabetes Metab. 2003;29:101-9.

11. Goyal J, Kumar N, Sharma M et.al. Factors affecting glycemic control among patients with type 2 diabetes at a tertiary health care center of western UP region: a cross-sectional study. Int J Health Sci Res. 2019; 9(3):12-20.

12. Kirk JK, Davis SW, Hildebrandt CA, et al. Characteristics associated with glycemic control among family medicine patients with type 2 diabetes. N C Med J 2011;72(5):345-50.

13. Zhao W, Katzmarzyk PT, Horswell R, et al. Sex differences in the risk of stroke and HbA1c among diabetic patients. Diabetologia 2014;57(5):918-26. Spanish patients with type 2 diabetes in the preinsulin stage. BMC Cardiovasc Disord. 2014; 14: 153.

14. Göbl C, Bozkurt L, Lueck J, et al. Sex-specific differences in long-term glycemic control and cardiometabolic parameters in patients with type 1 diabetes treated at a tertiary care centre. Wien KlinWochenschr 2012 Nov;124(21-22):742-9.

15. Shorr RI, Franse LV, Resnick HE, et al. Glycemic control of older adults with type 2 diabetes: findings from the Third National Health and Nutrition Examination Survey, 1988-1994. J Am Geriatr Soc. 2000;48(3): 264- 267.

16. Huang ES, Liu JY, Moffet HH, et al. Glycemic

Jour of Diab and Endo Assoc of Nepal Vol. 6, No. 1, January-June 2022
ISSN Print 2594-3367 ISSN Online 2631-2107
Journal of Diabetes and Endocrinology Association of Nepal
ORIGINAL ARTICLE OPEN ACCESS

Control, Complications, and Death in Older Diabetic Patients: the Diabetes and Aging Study. Diabetes Care 2011;34(6):1329-36.

17. Woldu MA, Wami CD, Lenjisa JL, et al. Factors Associated with Poor Glycemic Control among Patients with Type 2 Diabetes Mellitus in Ambo Hospital, Ambo; Ethiopia. Endocrinol Metab Syndr 2014;3:143.

18. Luis A Vázquez, Ángel Rodríguez, Javier Salvador, et al. Relationships between obesity, glycemic control, and cardiovascular risk factors: a pooled analysis of cross-sectional data from

19. Pan T et al. Int J Community Med Public Health. 2018 Nov;5(11):4768-4772, DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20184566 http://www.ijcmph.com

20. Chuang LM, Tsai ST, Huang BY, et al The status of diabetes control in Asia - a cross-sectional survey of 24317 patients with diabetes mellitus in 1998. Diabet Med 2002; 19: 978–985.

21. Souliotis, K., Koutsovasilis, A., Vatheia, G., Golna, C., Nikolaidi, S., Hatziagelaki, E., et al . (2020) Profile and Factors Associated with Glycaemic Control of Patients with Type 2 Diabetes in Greece: Results from the Diabetes Registry. BMC Endocrine Disorders , 20, Article No. 16. https://doi.org/10.1186/s12902-020-0496-7

22. Tekalegn, Y., Addissie, A., Kebede, T. and Ayele, W. (2018) Magnitude of Glycemic Control and Its Associated Factors among Patients with Type 2 Diabetes at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. PloS ONE, 13, e0193442. https://doi.org/10.1371/journal.pone.0193442

23. Hai, A.A., Iftikhar, S., Latif, S., Herekar, F. and Patel, M.J. (2019) Diabetes Self-Care Activities and Their Relation with Glycemic Control in Patients Presenting to The Indus Hospital, Karachi. Cureus , 11, e6297. https://doi.org/10.7759/cureus.6297

24. Rahman, M., Nakamura, K., Hasan, S.M.M., Seino, K. and Mostofa, G. (2020) Mediators of the Association between Low Socioeconomic Status and Poor Glycemic Control among Type 2 Diabetics in Bangladesh. Scientific Reports , 10, Article No. 6690. https://doi.org/10.1038/s41598-020-63253-8