Original Article

Medication Adherence and Glycemic Control among Elderly Diabetes Patients

Arunima Kamal[1]* [ID]**, Mohammad Abdus Sattar[2], Anjan Kumar Saha[3], Suvash Chandra Vadury[4], Anisur Rahman Bhuiyan[5], Mahabubur Rahman[6]**

ABSTRACT

Background: Elderly diabetic patients are urged to take their medications consistently in order to maintain glycemic control. This cross-sectional study was conducted from 01 January – 31 December, 2022 to assess medication adherence and glycemic control among elderly diabetes patients and to explore relation between them. **Methods & Materials:** The study was conducted conveniently on 300 elderly diabetes patients from Khulna Diabetic Hospital, Khulna. Data were collected by face-to-face interview and by reviewing medical documents using pretested semi structured questionnaire. Medication adherence was assessed by Morisky Medication Adherence-8 scale. **Results**: The age range was 60 to 84 years. The respondents were mostly female (57%), Muslims (91.3%), married (74.3%), housewives (52%), from nuclear families (57.7%), educated up to primary level (30.7%), positive family history for diabetes (53.3%), without complications of diabetes (70.3%), with comorbidities (78%). Most of them took both insulin and oral hypoglycemic agents (46.3%), faced difficulties to afford to buy medications sometimes (44.3%), took less medicines due to cost (31.7%), had exercise regularly (53.7%), followed recommended diet chart partially (44%), checked blood sugar regularly (58%). Medication adherence was low among 46.3% respondents and 62% had uncontrolled post prandial blood sugar. Medication adherence was related to affordability of cost of medicine (p<0.001) & others. Glycemic control was related to mostly following of recommended diet (p<0.001), regularity of blood glucose checking (p<0.001) and to other variables. Medication adherence and glycemic control are associated (p<0.05). **Conclusion**: Strategies, like counselling, health education etc. may be used by doctors, nurses and other health personnel to increase elderly population's adherence to anti-diabetic medication. Government should focus on public health strategies for wider educational program targeting medication adherence in elderly diabetes patients in Bangladesh.

Keywords- *Adherence, Glycemic Control, Elderly Diabetes*

1. Lecturer, Department of Community Medicine & Public Health, Gopalganj Medical College, Gopalganj, Bangladesh
2. Assistant Professor (Non-communicable Disease), OSD, DGHS; attached to Department of Community Medicine & Public Health, Gopalganj Medical College, Gopalganj, Bangladesh
3. Assistant Professor (CC), Department of Community Medicine & Public Health, Gopalganj Medical College, Gopalganj, Bangladesh
4. Associate Professor, Department of Medicine, Gopalganj Medical College, Gopalganj, Bangladesh
5. Associate Professor, Department of Medicine, Gopalganj Medical College, Gopalganj, Bangladesh
6. Assistant Professor, Department of Neurology, Gopalganj Medical College, Gopalganj, Bangladesh

INTRODUCTION

An important public health issue that is linked to both environmental and genetic causes is the diabetes mellitus. In Bangladesh, there are 7.1 million diabetics over the age of 60.[1, 2] Uncontrolled diabetes is regarded as a 'silent killer' since it typically results in a delayed discovery and might be prominent without any symptoms. Medication non-adherence is described as the deliberate or unintentional failure to follow a prescription's directions. Examples include, avoid buying all the prescription drugs, not taking the bought medications as instructed, skipping a dose or doses, and taking more medication than is recommended. A regulated diet, increased physical activity, and good medication adherence are

necessary for achieving and maintaining optimum blood glucose levels. It is anticipated that additional variables such as socioeconomic status, income level, length of illness, kind of medicine and related comorbidities would affect medication adherence.[3]

Non-adherence has a substantial impact on the course of diabetes and the efficacy of therapy. In particular, multiple studies have shown that non-adherence to therapy is linked to increased mortality and hospitalization rates, which raises the cost of healthcare.[4] The treatment result, including glycemic indices and the prevention of complications, is significantly influenced by medication adherence. Data shows that medication adherence ranges between 10% and 74% in

various groups.[5] Therefore, this large range may indicate challenges or implications of relevant characteristics including age, socioeconomic level, and illness duration on medication adherence in diabetics.[6] Non-adherence has financial as well as health-related repercussions, since the cost of emergency medical interventions as a result of non-adherence exceeds the whole cost of a pharmaceutical regimen that is followed. Health-related repercussions include failure of treatment, recurrent hospitalization, and death.[7] According to the WHO, non-adherence is a multifaceted issue brought on by the interaction of elements in any one of the following 5 areas: 1) the patient, 2) the condition, 3) the type of therapy prescribed, 4) socioeconomic factors, and 5) health system related factors.[8]

Only 35% of worldwide diabetes- related health spending is spent in Lower medium income countries, despite the fact that this burden is significant and growing. If no effective preventative interventions are implemented, the cost of healthcare related to diabetes will rise in the twenty-first century.[9] Medication adherence should be seen as a crucial factor in the glycemic management of diabetes. This study was conducted to analyze the glycemic control status of diabetic senior people in our nation, regardless of gender, and to identify the relationship between medication adherence and glycemic control as well as the socio-demographic traits and lifestyle habits of the elderly diabetic patients.

Considering the complex problems impacting older people, it would seem acceptable to recommend strong preventive and rehabilitation programs for geriatric healthcare in the future. With the right policy changes for geriatrics in Bangladesh, it is hoped that the results of this study would assist to minimize low medication attachment and enhance glycemic control. This will make aging with chronic health conditions more dignified and healthier.

METHODS & MATERIALS

An elderly person is defined by the United Nations as a person who aged 60 completed years and above. Although there are several methods to categorize this group.[10] Medication adherence was measured by using Morisky Medication Adherence Scale-8 (MMAS-8) questionnaire.[11] The patients were asked 8 questions to ascertain the variables that affected how well they followed their drug regimen. Patients are expected to respond with a "yes" or a "no" to each of the questions, and the last question is a standard five-point Likert item. Positive responses (yes) receive a 1 and negative responses (no) receive a 0. A score of >2 indicated low medication adherence, a score of 1 or 2 indicated medium medical adherence, and a score of 0 indicated strong medication adherence.

Fasting blood sugar (FBS) and glycosylated hemoglobin (HbA1c) are typically used to measure glycemic control in T2DM patients. However, postprandial blood sugar (PPBS) measurement has also been used extensively for the purpose.[12] But the majority of patients who visit clinics in the public health sector cannot afford HbA1c. Therefore, FBS is used to control the majority of diabetic patients who are monitored in outpatient clinics. However, because FBS requires overnight fasting, it might be uncomfortable for certain diabetic patients who visit outpatient clinics. This is particularly true for patients who travel a great distance to the outpatient clinics, for older patients, and for people who fast and have hypoglycemia. Since PPBS monitoring only requires two hours after the previous meal, it is a more practical, manageable, and economical approach.[13] Additionally, a number of studies have revealed that elevated PPBS is a standalone risk factor for cardiovascular illnesses.[14,15] Evidence indicates that a number of risk variables, including socio-demographic characteristics, are related to this therapeutic non-adherence; physical and mental health issues (such as cognitive impairment, functional dependency, depression, and anxiety), medication factors (such as complexity and multiple prescriptions, high costs), and health care system-related issues (such as pharmacy accessibility, lack of follow-up) are just a few examples of characteristics.[16,17,18]

This study was done by the first author as per requirement for the partial fulfilment of her Master of Public Health (MPH) course in the Department of Epidemiology during the session 2021-2022 at the National Institution of Preventive and Social Medicine (NIPSOM), Dhaka. This hospital based cross sectional study was conducted to assess anti-diabetic medication adherence and glycemic control among elderly diabetes patients in Bangladesh. The study also investigated the association between socio-demographic characteristics, diabetes duration, comorbidities, medication related factors, exercise and diet habit and medication adherence of elderly diabetes patients with their glycemic control. It was conducted in Khulna Diabetic Hospital, Boyra, Khulna. It is a health facility, situated at Khulna city in Bangladesh. On an average, 150 to 200 diabetes patients per day attend at the OPD of this health facility for treatment and follow up. Total 300 data was taken from this center. The study populations included both male and female diagnosed diabetic respondents taking anti-diabetic medication for at least one year, age of 60 years and above coming at out-patient department. Dependent variable was post-prandial blood sugar (PPBS). Independent variables were variables related to 8-items MMAS-8, variables related to clinical characteristics, variables related to other medication related factors, variables related to adherence to physical activities and diet by respondents and variables related to socio-demographic characteristics among the respondents.

Non-probability convenient sampling technique was used for data collection using a semi-structured questionnaire which was designed according to the objectives. Data was collected by face to face interview and reviewing the medical record. Reviewing medical record included result of PPBS test on the day of interview and the date of previous follow up. On an average it took around 20 minutes for data collection from every respondent. Variables were defined by SPSS Version 25 in accordance with the questionnaire. Analysis was done according to the objectives of the study.[19] Data analysis was initiated with descriptive analysis. Means and standard

deviations were calculated for continuous variables while frequencies and percentages were calculated for categorical variables. Inferential analysis was conducted using Chi-square (χ^2) test to assess association of qualitative data. Statistical significance was defined as p<0.05, p<0.01, p<0.001.

RESULTS

A cross sectional study was conducted on type 2 diabetes mellitus patients of 60 years and above at Khulna Diabetic Hospital. A pretested semi-structured questionnaire was used to assess the medication adherence and glycemic status of the patient. Data were collected from 300 elderly diabetic patients over 21 days.

The mean age of the respondents was 65.01 ± 4.577 years, ranged from 60 years to 84 years. Majority of diabetic patients were female (171, 57%) and 129 (43%) were male. Most of the respondents are Muslims who are 274 in number (91.3%). The rest are Hindus who are 26 in number (8.7%). Among 300 respondents 223 (74.3%) are married and 77 (25.7%) are widowed. Out of 300 respondents, it was observed that the highest portion of the respondents belong to the family which have 4 to 6 persons (162, 54%). Besides this 98 respondents (32.4%) belong to the family having below 3 members and 40 respondents belong to the family member of 7 or above. Most of the respondents are from nuclear family (173, 57.7%). The next portion is from joint family (79, 26.3%) and rest of them are from extended family. Among 300 respondents, highest portion (84, 28.0%) have monthly family income of ten thousand one to twenty thousand BDT. The level of education of the most of the respondents is from class 1 to 5 which is 30.7% (92 in number). 72 respondents (24%) do not have any formal education, 20.7% (62 in number) are graduate and above, 17% (51 in number) from class 6 to 10 and 7.7% (23 in number) are from class 11 to 12. Majority of the respondents are housewives (156, 52%). Besides this, retired persons are 66 in number (22%), service holders 27 in number (9%), businessman 27 in number (9%) and others i.e. farmers and unemployed are 24 in number (8%).

Mean duration of diabetes was 11.18 ± 7.744 years. Majority of the patients (160, 53.3%) have family history of diabetes. Out of three hundred patients, 29.7% have complications due to diabetes. Most of the patients (234, 78.0%) are suffering from other comorbidities along with diabetes. A small portion (9.7%, 29) were admitted in hospital due to diabetes and its complications. Regarding comorbidities of the respondents, two third of the patients (200, 66.67%) have hypertension. The second most (79, 26.3%) have osteoarthritis. Then 22.0% (66) have ischemic heart disease, 10.0% (30) have cataract, 9.0% (27) have dyslipidemia, 6.3% (19) have hypothyroidism, 4.7% (14) have cerebrovascular disease and 4.7% (14) have benign prostatic hypertrophy. The study showed that about half of the patients (139, 46.3%) took both insulin and oral hypoglycemic agents, 41% took OHA and 12.7% took only insulin. Majority of patients (124, 41.3%) took two anti-diabetic drugs per day and 9% took four or more drugs per day. Most of the respondents (133, 44.3%) reported that they faced difficulties to afford to buy their medications sometimes. In this study, about half of the

respondents (139, 46.3%) reported low medication adherence, 146 (48.7%) respondents had medium adherence and only 5% have high adherence.

In this study more than half of the respondents (53.7%) had exercise on regular basis. About one fourth of them (23.0%) were unable to perform exercise. Most of them (95.5%) preferred walking as exercise. Others included freehand exercise and cycling. Majority of them (80.5%) exercised for 150 or more minutes per week. The study found that about half of the respondents (44.0%) followed their prescribed diet chart partially. 41.7% followed the prescribed diet regularly but 14.3% never followed a chart. This study showed that more than half of the respondents (174, 58.0%) check their blood glucose regularly. Most of the respondents check Post Prandial Blood Sugar level in 0 to one month interval. In this study, more than half of the respondents (186, 62.0%) showed unsatisfactory PPBS results.

Inferential statistical tests were done using Pearson's Chi square (χ^2) method. There was no significant (p>0.05) association between age of respondents and glycemic control. Respondent's age of 65 to 69 were more frequent of having unsatisfactory PPBS than the other two age groups. Female respondents (69.0%) were more frequent in having less glycemic control i.e. unsatisfactory PPBS. There is a significant association between gender and glycemic control (P<0.005). Problem in glycemic control was more observed among Muslims (64.2%). There was a significant (p<0.05) association between religion of respondents and glycemic control. There was a significant association (p<0.05) between level of education and glycemic control. Respondents with no formal education have highest percentage of unsatisfactory PPBS (70.8%). There was a significant association (p<0.05) between occupation of the respondents and glycemic control. Housewives reported highest percentage of unsatisfactory PPBS (69.9%). Respondents who had 4 to 6 family member presented more frequency of unsatisfactory PPBS (63.6%). The study showed, there was a significant association (p<0.05) between monthly family income of respondents and glycemic control. Respondents who had monthly family income of 10001 to 20000 BDT had more frequency of unsatisfactory PPBS (71.4%). There was no significant association (p>0.05) between duration of diabetes mellitus of respondents and glycemic control. Respondents who had duration of diabetes from 11 years had more frequency of unsatisfactory PPBS (67.2%). There was no significant association (p>0.05) between hospital admission due to diabetes mellitus and glycemic control. Respondents who were admitted in the hospital due to DM were more prone to have unsatisfactory PPBS (75.9%). Though respondents who had comorbidities due to DM had less glycemic control (64.0%). This study found a significant association (p<0.05) between family history of diabetes and glycemic control. Respondents who had family history of DM had less glycemic control (62.5%). Less glycemic control was more observed in respondents who takes only insulin as anti-diabetic medicine (71.1%). But no significant association (p>0.05) was seen between type of medicine and level of last PPBS. This study showed no significant association (p>0.05) between number of

medication and glycemic control. But respondents who took three anti-diabetic drugs had less glycemic control (70.4%). In this study a significant association (p<0.05) was found between difficulty to bear the cost of medicine and glycemic control. Respondents who suffered more difficulty to bear the cost of medicine had less glycemic control (71.9%). A significant association (p<0.05) was found between less medication intake due to cost and glycemic control. Respondents who took less medicine due to unaffordable cost had less glycemic control (58.9%). A significant association (p<0.05) was observed between exercise and glycemic control. Respondents who performed irregular exercise had less glycemic control (79.5%). Current study revealed a significant association (p<0.05) between type of exercise and glycemic control.

Respondents who performed exercise other than walking had less glycemic control (58.9%). In the study a significant association (p<0.05) was found between duration of exercise and glycemic control. Respondents who performed exercise for less than 150 minutes per week had less glycemic control (74.4%). In the study a highly significant association (p<0.001) was found between following diabetic chart and glycemic control. Respondents who never followed their prescribed diabetic diet had less glycemic control (86.0%). A significant association (p<0.05) was observed between interval of blood glucose testing and glycemic control. Respondents who performed irregular blood glucose testing had less glycemic control (77.0%) (Table 1).

Table – I: Interval of blood glucose testing and glycemic control

Interval of blood glucose testing	Level of last PPBS		Total	χ2	p value
	Satisfactory PPBS	Unsatisfactory PPBS			
Regularly	85 (25.6%)	89 (51.1%)	174	20.703	
irregularly	29 (23.0%)	97 (77.0%)	126		.000
Total	90	110	200	df=1	

Male respondents had mostly medium medication adherence (54.3%) and female had mostly had poor medication adherence (50.9%). Though the current study showed no significant association (p>0.05) between gender of the respondents and anti-diabetic medication adherence. Married respondents had mostly medium medication adherence (50.7%) and widow or widower had mostly had poor medication adherence (50.6%). Though the current study showed no significant association (p>0.05) between marital relationship of the respondents and anti-diabetic medication adherence.

There was a significant association (p<0.05) between the level of education of the respondents and anti-diabetic medication adherence. Respondents who are graduate and above had mostly medium medication adherence (62.9%). But respondents with no formal education (55.6%) and respondents with 6 to 10 class of education (52.9%) had low adherence. This study found a significant association (p<0.05) between the types of medicine the respondents took and anti-diabetic medication adherence. Respondents who took oral hypoglycemic drugs were less frequent to have low medication adherence (35.5%). The number of medications that the respondents took and adherence to anti-diabetic medication were shown to be significantly correlated

(p<0.05). More respondents (54.4%) had low medication adherence when they used three or more hypoglycemic medications.

This study found a highly significant relation between difficulties paying for medications and adherence to anti-diabetic treatment (p<0.01). The respondents with the low medication adherence rate were those who found it more difficult to pay for their anti-diabetic medications (67.4%). Low medication adherence was more common among respondents who took less medicine because it was unaffordable (66.3%). Additionally, there was a strong association (p<0.01) between anti-diabetic medication adherence and less medication use because of cost.

No significant association (p>0.05) was found between interval of blood glucose testing among the respondents and anti-diabetic medication adherence. Though respondents who tested blood sugar regularly (at one month interval) were frequent to have medium medication adherence (54.6%).In this study, a significant relationship (p<0.05) between respondents' glycemic control and adherence to anti-diabetic medication was discovered. Low medication adherence (69.8%) was common among respondents who had unsatisfactory postprandial blood sugar (Table 2).

Table – II: Anti-diabetic medication adherence and glycemic control among the respondents

Level of medication adherence	Level of last PPBS		Total	χ2	p value
	Satisfactory PPBS	Unsatisfactory PPBS			
High adherence	6 (40.0%)	9(60.0%)	15		
Medium Adherence	66(45.2%)	80 (54.8%)	146	6.818	
Low adherence	42(30.2%)	97 (69.8%)	139	df=2	.032
Total	114	186	300		

DISCUSSION

This cross-sectional study was carried out on 300 elderly diabetes patients who were selected conveniently from a diabetic hospital in Khulna city. The objective was to find out whether glycemic control is related to medication adherence and to find out some factor related to both of them. About half of the patients were in the 60 – 64 years age range. This nearly sounds like another study.[20] In this study, there was no association between respondents' ages and glycemic control (p>0.05). Those between the ages of 65 and 69 were more likely to have unsatisfactory PPBS (62.2%). This study discovered no association between respondents' age group and adherence to their anti-diabetic medication (p>0.05). The biggest percentage (56.9%) of respondents who were 70 years of age or older reported a medium level of medication adherence. The finding was very comparable to that one.[20] More than half of the responders (57%) were female. This outcome is substantially identical to that of a research conducted by Islam et al. in 2021.[19] The glycemic control of female respondents in this research (69.0%) was lower than that of male respondents (52.7%). The respondent's sex and glycemic control are significantly associated (P <0.05). It was virtually identical to the findings of an earlier study.[3] The majority of male respondents (54.3%) had moderate medication adherence, whereas the majority of female respondents (50.9%) had poor medication adherence. Despite the fact that the current study found no connection between the respondents' sex and adherence to their anti-diabetic medication adherence (p>0.05), a different study did not discover a similar link.[19] Muslims (64.2%) were more likely to experience glycemic control issues than Hindus. A substantial (p<0.05) association between respondents' religion and glycemic control was found.

About three fourth (74.3%) of the respondents were married, while 25.7% were widows or widowers. An earlier Bangladeshi study revealed almost the same rate.[19] According to the current study, there was no correlation between respondents' marital status and glycemic control (p>0.05). The largest percentage of unsatisfactory PPBS was found among respondents who were widowed (63.6%). The majority of married respondents (50.7%) had moderate medication adherence, while the majority of widows or widowers (50.6%) had poor medication adherence. However, the current investigation found no connection between respondents' marital status and the adherence to their anti-diabetic medication (p>0.05). Previous research failed to discover any associations.[19] The majority of the respondents (52%) are housewives. In addition to this, there are 22% retired people, 9% service members, 9% business people, and 8% other people, including farmers and the unemployed. These contradict earlier research.[3] As because different research locations have different socio-demographic characteristics. In this study, there was a significant correlation between respondents' profession and glycemic control (p<0.05). The highest percentage of unsatisfactory PPBS was reported by respondents who were housewives (69.9%). The identical study that was conducted earlier did not find such a connection.[3] Here, there was a statistically significant correlation between the respondents' profession and their adherence to their anti-diabetic medication (p<0.05).

The majority (28.0%) of the respondents had a monthly household income between ten thousand one to twenty thousand BDT. The study found a significant relationship between respondents' monthly family income and glycemic control (p<0.05). There was no such association was found in the study conducted in 2021 by Olickal et al.[3] Most of the respondents (71.4%) with monthly family income 10001 to 20000 reported having inadequate PPBS. An earlier investigation conducted in Bangladesh discovered a link between monthly income and medication adherence.[19] Most of the respondents (30.7%) are educated to a level between class I and V. Due to differences in the research group, this was not exactly like the previous study.[19] Level of education of respondents and glycemic control were significantly correlated (p<0.05). Most respondents with substandard PPBS (70.8%) were those without a formal education. There was a significant association (p<0.05) between the level of education of the respondents and anti-diabetic medication adherence. The respondents' education level and medication adherence also showed a statistically significant relationship (p <0.05). Most respondents with graduate-level education and above reported moderate medication adherence (62.9%). However, those without any formal education (55.6%) and those with only a sixth through tenth-grade education (52.9%) reported poor adherence. Another investigation also discovered a connection.[19]

The majority of the patients (45.7%) had diabetes for more than 10 years. However, 24.3% people have been ill for 6 to 10 years, while 30.0% have been ill for less than 5 years. Diabetes lasted an average of 11.18 ±7.744 years. Almost same was found in a prior study.[3] This study found no correlation between respondents' glycemic control and the length of time they had diabetes mellitus (p>0.05). Respondents who had diabetes for at least 11 years, had an unsatisfactory PPBS (67.2%). The current investigation found no connection between respondents' occupations and adherence to their anti-diabetic medications (p>0.05). Most respondents (56.2%) who had diabetes for six to ten years reported moderate medication adherence. However, earlier research did not discover such a connection.[19]

The majority of respondents (53.3%) have a family history of diabetes. This is connected to a different Bangladeshi research.[19] According to this study, there is a connection between glycemic control and family history of diabetes (p<0.05). Less glycemic control (62.5%) was reported by respondents who had a family history of diabetes. No such link was seen in the earlier investigation.[3] Respondents with family history of diabetes were more likely to have medium medication adherence (50.6%). However, there was no relation (p>0.05) found between respondents' adherence to their anti-diabetic medications and their family history of diabetes, but another research did (Islam et al., 2021).[19] Out of 300 individuals, 29.7% have diabetes-related problems and 70.3% do not. Among 300 patients, 7.7% (23 patients) have

diabetic nephropathy, 19.7% (59 patients) have diabetic peripheral neuropathy, 4.3% (13 patients) have diabetic foot, and 2.0% (06 patients) have diabetic retinopathy. This study found a significant relationship between respondents' hospitalized due to diabetes mellitus complications and glycemic control (p <0.05). Less glycemic control (71.9%) was reported by respondents who had the problem brought on by DM. The existence of problems caused by diabetes in the respondents and adherence to anti-diabetic medication were not shown to be significantly correlated (p>0.05). The majority of respondents (56.2%) with diabetic problems had poor medication adherence.

The majority of respondents (78.0%) also have other concomitant diseases. This research was essentially identical to the findings with this one (Islam et al., 2021).[19] The concomitant diseases are hypertension (66.67%), osteoarthritis, ischemic heart disease, cataract, dyslipidemia, hypothyroidism, cerebrovascular disease and benign prostatic hypertrophy. In this study, there was no evidence of a connection between respondents' comorbidities and glycemic control (p>0.05). The similar conclusion was observed by Olickal et al, 2021[3] in their investigation from 2021. There was no association found between respondents' comorbidities and adherence to their anti-diabetic medication (p>0.05). Nevertheless, responders with co-morbidities showed moderate medication adherence (48.7%), similar to findings from an earlier research.[19] Only 29 out of 300 individuals (9.7%) required hospital admission because of diabetes and associated consequences. In this study, there was no correlation between respondents' glycemic control and hospital admission for diabetes mellitus (p>0.05). Unsatisfactory PPBS were more common among respondents who had been hospitalized owing to DM (74.9%). The respondents' adherence to their anti- diabetic medications and hospital admission owing to diabetes were significantly correlated (p<0.05). Most respondents with hospital admissions (65.5%) had poor medication adherence.

According to the study, 12.7% of respondents used only insulin, 41% took oral hypoglycemic medications, and 139 respondents (46.3%) took both insulin and OHA. This research was comparable to one conducted in South India.[3] Less glycemic control was more frequently noted in responders (71.1%) who solely use insulin as a diabetic medication. However, there was no correlation between the kind of medication and the level of the previous PPBS (p>0.05). Even yet, a research discovered a correlation between them.[3] The types of medications that the respondents used and adherence to anti-diabetic medication were shown to be significantly correlated (p< 0.05) in this study. Less frequently (35.5%) did respondents who took oral hypoglycemic medications report poor medication adherence. The same study in South India showed no association like this.[3]

In this case, the majority of respondents (124, 41.3%) used two anti-diabetic medications daily, while 9% took four or more. This research was quite comparable to one conducted by Islam et al, 2021.[19] This study found no correlation

between the number of medications used and glycemic management (p>0.05). However, the glycemic control of responders (71.9%) who took three anti-diabetic medications was lower. In this study, a significant association between the respondents' medication use and their adherence to anti-diabetic medication was found (p <0.05). When using three or more hypoglycemic drugs, more respondents (54.4%) reported having low medication adherence. But in earlier research, there was no relationship between the number of medicines and medication adherence.[3, 19]

In this study, a significant relationship between difficulties paying for medication and diabetic control was discovered (p<0.05). Less glycemic control (71.9%) was reported by those who had more difficulties paying for medication. According to this study, there is a highly significant link (p<0.01) between difficulty paying for prescription drugs and adherence to anti-diabetic treatment. The respondents who reported having a harder time paying for their anti-diabetic prescriptions (67.4%) also reported having a worse medication adherence rate. Due to cost, some respondents (31.7%) were unable to take all of their prescription medications. Less medication use because of cost was associated significantly (p <0.05) with glycemic control. Less glycemic control (58.9%) was reported by respondents who used less medication because the cost was too high. Respondents who took less medication because it was expensive had a higher incidence of low medication adherence (66.3%). Furthermore, there was a significant correlation between anti- diabetic medication adherence and reduced pharmaceutical use due to cost (p<0.01).

More than half of the respondents (53.7%) engaged in regular physical activity. One-fourth of them were unable to exercise. This finding is virtually identical to one from the past.[21] Exercise and diabetes control were shown to be significantly associated (p<0.05). Less glycemic control was reported by those who exercised irregularly (79.5%). This study demonstrated a substantial relationship between exercise performance and medication adherence (p<0.01). However, those who did not exercise had a higher likelihood of having a poor medication adherence rate (57.0%). Regarding exercise adherence, the majority of them (95.5%) favored walking. The current study found a statistically significant relationship between exercise type and glycemic control (p<0.05). Less glycemic control (58.9%) was seen in respondents who engaged in exercise other than walking. The majority of them (80.5%) worked out for 150 minutes or more per week. In the study, there was a significant relation between exercise duration and glycemic control (p <0.05). Glycemic control was higher (49.7%) in those who exercised more than 150 minutes per week.

According to the study, 44.0% of the respondents followed their recommended diet plan in part. 14.3% never followed a chart whereas 41.7% routinely followed the recommended diet. This findings are identical to one from the past.[21] According to the study, there is a clear association between adhering to the recommended diet chart and glycemic

management (p<0.001). Less glycemic control (86.0%) was seen among respondents who never followed the diabetes diet recommended to them. According to the study, more than half of the respondents (174, 58.0%) routinely monitor their blood sugar, while 42.0% do not. Glycemic control and the interval of blood glucose measurement were shown to be significantly correlated (p<0.05). Less glycemic control (77.0%) was reported by respondents who conducted irregular blood glucose testing. No correlation between the respondents' interval between blood glucose tests and adherence to their anti-diabetic medication was detected in this study (p>0.05). Although those who routinely checked their blood sugar (at intervals of one month) were more likely to have average medication adherence (54.6%).

About half of the respondents (139, 46.3%) reported having low medication adherence, and just 15 respondents, or 5%, had high adherence, which was lower than in the comparable previous study.[3] More than half (62.6%) of the low adherent responders are female. This study indicated that about half of the respondents had low adherence to their prescribed medications and more than half of respondents had inadequate glycemic control in a hospital. These findings are concerning. The current study's prevalence of poor adherence was higher than that of studies from Dhaka.[19] This difference in adherence levels may be related to the study population or facility. In addition to reporting a relation between poor medication adherence and poor glycemic control, this study also noted the prevalence of unsatisfactory glycemic control. In order to achieve optimal glycemic control and hence minimize diabetes complications, it may be helpful to introduce initiatives to increase patient adherence to anti-diabetic drugs. In line with the previous study, women in the present one had worse adherence than did males. According to the literature, women have more complicated drug regimens (many prescriptions) and report greater adverse effects, which results in lower medication adherence.[3] In addition, the out-of-pocket expense of diabetes care may make it difficult for women to continue adhering. Similar to males, some women may prioritize their roles in the home and overlook their own needs in the process. These study results point to the need for individualized treatment programs to address low compliance and glycemic management.[3]

People were generally unable to acquire the required medication owing to economic reasons, therefore they were forced to take less medication than was recommended by the treatment plan. Additionally, because oral hypoglycemics are more numerous and difficult to recall, they were missed more frequently. Respondents who used less medicine were more likely to require hospitalization because they had worse diabetic complications and worse glycemic control. They also did not frequently participate in the PPBS probe. In contrast to earlier research, ours found a relationship between patient education and drug adherence.[19] But this study revealed a significant association between the number of medications intake and low medication adherence which is supported by the same study.

More than half of the respondents (62%) had unsatisfactory PPBS findings. This was an increase in compared to earlier finding.[3] In our study, women's PPBS was lower. This was consistent with a study from South India that found that women were more likely to have poor glycemic control.[3] This study discovered a significant relationship between respondents' glycemic control and anti-diabetic drug adherence (p<0.05). Respondents with unsatisfactory postprandial blood sugar levels frequently had low medication adherence (69.8%). A prior research had almost identical results, although they were far more significant (p<0.001).[3] This previous study also showed respondents currently on insulin had unsatisfactory glycemic control compared to those who were currently on OHA alone. But this study could not find such association. Less time was spent exercising by responders, who also had worse glycemic control. Again, glycemic control was influenced by monthly income, employment, and education. Other variables, such as religion, the existence of comorbidities, and family history, affected glycemic control. Additionally, an association between self-medication, medication duration, and glycemic control was discovered. The cost of the prescription medication made it difficult to afford and thus taking less medication played a vital role in glycemic control.

CONCLUSION

The study showed an association between medication adherence and glycemic control. Female diabetic patients had low medication adherence as well as unsatisfactory glycemic control. Educational level, occupation, family history, self-medication, duration of medication, affordability to bear the cost, type and duration of exercise are also related to glycemic control.

About half of the respondents reported having low medication adherence and more than half of the respondents had unsatisfactory PPBS findings. Medication adherence was mostly related to affordability to buy the prescribed medicine and less medication intake due to cost. Furthermore glycemic control was mostly related to regularity of blood sugar testing and following of recommended diet. So it is crucial to develop innovative intervention approaches to address these issues for better medication adherence and glycemic control which would be effective for elderly diabetes patient management in Bangladesh.

REFERENCES
1. Akhtar, S., Nasir, J.A., Sarwar, A., Nasr, N., Javed, A., Majeed, R., Salam, M.A. and Billah, B. (2020). Prevalence of diabetes and pre-diabetes in Bangladesh: a systematic review and meta-analysis. BMJ Open, [online] 10(9), p.e036086. doi:10.1136/bmjopen-2019-036086.
2. Hasan, Md.M., Rahman, M., Rahman, Md.N., Rahman, S. and Mohsin, F. (2021). Knowledge of Diabetes in Geriatric Patients attending Hospitals in Dhaka City, Bangladesh. Indian Journal of Public Health Research & Development. doi:10.37506/ijphrd.v12i3.16092.
3. Olickal, J.J., Chinnakali, P., Suryanarayana, B.S., Saya, G.K., Ganapathy, K. and Subrahmanyam, D.K.S. (2021). Medication

adherence and glycemic control status among people with diabetes seeking care from a tertiary care teaching hospital, south India. Clinical Epidemiology and Global Health, 11(2021), p.100742. doi:10.1016/j.cegh.2021.100742.

4. Fottrell, E., Ahmed, N., Shaha, S.K., Jennings, H., Kuddus, A., Morrison, J., Akter, K., Nahar, B., Nahar, T., Haghparast-Bidgoli, H., Khan, A.K.A., Costello, A. and Azad, K. (2018). Distribution of diabetes, hypertension and non-communicable disease risk factors among adults in rural Bangladesh: a cross-sectional survey. BMJ Global Health, [online] 3(6), p.e000787. doi:10.1136/bmjgh-2018-000787.

5. Elsous, A., Radwan, M., Al-Sharif, H. and Abu Mustafa, A. (2017). Medications Adherence and Associated Factors among Patients with Type 2 Diabetes Mellitus in the Gaza Strip, Palestine. Frontiers in Endocrinology, [online] 8. doi:10.3389/fendo.2017.00100.

6. Monterroso, L., Joaquim, N. and Sá, L. (2015). Medication adherence in elderly people integrated in the Long-Term Care domiciliary teams. Revista de Enfermagem Referência, Nº5(IV Série), pp.9–16. doi:10.12707/riv14047.

7. Ho, P.M., Bryson, C.L. and Rumsfeld, J.S. (2009). Medication Adherence. Circulation, 119(23), pp.3028–3035. doi:10.1161/circulationaha.108.768986.

8. Al-Haj Mohd, M.M.M., Phung, H., Sun, J. and Morisky, D.E. (2016). Improving adherence to medication in adults with diabetes in the United Arab Emirates. BMC Public Health, [online] 16(1). doi:10.1186/s12889-016-3492-0.

9. Islam, R., Khan, M.N., Oldroyd, J.C., Rana, J., Chowdhury, E.K., Karim, M.N. and Hossain, M.B., 2021. Prevalence of diabetes and prediabetes among Bangladeshi adults and associated factors: Evidence from the Demographic and Health Survey, 2021

10. Lee, S.B., Oh, J.H., Park, J.H., Choi, S.P. and Wee, J.H. (2018). Differences in youngest-old, middle-old, and oldest-old patients who visit the emergency department. Clinical and Experimental Emergency Medicine, [online] 5(4), pp.249–255. doi:10.15441/ceem.17.261.

11. Morisky, D.E., Green, L.W. and Levine, D.M. (1986). Concurrent and Predictive Validity of a Self-reported Measure of Medication Adherence. Medical Care, 24(1), pp.67–74. doi:10.1097/00005650-198601000-00007.

12. Inzucchi, S.E., Bergenstal, R.M., Buse, J.B., Diamant, M., Ferrannini, E., Nauck, M., Peters, A.L., Tsapas, A., Wender, R. and Matthews, D.R. (2014). Management of Hyperglycemia in Type 2 Diabetes, 2015: A Patient-Centered Approach: Update to a Position Statement of the American Diabetes Association and the European Association for the Study of Diabetes. Diabetes Care, [online] 38(1), pp.140–149. doi:10.2337/dc14-2441.

13. Bastyr, E.J., Stuart, C.A., Brodows, R.G., Schwartz, S., Graf, C.J., Zagar, A. and Robertson, K.E. (2000). Therapy focused on lowering postprandial glucose, not fasting glucose, may be superior for lowering HbA1c. IOEZ Study Group. Diabetes Care, 23(9), pp.1236–1241. doi:10.2337/diacare.23.9.1236.

14. Avignon, A., Radauceanu, A. and Monnier, L. (1997). Nonfasting Plasma Glucose is a Better Marker of Diabetic Control Than Fasting Plasma Glucose in Type 2 Diabetes. Diabetes Care, 20(12), pp.1822–1826. doi:10.2337/diacare.20.12.1822.

15. Herath, H.M.M., Weerarathna, T.P., Fonseka, C.L. and Vidanagamage, A.S. (2017). Targeting postprandial blood sugar over fasting blood sugar: A clinic based comparative study. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 11(2), pp.133–136. doi:10.1016/j.dsx.2016.06.029.

16. van Dulmen, S., Sluijs, E., van Dijk, L., de Ridder, D., Heerdink, R. and Bensing, J. (2007). Patient adherence to medical treatment: a review of reviews. BMC Health Services Research, [online] 7(1). doi:10.1186/1472-6963-7-55.

17. Capoccia, K., Odegard, P.S. and Letassy, N. (2015). Medication Adherence With Diabetes Medication. The Diabetes Educator, 42(1), pp.34–71. doi:10.1177/0145721715619038.

18. Licht-Strunk, E., van der Windt, D.A., van Marwijk, H.W., de Haan, M. and Beekman, A.T. (2007). The prognosis of depression in older patients in general practice and the community. A systematic review. Family Practice, 24(2), pp.168–180. doi:10.1093/fampra/cml071.

19. Islam, S.M.S., Islam, Md.T., Uddin, R., Tansi, T., Talukder, S., Sarker, F., Mamun, K.A.A., Adibi, S. and Rawal, L.B. (2021). Factors associated with low medication adherence in patients with Type 2 diabetes mellitus attending a tertiary hospital in Bangladesh. Lifestyle Medicine, 2(4). doi:10.1002/lim2.47.

20. Borba, A.K. de O.T., Marques, A.P. de O., Ramos, V.P., Leal, M.C.C., Arruda, I.K.G. de and Ramos, R.S.P. da S. (2018). Factors associated with elderly diabetic adherence to treatment in primary health care. Ciência & Saúde Coletiva, [online] 23, pp.953–961. doi:10.1590/1413-81232018233.03722016.

21. Rosa Mendesa, Sonia Martins, Lia Fernandes (2019). Adherence to Medication, Physical Activity and Diet in Older Adults With Diabetes: Its Association With Cognition, Anxiety and Depression; J Clin Med Res. 2019;11(8):583-592