

**ADHERENCE TO RECOMMENDED TREATMENT AMONG TYPE 2  
DIABETES MELLITUS PATIENTS IN EAST DELHI, INDIA: A CLINIC  
BASED CROSS-SECTIONAL SURVEY**

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## LIST OF ABBREVIATIONS

**AUA** – American University of Armenia

**BMI** – Body Mass Index

**DM** - Diabetes Mellitus

**DALYs** – Disability Adjusted Life Years

**ICMR** – Indian Council of Medical Research

**IDDM** – Insulin Dependent Diabetes Mellitus

**DSMQ** - Diabetes self-management questionnaire

**IRB** – Institutional Review Board

**NIDDM** – Non Insulin Dependent Diabetes Mellitus

**NCDs** – Non Communicable Diseases

**NUDS** - National Urban Diabetes Survey

**MAQ** - Medication Adherence Questionnaire

**MI** - Myocardial Infarction

**YLDs** - Years lived with disability

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## **Executive summary**

**Background:** Diabetes mellitus (DM) is a chronic disease characterized by hyperglycemia due to lack of insulin or its ineffective utilization by body. Diabetes is considered as a leading cause of premature death and disability and most of this is due to type 2 DM. It is also considered as one of the four priority non communicable diseases. It leads to many micro and macro-vascular complications. India is known as the “diabetic capital of the world.” DM is a chronic illness demanding lifelong therapy. Evidence suggests that adherence to long term therapies is very low in low and middle income countries. Good adherence to the antidiabetic treatment like dietary modification, physical activity, routine ophthalmic screenings and foot care leads to improved quality of life with effective decrease in complications and disability due to DM.

**Aim:** This study aimed to assess the level of adherence to the recommended regime and medication, its determinants and perceived barriers to adherence to the treatment among type 2 diabetes mellitus patients in East Delhi, India

**Methods:** Cross sectional survey was conducted by using a self-administered questionnaire in a primary health care clinic among type 2 DM patients (aged 18 years and more) living in East Delhi, India. Convenience sampling was used and the sample size was 180. A validated tool (Medication Adherence Questionnaire) was used to measure adherence to the medication. All the study variables were analyzed descriptively and compared between two outcome groups: adherent and non-adherent. Chi<sup>2</sup> tests and t tests were run, univariate and multivariate logistic regression analysis was done to get the final predictor model and the model fit was checked by Hosmer and Lemeshow test.

**Result:** Only 36.6% of the study participants were adherent to the medication and the mean percent score for adherence to recommended regime was 59.6 (SD 24.7). Predictors for the adherence to recommended regime were adequate knowledge about DM (1.28 OR and CI 1.02-1.61), high level of income (OR 9.11 and CI 2.97-27.91), receiving advice from doctor (OR 5.22 and CI 1.34 - 20.32), current smoking (OR 6.54 and CI: 2.17-19.74) and being obese (OR 3.24 and CI: 1.161-9.49). The predictors for adherence to the medication only were adequate knowledge about DM (OR 2.26 and CI: 1.01-5.10), high income (OR 2.43 and CI: 1.06-5.55), receiving advice from doctor (OR 5.40 and CI: 1.04-28.03), age over 40 years (OR 0.29 and CI: 0.12-0.68) and being obese (OR 3.17 and CI: 1.32-7.61).

**Conclusion:** The level of adherence to the antidiabetic treatment was not optimal among population. Educational program should be implemented for diabetic patients to improve their DM-related knowledge, which further can improve their level of adherence. Some policies should be implemented to provide antidiabetic medicines free of charge to the patients or make them affordable for patients. Training programs for the physicians should be implemented to train the physicians to build trustful patient provider relationship.

## **1. Introduction/Literature Review**

### **1.1 Diabetes Mellitus and its Global Burden**

Diabetes Mellitus (DM) is a chronic disease characterized by hyperglycemia that occurs either when pancreas is unable to produce sufficient insulin (a hormone that regulates blood glucose level) or when body cannot utilize the produced insulin effectively or both.<sup>1,2</sup> DM leads to disturbance in carbohydrate, fat and protein metabolism.<sup>3</sup> There are two main categories of DM i.e. type 1 diabetes mellitus (type 1 DM) or insulin dependent diabetes (IDDM) and type 2 diabetes mellitus (type 2 DM) or non-insulin dependent diabetes (NIDDM).<sup>3</sup> Diabetes is considered as a leading cause of premature death and disability. In 2014, it was estimated that approximately 422 million people (aged 20-79 years) were living with diabetes worldwide.<sup>2</sup> Global prevalence of diabetes (age standardized) was estimated to be 8.5% among adult population in 2014.<sup>2</sup> Globally, vast majority of people with diabetes are suffering from type 2 DM.<sup>2</sup> Prevalence of DM has been increasing among adults in the past few decades worldwide from 30 million in 1964 and 108 million in 1980 to 422 million people in 2014.<sup>2,4</sup> The worldwide prevalence rate of DM has increased to 8.5% in 2014 from 4.7% in 1980.<sup>2</sup> In 2011, in their Political Declaration on the Prevention and Control of Non-Communicable Diseases (NCDs), world leaders considered diabetes as one of the four priority NCDs.<sup>2</sup>

There is a dramatic increase in the number of people suffering from DM in all countries, and in rural as well as urban areas.<sup>4</sup> It was estimated that 5 million deaths were attributable to diabetes worldwide in 2015.<sup>4</sup> Annual mortality rate due to DM is 21.6 per 100,000 people globally.<sup>5</sup> It was estimated that in the year 2013, Disability-Adjusted Life Years (DALYs) due to diabetes mellitus were 765.5 per 100,000 people in developing countries and 840.5 per 100,000 people in developed countries.<sup>5</sup> DM and its complications are related to chronic damage and failure of different organ



systems: mainly eyes, nerves, kidneys and heart.<sup>6</sup> The “pathological hallmark” of DM are vasculature changes, which cause micro-vascular and macro-vascular complications.<sup>6</sup> Diabetic microangiopathies in retina cause diabetic retinopathy which leads to blindness among DM patients, in kidneys they cause diabetic nephropathy which is a reason for chronic kidney failure among DM patients, and in neural system they cause diabetic neuropathies which, together with peripheral angiopathy lead to diabetic foot. Microvascular complications among DM patients predispose them to atherosclerosis and lead to cerebrovascular and cardiovascular disease and premature death. Some of the macro vascular complications among DM patients are stroke, myocardial infarction (MI) and acute coronary syndrome.<sup>6</sup>

## **1.2 Risk factors of DM**

Diabetes mellitus has non modifiable and modifiable risk factors. Non modifiable risk factors are those, which the individual cannot control like genetic predisposition, increasing age, history of gestational diabetes and low birth weight.<sup>7,8</sup> Race or ethnicity are also non modifiable factors strongly associated with DM, African Americans are at higher risk of developing type 2 DM as compared to Whites.<sup>8</sup>

Modifiable risk factors of DM are obesity, smoking, inadequate nutrition, alcohol use, physical inactivity, hypertension and dyslipidemia.<sup>7,8</sup> A study conducted in Saudi Arabia reported that low socioeconomic status, low education level, male gender and age over 40 years are associated with type 2 DM.<sup>7</sup> A meta-analysis showed that there is an association between depression and type 2 DM and concluded that adults with depression have 37% higher risk of developing type 2 DM.<sup>9</sup> Central/visceral obesity or increased waist to hip ratio is a strong risk factor for type 2 DM.<sup>10</sup> There is scientific evidence suggesting that obesity predisposes to type 2 DM due to insulin resistance by three distinct mechanisms: 1) increased production of cytokines like tumor necrosis factor-

alpha (TNF- $\alpha$ ), resistin, and retinol binding protein, 2) fat accumulation in liver and skeletal muscles which leads to disturbed metabolism, and 3) mitochondrial dysfunction which causes decreased insulin sensitivity and  $\beta$ -cell dysfunction.<sup>10</sup> A study conducted in US reported that adults with body mass index (BMI) of 40 or more had 7.37 (95% CI 6.39 – 8.50) times higher odds for being diagnosed with DM as compared to adults with normal weight.<sup>11</sup> Dietary habits are also associated with the risk of type 2 DM, glycemic diet (high sugar consumption) and low fiber intake increase the risk of developing type 2 DM.<sup>12</sup>

### **1.3 Burden of DM in India**

Prevalence of diabetes in India in 2015 was estimated to be 9.3%. Being second most populated country in the world, in year 2000 it had the largest population (around 30 million people) living with diabetes in the world. Therefore, India is also known as “diabetic capital of the world”.<sup>13,14</sup> In 2007, 41 million people and 61.3 million people in 2011 were diagnosed with the disease in India.<sup>15,16</sup> It is predicted that by 2030 there will be significant increase in the number of people affected by DM and 101.2 million people will be affected in India by 2030.<sup>15</sup> There are disparities in the prevalence of type 2 DM in India by socioeconomic status and geographical location.<sup>16</sup> India has lack of well-planned nationwide studies on the prevalence of type 2 DM which leads to unreliable and incomplete nationwide data on the disease.<sup>17</sup> Indian Council of Medical Research (ICMR) conducted a National Urban Survey and the results of the survey have shown the prevalence of diabetes to be 6% in Kashmir, 11.7% in Kolkata, 11.6% in New Delhi, 9.3% in Mumbai, 13.5% in Chennai and 16.6% in Hyderabad.<sup>18</sup> Literature suggest that these differences in the rates or prevalence of DM are due to many factors but one of the most probable factors is different ethnic origins of people residing in different parts of the country; for example; north Indians are migrant Asian population while south Indians are host population.<sup>14</sup>

The annual mortality rate due to DM in India is 19.0 per 100,000 people and the annual number of years to healthy life lost is 733.4 per 100,000 people.<sup>19</sup> Diabetes is one of the top ten causes of deaths in India and also ranked on 9<sup>th</sup> position among the top 10 causes of years lived with disability (YLDs).<sup>19</sup> Diabetes does not only affect the quality of life of a patient but also possesses financial burden on an individual due to high cost of treatment.<sup>20</sup>

#### **1.4 Burden of DM in Delhi**

In the year 2001, a national urban diabetes survey (NUDS) reported the prevalence of DM to be 11.6% in New Delhi.<sup>21</sup> A community-based cross-sectional survey was conducted in an urbanized village of East Delhi, which reported the prevalence of DM to be 15.3% in this region.<sup>22</sup> Another study has also shown a very high DM prevalence of 18.8% in urban slum area of East Delhi region.<sup>23</sup> A study was conducted in Delhi among type 2 DM patients to assess the financial burden which DM poses on patients due to high cost of treatment and disability and reported that the average annual direct cost of type 2 DM was INR 6,212.4 (USD 143 approx.) in 2005 and more than half of it were drug costs.<sup>24</sup>

#### **1.5 Treatment of DM**

DM requires a continuous medical care with adequate glycemic control and multifactorial risk reduction interventions.<sup>25</sup> Treatment of DM includes oral anti-hyperglycemic therapy in some patients or insulin therapy depending on the type of DM and its duration. Lifestyle management interventions are beneficial in both types of DM.<sup>26</sup> Oral anti-diabetic drugs for type 2 DM are divided into following classes: agents that increase insulin secretion (sulphonylureas), reduce hepatic glucose production (biguanides), improve insulin action (thiazolidinedione) and delay digestion and absorption of carbohydrates in intestine ( $\alpha$ -glucosidase inhibitors).<sup>27</sup> Type 1 DM is insulin dependent DM, therefore, it is treated by insulin therapy.<sup>25</sup>

DM leads to many complications but these complications can be prevented by effective management and appropriate and adequate control of blood glucose level. Morbidity and mortality due to DM can be decreased by secondary prevention through routine screening, early detection and appropriate treatment.<sup>7</sup>

## **1.6 Adherence to DM treatment**

Adherence to treatment is defined as “*the extent to which a person’s behavior – taking medication, following a diet, and executing lifestyle changes, corresponds with agreed recommendations from a health care provider.*”<sup>28</sup> DM is a chronic illness demanding lifelong therapy. There is scientific evidence that adherence to long term therapies is very low in developing countries; even in developed countries it is only 50%.<sup>29</sup> Many DM patients find it difficult to adhere to the anti-diabetic treatment due to complex prescription and high costs of medications.<sup>28</sup> Studies on the prevention of type 2 DM complications have shown that good adherence to the antidiabetic treatment like dietary modification, physical activity, routine ophthalmic screenings and foot care leads to improved quality of life with effective decrease in complications and disability among type 2 DM patients.<sup>30</sup> Poor adherence is strongly associated with development of many complications among DM patients, decreases their life expectancy and can present a public health challenge.<sup>30</sup> Poor adherence to insulin as well as oral hypoglycemic drugs is strongly associated with negative outcomes in DM patients.<sup>31</sup> Self- monitoring of blood glucose also has an impact on management and control of blood glucose level among patients on insulin therapy in both type 1 and type 2 DM patients.<sup>31</sup>

Factors associated with poor adherence to antidiabetic treatment include inadequate frequency or avoidance of visits to doctor, lack of physical activity (due to less time, lack of local facilities, perceived difficulty in exercising and feeling of tiredness) and depression in patient.<sup>31,26,32</sup> A study

reported that some of the factors associated with non-adherence to the antidiabetic treatment were alcohol use, medication side effects and long distance of the clinic from the patient.<sup>33</sup> Some of the determinants of poor compliance to dietary recommendations are female gender, increasing age, joint families and lack of knowledge about DM.<sup>34</sup> A study conducted in Saudi Arabia reported that out of their study population, 41.8% DM patients were not knowledgeable about diabetic foot care and only 25.8% patients wore special shoes designed for DM patients.<sup>7</sup> Identification of determinants of non-adherence to treatment among DM patients can help to develop recommendations to increase their adherence to treatment.

### **1.7 Study rationale and aim**

There are many studies which show that the prevalence of DM is very high in East Delhi region and there is evidence that the level of adherence to DM treatment is not optimal in Delhi.<sup>22,23,35</sup>

There is limited published literature and lack of research in the region of East Delhi about the level of adherence to antidiabetic treatment, its determinants and barriers to adherence among DM patients. This study aims to assess the level of adherence to the recommended regime and medication, the determinants of both and perceived barriers to adherence to the treatment among diabetes mellitus patients in East Delhi, India. By using the results of this study, we can suggest some interventions to the healthcare providers and policy changes to the organizations providing health care and counseling to DM patients and improve the level of adherence of patients to treatment by reducing barriers to compliance.

### **1.8 Research questions**

1. What are the prevalence of adherence to recommended treatment regime and medication alone among type 2 DM patients aged 18 years and above in East Delhi, India?

2. What are the determinants of adherence to recommended treatment regime and medication alone among type 2 DM patients aged 18 years and above in East Delhi, India?
3. What are the perceived barriers to adherence to recommended treatment regime among type 2 DM patients aged 18 and above in East Delhi, India?

## **2. Methods**

### **2.1 Study Design**

A cross sectional survey was conducted to assess the level of adherence to recommended antidiabetic treatment regime among the study participants visiting a primary health care clinic in East Delhi, India. Cross sectional survey design was chosen because it was a feasible and cost effective method to answer the research questions. A self-administered questionnaire was used for data collection due to time and resource constraints.

### **2.2 Study Population and Settings**

Target population included patients with diabetes mellitus type 2, in the age group of 18 years and above, residing in East Delhi, and visiting the selected primary health care clinic situated in East Delhi. I have chosen the age group of 18 years and above to include only adult population in this study. Also, as literature suggests, the age of acquiring diabetes mellitus is decreasing nowadays; earlier it was a disease of middle age and old age people, but now it is also affecting younger age people and a juvenile onset of the disease is observed too.<sup>36</sup> I contacted many clinics situated in East Delhi, but only one primary health care clinic gave a permission to conduct data collection in its waiting area. Therefore, data was collected in this clinic after getting the instrument approved by the head of the clinic.

Inclusion criteria:

- Patient with type 2 DM aged 18 years and above
- Being a resident of East Delhi district
- Suffering from type 2 DM for 6 months or more
- Being a visitor of the selected outpatient clinic

Exclusion criteria:

- Patients with other types of diabetes
- Patients who do not speak Hindi or English.

### **2.3 Sampling Method**

Convenience sampling method was used due to time and resource constraints. The interviewer approached every person in the waiting area of the primary health care clinic after omitting the first 10 patients in the row and explained them the study aim and procedure. The questionnaire was given to an eligible patient based on the results of the application of the screening form (Appendix 3) and after taking their oral consent to participate (Appendix 4). The participant was taken to a separate room in the waiting area to complete the questionnaire. If the person disagreed, then the interviewer approached the next person. The interviewer continued the attempts to recruit participants until the required number of surveys were completed.

### **2.4 Sample Size**

Sample size was calculated for two equal samples for detecting difference in proportions;

$$n = (Z_{\alpha/2} + Z_{\beta})^2 * (P_1(1-P_1) + P_2(1-P_2)) / (P_1 - P_2)^2$$

$N = 2n$ , where  $n$  is the required sample for one group.

Z is the level of significance. P<sub>1</sub> is the predicted percentage of low adherence to the antidiabetic treatment regime among non-educated and P<sub>2</sub> is the percentage of low adherence to antidiabetic treatment regime among educated. The value of P<sub>1</sub> is taken as 0.5 - an average value from previous similar studies.<sup>34,37,38,39,40</sup> P<sub>2</sub> is set as 0.3 to be able to detect a between-group difference of 20%. For a confidence level of 95% when  $\alpha = 0.05$  (and  $Z_{1-\alpha/2} = 1.96$ ) and a power (1- $\beta$ ) is equal to 0.8 (and  $Z_{1-\beta}$  is 0.84), the required sample size was calculated as:

$$n = (1.96+0.84)^2 * (0.5(1-0.5) + 0.3(1-0.3)) / (0.5-0.3)^2 = 7.84 * (0.25+0.21) / 0.04 = 90.16$$

$$N = 2 * 90 = 180$$

## 2.5 Study Instrument

The survey instrument was developed based on questionnaires used in previous studies on the related topics. Items appropriate to answer the research questions of this study were selected from these questionnaires.<sup>37,39</sup> Medication Adherence Questionnaire (MAQ) was used for assessing the level of adherence to medication among participants, which is a validated tool. To assess adherence to recommended regime (medication plus diet, physical activity, etc.) a few additional items were taken from diabetes self-management and care (DSMQ) questionnaire, which is also validated as a whole. Items measuring the covariates were taken from the evidence based literature. The questionnaire (Appendix 5) was translated into Hindi and was pre tested on five diabetic patients before the actual data collection. Changes were made after pre testing as needed.

The questionnaire had four main domains:

- Sociodemographic information



- Questions on knowledge about diabetes mellitus and recommended treatment regime
- Level of adherence to antidiabetic treatment regime
- Questions regarding perceived barriers to adherence to treatment

## **2.6 Study Variables**

Dependent variable was the adherence status to the recommended antidiabetic regime (dichotomous: adherent vs. non adherent). Adherence to medication only (measured using a validated scale Medication Adherence Questionnaire (MAQ)) was taken as a secondary outcome variable (Table 1). Adherence to the recommended regime was measured using the four items included in the adherence to medication scale plus four single items on adhering to the recommended diet, exercise, checking feet and visiting a doctor. Dichotomous (0 for adherence and 1 for non-adherence) response scale was applied for each item in the scale. Participants were asked whether they were exercising every day for at least 30 minutes. Each ‘yes’ option was given 0 point and each ‘no’ option was given 1 point. Adherence to the diet and checking feet were measured by asking about how many days in the last week participants checked their feet and followed the recommended diet. Participants, who reported 0 to 4 days were given 1 score and those who reported more than 4 days were scored as 0. Participants who reported visiting a doctor for five or more times per year were given 0 score and those who visited less frequently were given 1 score. Thus, the whole 8-item scale generated a total score ranging from 0 to 8. This score was dichotomized at 5 cut-off level based on the distribution of data. Those having a cumulative score of 0 to 5 (40% of the sample) were considered as adherent and those scoring 6 to 8 (60%) as non-adherent. The secondary outcome - adherence to medication - was measured by using only the four items of the MAQ validated scale.<sup>41</sup> This outcome measure was used to add to the study rigor. The MAQ scale consists of 4 items measuring non-adherent behaviors and each item has two response

options - 'yes' and 'no'. For each 'yes' option 1 score was given and for each 'no' option 0 score was given. The score range was, therefore, 0 to 4. A cut off value of 2 was applied for MAQ scale (those with a cumulative score of 0 or 1 were considered as adherent and those with 2, 3 or 4 score - as non-adherent).<sup>41</sup>

Independent variables were sociodemographic characteristics (gender, age, education, employment status, marital status, living in a joint family, socioeconomic status), health behavior characteristics (alcohol use, active and passive smoking, physical activity), diabetes- and diabetes care-related characteristics (family history of DM, duration of the diabetes, having a glucometer at home, insulin administration, receiving educational materials about DM control and management), potential barriers to adherence to treatment (to taking medicine, doing physical exercise, and making regular visits to doctor), depression status and DM knowledge score measured by a set of questions measuring knowledge about DM and its complications. All the variables are given in Appendix 1.

## **2.7 Data collection**

Data collection was done by a thoroughly trained interviewer. Instructions manual was provided to the interviewer by the student investigator. After identifying an eligible person via the screening form and receiving the person's initial consent to participate, the interviewer took him/her to a small separate room near the waiting area, provided the informed consent form and took his/her oral consent to participate. Then, the interviewer provided the questionnaire to the participant and asked to complete it. Completed questionnaires were collected by the interviewer after 10-15 minutes of the administration or, if by that time the participant did not complete it, the interviewer approached him/her again after an additional 5 minutes and collected the completed questionnaire. ID numbers were assigned to the participants by the interviewer based on the sequential number

of the participant in the Journal Form (Appendix 6) completed by the interviewer to keep track of the attempts made and responses received.

## **2.8 Data Entry**

The interviewer scanned all the completed questionnaires and sent those to the student investigator by e-mail. Single data entry was done by the student investigator using SPSS 16 software and 10% of the data was randomly double-checked with the questionnaires. Range checks were done for outliers.

## **2.9 Data Analysis**

All the study variables were analyzed descriptively and compared between two outcome groups: adherent and non-adherent (for both the outcome variables). For the total sample and for each of the outcome groups (adherent and non-adherent), frequencies and proportions were obtained for categorical variables and compared between the groups using chi2 test, and means and standard deviations were estimated for continuous independent variables and compared between the outcome groups using t-test. For answering the second research question (predictors of adherence), all the variables that were significant at  $p < 0.25$  level in descriptive comparisons, were put into univariate logistic regression analysis with both outcomes, adherence to the recommended treatment regime and adherence to the medication only. Dummy variables were created for categorical variables with more than two categories to include those into logistic regression analysis. Then, all the variables that were significant in the univariate analysis ( $p < 0.25$ ) were put into multivariable logistic regression analysis with the respective outcome, and insignificant variables ( $p < 0.05$ ) were removed one by one from the multivariable regression analysis until all the variables in the final models were significant. Fit of the final models was checked by Hosmer

and Lemeshow test. For answering the third research question (barriers to adherence), descriptive analysis was done.

## **2.10 Ethical Considerations**

An approval was taken from the Institutional Review Board (IRB) of the American University of Armenia (AUA). An oral consent was obtained from each participant after explaining them the research purposes and procedures, confidentiality of the study and participant's rights. To maintain the confidentiality, no information regarding the name of the participant or any identifiable information was collected. ID numbers were given to all completed questionnaires. Only the interviewer and the student investigator had an access to completed questionnaires.

## **3. Results**

Fifteen hundred attempts were made to get 180 participants. Of those approached, 1301 were not eligible and 19 were eligible but refused to participate. Thus, the response rate was 90.5%.

### **3.1 Adherence to the recommended regime**

#### **3.1.1 Descriptive characteristics**

As depicted in (Appendix 2) Table 1, the mean percent score for adherence to recommended regime was 59.6 (SD 24.7) and, 67.8% of the participants have ever forgotten to take their prescribed medicines, 50.6% were careless at times about taking their medicines, 32.8% and 67.8% reported that they stopped taking medicine when feeling better or when feeling worse, respectively. Of the study population, 32.2% reported that they followed a recommended diet for more than or equal to 4 days in the last week, 42.8% reported doing exercise every day for at least 30 minutes per day. Fifty-two percent of the study participants reported that they were visiting a doctor for

more than or equal to 5 times per year. The adherence-to-regime score range was 0 to 8 and the cut off was applied at six, based on the data distribution (the closest value to the upper third). Therefore, sixty percent of the total population scored less than six and were considered as adherent, while 40% scored six to eight and were considered as non-adherent to the recommended regime.

### ***Sociodemographic characteristics of participants***

Sociodemographic characteristics of the participants are presented in table 2. The mean age of the study participants was 42.6 (SD 13.6), and there was no statistically significant age difference between adherent and not adherent groups. The study population comprised of 55.0% males, the proportion of males was significantly higher among adherent group as compared to non-adherent group (62.0 vs. 44.4,  $p=0.015$ ). Twenty percent of the total study population had more than secondary education, there was marginally significantly higher proportion of those who had more than secondary education among adherent group as compared to non-adherent group (24.1 vs. 13.9,  $p=0.104$ ). The total study population consisted of 43.8% participants with higher income, this proportion was significantly different between the two groups i.e. adherent vs. non-adherent (57.1% vs. 19.6%, respectively,  $p=0.000$ ). The study population consisted of 75.0% married people, the proportion of married people was marginally significantly higher among non-adherent group as compared to adherent group (81.9 vs. 70.4,  $p=0.056$ ).

### ***Health characteristics and behavior of participants***

Health status and behavior characteristics of the participants are presented in Table 2. The mean duration of being diagnosed with type 2 DM was 8.45 (SD 6.38) years among overall study participants and the mean duration of DM diagnosis was marginally significantly higher in the

non-adherent group as compared to the adherent (9.44 vs. 7.79 years,  $p=0.089$ ). Among total study population, 69.4% of the participants had positive family history of DM and there was no statistically significant difference between the two groups. The study population comprised of 32.7% of the participants who reported smoking regularly, there was significantly lower proportion of smokers among non-adherent group as compared to adherent group (21.5% vs. 39.6%,  $p=0.011$ ). Only 19.4% of the total study population received educational materials on DM and the proportion of those who received these materials was significantly higher among adherent group as compared to non-adherent group (24.1% vs. 12.5%,  $p=0.040$ ). When asked about having financial problem buying medicine, 35.6% of the study population reported yes; the proportion was higher among non-adherent as compared to adherent group (44.4 vs. 29.6,  $p=0.040$ ). Of the study participants 15.0% did not receive an advice from doctor about diet, exercise and glucose monitoring frequency, the proportion of those who did not receive an advice was significantly higher among non-adherent as compared to adherent group (27.8% vs. 6.5%,  $p=0.000$ ). Out of total study population 67.8% had blood glucometer, there was significantly higher proportion of those having glucometer among adherent as compared to non-adherent group (78.7% vs. 51.4%,  $p=0.000$ ).

### ***Knowledge about DM***

Knowledge score was measured by 9 item scale (score range 0 to 9). The mean knowledge score of the study population was 5.08 (SD 2.15) and there was statistically significant difference in the mean knowledge score of adherent group as compared to non-adherent (5.59 vs. 5.08,  $p=0.000$ ).

### ***Depression***

Depression symptoms were present among 10.0% of the study population and there was no statistically significant difference between adherent and non-adherent groups.

### ***Reasons for not taking medicine***

As demonstrated in Table 2, sixty percent of the participants reported that there were instances when they did not take their medicine and the proportion was significantly higher among non-adherent as compared to adherent group (79.2% vs 47.2%,  $p=0.000$ ). High cost of medicine was reported as a barrier to taking medicine by 27.8% of the study population and there was no statistically significant difference between the two groups. Complex prescription was reported as a reason of not taking medicine by 12.8% of the participants and the proportion was marginally significantly higher among non-adherent group as compared to adherent group (18.1% vs. 9.3%,  $p=0.067$ ). Forgetfulness was reported as a reason for not taking medicine by 38.3% of the overall study participants and the proportion was higher among non-adherent vs. adherent group (47.2% vs. 32.4%,  $p=0.033$ ).

### ***Barriers to adherence to visit to doctor***

As shown in Table 2, of the study participants, 52.8% were visiting a doctor for their diabetes five or more times a year and the proportion was significantly higher among adherent group as compared to non-adherent (71.3% vs. 25.0%,  $p=0.000$ ). Long distance to the clinic was reported as a barrier to make frequent visits to doctor by 13.3% of the study participants and this proportion was significantly higher in non-adherent group as compared to adherent group (20.8% vs. 8.3%,  $p=0.015$ ). Lack of time was reported as a barrier by 21.7% of the study participants and the proportion was higher among non-adherent vs adherent group (37.5% vs. 11.1%,  $p=0.000$ ). Twenty-one percent of the study participants reported that they do not visit a doctor because they

don't want to and the proportion was significantly higher among non-adherent as compared to adherent group (29.2% vs. 15.7%,  $p=0.025$ ).

### ***Barriers to adherence to exercise***

Out of the total study participants (Table 2), 26.1% reported that they do not exercise due to having no time and the proportion was significantly higher among non-adherent group (38.9% vs. 17.6%,  $p=0.001$ ). Only 5.6% reported that lack of local facilities was a barrier, and there was no statistically significant difference in this term between the two groups. Of the study participants, 28.9% reported that doing exercise is difficult and the proportion was marginally significantly higher in non-adherent group as compared to adherent group (36.1% vs. 24.1%,  $p=0.058$ ). Getting tired after exercise was reported as a barrier to perform exercise by 26.7% of the total population and the proportion was significantly higher among non-adherent group (38.9 vs. 18.5,  $p=0.002$ )

### **3.1.2 Simple and multivariable logistic regression analyses' results**

In the unadjusted logistic regression analysis (Table 3), participant's BMI, gender, family income, marital status, living in joint family, knowledge about DM, duration of being diagnosed with DM, receiving educational materials on DM, having financial problem to buy medicine, receiving advice from doctor, having blood glucometer, and high cost of medicine, all were significantly associated with adherence to the recommended regime at the level of significance  $P<0.25$ .

All the significant variables in the unadjusted analysis were entered into multivariable analysis and a final model of predictors of adherence to the recommended regime was fit. Good knowledge about DM, higher income, receiving advice from doctor, smoking and being obese were independent predictors of adherence to the recommended regime in the multivariable analysis.



Having good knowledge about DM 1.28 times increased the odds of being adherent as compared to having less-than-good knowledge about DM. Those belonging to high income level had 9.11 times higher odds of being adherent as compared to those in low and middle income groups. The patients who reported that they have received advice from a doctor had 5.22 times higher odds of being adherent as compared to those who did not receive. Smokers had 6.54 times higher odds of being adherent, and being obese was associated with 3.24 times higher chances of being adherent to the recommended regime (Table 4). The model fit was adequate - Hosmer and Lemeshow test significance was 0.125.

### **3.2 Adherence to medication**

This outcome was based solely on the items included in the validated Medication Adherence Scale (MAQ), (first four items in Table 1). The score range was 0-4 and the score of 0 and 1 were considered as adherent and score of 2, 3 and 4 were considered non adherent based on the cut off recommended by literature.<sup>41</sup> Only 36.6% of the participants were adherent to the medication as they reported “No” for all 4 questions or “Yes” only for one question (the rest – “No”).

#### **3.2.1 Descriptive characteristics**

##### ***Sociodemographic characteristics of participants***

As demonstrated in Table 5, there was statistically significant age difference between adherent-to-medication and not adherent groups (39.9 years vs. 44.2 years,  $p=0.039$ ). The mean BMI was significantly higher among adherent group as compared to non-adherent group (26.8 vs. 25.2,  $p=0.015$ ). There was significantly higher proportion of those who had more than secondary education among adherent group as compared to non-adherent group (27.2% vs. 15.8%,  $p=0.030$ ). The proportion of participants with higher income was significantly higher among adherent group as compared to non-adherent group (60.0% vs. 33.8%,  $p=0.003$ ). The proportion of married people

was significantly higher among non-adherent group as compared to adherent group (79.8% vs. 66.7%,  $p=0.038$ ). The proportion of people living in a joint family was statistically significantly higher among non-adherent group as compared to adherent (57.9% vs. 42.4%,  $p=0.032$ ).

### ***Health status and behavior of participants***

The mean duration of being diagnosed with DM was not statistically significantly different between non-adherent and adherent groups (Table 5). The proportion of participants with positive family history of DM was significantly higher among non-adherent group as compared to adherent group (74.3% vs. 60.7%,  $p=0.047$ ). The proportion of those who reported having financial problem buying medicine was significantly higher among non-adherent as compared to adherent group (42.1% vs. 24.2%,  $p=0.01$ ). The proportion of those who did not receive advice from doctor about diet, exercise and glucose monitoring frequency was significantly higher among non-adherent as compared to adherent group (21.1% vs. 4.5%,  $p=0.002$ ). The proportion of those having glucometer was significantly higher among adherent as compared to non-adherent group (80.3 vs. 60.5,  $p=0.004$ ).

### ***Knowledge about DM***

The mean DM knowledge score was statistically significantly higher among adherent group as compared to non-adherent group (5.80 vs. 4.67,  $p=0.001$ ).

### ***Depression***

There was no statistically significant difference between adherent and non-adherent groups in the proportion of those having depressive symptoms.

### ***Reasons for not taking medicine***

As shown in Table 5, the proportion of participants, who reported that there were instances when they did not take their medicine was significantly higher among non-adherent as compared to adherent group (68.4% vs 45.5%,  $p=0.002$ ). The proportion of those who reported complex prescription as a barrier to taking medicine was insignificantly higher among non-adherent group as compared to adherent group (14.9% vs. 9.1%,  $p=0.187$ ). The proportion of those who reported forgetfulness as a reason for not taking medicine was higher among non-adherent vs. adherent group (43.0% vs. 30.3%,  $p=0.063$ ).

### ***Barriers to adherence to exercise***

As Table 5 demonstrates, the proportion of those participants who reported having no time as a barrier to exercise was statistically significantly higher among non-adherent group as compared to adherent group (30.7% vs. 18.2%,  $p=0.046$ ). The proportion of those participants who reported getting tired after exercise as a barrier was statistically significantly higher among non-adherent group as compared to adherent group (32.5% vs. 16.7%,  $p=0.015$ ).

### ***Barriers to adherence to visit to doctor***

As shown in Table 5, there was no statistically significant difference between adherent and non-adherent groups in the proportions of those who reported long distance to clinic, financial burden or lack of will as a reason for not making regular visits to a doctor. The proportion of those participants who reported lack of time as a barrier was statistically significantly higher among non-adherent group as compared to adherent group (29.8 vs. 7.6,  $p=0.000$ ).

### **3.2.2 Simple and multivariable logistic regression analyses' results**

In unadjusted analysis (Table 6), age, obesity, education, family income, marital status, living in joint family, family history of DM, knowledge about DM, duration of being diagnosed with DM, number of family members, receiving education on DM, receiving advice from doctor, having blood glucometer, forgetfulness, lack of time, visiting a doctor, experiencing side effects of medicine and getting tired after exercise, all were significantly associated with adherence to medication at the level of significance  $P\text{-value} < 0.25$ .

All these variables were entered into multivariable analysis and a model of predictors of adherence to medication was fitted. In the final model (Table 7), good knowledge about DM, higher income, receiving advice from doctor, being obese and over 40 years of age were independent predictors of adherence to medication. Those who had good knowledge about DM, had 2.26 times higher odds of being adherent to medication. Those who were in a high income group had 2.43 times higher odds of being adherent as compared to low and middle income groups. The patients who reported that they have received advice from a doctor on anti-diabetic care had 5.40 times higher odds of being adherent. Age more than 40 years decreased the chance of being adherent to medication by 71%. Being obese was associated with 3.17 times higher chance of being adherent. The model fit was adequate - Hosmer and Lemeshow test significance was 0.529.

## **4. Discussion**

### **4.1 Expected findings**

This study identified the level of adherence to antidiabetic treatment, the determinants of adherence to recommended regime and medication, and perceived barriers to adherence to both regime and medication among type 2 DM patients in a clinic in East Delhi, India. The identified prevalence of adherence to medication was not optimal (36.6%). It was less than that in a similar

study conducted in South India, where the level of adherence to medication was approximately 47%.<sup>42</sup> A study was conducted in Dehradun, Uttarakhand, India, which showed that only 23% of the participants followed a diet and 31.7% were exercising, which is less than in our study, where we found 32.2% were following a diet and 42.8% were exercising every day for at least 30 minutes.<sup>40</sup> A systematic review of 51 studies supports our findings that high income increases the chance of being adherent to the treatment.<sup>43</sup> In our study the participants who received advice from doctor were much more adherent as compared to those who did not receive and similar results were found in other studies also.<sup>44</sup> We found results consistent to other studies indicating that receiving advice from the doctor about medication, diet and frequency of glucose monitoring, adequate knowledge about DM and high income increase the chances of being adherent to treatment.<sup>42,45</sup> We also found that the chances of being adherent to the treatment decrease after 40 years of age, which is consistent with a study conducted in Nepal.<sup>34</sup> In our study we found that forgetfulness (38.3%) and high cost of medicine (27.8%) were the two main reasons for not taking medicine, which is consistent with the literature.<sup>37</sup> We found almost similar sets of predictors of adherence to the recommended regime (which was measured by a tool we developed) and adherence to medication (which was measured by using a validated tool (MAQ)), which shows that we did not jeopardize the validity of the MAQ scale by adding to it some items about non-medical care.

#### **4.2 Unexpected findings**

We got two unexpected findings that smoking and obesity increased the chance of being adherent to the recommended regime. These findings could be explained by the hypothesis that smokers (and obese people) might adhere to the treatment more to compensate the loss which they know

smoking (and obesity) is causing to their health. These findings could be a potential topic for future research to explore this area more.

### **4.3 Strengths of the study**

This study fills the gap in the area of investigating the level of adherence to recommended treatment among type 2 DM patients in East Delhi. The study had a high response rate and we had the opportunity to include in our instrument all the predictive variables of adherence suggested by literature. We measured one of the outcome variables using a validated scale for adherence to the medication. This was a self-administered survey so it avoids interviewer bias.

### **4.4 Limitations of the study**

One of the limitation of this study is that convenience sampling method was used to detect the level of prevalence and also the study was conducted in a single clinic. Therefore, while interpreting the results of this study, one should keep in mind its low generalizability. Also, the study participants were visitors of a clinic, meaning that they might be more adherent to treatment as compared to those not visiting a clinic at all. We had relatively low sample size in our final model, therefore, we might have missed some possibly significant differences among both the groups. Some of the questions asked were about how many of the last seven days did participants followed diet, checked their feet, etc. Therefore, recall bias was there for both dependent and independent variables. Self-reported data and cross sectional survey design did not allow to make causal inferences.

### **4.5 Recommendations**

Our findings suggest that an educational program should be implemented for diabetic patients to improve their DM-related knowledge, which further can improve their level of adherence. Many

of our participants reported that high cost of medicine was a barrier to adhere to medication. Therefore, some policies should be implemented to provide antidiabetic medicines free of charge to the patients or make them affordable for patients. Twenty one percent of our population reported that they did not visit the doctor for their DM because they did not want to: this somehow shows that there are some trust issues between doctors and patients<sup>28</sup>. Training programs for the physicians should be implemented to train the physicians to build trustful patient provider relationship, this could further increase the chances of adherence because receiving advice from doctor multiplies the chances of being adherent to the treatment. Further, larger scale studies are required with representative sample size to increase the representativeness and validity of the findings.

## **5. Conclusion**

Lack of adherence to the antidiabetic medication and recommended regime is the major issue in management of diabetes mellitus. Level of adherence is not optimal among type 2 DM patients in East Delhi. Some of the determinants to high adherence to the treatment are good knowledge about DM, high income and receiving advice from doctor. High cost of medicine, complex prescription and forgetfulness are potential reasons for not taking medicine. Financial burden and lack of time are barriers to visit a doctor. Adherence could be improved by focusing on these determinants and avoiding these barriers to attain better quality of life and avoid early onset of diabetic complications.

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## Appendix: 1 Study Variables Included in Logistic Regression Analysis

### Dependent variables

Variable	Type	Measure
Adherence to recommended regime	Dichotomous	1=Adherent 0=Non adherent
Adherence to medication only	Dichotomous	1= Adherent 0=Non adherent

### Independent variables

Variable	Type	Measure
Age	Numeric (continuous)	Years
Gender	Dichotomous	0=Female 1=Male
BMI	Dichotomous	0=Not obese 1=Obese
Education	Dummy variables: Low education Middle education High education	1=Less than 9 years; 0=other 1=9 to 12 years; 0=other 1=More than 12 years; 0=other
Employment	Dichotomous	0=Unemployed 1=Employed
Family income	Dichotomous	0=Low and middle income 1=High income
Marital status	Dichotomous	0=Unmarried 1=Married
Living in joint family	Dichotomous	0=No 1=Yes
Number of family members	Numeric (continuous)	
Knowledge about DM	Dichotomous	0=Inadequate knowledge 1=Adequate knowledge
Depression symptoms	Dichotomous	0=Absent (score $\leq 3$ points) 1=Present (score $> 3$ points)
Duration of DM diagnosis	Numeric (continuous)	Years
Family history of DM	Dichotomous	0=No 1=Yes
Smoking	Dichotomous	0=No 1=Yes
Alcohol	Dichotomous	0=Non drinker 1=Drinker
Taking Insulin	Dichotomous	0=No

		1=Yes
Education educational material on DM	Dichotomous	0=No
Financial problem buying medicine	Dichotomous	1=Yes
Experience side effects with DM medicine	Dichotomous	0=No
Asked by a doctor to report side effects	Dichotomous	1=Yes
Received advice from doctor about diet, exercise and glucose monitoring frequency	Dichotomous	0=No
Having blood glucometer	Dichotomous	1=Yes
Making visit to the doctor	Dichotomous	0=<5times per year
		1= $\geq$ 5 times per year
<hr/> Reasons for not taking medicine <hr/>		
High cost of medicine	Dichotomous	0=No
		1=Yes
Complex prescription	Dichotomous	0=No
		1=Yes
Forgetfulness	Dichotomous	0=No
		1=Yes
<hr/> Barriers to visit to a doctor <hr/>		
Long distance of the clinic	Dichotomous	0=No
		1=Yes
Financial burden	Dichotomous	0=No
		1=Yes
Lack of time	Dichotomous	0=No
		1=Yes
<hr/> Barriers to exercise <hr/>		
Due to having no time	Dichotomous	0=No
		1=Yes
Lack of local facilities	Dichotomous	0=No
		1=Yes
Doing exercise is difficult	Dichotomous	0=No
		1=Yes
Get tired after exercise	Dichotomous	0=No
		1=Yes

## Appendix 2: Tables of results of analysis

**Table 1: Adherence to the recommended regime and medication among type 2 DM patients visiting a PHC clinic in East Delhi, India, 2018**

Questions	Yes		No	
	n	%	n	%
Have you ever forgotten to take your medicine?	122	67.8	58	32.2
Are you careless at times about taking your medicine?	91	50.6	89	49.4
When you feel better, do you sometimes stop taking your medicine?	59	32.8	121	67.2
Sometimes if you feel worse when you take medicine, do you stop taking it?	122	67.8	58	32.2
Do you exercise every day for at least 30 minutes?	77	42.8	103	57.2
Frequency of visit to doctor for diabetes, n (%)	<b>≤ 4 times per year</b>		<b>≥ 5 times per year</b>	
	85	47.2	95	52.8
How many of last seven days have you followed a diet recommended by your doctor?	<b>&lt; 4 days</b>		<b>≥ 4 days</b>	
	58	32.2	122	67.8
How many of the last seven days have you checked your feet?	25	13.9	155	86.1

**Table 2: Sociodemographic characteristics and health behavior of participants by adherence to recommended regime groups (among type 2 DM patients visiting a PHC clinic in East Delhi, India, 2018)**

Characteristics	Total sample (N=180)		Non adherent (N=72)		Adherent (N=108)		P value
	n/mean	%/SD	n/mean	%/SD	n/mean	%/SD	
<b>Age</b>	42.61	13.63	43.52	13.85	41.99	13.50	0.460
<b>Gender</b>							
Male	99	55.0	32	44.4	67	62.0	0.015
Female	81	45.0	40	55.6	41	38.0	
<b>BMI</b>	25.78	4.30	24.04	4.33	26.27	4.23	0.060
<b>Education</b>							
< 9 years	64	35.6	29	40.3	35	32.4	0.218
9 to 12 years	80	44.4	33	45.8	47	43.5	0.208
> 12years	36	20.0	10	13.9	26	24.1	0.104
<b>Employment</b>							
Employed	92	51.1	33	45.8	59	54.6	0.409
Homemaker	53	29.4	25	34.7	28	25.9	0.411
Other	35	19.4	14	19.5	21	19.5	0.405
<b>Family income</b>							
Low and middle	73	56.2	37	80.4	36	42.8	0.000
High Income	57	43.8	9	19.6	48	57.1	
<b>Marital status</b>							
Married	135	75.0	59	81.9	76	70.4	0.056
Unmarried	45	25.0	13	18.1	32	29.6	
<b>Living in joint family</b>							
Yes	94	52.2	43	59.7	51	47.2	0.068
No	86	47.8	29	40.3	57	52.8	
<b>Number of family members</b>	9.02	4.98	9.49	5.69	8.70	4.44	0.302
<b>Health characteristics</b>							
<b>Duration of diagnosis</b>	8.45	6.389	9.44	6.67	7.79	6.13	0.089
<b>Family history of DM</b>							
Yes	118	69.4	51	72.9	67	67.0	0.258
No	52	30.6	19	27.1	33	33.0	
<b>Smoking</b>							
Yes	56	32.7	14	21.5	42	39.6	0.011
No	115	67.3	51	78.5	64	60.4	
<b>Alcohol</b>							
Drinker	44	24.4	17	38.6	27	40.4	0.832
Non drinker	136	75.6	55	61.4	81	59.6	

Characteristics	Total sample (N=180)		Non adherent (N=72)		Adherent (N=108)		P value
	n/mean	%/SD	n/mean	%/SD	n/mean	%/SD	
<b>Taking insulin</b>							
Yes	62	34.4	28	38.9	34	31.5	0.193
No	118	65.6	44	61.1	74	68.5	
<b>Depression symptoms</b>							
Present	18	10.0	7	9.7	11	10.1	0.919
Absent	162	90.0	65	90.3	97	89.9	
<b>Received educational material on DM</b>							
Yes	35	19.4	9	12.5	26	24.1	0.040
No	145	80.6	63	87.5	82	75.9	
<b>Financial problem buying medicine</b>							
Yes	64	35.6	32	44.4	32	29.6	0.031
No	116	64.4	40	55.6	76	70.4	
<b>Side effects</b>							
Yes	37	20.6	16	22.2	21	19.4	0.651
No	143	79.4	56	77.8	87	80.6	
<b>Asked by doctor to report side effects</b>							
Yes	146	81.1	55	76.4	91	84.3	0.130
No	34	18.9	17	23.6	17	15.7	
<b>Received advice from doctor about diet, exercise and glucose monitoring frequency</b>							
Yes	153	85.0	52	72.2	101	93.5	0.000
No	27	15.0	20	27.8	7	6.5	
<b>Knowledge score, mean (SD)</b>	5.08	2.15	5.08	2.15	5.59	2.18	0.000
<b>Having a blood glucometer</b>							
Yes	122	67.8	37	51.4	85	78.7	0.000
No	58	32.2	35	48.6	23	21.3	
<b>Instances of not taking medicines</b>							
Yes	108	60.0	57	79.2	51	47.2	0.000
No	72	40.0	15	20.8	57	52.8	
<b>Reasons for not taking medicine</b>							
<b>High cost of medicine</b>							
Yes	50	27.8	21	29.2	29	26.9	0.231
No	130	72.7	51	70.8	79	73.1	
<b>Complex prescription</b>							
Yes	23	12.8	13	18.1	10	9.3	0.067
No	157	87.2	59	81.9	98	90.7	
<b>Forgetfulness</b>							
Yes	69	38.3	34	47.2	35	32.4	0.033
No	111	61.7	38	52.8	73	67.6	
<b>Making visits to doctor for DM</b>							



Characteristics	Total sample (N=180)		Non adherent (N=72)		Adherent (N=108)		P value
	n/mean	%/SD	n/mean	%/SD	n/mean	%/SD	
<5 times per year	85	47.2	54	75.0	31	28.7	0.000
≥5 times per year	95	52.8	18	25.0	77	71.3	
<i>Barriers to visiting doctor</i>							
<b>Long distance of the clinic</b>							
Yes	24	13.3	15	20.8	9	8.3	0.015
No	156	86.7	57	79.2	99	91.7	
<b>Financial burden</b>							
Yes	25	13.9	14	19.4	11	10.2	0.063
No	155	86.1	58	80.6	97	89.8	
<b>Lack of time</b>							
Yes	39	21.7	27	37.5	12	11.1	0.000
No	141	78.3	45	62.5	96	88.9	
<b>Don't want to</b>							
Yes	38	21.1	21	29.2	17	15.7	0.025
No	142	78.9	51	70.8	91	84.3	
<i>Barriers to exercise</i>							
<b>Due to having no time</b>							
Yes	47	26.1	28	38.9	19	17.6	0.001
No	133	73.9	44	61.1	89	82.4	
<b>Lack of local facilities</b>							
Yes	10	5.6	5	6.9	5	4.6	0.364
No	170	94.4	67	93.1	103	95.4	
<b>Doing exercise is difficult</b>							
Yes	52	28.9	26	36.1	26	24.1	0.058
No	128	71.1	46	63.9	82	75.9	
<b>Get tired after exercise</b>							
Yes	48	26.7	28	38.9	20	18.5	0.002
No	132	73.3	44	61.1	88	81.5	

**Table 3: Simple logistic regression analysis with the outcome ‘adherence to recommended regime’ (among type 2 DM patients visiting a PHC clinic in East Delhi, India, 2018)**

	<b>OR</b>	<b>95% CI</b>	<b>P-value</b>
<b>Gender</b>			
Male	2.04	1.11-3.74	0.021
Female	1.00		
<b>Obesity status</b>			
Obese	1.68	0.86-6.71	0.129
Not obese	1.00		
<b>Education</b>			
Less than 9 years	1.00		
9 to 12 years	1.18	0.61-2.29	0.625
More than 12 years	2.15	0.89-5.19	0.087
<b>Family Income</b>			
High Income	5.48	2.35-12.79	0.000
Low and middle income	1.00		
<b>Marital Status</b>			
Married	0.52	0.25-1.08	0.082
Unmarried	1.00		
<b>Living in joint family</b>			
Yes	0.60	0.33-1.10	0.101
No	1.00		
<b>Knowledge about DM</b>			
Adequate knowledge	1.34	1.15-1.56	0.000
Poor knowledge	1.00		
<b>Duration of being diagnosed with DM (years)</b>			
	0.96	0.92-1.00	0.090
<b>Smoking</b>			
Yes	2.39	1.12- 4.85	0.016
No	1.00		
<b>Received any education on DM</b>			
Yes	2.29	0.97-5.07	0.059
No	1.00		
<b>Financial problems to buy medicine</b>			
Yes	0.52	0.28-0.98	0.043
No	1.00		
<b>Asked by doctor to report side effects</b>			
Yes	1.65	0.78-3.50	0.189
No	1.00		
<b>Received advice about diet, exercise, medication and glucose monitoring frequency</b>			
Yes	5.50	2.20-13.97	0.000
No	1.00		
<b>Having a blood glucometer</b>			
Yes	3.49	1.82-6.71	0.000
No	1.00		

	<b>OR</b>	<b>95% CI</b>	<b>P-value</b>
<b>High cost of medicine</b>			
Yes	2.25	1.04-4.89	0.039
No	1.00		
<b>Complex prescription</b>			
Yes	0.82	0.33-2.09	0.685
No	1.00		
<b>Forgetfulness</b>			
Yes	1.48	0.67-3.27	0.333
No	1.00		

**Table 4: Multiple logistic regression model of determinants of adherence to recommended regime among type 2 DM patients in a primary health care clinic in East Delhi, India, 2018**

	<b>OR</b>	<b>95% CI</b>	<b>P- Value</b>
<b>Adequate knowledge about DM</b>	1.28	1.02 – 1.61	0.034
<b>High level of income (vs. middle/low income)</b>	9.11	2.97 – 27.91	0.000
<b>Received advice from doctor about diet, exercise, medication and frequency of glucose monitoring</b>	5.22	1.34 – 20.32	0.017
<b>Current smoking</b>	6.54	2.17- 19.74	0.001
<b>Being obese</b>	3.24	1.16- 9.49	0.032

Cases included in the analysis = 124

Hosmer and Lemeshow test significance=0.125

**Table 5: Sociodemographic factors and health behavior of participants by adherence to medication groups (among type 2 DM patients visiting a PHC clinic in East Delhi, India, 2018)**

Characteristics	Total sample (N=180)		Non adherent (N=114)		Adherent (N=66)		P value
	n/mean	%/SD	n/mean	%/SD	n/mean	%/SD	
<b>Age, mean (SD)</b>	42.60	13.62	44.19	13.72	39.86	13.11	0.039
<b>Gender</b>							
Male	99	55.0	61	53.5	38	57.6	0.355
Female	81	45.0	53	46.5	28	42.4	
<b>BMI, mean (SD)</b>	25.78	4.30	25.19	3.91	26.80	4.77	0.015
<b>Education</b>							
Less than 9 years	64	35.6	46	40.4	18	27.3	0.091
9 to 12 years	80	44.4	50	43.9	30	45.5	0.092
More than 12 years	36	20.0	18	15.8	18	27.2	0.030
<b>Employment</b>							
Employed	92	51.1	58	50.9	34	51.5	0.944
Homemaker	53	29.4	33	28.9	20	30.3	0.944
Other	35	19.4	23	20.2	12	18.2	0.755
<b>Family income</b>							
Low/middle	73	56.2	53	66.2	20	40.0	0.003
High Income	57	43.8	27	33.8	30	60.0	
<b>Marital status</b>							
Married	135	75.0	91	79.8	44	66.7	0.038
Unmarried	45	25.0	23	20.2	22	33.3	
<b>Living in joint family</b>							
Yes	94	52.2	66	57.9	28	42.4	0.032
No	86	47.8	48	42.1	38	57.6	
<b>Number of family members, mean (SD)</b>	9.02	4.98	9.42	5.20	8.31	4.52	0.152
<b>Health characteristics</b>							
<b>Duration of diagnosis, mean (SD)</b>	8.45	6.38	8.76	6.24	7.91	6.65	0.388
<b>Family history of DM</b>							
Yes	118	69.4	81	74.3	37	60.7	0.047
No	52	30.6	28	25.7	24	39.3	
<b>Smoking</b>							
Yes	56	32.7	33	31.1	23	35.4	0.341
No	115	67.3	73	68.9	42	64.6	
<b>Alcohol</b>							
Drinker	44	24.4	27	23.7	17	25.8	0.444
Non drinker	136	75.6	87	76.3	49	74.2	

Characteristics	Total sample (N=180)		Non adherent (N=114)		Adherent (N=66)		P value
	n/mean	%/SD	n/mean	%/SD	n/mean	%/SD	
<b>Taking Insulin</b>							
Yes	62	34.4	42	36.8	20	30.3	0.234
No	118	65.6	72	63.2	46	69.7	
<b>Depression symptoms</b>							
Present	18	10.0	10	8.8	8	12.1	0.317
Absent	162	90.0	104	91.2	58	87.9	
<b>Received educational material on DM</b>							
Yes	35	19.4	23	20.2	12	18.2	0.452
No	145	80.6	91	79.8	54	81.8	
<b>Financial problem buying medicine</b>							
Yes	64	35.6	48	42.1	16	24.2	0.011
No	116	64.4	66	57.9	50	75.8	
<b>Side effects</b>							
Yes	37	20.6	27	23.7	10	15.2	0.119
No	143	79.4	87	76.3	56	84.8	
<b>Asked by doctor to report side effects</b>							
Yes	146	81.1	91	79.8	55	83.3	0.355
No	34	18.9	23	20.2	11	16.7	
<b>Received advice from doctor about diet, exercise and glucose monitoring frequency</b>							
Yes	153	85.0	90	78.9	63	95.5	0.002
No	27	15.0	24	21.1	3	4.5	
<b>Knowledge score, mean (SD)</b>	5.08	2.15	4.67	2.14	5.80	1.99	0.001
<b>Blood glucometer</b>							
Yes	122	67.8	69	60.5	53	80.3	0.004
No	58	32.2	45	39.5	13	19.7	
<b>Instances of not taking medicine</b>							
Yes	108	60.0	78	68.4	30	45.5	0.002
No	72	40.0	36	31.6	36	54.5	
<b>Reasons for not taking medicine</b>							
<b>High cost of medicine</b>							
Yes	50	27.8	34	29.8	16	24.2	0.265
No	130	72.8	80	70.2	50	75.8	
<b>Complex prescription</b>							
Yes	23	12.8	17	14.9	6	9.1	0.186
No	157	87.2	97	85.1	60	90.9	
<b>Forgetfulness</b>							
Yes	69	38.3	49	43.0	20	30.3	0.063
No	111	61.7	65	57.0	46	69.7	

Characteristics	Total sample (N=180)		Non adherent (N=114)		Adherent (N=66)		P value
	n/mean	%/SD	n/mean	%/SD	n/mean	%/SD	
<b>Visit to doctor for DM</b>							
< 5 times per year	85	47.2	64	56.1	21	31.8	0.001
≥ 5 times per year	95	52.8	50	43.9	45	68.2	
<b><i>Barriers to visit to the doctor</i></b>							
<b>Long distance of the clinic</b>							
Yes	24	13.3	17	14.9	7	10.6	0.281
No	156	86.6	97	85.1	59	89.4	
<b>Financial burden</b>							
Yes	25	13.9	16	14.0	9	13.6	0.565
No	155	86.1	98	86.0	57	86.4	
<b>Lack of time</b>							
Yes	39	21.7	34	29.8	5	7.6	0.000
No	141	78.3	80	70.2	61	92.4	
<b>Don't want to</b>							
Yes	38	21.9	26	22.8	12	18.2	0.296
No	142	78.1	88	77.2	54	81.8	
<b><i>Barriers to exercise</i></b>							
<b>Due to having no time</b>							
Yes	47	26.1	35	30.7	12	18.2	0.046
No	133	73.9	79	69.3	54	81.8	
<b>Lack of local facilities</b>							
Yes	10	5.6	7	6.1	3	4.5	0.467
No	170	94.4	107	93.9	63	95.5	
<b>Doing exercise is difficult</b>							
Yes	52	28.9	35	30.7	17	25.8	0.298
No	128	71.1	79	69.3	49	74.2	
<b>Get tired after exercise</b>							
Yes	48	26.7	37	32.5	11	16.7	0.015
No	132	73.3	77	67.5	55	83.3	

**Table 6: Simple logistic regression analysis with outcome ‘adherence to medication’ (among type 2 DM patients visiting a PHC clinic in East Delhi, India, 2018)**

	<b>OR</b>	<b>95%CI</b>	<b>P-value</b>
<b>Age</b>	0.97	0.95-0.91	0.042
<b>Obesity status</b>			
Obese	2.49	1.29-4.80	0.006
Not obese	1.00		
<b>Education</b>			
Less than 9 years	1.00		
9 to 12 years	1.53	0.75-3.11	0.237
More than 12 years	2.55	1.09-5.98	0.031
<b>Family income</b>			
High income	2.94	1.41-6.11	0.004
Low and middle income	1.00		
<b>Marital status</b>			
Married	0.50	0.25-1.00	0.051
Unmarried	1.00		
<b>Living in joint family</b>			
Yes	0.53	0.29-0.99	0.046
No	1.00		
<b>Family history of DM</b>			
Yes	0.53	0.27-1.04	0.065
No	1.00		
<b>Knowledge about DM</b>			
Adequate knowledge	2.76	1.48-5.11	0.001
Poor knowledge	1.00		
<b>Received advice about diet, exercise, medication and glucose monitoring frequency</b>			
Yes	5.60	1.61-19.40	0.007
No	1.00		
<b>Having a blood glucometer</b>			
Yes	2.65	1.30-5.43	0.007
No	1.00		
<b>Forgetfulness</b>			
Yes	0.58	0.30-1.09	0.093
No	1.00		
<b>Number of family members</b>	0.95	0.89-1.01	0.153
<b>Visit to doctor</b>			
Less than five times per year	1.00	0.19-0.68	0.002
More than equal to 5 times per year	0.36		
<b>Getting tired after exercise</b>			
Yes	0.41	0.19-0.89	0.023
No	1.00		
<b>Due to having no time</b>			
Yes	0.50	0.24-1.05	0.068
No	1.00		



	<b>OR</b>	<b>95%CI</b>	<b>P-value</b>
<b>Experienced side effects</b>			
Yes	0.57	0.26-1.27	0.175
No	1.00		
<b>Lack of time</b>			
Yes	0.27	0.09-0.84	0.024
No	1.00		

**Table 7: Multiple logistic regression model of determinants of adherence to medication among type 2 DM patients in a PHC clinic in East Delhi, India, 2018**

	<b>OR</b>	<b>95% CI</b>	<b>P- Value</b>
<b>Adequate knowledge about DM</b>	2.26	1.01-5.10	0.048
<b>High income (vs. middle/low income)</b>	2.43	1.06-5.55	0.035
<b>Received advice from doctor about diet, exercise and medication</b>	5.40	1.04-28.03	0.045
<b>Age over 40 years</b>	0.29	0.12-0.68	0.004
<b>Being obese</b>	3.17	1.32-7.61	0.010

Cases = 150

Hosmer and Lemeshow significance = 0.529

## Appendix 3: Screening form (English)

### Screening Form

**1. What is your current age (in years)?**

- 18 years or more
- Less than 18 years → *Stop the interview and thank the person.*

**2. Are you a resident of East Delhi?**

- Yes
- No → *Stop the interview and thank the person.*

**3. Have you ever told by a doctor that you have diabetes mellitus?**

- Yes
- No → *Stop the interview and thank the person.*

**4. How long ago were you diagnosed with diabetes?**

- More than 6 months ago
- Less than 6 months ago → *Stop the interview and thank the person.*
- Do not remember → *Stop the interview and thank the person.*

**5. When your diabetes was first diagnosed, were you prescribed with insulin?**

- No
- Yes → *Stop the interview and thank the person.*
- Don't remember → *Stop the interview and thank the person.*

## Appendix 3 a: Screening form (Hindi)

### जाँच पत्र

#### 1. आपकी वर्तमान आयु (वर्ष में) क्या है?

- 18 वर्ष या अधिक
- 18 वर्ष से कम → साक्षात्कार बंद करो और व्यक्ति को धन्यवाद करे।

#### 2. क्या आप पूर्वी दिल्ली के निवासी हैं?

- हाँ
- नहीं → साक्षात्कार बंद करो और व्यक्ति को धन्यवाद करे।

#### 3. क्या आपसे कभी डॉक्टर ने कहा है कि आपको मधुमेह है?

- हाँ
- नहीं → साक्षात्कार बंद करो और व्यक्ति को धन्यवाद करे।

#### 4. कितनी समय पहले आप के मधुमेह का निदान किया गया था?

- पिछले 6 महीने से अधिक पहले
- पिछले 6 महीने के भीतर → साक्षात्कार बंद करो और व्यक्ति को धन्यवाद करे।
- याद नहीं → साक्षात्कार बंद करो और व्यक्ति को धन्यवाद करे।

#### 5. जब आपके मधुमेह पहले का निदान किया गया था, आप इंसुलिन के साथ निर्धारित थे?

- नहीं
- हाँ → साक्षात्कार बंद करो और व्यक्ति को धन्यवाद करे।
- याद नहीं → साक्षात्कार बंद करो और व्यक्ति को धन्यवाद करे।

## Appendix 4: Consent form (English)

### American University of Armenia

Gerald and Patricia Turpanjian School of Public Health

#### Consent Form

Hello, my name is \_\_\_\_\_ and I am a trained interviewer working for Shiba, a graduate student of Master of Public Health Program at Gerald and Patricia Turpanjian School of Public Health at American University of Armenia (AUA). In the scope of her master of public health thesis project, she is conducting a study to assess the level of adherence to recommended treatment regime, its determinants and perceived barriers to non-adherence among type 2 diabetic patients in East Delhi district. This hospital was chosen to be included in this study. If you agree to participate in this study, then you will be one of the 180 participants randomly selected for this study. Questionnaire include questions about diabetes mellitus and its treatment, and the barriers you face to adhere to treatment. Your participation in this study is voluntary and there is no risk if you accept to participate. I will give you a questionnaire to complete and its completion will take about 10-15 minutes. Your participation is limited to this interview only and we will not contact you after this. This study will not benefit you personally, but we hope that our results will be helpful to understand how to improve the adherence to treatment regime among type 2 diabetic patients by reducing the barriers.

You may skip any question that you do not want to answer and also refuse to participate. Refusing to participate will not involve any penalty and whether or not participating in the study will not affect your future treatment services at this clinic.

All the information provided by you will be confidential as no identifiable information like your name or phone number will be collected and only your answers will be combined with the answers provided by other 180 participants, will be used for analysis and aggregated data will be reported. If you have more questions about this study or you feel you are not treated fairly you can contact Dr. Rajesh Makkar, Head of Makkar Hospital (+91 9560749535) or Dr. Anahit Demirchyan, principal investigator of this study by contacting (+374 60612562) or [ademirch@.aua.am](mailto:ademirch@.aua.am) (English language) and Varduhi Hayrumyan AUA Human participation protection administrator by contacting (+374 60612562) or emailing [AUAIRB@aua.am](mailto:AUAIRB@aua.am) (English language).

If you agree to participate, could we continue?

Thank you for participation.

## Appendix 4 a: Consent form (Hindi)

आर्मेनिया के अमेरिकी विश्वविद्यालय

गेराल्ड और पेट्रीसिया तुरपानजियान स्कूल आफ पब्लिक हेल्थ

#1 मौखिक सहमति प्रपत्र

नमस्ते, मेरा नाम \_\_\_\_\_ है। मैं एक प्रशिक्षित साक्षात्कारकर्ता हूँ। मैं शिबा शिबा के लिए काम कर रहा हूँ जो कि गेराल्ड और पेट्रीसिया तुरपानजियान स्कूल आफ पब्लिक हेल्थ, आर्मेनिया के अमेरिकी विश्वविद्यालय में सार्वजनिक स्वास्थ्य के कोर्स में अंतिम वर्ष की छात्रा है। सार्वजनिक स्वास्थ्य थीसिस परियोजना के दायरे में, वह एक अध्ययन का आयोजन कर रहे हैं जिसका उद्देश्य पूर्वी दिल्ली जिले में रहने वाले मधुमेह के रोगियों में निर्देशित उपचारों के पालन का स्तर, उसके निर्धारकों और कथित बाधाओं को जाचना है।

इस अस्पताल को इस अध्ययन में शामिल करने के लिए चुना गया था। यदि आप इस अध्ययन में भाग लेने के लिए सहमत हैं, तो आप बेतरतीब ढंग से इस अध्ययन के लिए चयनित 180 प्रतिभागियों में से एक होंगे। मैं आपसे मधुमेह और उसके उपचारों के पालन से संबंधित बाधाओं के बारे में कुछ सवाल पूछूंगा। इस अध्ययन में आपकी भागीदारी स्वैच्छिक है और इसमें कोई जोखिम नहीं है। यदि आप भाग लेने के लिए स्वीकार करते हैं, तो आपको एक प्रश्नावली पूरी करने के लिये दी जाएगी और इसे पूरा करने में लगभग 10-15 मिनट लग जाएंगे। इस अध्ययन में आपको व्यक्तिगत रूप से लाभ नहीं होगा, लेकिन हमें उम्मीद है कि हमारे परिणाम मधुमेह रोगियों के बीच उपचार के शासन के पालन में सुधार करने और बाधाओं को समझके कम करने के लिए उपयोगी होंगे।

आप जिस भी सवाल का जवाब नहीं देना चाहते उसे छोड़ सकते हैं और भाग लेने से भी मना कर सकते हैं। भाग लेने से इनकार करने पर किसी भी प्रकार का जुर्माना शामिल नहीं है और ना ही इस क्लिनिक में आपके भविष्य की उपचार सेवाओं को प्रभावित करेगा।

आपके द्वारा प्रदान की गई सभी जानकारी आपके नाम या फ़ोन नंबर जैसे कोई पहचाने जाने योग्य जानकारी एकत्र नहीं की जाएगी और केवल आपके उत्तरों को अन्य 180 प्रतिभागियों के उत्तरों के साथ विश्लेषण के लिए उपयोग की जाएगी और डेटा सूचित किया जाएगा यदि आपको इस अध्ययन के बारे में अधिक प्रश्न हैं या आपको लगता है कि आपके साथ दुरव्यवहार हुआ है तो आप इस क्लिनिक के प्रमुख डॉ. राजेश मक्कर (+91 9560749535) और डॉ. अनाहित देमिर्चियान, इस अध्ययन की प्रमुख अंवेशक से संपर्क कर सकते हैं (+374 60612562) [ademirch@aua.am](mailto:ademirch@aua.am) (अंग्रेजी भाषा में)। वारदुहि हायरूमयान, मानव भागीदारी संरक्षण प्रशासक को ईमेल द्वारा (+374 60612562) [AUAIRB@aua.am](mailto:AUAIRB@aua.am) (अंग्रेजी भाषा में) संपर्क कर सकते हैं।

यदि आप भाग लेने के लिए सहमत हैं, तो हम जारी रख सकते हैं?

आपकी भागीदारी के लिए धन्यवाद।

**Appendix5 Questionnaire : (English)**

**American University of Armenia**

*Adherence to recommended regime among Diabetes Mellitus patients in East Delhi,  
India: A cross sectional survey*

**Instructions for completing the questionnaire:**

*First; carefully read each question and possible responses. Choose the option that best represents your response and check (✓) in the corresponding box. Some questions should be answered by a number or words. There are blank lines in front of these questions for you to write your response.*

*Please follow the instructions in **ITALICS** . These instructions will help you to complete the questionnaire. Please answer ALL THE questions.*

Example:

*Below given is an example to show how to check a response in tables.*

	<b>Question</b>	<b>Correct (1)</b>	<b>Incorrect (2)</b>	<b>Don't know (3)</b>
1.	Delhi is the capital of India.	<input checked="" type="checkbox"/> 1. Correct	<input type="checkbox"/> 2. Incorrect	<input type="checkbox"/> 3. Don't know

## Questionnaire

ID 

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Start time (hh/mm) \_\_\_\_/\_\_\_\_

Date (dd/mm/yyyy) \_\_\_\_/\_\_\_\_/\_\_\_\_

1. **How many years ago were you first diagnosed with diabetes?** (*Instruction: if you do not remember the exact number of years, mention the approximate number.*) \_\_\_\_\_
  
2. **Does anyone in your family has or had diabetes mellitus (eg. your mother, father or siblings)?**  
 1. Yes             0. No             99. Don't know

### Section A: Demographic information

3. **What is your current age in years?** \_\_\_\_\_
  
4. **What is your gender?**                             0. Female     1. Male
  
5. **What is your current wieght (in kg)?** \_\_\_\_\_ kg
  
6. **What is your height (in feet)?** \_\_\_\_\_ feet
  
7. **What is your level of education?**  
 1. Primary school (1<sup>st</sup> to 5<sup>th</sup> grade)  
 2. Middle school (6<sup>th</sup> to 8<sup>th</sup> grade)  
 3. High school (9<sup>th</sup> to 10<sup>th</sup> grade)  
 4. High secondary school (11<sup>th</sup> to 12<sup>th</sup> grade )  
 5. College (Undergraduate)  
 6. College (Postgraduate) or higher
8. **What is your employment status?**  
 0. Student  
 1. Unemployed  
 2. Employed  
 3. Homemaker/housewife  
 4. Retired



**9. What is the monthly income of your family?**

- 1. INR 1000 to 33000
- 2. INR 33001 to 55000
- 3. INR 55001 to 88800
- 4. INR 88801 to 150,000
- 5. Above INR 150,000
- 99. Don't know/refusal

**10. What is your marital status?**

- 0. Single
- 1. Married
- 2. Divorced
- 3. Widow

**11. Do you live in joint family?**

- 0. No
- 1. Yes

**12. How many people live in your family/household? \_\_\_\_\_**

**13. Do you smoke regularly?**

- 1. Yes
- 0. No
- 99. Refuse to answer

**14. Does any of your family members smoke indoors in your presence regularly?**

- 1. Yes
- 0. No
- 99. Refuse to answer

**15. How often do you have a drink containing alcohol?**

- 0. Never (*skip to question 18*)
- 1. Monthly or less
- 2. Two to four times a month
- 3. Two to three times a week
- 4. Four or more times a week

**16. How many drinks containing alcohol do you have on a typical day when you are drinking?**

- 0. One or two
- 1. Three or four
- 2. Five or six
- 3. Seven to nine

4. Ten or more

**17. How often do you have more than five or more drinks on one occasion?**

- 0. Never
- 1. Less than monthly
- 2. Monthly
- 3. Weekly
- 4. Daily or almost daily

Section B: Knowledge about diabetes mellitus (check the correct option)

	<b>Questions</b>	<b>Correct (1)</b>	<b>Incorrect (2)</b>	<b>Don't know (3)</b>
18.	Eating too much sugar and sweet food can lead to high blood glucose level.	<input type="checkbox"/> 1. Correct	<input type="checkbox"/> 2. Incorrect	<input type="checkbox"/> 3. Don't know
19.	The usual cause of diabetes is lack of effective insulin in the body.	<input type="checkbox"/> 1. Correct	<input type="checkbox"/> 2. Incorrect	<input type="checkbox"/> 3. Don't know
20.	Alcohol intake can lead to high blood glucose level.	<input type="checkbox"/> 1. Correct	<input type="checkbox"/> 2. Incorrect	<input type="checkbox"/> 3. Don't know
21.	High level of blood glucose for longer duration leads to early onset of diabetic complications.	<input type="checkbox"/> 1. Correct	<input type="checkbox"/> 2. Incorrect	<input type="checkbox"/> 3. Don't know
22.	Diabetes can damage major organs of the patient (for example, kidneys or heart).	<input type="checkbox"/> 1. Correct	<input type="checkbox"/> 2. Incorrect	<input type="checkbox"/> 3. Don't know
23.	Diabetes can cause loss of feeling in patient's hands, fingers and feet.	<input type="checkbox"/> 1. Correct	<input type="checkbox"/> 2. Incorrect	<input type="checkbox"/> 3. Don't know
24.	Diabetes can cause retinopathy (blindness).	<input type="checkbox"/> 1. Correct	<input type="checkbox"/> 2. Incorrect	<input type="checkbox"/> 3. Don't know
25.	I know what is diabetic foot.	<input type="checkbox"/> 1. Correct	<input type="checkbox"/> 2. Incorrect	<input type="checkbox"/> 3. Don't know
26.	A person can control his/her glucose level by following proper diet and exercise.	<input type="checkbox"/> 1. Correct	<input type="checkbox"/> 2. Incorrect	<input type="checkbox"/> 3. Don't know

Section C: Adherence to medication (MGL Scale) (*tick in the corresponding box*)

	Questions	Yes (1)	No (2)
27.	Have you ever forgotten to take your medicine?	<input type="checkbox"/> 1.Yes	<input type="checkbox"/> 2. No
28.	Are you careless at times about taking your medicine?	<input type="checkbox"/> 1.Yes	<input type="checkbox"/> 2. No
29.	When you feel better, do you sometimes stop taking your medicine?	<input type="checkbox"/> 1.Yes	<input type="checkbox"/> 2. No
30.	Sometimes if you feel worse when you take the medicine, do you stop taking it?	<input type="checkbox"/> 1.Yes	<input type="checkbox"/> 2. No

**31. How many of last seven days have you followed a diet recommended by your doctor? \_\_\_\_\_**

**32. How many of the last seven days have you checked your feet? \_\_\_\_\_**

**33. Do you exercise every day for at least 30 minutes?**

1. Yes (*go to question 35*)       0. No       99. Don't know

**34. Due to which of the following you don't exercise for at least 30 minutes per day?**

(*tick all what applies*)

1. Due to having no time  
 2. Because of lack of local facilities (like a park, gym or pedestrian way) to exercise  
 3. Because doing exercise is difficult  
 4. Because I get tired after exercise  
 5. Other reason (*specify*) \_\_\_\_\_

**35. Are you taking insulin injections?**

1. Yes       0. No

**36. Usually how often do you visit a doctor for your diabetes?**

0. Never  
 1. Once in 4-5 years

- 2. Once in 2-3 years
- 3. One or two times a year
- 4. Three to four times a year
- 5. Five or more times a year (*go to question 38*)

**37. What hinders you to visit the doctor for diabetes more often?** (*tick all what applies*)

- 1. Long distance of the clinic from home
- 2. Financial burden
- 3. Lack of time
- 4. Don't want to
- 5. Other \_\_\_\_\_

**Section D: Perceived barriers to adherence**

**38. Have you ever received advice from your doctor or nurse about exercise, diet and frequency of blood glucose monitoring?**

- 1. Yes
- 0. No
- 99. Don't know

**39. Have you ever had problem in buying prescribed medicines due to financial problems?**

- 1. Yes
- 0. No
- 99. Don't know

**40. Are there any instances when you cannot take your medicines?**

- 1. Yes
- 0. No (*go to question 42*)

**41. What are some of the reasons due to which, sometimes you cannot take medicines?**

*(tick all what applies)*

- 1. High cost of medicine
- 2. Complex prescription (too many pills)
- 3. Forgetfulness
- 4. Other (*specify*)\_\_\_\_\_

**42. Have you experienced any side effects with your prescribed drugs for diabetes?**

- 1. Yes
- 0. No
- 99. Don't know

**43. Have you been asked by your doctor to report if you develop any side effects?**

- 1. Yes
- 0. No
- 99. Don't know

**44. Do you have a blood glucometer at home?**

- 1. Yes
- 0. No
- 99. Don't know

**Over the past two weeks, how often have you been bothered by any of the following problems?**

<b>Problem</b>	<b>Not at all (0)</b>	<b>Several days (1)</b>	<b>More than half the days (2)</b>	<b>Nearly every day (3)</b>
<b>45.</b> Feeling little interest or pleasure in doing things.	<input type="checkbox"/> 0. Not at all	<input type="checkbox"/> 1. Several days	<input type="checkbox"/> 2. More than half the days	<input type="checkbox"/> 3. Nearly every day
<b>46.</b> Feeling down, depressed or hopeless.	<input type="checkbox"/> 0. Not at all	<input type="checkbox"/> 1. Several days	<input type="checkbox"/> 2. More than half the days	<input type="checkbox"/> 3. Nearly every day

**47. Have you ever received any training or written material on diabetes?**

- 1. Yes
- 0. No

*Thank you for answering the questions!*

## Appendix 5 a : Questionnaire (Hindi)

### आर्मेनिया के अमेरिकी विश्वविद्यालय

पूर्वी दिल्ली, भारत में मधुमेह रोगियों के बीच अनुशासित उपचर का पालन: एक क्रॉस अनुभागीय सर्वेक्षण

#### प्रश्नावली को पूरा करने के लिए निर्देश:

पहले; ध्यान से प्रत्येक प्रश्न और संभव प्रतिक्रियाओं को पढ़ें। विकल्प है कि सबसे अच्छा अपनी प्रतिक्रिया का प्रतिनिधित्व करता है और जांच (✓) संबंधित बॉक्स में चिह्नित करे। कुछ प्रश्नों का उत्तर किसी संख्या या शब्दों से देना है। आपकी प्रतिक्रिया लिखने के लिए इन प्रश्नों के सामने रिक्त पंक्तियाँ हैं।

**इटलिक्स** में दिए गए निर्देशों का पालन करें। ये निर्देश आपको प्रश्नावली को पूरा करने में मदद करेंगे। कृपया सभी प्रश्नों का उत्तर दें।

#### उदाहरण:

नीचे दिया गया एक उदाहरण आपको दिखाता है कि तालिकाओं में से विकल्प कैसे चुनें।

	सवाल	सही (1)	गलत (2)	पता नहीं (3)
1.	दिल्ली भारत की राजधानी है।	<input type="checkbox"/> <input type="checkbox"/> 1. सही	<input type="checkbox"/> 2 . गलत	<input type="checkbox"/> 3. पता नहीं

## प्रश्नावली

ID

प्रारंभ समय (hh/mm) \_\_\_\_/\_\_\_\_

1. कितने साल पहले आपको अपनी मधुमेह (शुगर) की बिमारी के बारे में पता चला था? (अनुदेश: यदि आपको वर्षों की सही संख्या याद नहीं है, तो अनुमानित संख्या का उल्लेख करें।) \_\_\_\_\_
2. क्या आपके परिवार में किसी को भी मधुमेह (शुगर की बिमारी) थी या अभी है (उदाहरण आपकी मां, पिता या भाई बहन)?  
 1. हाँ  0. नहीं  99. पता नहीं

अनुभाग A: जनसांख्यिकीय जानकारी

3. आपकी वर्तमान उम्र क्या है (वर्षों में)? \_\_\_\_\_
4. आपका लिंग क्या है?  0. महिला  1. पुरुष
5. आपका वर्तमान वजन (किलोग्राम में) क्या है? \_\_\_\_\_
6. आपकी ऊँचाई क्या है (फुट में)? \_\_\_\_\_
7. आपकी शिक्षा का स्तर क्या है?  
 1. प्राथमिक विद्यालय (पहली -5<sup>वीं</sup> कक्षा)  
 2. माध्यमिक विद्यालय (6<sup>वीं</sup>- 8<sup>वीं</sup> कक्षा)  
 3. उच्च विद्यालय (9<sup>वीं</sup>- 10<sup>वीं</sup> कक्षा)  
 4. वरिष्ठ माध्यमिक विद्यालय (11<sup>वीं</sup> से 12<sup>वीं</sup> कक्षा)  
 5. कॉलेज (स्नातक/ग्रेजुएट)  
 6. कॉलेज (स्नातकोत्तर/पोस्ट ग्रेजुएट) या उच्चतर
8. आपके रोजगार की स्थिति क्या है?  
 0. छात्र  
 1. बेरोजगार  
 2. कार्यरत  
 3. गृहिणी

4. सेवानिवृत्त

9. आपके परिवार की मासिक आय क्या है?

1. रु 1000 से 33000  
 2. रु 33001 से 55000  
 3. रु 55001 से 88800  
 4. रु 88801 से 150,000  
 5. रु 150,000 से ऊपर  
 99. पता नहीं / जवाब देने से इनकार

10. आपकी वैवाहिक स्थिति क्या है?

0. एकल  
 1. विवाहित  
 2. तलाकशुदा  
 3. विधवा

11. क्या आप संयुक्त परिवार में रहते हैं?

0. नहीं     1. हां

12. आपके परिवार में कितने लोग रहते हैं ? \_\_\_\_\_

13. क्या आप नियमित रूप से धूम्रपान करते हैं?

1. हां     0. नहीं     99. जवाब देने से इनकार

14. क्या आपके परिवार का कोई भी सदस्य नियमित रूप से आपकी उपस्थिति में घर के अंदर धूम्रपान करता है?

1. हां     0. नहीं     99. जवाब देने से इनकार

15. कितनी बार आप शराब युक्त ड्रिंक का सेवन करते हैं?

0. कभी नहीं (18 प्रश्न पर जाएं)  
 1. मासिक या उससे कम  
 2. महीने में दो से चार बार



- 3. सप्ताह में दो से तीन बार
- 4. सप्ताह में चार या अधिक बार

16. एक आम दिन पर आप शराब से युक्त कितने पेय (ड्रिंक) पीते हैं?

- 0. एक या दो
- 1. तीन या चार
- 2. पांच या छह
- 3. सात से नौ
- 4. दस या अधिक

17. आप कितनी बार एक अवसर पर पांच या उस से अधिक पेय (ड्रिंक) पीते हैं?

- 0. कभी नहीं
- 1. मासिक से कम
- 2. मासिक
- 3. साप्ताहिक
- 4. दैनिक या लगभग दैनिक

अनुभाग B: मधुमेह के बारे में ज्ञान (सही विकल्प चुनें)

	प्रश्न	सही (1)	गलत (2)	पता नहीं (3)
18.	बहुत ज्यादा चीनी और मीठा खाना खाने से उच्च रक्त शर्करा का स्तर बढ़ सकता है।	<input type="checkbox"/> 1. सही	<input type="checkbox"/> 2. गलत	<input type="checkbox"/> 3. पता नहीं
19.	मधुमेह का सामान्य कारण शरीर में प्रभावी इंसुलिन की कमी है।	<input type="checkbox"/> 1. सही	<input type="checkbox"/> 2. गलत	<input type="checkbox"/> 3. पता नहीं
20.	शराब का सेवन उच्च रक्त शर्करा के स्तर को जन्म दे सकता है।	<input type="checkbox"/> 1. सही	<input type="checkbox"/> 2. गलत	<input type="checkbox"/> 3. पता नहीं
21.	लमबी अवधि के लिए उच्च रक्त ग्लूकोज स्तर मधुमेह की जटिलताओं को जल्दी शुरू करता है।	<input type="checkbox"/> 1. सही	<input type="checkbox"/> 2. गलत	<input type="checkbox"/> 3. पता नहीं
22.	मधुमेह, रोगी के प्रमुख अंगों को नुकसान पहुंचा सकता है (उदाहरण के लिए, गुर्दे या दिल)	<input type="checkbox"/> 1. सही	<input type="checkbox"/> 2. गलत	<input type="checkbox"/> 3. पता नहीं

23.	मधुमेह रोगी के हाथ, उंगलियों और पैरों में महसूस करने की क्षमता को हानि पहुँचा सकता है।	<input type="checkbox"/> 1. सही	<input type="checkbox"/> 2. गलत	<input type="checkbox"/> 3. पता नहीं
24.	मधुमेह रेटिनोपैथी (अंधापन) पैदा कर सकता है।	<input type="checkbox"/> 1. सही	<input type="checkbox"/> 2. गलत	<input type="checkbox"/> 3. पता नहीं
25.	मैं जानता हूँ कि क्या मधुमेह पैरो को नुकसान पहुँचाता है।	<input type="checkbox"/> 1. सही	<input type="checkbox"/> 2. गलत	<input type="checkbox"/> 3. पता नहीं
26.	एक व्यक्ति उचित आहार और व्यायाम का पालन करके अपने ग्लूकोज स्तर को नियंत्रित कर सकते हैं।	<input type="checkbox"/> 1. सही	<input type="checkbox"/> 2. गलत	<input type="checkbox"/> 3. पता नहीं

अनुभाग C: दवा का पालन (MGL स्केल) (आपके जवाब वाले बॉक्स में चिह्नित करें)

	प्रश्न	हाँ (1)	नहीं (2)
27.	क्या आप कभी अपनी दवा लेना भूलें हैं?	<input type="checkbox"/> 1. हाँ	<input type="checkbox"/> 2. नहीं
28.	क्या आप अपनी दवा लेने के बारे में कई समय पर लापरवाह हैं?	<input type="checkbox"/> 1. हाँ	<input type="checkbox"/> 2. नहीं
29.	जब आप बेहतर महसूस करते हैं, तो आप कभी कभार अपनी दवा लेना बंद कर देते हैं?	<input type="checkbox"/> 1. हाँ	<input type="checkbox"/> 2. नहीं
30.	कई बार अगर आपको दवा लेने पर बुरा महसूस होता है तो, क्या आप दवा लेना बंद कर देते हैं?	<input type="checkbox"/> 1. हाँ	<input type="checkbox"/> 2. नहीं

31. पिछले सात दिनों में से कितने दिन आपने अपने डॉक्टर द्वारा अनुशंसित आहार का पालन किया है? \_\_\_\_\_

32. पिछले सात दिनों में से कितने दिन आपने अपने पैरों की जाँच की है? \_\_\_\_\_

33. क्या आप हर दिन कम से कम 30 मिनट के लिए व्यायाम करते हैं?

1. हां (प्रश्न 35 पर जाएं)       0 नहीं       99. नहीं जानते

34. निम्नलिखित में से किस कारण से आप प्रति दिन कम से कम 30 मिनट के लिए व्यायाम नहीं करते हैं? (सभी जो लागू होता है, चुनें)

1. समय नहीं होने के कारण  
 2. स्थानीय सुविधाओं की कमी के कारण (जैसे एक पार्क, जिम या पैदल रास्ता) व्यायाम करने के लिए  
 3. क्योंकि व्यायाम करना मुश्किल है  
 4. क्योंकि मैं व्यायाम के बाद थक गया हूँ  
 5. अन्य कारण (निर्दिष्ट करें) \_\_\_\_\_

35. क्या आप इंसुलिन इंजेक्शन ले रहे हैं?

1. हां       0. नहीं

36. आमतौर पर आप अपने मधुमेह के लिए डॉक्टर से कितनी बार मिलने जाते हैं?

0. कभी नहीं  
 1. चार-पाँच साल में एक बार  
 2. दो-तीन साल में एक बार  
 3. एक साल में 1 या 2 बार  
 4. एक साल में 3 से 4 बार  
 5. एक साल में 5 या अधिक बार (प्रश्न 38 पर जाएं)

37. आपको मधुमेह के लिए डॉक्टर से मिलने में अधिकतर क्या बाधाएँ आती हैं? (सभी जो लागू होता है, चुनें)

1. घर से क्लिनिक की लंबी दूरी  
 2. वित्तीय बोझ  
 3. समय की कमी  
 4. नहीं करना चाहती  
 5. अन्य \_\_\_\_\_

अनुभाग D: पालन करने के लिए कथित बाधाएं

38. क्या तुमने कभी व्यायाम, आहार और रक्त ग्लूकोज की निगरानी की आवृत्ति के बारे में अपने चिकित्सक या नर्स से सलाह प्राप्त की है?

1. हां  0. नहीं  99. नहीं जानते

39. क्या तुमने कभी वित्तीय समस्याओं के कारण निर्धारित दवाओं को खरीदने में समस्या थी?

1. हां  0. नहीं  99. नहीं जानते

40. क्या कभी एसी कोई परिस्थिती होती है जब आप दवाई नहीं ले पाते?

1. हां  0. नहीं (प्रश्न 42 पर जाएं)

41. किन कारणों की वजह से आप कभी-कभार दवाई नहीं ले पाते? (सभी जो लागू होता है, चुनें)

1. दवाओं के उच्च दाम  
 2. जटिल पर्चे (कई गोलियां)  
 3. भूल जाना  
 4. अन्य (निर्दिष्ट करें) \_\_\_\_\_

42. क्या आपको मधुमेह के लिए अपनी निर्धारित दवाओं के साथ किसी भी दुष्प्रभाव का अनुभव है?

1. हां  0. नहीं  99. नहीं जानते

43. क्या आपके डाक्टर ने आपसे कहा है कि अगर आपको कोई भी दुष्प्रभाव विकसित हो तो आप उनहे बताएं ?

1. हां  0. नहीं  99. नहीं जानते

44. क्या आपके पास घर पर ग्लूकोमीटर है?

1. हां  0. नहीं  99. नहीं जानते

पिछले दो हफ्तों से, कितनी बार आप निम्नलिखित समस्याओं में से किसी ने परेशान किया गया है?

समस्या	बिल्कुल नहीं (0)	कई दिन (1)	आधे से ज्यादा दिन (2)	लगभग हर दिन (3)
45. कोई भी काम करने में कोई खुशी नहीं होती और नहीं कोई चाहत होती है।	<input type="checkbox"/> 0. बिल्कुल नहीं	<input type="checkbox"/> 1. कई दिन	<input type="checkbox"/> 2. आधे से ज्यादा दिन	<input type="checkbox"/> 3. लगभग हर दिन
46. उदास रहना या हर वक्त निराशा में रहना।	<input type="checkbox"/> 0. बिल्कुल नहीं	<input type="checkbox"/> 1. कई दिन	<input type="checkbox"/> 2. आधे से ज्यादा दिन	<input type="checkbox"/> 3. लगभग हर दिन

47. क्या आपको कभी मधुमेह के बारे में कोई प्रशिक्षण या लिखित सामग्री प्राप्त कि है ?

1. हां       0. नहीं

आपकी भागीदारी के लिये धन्यवाद।

## Appendix 6 : Journal Form

Date: \_\_\_\_\_

<i>Visit/attempt number</i>	00 1	00 2	00 3	00 4	00 5	00 6	00 7	00 8	00 9	01 0	01 1	01 2	01 3	01 4
<i>Result</i>														

<i>Visit/attempt number</i>	01 5	01 6	01 7	01 8	01 9	02 0	02 1	02 2	02 3	02 4	02 5	02 6	02 7	02 8
<i>Result</i>														

<i>Visit/attempt number</i>	02 9	03 0	03 1	03 2	03 3	03 4	03 5	03 6	03 7	03 8	03 9	04 0	04 1	04 2
<i>Result</i>														

### RESULT CODES

1. Completed interview
2. Non diabetic
3. Age less than 18 years
4. Other type of DM
5. Prescribed by insulin when diagnosed
6. Not a resident of East Delhi
7. Refusal
8. Other \_\_\_\_\_
9. Incomplete interview