



## **Assessment of Anti-Diabetic Medications Adherence among Diabetic Patients in Sana'a City, Yemen: A Cross Sectional Study**

**Gamil Othman<sup>1</sup>, Faisal Ali<sup>2,3,4\*</sup>, Mohamed Izham Mohamed Ibrahim<sup>5</sup>,  
Yaser Mohammed Al-Worafi<sup>6</sup>, Mukhtar Ansari<sup>7</sup> and Abdulsalam M. Halboup<sup>1\*</sup>**

<sup>1</sup>Department of Clinical Pharmacy and Pharmacy Practice, Faculty of Pharmacy, University of Science and Technology, Sana'a, Yemen.

<sup>2</sup>Department of Clinical Nutrition and Dietetics, Faculty of Medicine and Health Sciences, University of Science and Technology, Sana'a, Yemen.

<sup>3</sup>Nan Yang Academy of Sciences (NAS), Singapore.

<sup>4</sup>Department of Biochemistry, Faculty of Medicine and Health Sciences, University Hospital, Sana'a, Yemen.

<sup>5</sup>College of Pharmacy, Qatar University, Doha, Qatar.

<sup>6</sup>Clinical Pharmacy Department, Ajman University, Ajman, UAE.

<sup>7</sup>Department of Clinical Pharmacy, College of Pharmacy, University of Hail, Hail, Saudi Arabia.

### **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors GO and AMH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MIMI, AM and YMAW managed the analyses of the study. Author FA managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Background:** Lack of adherence to anti-diabetic medications use is linked with suboptimal glycemic control which in turn leads to increase rate of diabetic complications. The adherence to anti-diabetic medications among adult diabetic patients in Sana'a city has not been yet evaluated.

**Objective:** This study, therefore, assessed the extent to which diabetic patients are adherent to their antidiabetic medications and explored the factors underlying such adherence attitude in Sana'a City, Yemen.

**Methods:** A cross-sectional method was conducted among a sample of 365 diabetic patients attending public and private hospitals from March to April 2017 in Sana'a City-Yemen. Random patients were selected and data regarding their treatment adherence were obtained using a questionnaire. Adherence to diabetes medications was measured using medication adherence index followed by structured interviews. Descriptive analysis was used to compare between different groups of diabetic patients. Bivariate analyses were conducted to evaluate the associations between clinical variables.

**Results:** The cross-sectional study included 365 patients (263 males; 102 females). A high level of medication adherence rate to anti-diabetic drugs in the present study was (70%). The adherence rate was not similar in both genders where males were more adherent than females. The most common reason for non-adherence was forgetfulness (n= 67; 61%). While the lowest factor for non-adherence was associated with ineffective (n= 7; 6%). Adherence was strongly associated with diabetes duration, monthly income, blood sugar monitoring, communication with physician, and patient's knowledge regarding importance of medication use (p <0.05).

**Conclusions:** The degree of adherence in patients with diabetes in Sana'a to anti-diabetic medication was shown to be mostly suboptimal. The medication adherence levels are still crucial strategy for optimal treatment against diabetes. However, additional studies on strategies to improve adherence rate and health care should be carried out in the future.

*Keywords: Diabetes mellitus; medication adherence; cross sectional study; adherence rate; Sana'a, Yemen.*

## 1. INTRODUCTION

Diabetes is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. In semirural area regions near Sana'a, the capital of Yemen, the crude prevalence of type 2 diabetes is 10.4% [1]. Another cross-sectional study conducted in urban city of Yemen using WHO criteria for diagnosis of diabetes mellitus and impaired glucose tolerance test. This study showed that, the overall prevalence of type 2 diabetes mellitus was 4.6%, and impaired glucose tolerance was found in 2% [2].

The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels [3]. According to the World Health Organization (WHO), adherence is the extent to which a person's behavior; taking medication, following a prescribed diet, and/or executing lifestyle changes corresponds with agreed recommendations from the health care provider [4], when it comes to diabetic patients, adherence is always the key important factor to get the expected benefits and outcomes from anti-diabetic medications, to achieve the glycemic goals, to reduce morbidity and mortality, and to avoid complications related to

non-adherence, which ultimately leads to health-care costs minimization. In 2003, the WHO emphasized that "increasing the effectiveness of adherence interventions may have a far greater impact on the health of the population than any improvement in specific medical treatments [5]. Reasons for non-adherence to therapies include age, knowledge, perception and duration of disease, complexity of dosing regimen, multi approaches of therapy, psychological factors, tolerability, forgetfulness, gender and cost of therapy[6-12]. The main consequence of poor adherence to antidiabetic medications is decreased glycemic control, leading to the known complications of diabetes, including microvascular and macrovascular diseases and altered lipid metabolism [5, 13]. Despite the extensive therapy modalities available for type 2 diabetes mellitus, studies have indicated that less than 50% of "adherent" patients achieve the glycemic goals recommended by the American Diabetes Association (ADA) and approximately two-third die prematurely of cardiovascular diseases[14]. Reducing medication complexity, factors such as better patient information, education and motivation have been shown in a recent study in Spain to be associated with improved adherence[15]. The importance of the adherence to anti-diabetic medications is to prevent serious long- and short-term complications related to non-adherence. Improve

awareness of diabetic patients is imperative. The adherence to anti-diabetic medications among patients in Sana'a city has not been well documented so far. Hence, this work was conducted to explore patient's adherence level to their anti-diabetic treatment in the capital Sana'a city and predicting the most determinant factors and their association degree with adherence or non-adherence patterns.

## **2. METHODOLOGY**

### **2.1 Study Design**

This cross-sectional study was conducted in Sana'a city using a structured survey questionnaire. The study was carried out between March and April 2017 among the diabetes mellitus patients attending public and private hospitals as well as out-patient clinics in the capital Sana's city.

### **2.2 Study Population and Sampling Procedure**

The study was carried out among the diabetes mellitus patients who attend out-patients clinic in public and private hospitals as well as in the out-patient clinics in the capital city of Yemen. It included a simple random sample from patients visiting outpatient clinic of public and private hospitals in addition a group of private clinics in Sana'a.

Sample size was calculated based on OpenEpi program. Since there was no available literature showing the prevalence adherence among Yemen's population in general, a 50% expected prevalence and 95% confidence interval were used to calculate the sample. Thus, 400 patients were asked to participate in the study to complete the questionnaire and return immediately after they finished answering the questionnaire.

### **2.3 Data Collection Tool**

A structured questionnaire was used to obtain the demographic data of the patients and their information regarding adherence to the anti-diabetic medications. The questionnaire is consist of two parts, the first part was used to collect the demographic data from the study participants, including age, gender, education level, Nationality, Marital Status, occupation, monthly income, DM duration, Family history, and adherence. The second part was used to

collect information related to the adherence of diabetic medications. The questionnaire was checked for its structure and content validity by five academic and physicians of the university and hospital of science and technology. These reviewers were asked to evaluate the relevance, clarity, conciseness of the items and ease of understanding of the questions. Their comments and feedbacks were taken into consideration in the final draft of questionnaire. Prior to survey, the questionnaire was piloted with convenience sample of 30 patients and Cronbach's alpha of the pilot study was calculated as 0.8. We considered patients who are adherent to their medication when they took 80% and above from the prescribed medications as adherent to antidiabetic medications as defined by [16, 17].

### **2.4 Data Collection Procedure**

A group of fifth year pharmacy students were distributed between outpatient clinic in a public and private hospitals as well as private clinics in Sana'a. During the study period, a random sample of diabetic patients who attended diabetic clinic was asked to participate in the study. Nature and study objective of the study were explained to the participants before starting collecting data. The patients who were willing to participate were approached by the pharmacy students. Respondents who were not willing to participate were excluded from this study.

### **2.5 Data Analysis**

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 21.0 for Windows® (IBM Corp., Armonk, NY, USA). Mean, standard deviation, and frequency (%) were used to evaluate the demographic data characteristics of responses. Bivariate correlation test was used to compare between different groups of patients. The data was collected by calculating number of various responses (including true, false, more than, less than, agree, and disagree) then, final percentage was calculated. Statistical significance level was set at  $p$  value  $<0.05$  for all analyses.

## **3. RESULTS**

Out of 400 patients, 365 patients gave consent to participate in our study with a response rate of 91.3%; 263 were (72%) males. The majority

(n=230; 63%) of patients interviewed aged less than 50 years old. The education level profile of the participants revealed that 278 of them (76%) were educated. A total of 353 (97%) of the included patients were from Yemen, and approximately 312 (85%) of them were married. A total of 217 (59%) of patients were employees. regarding monthly income, about 59% of participants had an income of less than 200 \$ Table 1.

About two-third 243 (67%) of the patients were reported with diabetes mellitus for less than ten years which comprised the majority of the participants in our study. Regarding to patients adherence, majority 255 (70%) of them were adherent to their anti-diabetic medications,

whereas about 110 (30%) were non-adherent, and the reasons behind non-adherence were varied and ranging from forgetfulness 67 (61%) to medications' costs 60 (55%), no family support 53 (49%), and medications' unavailability 46 (42%). As many as 211 (58%) of patients regularly monitored their blood glucose levels. Self-optimization of the dose and timing of the drugs were reported to be 98 (27%) and 123 (34%) respectively. Eighty nine percent of the patients were well aware with the importance of anti-diabetic medications. Similarly, 74% reported that their physician provided them suitable information regarding diabetes mellitus. Sixty one percent of the patients felt comfortable communicating with their physician Table 2.

**Table 1. Demographic profile and total diabetic patients (N=365)**

<b>Characteristics</b>	<b>No</b>	<b>%</b>
<b>Gender</b>		
Male	263	72%
Female	102	28%
<b>Age</b>		
less than 50	230	63%
more than 50	135	37%
<b>Education level</b>		
Educated	278	76%
non-educated	87	24%
<b>Nationality</b>		
Yemeni	353	97%
Other	12	3%
<b>Marital Status</b>		
Single	53	15%
Married	312	85%
<b>Occupation</b>		
Employee	217	59%
non-employee	148	41%
<b>Income</b>		
less than 200 \$	216	59%
more than 200 \$	149	41%

**Table 2. Patient characteristics and adherence to their anti-diabetic medications**

<b>Variables</b>	<b>No</b>	<b>%</b>	
DM duration	less than 10 years	243	67%
	between 10-20 year	99	27%
	more than 20 years	23	6%
Family history	Yes	184	50%
	No	181	50%
DM in the family	First relative	161	87%
	Other	25	13%
Adherence	Yes	255	70%

Variables		No	%
don't adhere because of cost	No	110	30%
	Yes	60	55%
don't adhere because of ineffectiveness	No	49	45%
	Yes	7	6%
don't adhere because of DDI	No	102	94%
	Yes	11	10%
don't adhere because of long duration	No	98	90%
	Yes	41	38%
don't adhere because of forgetfulness	No	68	62%
	Yes	67	61%
don't adhere because of unavailable	No	42	39%
	Yes	46	42%
don't adhere because of side effect	No	63	58%
	Yes	11	10%
don't adhere because of intolerable S/E	No	98	90%
	Yes	10	9%
don't adhere because of difficult drug use	No	99	91%
	Yes	23	21%
don't adhere because of polypharmacy	No	86	79%
	Yes	40	37%
don't adhere because of no supporting	No	69	63%
	Yes	53	49%
don't adhere because of other causes	No	56	51%
	Yes	14	13%
Blood sugar monitoring	No	95	87%
	Yes	211	58%
Self-dose modification	No	154	42%
	Yes	98	27%
Dose timing modification	No	266	73%
	Yes	123	34%
Good knowledge about medication	No	242	66%
	Yes	220	60%
Importance of medication use	No	145	40%
	Yes	325	89%
Medication education by physician	No	40	11%
	Yes	256	70%
DM education by physician	No	109	30%
	Yes	271	74%
Patient own decision during treatment	No	94	26%
	Yes	225	62%
Easy communication with physician	No	140	38%
	Yes	224	61%
Alternative medicine	No	141	39%
	Yes	157	43%
	No	208	57%

\*S/E: side effect

It was noted that there is a negative correlation between patient's adherence and their income, the lower the income the higher the adherence to anti-diabetic medications, which was found to be statistically significant ( $p = 0.011$ ). There was also a negative correlation between diabetes mellitus duration and adherence with which was also highly significant ( $P < 0.001$ ). However, there was a positive correlation

between patient's adherence and the importance of medication use ( $p=0.004$ ). Similarly, blood sugar monitoring, ease of communication with physician, and having a good knowledge regarding medications, all of which had a positive correlation with patient's adherence to their anti-diabetic medications with statistically significant p-values ( $p<0.001$ ,  $p=0.001$ ,  $p=0.008$ ) Table 3.

**Table 3. Factors associated with patient's adherence**

Variables	Mean	SD	N	Correlation	p-value
Adherence	1.301	0.4595	365	1	0.011*
Income	1.408	0.4922	365	-0.132	
Adherence	1.301	0.4595	365	1	< 0.001*
DM Duration	1.397	0.6054	365	-.283	
Adherence	1.301	0.4595	365	1	0.004*
Importance of medication use	1.110	0.3128	365	0.152	
Adherence	1.301	0.4595	365	1	< 0.001*
Blood sugar monitoring	1.422	0.4945	365	0.309	
Adherence	1.301	0.4595	365	1	0.001*
Easy communication with physician	1.386	0.4876	365	0.166	
Adherence	1.301	0.4595	365	1	0.008*
Good knowledge about medication	1.397	0.4900	365	0.138	

\* Significantly different

#### 4. DISCUSSION

In this study, the prevalence of patient's adherence to their anti-diabetic medications was 70% and this may be associated with drug availability and having ever had diabetic education. As described by patient's adherence index to their antidiabetic medication [16, 17], patients in Sana'a are sub-optimal adherence to their antidiabetic medications compared with other studies conducted in Ajman, eastern Uganda, and Tayside region of Scotland which showed adherence level of 84%, 83.3%, and 90% respectively [7, 18, 19]. Additionally, adherence to oral hypoglycemic agents were assessed among Chinese patients using cohort study and found to be 89.6% [9]. The most contributing factors for non-adherence are forgetfulness (61%) and cost of medication (55%). The finding of this study was similar to other studies conducted in Saudia Arabia, India, and Malaysia that revealed adherence rates of 68%, 74%, and 53% respectively. [20-22]. Additionally, two studies in India showed an overall adherence rate to antidiabetic medications of 39.8% and 25% [23, 24], and one study was conducted in Sudan showed 45% as adherence level of type 2 diabetic patients [25].

The discrepancy in the adherence among patients may be attributed to financial costs which may delay patients from re-filling the prescribed medications, and this negatively effects on patients' adherence. Secondly, the high costs of the prescribed oral anti-diabetic agents, especially the newer agents or less abundance of prescribed brands of anti-diabetic medications further hampers optimal adherence [26, 27]. Both direct and indirect costs associated with diabetic care significantly reduce access to therapy of diabetes, and thus influence patient's

adherence, especially in developing countries [10, 28]. Regarding patient's monthly income, there was a negative correlation with overall adherence so those with lower income tend to be more compliant than those with high income. As patients with lower income tend to avoid diabetes mellitus complications related to non-adherence and the high costs of hospitalizations, they were more compliant than those with high income. In contrast, two other studies showed a positive relationship between monthly income and adherence rate [29].

The finding of this study showed that the duration of diabetes mellitus directly influences patients' adherence to their anti-diabetic medications. Patients with short course of diabetes were more adherent than those with long disease course. This study was consistent with these studies[7, 30]. The good adherence of the sort course diabetic patients might attribute to their type of medications. Oral hypoglycemic agents are easier to use and less invasive and more affordable compared to Insulin. Moreover, longer duration of diabetes disease usually associated with more diabetes- related health complications, therefore more medications to be used, which make it much more difficult for the patients to adhere to their anti-diabetic medications.

Our findings showed a significantly positive correlation between patients' adherence and their knowledge regarding the importance of medication use. More adherence rates were noticed among patients who believed in the importance of medication use. Similar results were observed in a study conducted by [7, 30]. It revealed that the patients, who know the importance of their medications in relieving symptoms, preventing complications, and

improving their overall health, will become more compliance to their medications.

In consistent with a study conducted by Arifulla et al. , our study also revealed that adherence rates were significantly increased among patients who reported self-monitoring of their blood glucose levels on a regular basis, similar results were also reported by Grant and his colleagues' findings showed that the patients who regularly monitor their blood-glucose levels immediately get to determine the need for taking their medications in accordance to the measured blood-glucose levels, which makes them more adherent to their medications and reflects their concern towards health issues [31].

Easy communication between diabetic patients with their physicians had a great impact on the patients' adherence rates, which is significantly stated by our study to be as a positive correlation. similarly, a study reported that a presence of communicating channel between physician and patient was associated with a greater adherence rates[32]. Because ease of communication will result in providing more adequate information regarding the disease and medications, patients' adherence towards their prescribed anti-diabetic medications will improve.

Having a good knowledge about medications directly impacts the extent to which patients are adherent. This study as well as two other studies [7, 30] stated that patients with a good knowledge regarding their anti-diabetic medications tend to be more adherent. This is because they are apparently more aware of the importance and the possible side effects of anti-diabetic medications which are of a great impact on patients' adherence.

The most common independent factor affecting patients adherence in our study was forgetfulness comprising 61%, in consistent with two other studies which reported forgetfulness to be also the most common reason of non-adherence [6, 7]. It also appears to be as the second most common factor of non-adherence in a study conducted by [31]. Such a barrier can be effectively overcome by helping diabetic patients remembering to take their medications either by educating them to have their alarms set in accordance to their medication's time or by directly reminding them to take their medications on a regular basis.

Another independent factor and the second most related factor of non-adherence in this study was the relatively high costs of medications (55%), which is also considered an important factor

resulting in patient's non-adherence in other studies [31, 33]. Nevertheless, costs of medications was not reported as a reason of non-adherence according to a study conducted by Jimmy et al. Costs related non-adherence is strongly related to the vastly deteriorating health-care system, along with the absence of insurance plans in Yemen. All resulted in financial burdens and difficulty affording diabetic medications in the near or far future.

Family support is a crucial factor resulting in patients' non-adherence in our study 53%, similarly, two other studies stated that family support frequently affects patients' adherence [32, 34]. These studies showed that being a member of a supportive family will positively impact on the diabetic patients' adherence patterns to their medications in many aspects, either by acting as a reminder for them to take their medications in times or by emotional support that will reinforce a more adherence tendency patterns in those patients.

Medications unavailability contributed to the non-adherence of approximately 42% of the overall participants in our study, which is as well a considerable factor in many other studies [19, 35]. The scarcity of either oral hypoglycemic medications or insulin will spontaneously have a negative impact on patient's adherence patterns. However, the reasons behind medications unavailability in Yemen is mostly due to the war circumstances which made the entry or import of such medications even more difficult during the conduction of this study . Besides the absence of a good storage conditions required for insulin to maintain its effectiveness all contributed to unavailability issues.

Estimation of patients' adherence levels using self-reports has limitations. Self-reports are considered subjective and may overestimate patient's adherence status comparing to other methods such as biological assays or pill counts. Adherence rates were generalized in this study regardless of the type of diabetes. This study was only conducted within the capital Sana'a city and could not be generalized to evaluate the adherence rates of the whole Yemeni population. Another limitation of the study is that the type of medication used, whether oral hypoglycemic agent or insulin was not included in the current study.

## 5. CONCLUSION

This study demonstrated that patients' adherence rate for diabetic therapies was 70%.

Additionally, the most contributing factor for non-adherence was forgetfulness of taking medication which can be overcome by alarms and family assistance. Adherence level was also found to have high association with diabetes duration, income, blood sugar monitoring, easy communication with physician, and patient's knowledge regarding importance of medication use. However, large scale and comprehensive studies are still needed in the future to optimize health education on diabetic care and self-management that would be improving adherence levels among diabetic patients in Yemen.

### CONSENT AND ETHICAL APPROVAL

Ethical approval was obtained from the Ethical Committee of the University of Science and Technology. The purpose of the study was well-explained to all participants and every patient was informed about the objectives of the study and written consent was taken from each patient before interviewing them. The questionnaire was administered among patients who agreed to participate voluntarily and the subject whoever refused to take part in the study, debilitated and having any diseases affecting their cognition and ability to answer the questionnaire properly were excluded from the study.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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