



Barriers to Medications Adherence among Uncontrolled Type 2 Diabetic Patients in PHCs, Riyadh, Saudi Arabia

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Abstract

Introduction: Diabetes Mellitus is one of the most common metabolic problems in Saudi Arabia and its chronic progressive disease is characterized by numerous health complications. Diabetes is a growing medical problem and the costs to society are great and rising. The recent report formed by International Diabetes Federation Diabetes Atlas values that there are presently 387 million people alive with diabetes globally in 2014, a 105% rise from its last report in 2011 with the highest number of people living in the western pacific. A recent systematic analysis study on global load disease analyzed data from health examination surveys and epidemiological studies involving data from 2.7 million participants and 370 country-years reports that a total of 347 million adults are alive with diabetes worldwide. **Aim:** This study aimed to improve health services provided to Diabetic patients and identify the barriers to medication adherence in those who attend Wazarat health center, chronic illness clinics. **Methods:** A descriptive, observation retrospective case-control study enrolled 162 patients with type 2 diabetes aged 35 years and above at Prince Sultan Military Medical City (PSMMC), Wazarat Health Center, Riyadh, KSA within two years (Year 2020-2021). Using a probability stratified sampling method, we recruited patients who were able to provide a consent form, following up in chronic illness clinics and received treatment for at least 3 months and actively filled prescriptions for medications related to a chronic disease were subjects of this study. The sample was collected from chronic illness clinics, in which where the majority of patients were uncontrolled type 2 diabetes due to the COVID-19 pandemic. The target HbA1C is 7%. **Results:** The prevalence of poor glycemetic control was 67.9% and the prevalence of poor glycemetic control was significantly higher among females ($p=0.031$), those who have blood glucose devices at home ($p=0.032$), those who regularly monitored blood glucose levels ($p=0.001$) and those with a regular visit to DM clinic ($p=0.001$). The most common barrier to medication was fear of side effects (20.4%) and taking too many drugs (19.1%). Non-adherence to medication was significantly more common among those with uncontrolled HbA1c ($p=0.022$), those who did not receive education about medication side effects ($p=0.010$), and those who were non-adherence to diet and exercise ($p=0.001$). **Conclusion:** More than one-third of the diabetic population was non-adherence to diabetic medication. Patients with poor glycemetic control who did not receive education about medication side effects and who were non-compliance with diet and exercise were more likely to be non-adherent to Diabetes mellitus medication.

Keywords: Type 2 diabetes; Medication adherence; Barriers; Uncontrolled HbA1c

Introduction

Diabetes mellitus is one of the most common metabolic problems in Saudi Arabia and it's a chronic progressive disease characterized by numerous health complications. Diabetes is a growing medical problem and the costs to society are great and rising. The recent report formed by International Diabetes Federation Diabetes Atlas values that there are presently 387 million people alive with diabetes globally in 2014, a 105% rise from its last report in 2011 with the highest number of people living in the western pacific [1]. Recent systematic analysis study on global load disease analyzed data from health examination surveys and epidemiological studies involving data from 2.7 million participants and 370 country-years reports that a total of 347 million adults are alive with diabetes worldwide [2]. It is estimated that by 2030 a total of 439 million people will suffer from diabetes mellitus, which represents approximately 7.7% of the global adult population aged 20-79 years [3]. In the Kingdom of Saudi Arabia, there is a high prevalence of type 2 diabetic patients. A study conducted in 2019 about the prevalence of type 2 Diabetic patients give the result that the prevalence of type 2 Diabetic patients in the Kingdom Of Saudi Arabia is 29.10 % [4]. Insufficient management of diabetic patients will raise the risk of developing diabetes complications which will have a negative effect on the health system [5,6]. However, applying protocols to manage the disease and initiating methods to increase the adherence to treatments and self-management by patients will help achieve optimal glycemic control and hence decrease the complications and the risk of death [7]. Patients who are not adherent to their medication may fail to reach optimal therapeutic outcomes. Physiologically hemoglobin A1c is inversely proportionate to diabetes medication adherence. Several studies have determined the relationship between medication non-adherence and higher incidence of diabetes complications, inpatient and emergency department utilization [8]. Several factors affect glycemic control and patient adherence to the treatment plan. To reach aimed glycemic control, patients have to follow multiple care models involving Self-Monitoring Blood Glucose (SMBG), Dietary modifications, exercise, improved diabetes medication knowledge, and medication adherence [9]. Poor knowledge about medication and treatment goals, perceptions about the medication, complexity of regimens, side effects, and cost are the major causes of non-adherence to medication [10,11]. Disability is a vital indicator linking both overall morbidity and the success of public health efforts to compress the period of morbidity among geriatrics for the overall population. Disabilities are more prevalent among diabetics than among those without diabetes. Physical inactivity, obesity, peripheral arterial disease, neuropathy, coronary heart

disease, and depression influence strongly higher disability risk among diabetic patients. The best management of hyperglycemia and decrease of risk factors for cardiovascular disease give long-term prevention of disability. Preventing disability will depend on a mixture of secondary and tertiary prevention along with diabetes prevention [12]. Many studies have discussed the barriers to medication adherence in type 2 Diabetes Mellitus in many countries or regions or cities such as Kuwait, the UK, etc., but there are no studies found in Saudi Arabia.

Literature Review

Gast, et al. in his study Medication adherence-influencing factors-an (updated) overview of systematic reviews determined factors that can influence the adherence of adult patients with chronic physical diseases. The study was conducted by a systematic literature search in MEDLINE and Embase on June 13, 2018. We included SRs on the factors that can influence adherence in adult patients taking oral medications for treating physical chronic diseases. Two reviewers independently selected studies according to pre-defined inclusion criteria. Two reviewers independently assessed the risk of bias with the ROBIS tool. Data were extracted in standardized tables previously piloted by one reviewer and verified by a second reviewer. We synthesized data in tables in a structured narrative manner. Study concluded that there is a social gradient in adherence. However, for most factors, the evidence was not conclusive due to the risk of bias, inconsistency, or imprecision [13]. The study of Thota, et al. investigated the effects of curcumin and/or Long-Chain omega-3 Polyunsaturated Fatty Acids (LCn-3PUFA) supplementation on glycemic control and blood lipid levels in individuals at high risk of developing T2D. The study was conducted in a 2 × 2 factorial, randomized, double-blinded, placebo-controlled study. Participants were allocated to either double placebo (PL) or curcumin plus placebo matching for LCn-3PUFA (CC), or LCn-3PUFA plus placebo matching for curcumin (FO), or curcumin plus LCn-3PUFA (CC-FO) for twelve weeks. The primary outcome of the trial was glycemic indices (HbA1C, fasting glucose, and insulin). The results showed that reduction in insulin resistance and triglycerides by curcumin and LCn-3PUFA appears to be attractive strategies for lowering the risk of developing T2D. However, this study failed to demonstrate the complementary benefits of curcumin and LCn-3PUFA on glycemic control [14]. The study of Horii T, et al. investigated the medication adherence status and factors affecting adherence 3 years after initiation of hypoglycemic agents, using a nationwide medical claim-based database in Japan. The study was conducted by the retrospective study was conducted on data from 884 subjects with T2DM to better understand medication adherence, the effects of polypharmacy, and other factors. The results showed that subjects aged 50-<60 years, those with ≥3 concomitant medications, and those with a total number of visits ≥17 were more likely to be

adherent and persistent, and more likely to continue their hypoglycemic agents. A high degree of medication adherence was found to have a positive influence on hemoglobin A1c levels [15]. Lemay, et al. study Medication adherence in chronic illness: do beliefs about medications play a role? investigated the relationship between patients' beliefs about medications with self-reported adherence to treatment among a chronically ill multicultural patient population. The study was conducted by a prospective cross-sectional study was conducted among patients treated for chronic illnesses in the Ministry of Health primary care clinics in Kuwait. Patients completed a questionnaire that consisted of questions to collect information about their health status and demographics using validated instruments: the Beliefs about Medication, Sensitive Soma Assessment Scale, and Medication Adherence Report Scale-5 items. The main outcome measures were self-reported adherence to medications, beliefs, and perceived sensitivity toward medications. The study concluded that Medication adherence is a complex, multifaceted issue and patient beliefs about medications contribute significantly, although partially, to adherence among a multicultural Middle Eastern patient population [16]. However, Srinivasan Beddhu, et al. study investigated the effects of intensive systolic blood pressure lowering on cardiovascular events and mortality in patients with type 2 Diabetes Mellitus on standard glycemic control and those without Diabetes Mellitus. The study was conducted by SPRINT tested the effects of intensive (<120 mm Hg) versus standard (<140 mm Hg) SBP goals on CVD events and all-cause mortality. The study concluded that the effects of intensive SBP control on CVD events and all-cause mortality were similar in patients without diabetes mellitus and in those with diabetes mellitus on standard glycemic control [17]. In the study Twenty Minute Moderate-Intensity Post-Dinner Exercise Reduces the Postprandial Glucose Response in Chinese Patients with Type 2 Diabetes, conducted by Li Z, et al. investigated the effects of a single session of post-dinner moderate-intensity exercise on the postprandial glycemic response compared with a non-exercise condition in a study population of Chinese patients with type 2 diabetes. The study was conducted by a randomized crossover self-controlled pilot study involving 29 patients with type 2 diabetes who participated in post-dinner exercise days using non-exercise days as a control. The results showed that a short session of moderate-intensity post-dinner exercise can improve postprandial hyperglycemia and glycemic excursions in Chinese patients with type 2 diabetes, with no potential hypoglycemia risk at a later period [18]. However, Aberer F, et al. study investigated the efficacy, safety, and usability of the GlucoTab system for glycaemic management using insulin glargine U300 in non-critically ill-hospitalized patients with type 2 diabetes (T2D). The study was conducted in this open, non-controlled single-arm pilot study, glycemic control in the general ward of a tertiary care hospital was

guided by a mobile decision support system (GlucoTab) for basal-bolus insulin dosing using the novel basal insulin analog insulin glargine U300 for the first time. The study concluded that treatment with GlucoTab using insulin glargine U300 in hospitalized patients with T2D is effective and safe [19]. The study of Jabbour, et al. investigated the effects on cardiovascular risk factors of body weight, Systolic Blood Pressure (SBP), and triglycerides after 28 weeks of treatment with exenatide once weekly plus dapagliflozin, as compared with exenatide once weekly or dapagliflozin. The study was conducted by patient subpopulations from the DURATION-8 trial of patients with Type 2 Diabetes Mellitus (T2DM) inadequately controlled with metformin alone. The study concluded that in patients with T2DM with inadequate glycemic control on metformin alone, adding a combination of exenatide once weekly plus dapagliflozin reduced cardiovascular risk factors across baseline subgroups for each variable to a greater extent than adding individual drug [20]. But Bhanpuri, et al. study examined CVD risk factors in this cohort. The study was conducted as a non-randomized, controlled study. The CCI group (n=262) received treatment from a health coach and medical provider. A Usual Care (UC) group (n=87) was independently recruited to track customary T2D progression. The results showed that a continuous care treatment including nutritional ketosis in patients with T2D improved most biomarkers of CVD risk after 1 year. The increase in LDL cholesterol appeared limited to the large LDL sub fraction. LDL particle size increased, total LDL-P and ApoB were unchanged, and inflammation and blood pressure decreased [21]. Bukhsh, et al. study investigated the impact of pharmacist-led educational intervention on glycemic control, self-care activities, and disease knowledge among T2DM patients in Pakistan. The study was conducted by randomized controlled trial, the effectiveness of a 6-month pharmacist-led educational intervention will be examined on glycemic control, diabetes self-care activities, and disease knowledge of 80 adult T2DM patients (age >30 years) with poorly controlled T2DM (HbA1c>7%), after randomizing them into intervention and control groups, at diabetes care clinic of Capital Hospital Islamabad, Pakistan. The study concluded that Glycemic control in T2DM patients requires optimum self-care activities. This study is an attempt to improve self-care behaviors among poorly controlled T2DM patients who are at higher risk of diabetes-associated late complications [22]. However, Osman Ahmed, et al. assessed hypoglycemic medication adherence in his study about Adherence to oral hypoglycemic medication among patients with diabetes in Saudi Arabia. The study was conducted by a descriptive cross-sectional web-based study. The eight-item Morisky medication adherence scale was used to assess adherence. The study concluded that the majority of patients with diabetes in this study had a low adherence rate. The three main factors that may contribute to non-adherence to medication are non-adherence to regular follow-up in a diabetes clinic, non-adherence to a healthy

diet, and non-adherence to instruction to take medication [23]. In a title named Gaps and barriers in the control of blood glucose in people with type 2 diabetes, Blonde, et al. study evaluated attitudes and practices among healthcare professionals that may contribute to suboptimal glycemic control through a review of recent relevant publications in the scientific literature. The study was conducted by an electronic search of the PubMed database was performed to identify relevant publications from January 2011 to July 2015. The electronic search was complemented by a manual search of abstracts from key diabetes conferences in 2014/2015 available online. The study concluded that many people with type 2 diabetes are failed by current management, with approximately half not achieving or maintaining appropriate target blood glucose levels, leaving these patients at increased and avoidable risk of serious complications [24]. Gillani, et al. study determined self-monitoring practices, awareness of dietary modifications, and barriers to medication adherence among physically disabled type 2 diabetes mellitus patients. The study was conducted through interview sessions were conducted at the diabetes clinic-Penang general hospital. The invited participants represented three major ethnic groups of Malaysia (Malay, Chinese, and Indians). An open-ended approach was used to elicit answers from participants. Interview questions were related to participants' perception of self-monitoring blood glucose practices, Awareness of diet management, behavior toward diabetes medication, and cues of action. The study concluded that patients with physical disabilities required extensive care and effective strategies to control glucose metabolism [25]. But Ahmed, et al. study assessed hypoglycemic medication adherence. The study was conducted by a descriptive cross-sectional web-based study using the eight-item Morisky medication adherence scale was used to assess adherence. The study concluded that the majority of patients with diabetes in this study had a low adherence rate. The three main factors that may contribute to non-adherence to medication are non-adherence to regular follow-up in a diabetes clinic, non-adherence to a healthy diet, and non-adherence to instruction to take medication [23]. On the other hand, Aghili, et al. study evaluated the related factors and their intercorrelated impacts on glycemic control in people with type 2 diabetes mellitus. The study was conducted by patients with type 2 diabetes who were recruited for this study during their regular clinic visits at a major medical center in Iran. Glycated hemoglobin (A1C) levels were used as the indicator of glycemic control. Regression analysis was used to determine the relationships between glycemic control and demographics, self-care behaviors, resources, and affective variables. Moreover, the associations between diabetes-related distress and measured variables were tested. The study concluded that Diabetes-related distress was found to be associated with glycemic control in people with type 2 diabetes, whereas age, depression, anxiety, self-management, and family and social support may affect glycemic control indirectly

through diabetes-related distress. Thus, it is important to assess and, if appropriate, treat people with diabetes for diabetes-related distress in order to identify and help them overcome barriers to optimal glycemic control [26]. In Kuwait, Jeragh-Alhaddad, et al. made a study about Barriers to medication taking among Kuwaiti patients with type 2 diabetes: a qualitative study. Investigated barriers to medication adherence among Kuwaiti adults with T2DM. The study was conducted by Semi-structured interviews were conducted with 20 Kuwaiti patients with type 2 diabetes. The interviews were digitally recorded, transcribed, and analyzed using thematic analysis. The study concluded that Personal, sociocultural, religious, healthcare provider and healthcare system-related factors may impede medication adherence among Kuwaitis with type 2 diabetes. Interventions to improve care and therapeutic outcomes in this particular population must recognize and attempt to resolve these factors [27]. On the other hand, Balk, et al. study evaluated D&PA programs for individuals at increased risk for type 2 diabetes primarily to lower diabetes risk, lower body weight, and improve hyperglycemia. The study was conducted by 8 researchers who screened articles for a single group or comparative studies of combined D&PA programs with at least 2 sessions of at least 3-month duration in participants at increased risk for type 2 diabetes. The study concluded that Combined D&PA promotion programs are effective to decrease diabetes incidence and improve cardiometabolic risk factors for patients at increased risk. More intensive programs are more effective [28]. On the other hand, Krass, et al. study investigated the extent of and factors associated with adherence to Type 2 diabetes medication. The study was conducted by searches in CINAHL, Embase, International Pharmaceutical Abstracts, Medline, PubMed, and PsychINFO databases for the period January 2004 to July 2013. Papers were included in the present review if they reported the prevalence of adherence (the percentage of the study population that is classified as adherent) to Type 2 diabetes medication and used validated adherence measures with a defined cut-off point to indicate adherence. Reported factors were classified as potential predictors if the studies that examined that particular variable reported consistent findings. The study concluded that Adherence to diabetes medication remains an ongoing problem. This review has highlighted the urgent need to develop a consensus about what constitutes good adherence in diabetes. Further research is needed to clarify modifiable factors, in addition to depression and medication cost, that influence adherence and may provide a focus for targeted interventions to promote adherence, optimize diabetes control and limit the progression of diabetes [29]. On the other hand, Al-Qasem, et al. study reviewed studies that have investigated adherence to medication among patients with chronic conditions in Middle Eastern countries. The study was conducted by a comprehensive literature search that yielded 19 relevant studies. These focused on the extent and predictors of nonadherence to

medication across different conditions, including hypertension, chronic obstructive pulmonary disease, asthma, diabetes, depression, schizophrenia, and epilepsy. The study concluded that the existence of nonadherence is a problem among patients with chronic diseases and examines our understanding of the reasons and variables affecting patients' adherence to their medication in Middle Eastern countries. However, the studies employed a wide range of methods, sometimes with limitations. Further work to determine the prevalence and causes of patients' nonadherence to medication in Middle Eastern countries is needed in order to recommend the best interventions to improve adherence [30]. In the study of Morisky, et al. Predictive validity of a medication adherence measure in an outpatient setting examined the psychometric properties and tests the concurrent and predictive validity of a structured, self-reported medication adherence measure in patients with hypertension and assessed various psychosocial determinants of adherence, such as knowledge, social support, satisfaction with care, and complexity of the medical regimen. The study was conducted by A total of 1367 patients participated in the study; the mean age was 52.5 years, 40.8% were male, 76.5% were black, 50.8% graduated from high school, 26% were married, and 54.1% had income <\$5,000. The 8-item medication adherence scale was reliable ($\alpha=.83$) and significantly associated with blood pressure control ($P<.05$). Using a cut-point of <6, the sensitivity of the measure to identify patients with poor blood pressure control was estimated to be 93%, and the specificity was 53%. The study concluded that the medication adherence measure proved to be reliable, with good concurrent and predictive validity in primarily low-income, minority patients with hypertension, and might function as a screening tool in outpatient settings with other patient groups [31].

Aim

This study aimed to improve health services provided to Diabetic patients and identify the barriers to medication adherence in those who attend Wazarat health center, chronic illness clinics.

Objectives

- To describe the compliance of medications among diabetic patients.
- Identify the barriers among non-adherent to medications behind uncontrolled blood glucose in type 2 diabetic patients and control blood glucose.

Methods

A descriptive, observation retrospective case-control study enrolled 162 patients with type 2 diabetes aged 35 years and above at Prince Sultan Military Medical City (PSMMC), Wazarat Health Center, Riyadh, KSA within two years (Year 2020-2021). Using a probability stratified sampling method, we recruited patients

who were able to provide a consent form, following up in chronic illness clinics and received treatment for at least 3 months and actively filled prescriptions for medications related to a chronic disease were subjects of this study. The sample was collected from chronic illness clinics, in which where the majority of patients were uncontrolled type 2 diabetes due to the COVID-19 pandemic. The target HbA1C is 7%.

Ethical Considerations

The study was approved by the Medical Ethics Committee of the Medical Services Department for Armed Forces Scientific Research Center in Riyadh (Ethics approval number PSMMC HP-01-R079) and conducted according to its guidelines. Written informed consent was obtained from all participants (or their legal guardians where applicable) before enrolment in the study.

Results

The prevalence of poor glycemic control was 67.9% and the prevalence of poor glycemic control was significantly higher among females ($p=0.031$), those who have blood glucose devices at home ($p=0.032$), those who regularly monitored blood glucose levels ($p=0.001$) and those with a regular visit to diabetes clinic ($p=0.001$). The most common barrier to medication was fear of side effects (20.4%) and taking too many drugs (19.1%). Non-adherence to medication was significantly more common among those with uncontrolled HbA1c ($p=0.022$), those who did not receive education about medication side effects ($p=0.010$), and those who were non-adherence to diet and exercise ($p=0.001$). This survey included 162 diabetic patients. Table 1 presented the socio-demographics of the patients. The most common age group was less than 60 years old (54.9%) with more than half being males (53.1%) and mostly being Saudis (97.5%). Nearly all were married (95.7%) and were living inside Riyadh (89.5%). With regards to education, 38.9% finished primary school. Only 27.2% were working even though 87.7% reported that they are earning 5,000 SAR or more per month. Patients who were living alone constitute 17.3%. Approximately, 57.4% were obese with nearly 60% having a diabetes duration of more than 10 years. The prevalence of patients who were having associated chronic disease was 90.7%. Furthermore, a considerable proportion of patients reported that they received social support from their relatives or community. The prevalence of patients with uncontrolled HbA1c was 67.9% and the prevalence of poor glycemic control was significantly higher among female patients ($p=0.031$). In Table 2, patients who received education about diabetes, its medication, and its side effect constitute 80.2%, 90.7%, and 40.7%, respectively. The prevalence of patients who suffered diabetic complications was 39.5%. Also, 83.3% of the patients received education about diet and exercise. Nearly 80% of the patients reported the availability of blood glucose devices at home and 67.3% were monitoring their

blood glucose regularly. Regarding diabetes management, approximately 74.1% and 61.7% had regular visits to diabetic and nutrition clinics. The proportion of patients who were in adherence to diabetes medication was 62.3% while the proportion of patients who took the medication without the help of others was 88.3%. Adherence to diet and exercise was reported by 33.3 while adherence to regular follow-up was reported by 90.1%. Only 4.9% were using the alternative medication as a diabetes regimen. When comparing the level of glycemic control, we observed that the prevalence of poor glycemic control was significantly more common among those who reported the availability of a blood glucose device at home ($p=0.007$), those who were regularly monitoring blood glucose level ($p=0.032$) and those who indicated a regular visit to a diabetic clinic ($p=0.001$) while the prevalence of good glycemic control was significantly more common among those who had no complication of diabetes ($p=0.009$) and those who were in adherence to diabetes medication ($p=0.022$). In Figure 1, poor glycemic control was more associated with taking three or more drug regimens ($p<0.001$). In Figure 2, the number of visits for follow-up between uncontrolled and controlled was not significantly different ($p=0.834$). In Figure 3, the most common reason for not adhering to medication was due to the side effect (20.4%), followed by taking too many drugs (19.1%) and unavailability of the drugs (19.1%). We used the Chi-square test in Table 3 to determine the relationship between adherence to medication and the socio-demographic characteristics of the patients. Our results revealed that medication adherence was significantly more common among those who regularly monitor blood glucose levels ($p=0.015$) and those who regularly visit a nutrition clinic ($p=0.026$). On the other hand, non-adherence to medication was significantly more common among those with poor glycemic control ($p=0.022$), those who did not receive education about medication side effects ($p=0.010$), and those who were not in adherence to diet and exercise ($p=0.001$).

Study Data	Overall N (%) (n=162)	HbA1c level		P-value [§]
		Uncontrolled N (%) (n=110)	Controlled N (%) (n=52)	
Age group				
<60 years	89 (54.9%)	58 (65.2%)	31 (34.8%)	0.411
≥60 years	73 (45.1%)	52 (71.2%)	21 (28.8%)	
Gender				
Male	86 (53.1%)	52 (60.5%)	34 (39.5%)	0.031**
Female	76 (46.9%)	58 (76.0%)	18 (23.7%)	
Nationality				
Saudi	158 (97.5%)	107 (67.7%)	51 (32.3%)	0.758
Non-Saudi	04 (2.5%)	03 (75.0%)	01 (25.0%)	
Marital status				
Single	07 (04.3%)	05 (71.4%)	02 (28.6%)	0.838
Married	156 (95.7%)	105 (67.7%)	50 (32.3%)	
Residence location				
Inside Riyadh	145 (89.5%)	97 (66.9%)	48 (33.1%)	0.424
Outside Riyadh	17 (10.5%)	13 (76.5%)	04 (23.5%)	
Educational level				
Primary	63 (38.9%)	47 (74.6%)	16 (25.4%)	0.206
Intermediate	31 (19.1%)	23 (74.2%)	08 (25.8%)	
Secondary	43 (26.5%)	26 (60.5%)	17 (39.5%)	
Bachelor	25 (15.4%)	14 (56.0%)	11 (44.0%)	

Working				
Yes	44 (27.2%)	25 (56.8%)	19 (43.2%)	0.065
No	118 (72.8%)	85 (72.0%)	33 (28.0%)	
Monthly income (SAR)				
<5,000	20 (12.3%)	14 (70.0%)	06 (30.0%)	0.830
≥5,000	142 (87.7%)	96 (67.6%)	46 (32.4%)	
Living alone				
Yes	28 (17.3%)	20 (71.4%)	08 (28.6%)	0.660
No	134 (82.7%)	90 (67.2%)	44 (32.8%)	
BMI Level				
Normal (18.5-24.9 kg/m ²)	25 (15.4%)	14 (56.0%)	11 (44.0%)	0.064
Overweight (25-29.9 kg/m ²)	44 (27.2%)	26 (59.1%)	18 (40.9%)	
Obese (≥30 kg/m ²)	93 (57.4%)	70 (75.3%)	23 (24.7%)	
Duration of DM				
<5 years	34 (21.0%)	18 (52.9%)	16 (47.1%)	0.094
5-10 years	31 (19.1%)	21 (67.7%)	10 (32.3%)	
>10 years	97 (59.9%)	71 (73.2%)	26 (26.8%)	
Associated disease				
Yes	147 (90.7%)	100 (68.0%)	47 (32.0%)	0.914
No	15 (09.3%)	10 (66.7%)	05 (33.3%)	
Felt the social support from your relatives/community				
Yes	138 (85.2%)	91 (65.9%)	47 (34.1%)	0.200
No	24 (14.8%)	19 (79.2%)	05 (20.8%)	
§P-value has been calculated using Chi-square test; **Significant at p<0.05 level				

Table 1: Socio-demographic characteristics of type 2 diabetic patients according to HbA1c level.

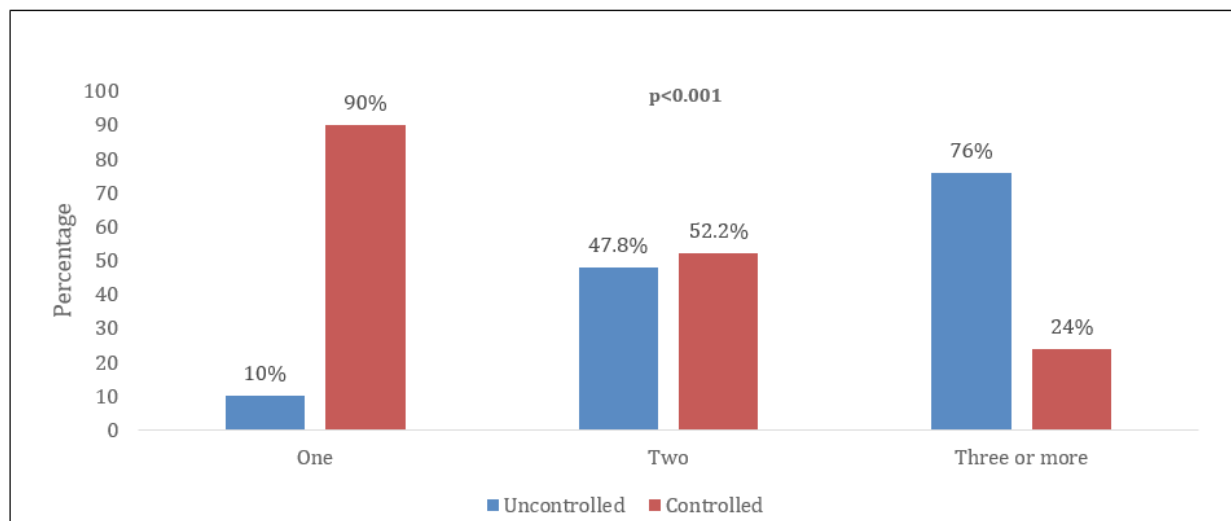


Figure 1: Number of diabetic medications according to HbA1c level.

Variables	Overall N (%) (n=162)	HbA1c level		P-value [§]
		Uncontrolled N (%) (n=110)	Controlled N (%) (n=52)	
Received education about diabetes				
Yes	130 (80.2%)	85 (65.4%)	45 (34.6%)	0.376
No	17 (10.5%)	13 (76.5%)	04 (23.5%)	
Not remember	15 (09.3%)	12 (80.0%)	03 (20.0%)	
Received education about medications				
Yes	147 (90.7%)	99 (67.3%)	48 (32.7%)	0.636
No	15 (09.3%)	11 (73.3%)	04 (26.7%)	
Received medication side effect education				
Yes	66 (40.7%)	44 (66.7%)	22 (33.3%)	0.780
No	96 (59.3%)	66 (68.8%)	30 (31.2%)	
Complication of DM				
Yes	64 (39.5%)	51 (79.7%)	13 (20.3%)	0.009**
No	98 (60.5%)	59 (60.2%)	39 (39.8%)	
Received education about diet and exercise				
Yes	135 (83.3%)	91 (67.4%)	44 (32.6%)	0.763
No	27 (16.7%)	19 (70.4%)	08 (29.6%)	
Availability of blood glucose device at home				

Yes	129 (79.6%)	94 (72.9%)	35 (27.1%)	0.007 **
No	33 (20.4%)	16 (48.5%)	17 (51.5%)	
Regular monitoring of blood glucose level				
Yes	109 (67.3%)	80 (73.4%)	29 (26.6%)	0.032 **
No	53 (32.7%)	30 (56.6%)	23 (43.4%)	
Regular visit to the diabetic clinic				
Yes	120 (74.1%)	90 (75.0%)	30 (25.0%)	0.001 **
No	42 (25.9%)	20 (47.6%)	22 (52.4%)	
Regular visit to a nutrition clinic				
Yes	100 (61.7%)	73 (73.0%)	27 (27.0%)	0.077
No	62 (38.3%)	37 (59.7%)	25 (40.3%)	
Adherence to the given medication				
Yes	101 (62.3%)	62 (61.4%)	39 (38.6%)	0.022 **
No	61 (37.7%)	48 (78.7%)	13 (21.3%)	
Taking medication without help from others				
Yes	143 (88.3%)	94 (65.7%)	49 (34.3%)	0.105
No	19 (11.7%)	16 (84.2%)	03 (15.8%)	
Adherence to diet and exercise				
Yes	54 (33.3%)	33 (61.1%)	21 (38.9%)	0.191
No	108 (66.7%)	77 (71.3%)	31 (28.7%)	
Regular follow up				
Yes	146 (90.1%)	97 (66.4%)	49 (33.6%)	0.228
No	16 (09.9%)	13 (81.2%)	03 (18.8%)	
Use of alternative medicine				
Yes	08 (04.9%)	05 (62.5%)	03 (37.5%)	0.737
No	154 (95.1%)	105 (68.2%)	49 (31.8%)	

[§]P-value has been calculated using Chi-square test; **Significant at p<0.05 level.

Table 2: Treatment and adherence to the medication of the diabetic patients according to HbA1c level.

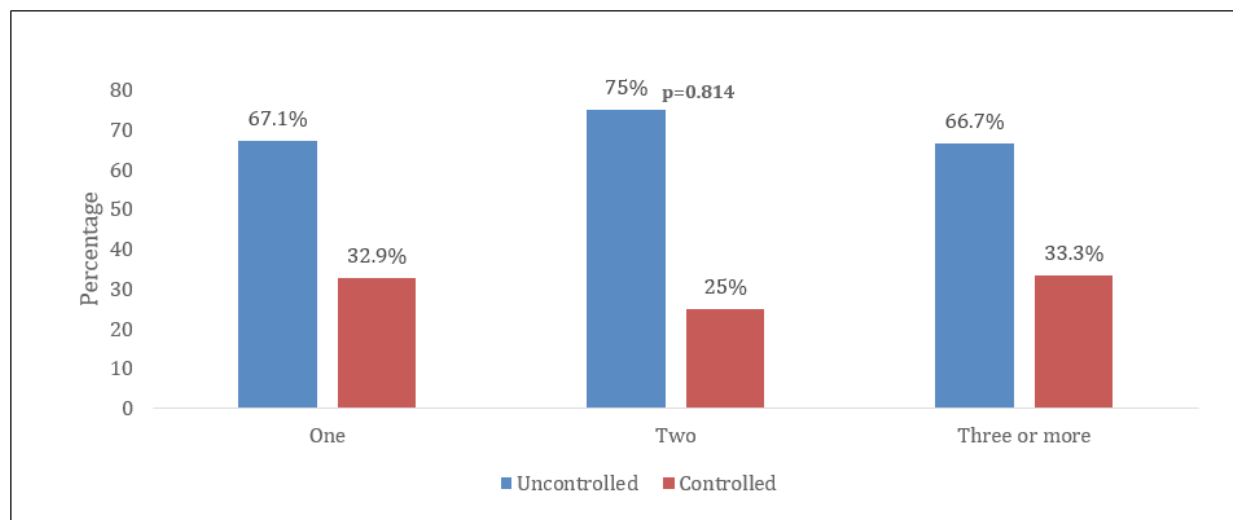


Figure 2: Number of hospitals visit for follow up according to HbA1c level.

Factor	Adherence to medication		P-value ^s
	Yes N (%) (n=101)	No N (%) (n=61)	
Age group			
<60 years	52 (58.4%)	37 (41.6%)	0.256
≥60 years	49 (67.1%)	24 (32.9%)	
Gender			
Male	54 (62.8%)	32 (37.2%)	0.901
Female	47 (61.8%)	29 (38.2%)	
Educational level			
Intermediate or Primary	61 (64.9%)	33 (35.1%)	0.431
Bachelor or Secondary	40 (58.8%)	28 (41.2%)	
Working			
Yes	27 (61.4%)	17 (38.6%)	0.875
No	74 (62.7%)	44 (37.3%)	
BMI level			
Normal	13 (52.0%)	12 (48.0%)	0.354
Overweight	26 (59.1%)	18 (40.9%)	
Obese	62 (66.7%)	31 (33.3%)	
Duration of DM			

<5 years	22 (64.7%)	12 (35.3%)	0.846
5-10 years	18 (58.1%)	13 (41.9%)	
>10 years	61 (62.9%)	36 (37.1%)	
HbA1c level			
Uncontrolled	62 (56.4%)	48 (43.6%)	0.022**
Controlled	39 (75.0%)	13 (25.0%)	
Number of medication			
<3	20 (60.6%)	13 (39.4%)	0.817
≥3	81 (62.8%)	48 (37.2%)	
Received education medication side effect			
Yes	49 (74.2%)	17 (25.8%)	0.010**
No	52 (54.2%)	44 (45.8%)	
Complication of DM			
Yes	43 (67.2%)	21 (32.8%)	0.304
No	58 (59.2%)	40 (40.8%)	
Regular monitoring of blood glucose level			
Yes	75 (68.8%)	34 (31.2%)	0.015**
No	26 (49.1%)	27 (50.9%)	
Regular visit to the diabetic clinic			
Yes	76 (63.3%)	44 (36.7%)	0.661
No	25 (59.5%)	17 (40.5%)	
Regular visit to a nutrition clinic			
Yes	69 (69.0%)	31 (31.0%)	0.026**
No	32 (51.6%)	30 (48.4%)	
Adherence to diet and exercise			
Yes	43 (79.6%)	11 (20.4%)	0.001**
No	58 (53.7%)	50 (46.3%)	
§P-value has been calculated using Chi-square test; **Significant at p<0.05 level.			

Table 3: Relationship between adherence to medication and the Socio-demographic characteristics of type 2 diabetic patients (n=162).

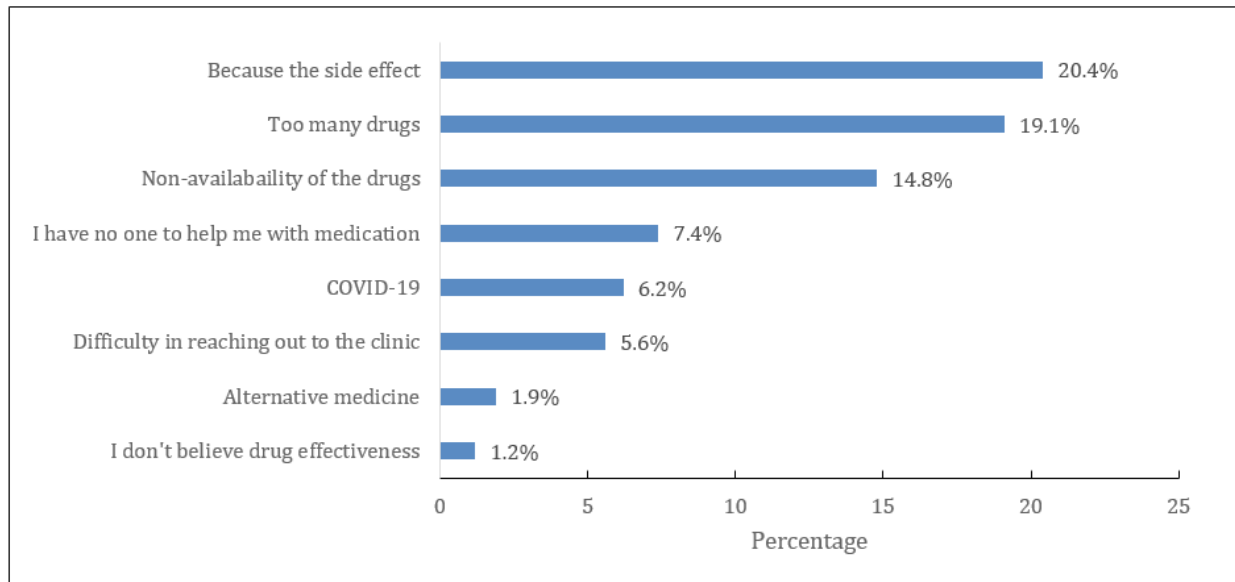


Figure 3: Reason for not adhering to medication.

Discussion

This study attempted to evaluate the barriers to medication adherence among patients with type 2 diabetes. The finding of this study revealed that nearly two-thirds of the patients (62.3%) demonstrated adherence to medication while non-adherence was seen among 37.7%. Our results seem to be better than the paper of Ahmed et al [23]. According to their results, more than half (54.8%) showed low adherence to medication, while 34.5% exhibited moderate adherence and only 10.7% had high adherence. In a qualitative study by Gillani, et al. [25], more than 80 percent of diabetic patients with physical disabilities were non-adherent to medication with most of these patients requiring extensive care and management to control glucose metabolism. Another study conducted in Northern Ethiopia [33], showed poor compliance with diabetic medication. The authors further emphasized the need for immediate intervention and therapeutic guidelines to improve the quality of care among this group population. The study suggests that non-adherent to diabetic medication is directly associated with uncontrolled HbA1c levels. Consistent with this assumption, our results also indicate that non-adherent to medication negatively affected glycemic control. A similar report by AlQarni, et al. [33] indicated that there was a negative but highly significant correlation between adherence to medication and HbA1c level; however, most of these patients modified their medication regimens during the month of Ramadan or Eid occasions, which may have a direct effect with patients level of HbA1c. Contradicting these reports, Horii, et al. [16] noted that medication adherence had a positive effect on the decreased level of blood glucose at the end

of the observation period. They reasoned that the adherence to hypoglycemic administration resulted in a better outcome leading to a more satisfactory result at the endpoint of the observations period. The importance of receiving diabetic education had been well discussed among publications as it is correlated with better therapeutic outcomes. In our study, patients who did not receive education about medication side effects and those who were non-compliant with diet and exercise tend to be more non-adherent compared to the other groups. These scenarios concurred with the paper of Araya et al [32]. Based on their investigation, patients who never received counseling were significantly associated with non-adherence to medication. In another study conducted among patients admitted to Alimosho General Hospital, Igando, Lagos, Nigeria, [34] patients who attended counseling and health education were more likely to increase their adherence rate than those who failed to attend education while in a prospective cross-sectional study conducted in Kuwait [16], patients' higher negative belief on medications negatively impacted their adherence to medication. Given the impact of negative beliefs on drug regimens, strategies are necessary to develop to mitigate the impact. Moreover, we observed that medication adherence rates were significantly better among those who regularly monitor blood glucose levels and those who regularly visit a nutritional clinic. However, the differences in the adherence rate were not significantly different among age, gender, educational level, working, BMI level, duration of diabetes, the complication of diabetes, regular visits to the diabetes clinic, and the number of medications being taken. Inconsistent with our findings, several papers documented a direct correlation between adherence to medication among age and gender

[13,15,23,34]. For instance, in a systematic review conducted by Alina and Mathes [13], there was an assumption that age showed a concave association with adherence such that a lower adherence was shown in very young and very old people. Supporting this scenario, Horii, et al. [15] observed that adherence to medication was associated with increasing age but older people tend to decrease adherence rate specifically if patients reached elderly age (≥ 60 years old). Reinforcing previous reports, Ahmed, et al [23], reported that there was a positive and significant correlation between adherence scores among age and gender but diabetes duration and number of hypoglycemic medications did not differ significantly with adherence scores. Not with standing adherence, several papers examined the factors representing roadblocks to a successful therapeutic regimen. A recent publication indicates that therapeutic inertia emerges to be a significant contributor to poor glycemic control. The author cited that majority of patients with type 2 diabetes had failed the current diabetes management being set and were unable to achieve the reasonable target for blood glucose level, leading them to be at higher risk of major complications. A qualitative study by Gillani and colleagues [25], reported that the barrier to self-care practices was financial conflict which was reported by age more than 40 years and those with more than 11 years of diabetes duration, however, those who were aged more than 60 years limited experience with the symptoms were the major barriers for self-care adding that they are more relying on their caregiver for blood glucose monitoring. Another qualitative study conducted among Kuwaiti patients described several barriers according to themes. Among them were a lack of education/awareness about diabetes and its medications, beliefs about medicines/diabetes, God-centered focus of control, attitudes toward diabetes, and perception of self-expertise with the disease and body awareness. In our study, the primary reason for not adhering to medication was the fear of side effects (20.4%) and taking too many drugs (19.1%). Other reported barriers were unavailability of drugs (14.8%), and unavailability of help (7.4%). COVID-19 related issues (6.2%), difficulties in reaching out to the clinic (5.6%), use of alternative medicine (1.9%), and the lack of trust in the medicine (1.2%). It is important to note that the prevalence of uncontrolled levels of HbA1c was 67.9% with poor glycemic control was significantly higher among females, those with available blood glucose devices at home, those who regularly monitored blood glucose levels, those who regularly visit a diabetic clinic and those who were taking three or more medications. On the other hand, good glycemic control was seen among patients without diabetes complications and those with good adherence to medication. Controlling blood sugar levels is difficult to achieve specifically among older people. In a study published by Blonde, et al. [24] evidence pointed out that many people with diabetes type 2 had never achieved good control of blood glucose levels

and they are left without any choice but to suffer from diabetic complications. Often delays in appropriate interventions were seen as the cause of underachieving the desired target of glycemic levels. A better approach to addressing these negative factors is vital to assist healthcare practitioners to provide treatment in a more timely manner among patients with poor glycemic control.

Conclusion

More than one-third of the diabetic population was non-adherent to diabetic medication. Patients with poor glycemic control who did not receive education about medication side effects and who was non-compliance with diet and exercise were more likely to be non-adherent to diabetic medication. This study highlights the need to address the lack of compliance with diabetes regimens. The gaps can be addressed by inviting the patients to attend regular diabetic and nutritional education. Education emphasis is further needed for those patients who reported medication adherence-related barriers. Albeit, through diabetes education, they could get a better understanding in regards to diabetes treatment-related obstacles. Fear of adverse reactions, afraid of taking too many drugs, and the unavailability of drugs are detrimental factors to adherence, and the role of healthcare providers is important to eradicate these negative factors. Providing a constructive solution related to these barriers would definitely increase the likelihood of adherence to medication among type 2 diabetic patients with poor glycemic control.

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