Prevalence and factors associated with low medication adherence among Type 2 Diabetic patients attending a diabetic clinic at the Tema general hospital, Ghana

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KEYWORDS: Type 2 diabetes mellitus, adherence, medication, glycemic control, Ghana

ABSTRACT

Introduction: Poor adherence to diabetes medication has been linked to poor glycemic control, increased cost, morbidity, and mortality rates. This study assessed factors influencing adherence to medication regimens among outpatients with type 2 diabetes mellitus (T2DM) patients at a diabetes clinic, Tema General Hospital, Ghana. **Methods:** This was a cross-sectional study using quantitative methods. A culturally tailored semi-structured questionnaire and the Morisky Medication Adherence Scale (MMAS-8) were used to evaluate the levels of adherence to T2DM medications. Chi-square test and logistic regression were used to assess the association between exposure variables and medication adherence. **Results:** A total of 206 T2DM patients aged 24 to 90 years, mean age=59.1(±1) years were interviewed. The majority were female (82.5%) and married (56.8%). The prevalence of low adherence to T2DM medication was 47.6% (95%CI: 0.41-0.55). Respondents who were on herbal medication (AOR: 5.99; 95%CI= (0.21–71.65)) had the lowest adherence compared to those on insulin followed by Insulin +OHA (AOR; 95%CI=3.15(0.79-12.53)) and OHA medication (AOR: 1.24; 95%CI (0.42-3.68)). Among those who reported side effects from medication, the odds of low adherence was 2.9 times compared to those who did not report any (AOR;95%CI=2.91(1.16-7.29)). Those who reported that their pill burden affected the continued usage of medication had 8.3 times the odds of low adherence compared to those who did not (AOR; 95%CI=8.25 (2.95-23.08)). Irregular visits to the health facility (AOR; 95%CI=6.71(2.35-19.16)) and the provision of information on the disease condition by the health provider (AOR; 95%CI= 1.14 (0.15-8.75)) significantly influenced adherence to the medication regimen. **Conclusion:** The prevalence of low adherence to the T2DM medication regimen was influenced by current medication intake, experiencing side effects from medication, pill burden, irregular visits to the health facility, and adequacy of information provided by health providers on the disease condition. National level interventions are needed to intensify health education on diabetes management.

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RECEIVED
11/05/2020

ACCEPTED
31/03/2021

PUBLISHED
20/04/2022

LINK

https://www.afenet-journal.net/content/article/5/4/full/

CITATION
Perpetual Enam Aflakpui et al . Prevalence and factors associated with low medication adherence among Type 2 Diabetic patients attending a diabetic clinic at the Tema general hospital, Ghana. Journal of Interventional Epidemiology and Public Health. 2022 April;5(2):4

DOI: https://doi.org/10.37432/jieph.2022.5.2.52

Introduction

The prevalence and incidence of non-adherence to diabetes medication have increased in recent times. This has caused a considerable impact on morbidity and mortality among T2DM [1]. Non-adherence to diabetes medication has been linked to lower glycemic levels, increased cost, morbidity, and mortality rate; hence the full benefit of the medications will be achieved only if patients follow the prescribed medication regimen [2,3]. This makes non-adherence to diabetes medication one of the major public health challenges in present times. Non-adherence to diabetes medication is a risk factor for developing cardiovascular and other chronic diseases [4] and when coupled together with the westernization of lifestyle associated with decreased physical activity, changes in dietary habits as well as the rapid aging of the African population [5], non-adherence to diabetes medication results in increased family and societal burdens of T2DM [6].

Currently, the non-adherence of T2DM patients to medication ranges from 30% to as high as 100% [7]. This results in sub-optimal treatment, leading to complications and decreased productivity of patients. Some factors that predict non-adherence include poor understanding of medication regimen and inability to afford medication [7,8,9,10]. Poor patient-provider relationships, side effects of the medication, polypharmacy, and morbidities have also been implicated in influencing non-adherence to medication [9,10,11,12]. Compounding these are the lack of national diabetes programs in most countries, lack of health professionals, and well-structured educational programs [12]. Moreover, non-adherence to medication poses a major barrier to the achievement of positive clinical results (good glucose control). Self-management practices including diet and exercise, as well as regular hospital visits, can improve medication adherence and minimize long-term complications of diabetes [9]. These complications affect the patient´s quality of life, worsen glycemic control, increase mortality, morbidity, and the economic cost to society.

Medication adherence has been commonly assessed using the Medication Adherence Individual Review-Screening Tool (MedAdhIR-ST) and the Medication Adherence Questionnaire (MAQ). Shelton et al. compared the reliability and validity of the MedAdhIR-ST and MAQ for assessing medication adherence in a community-dwelling elderly population and concluded that it is a reliable and valid tool for screening -non-adherence among elderly populations in the community [13]. Medication-related problems remain one of the largest health risks for older adults, yet there are few resources available to effectively reduce medication?related problems for community-dwelling older adults. Marsha et al. have determined the efficiency of a multifaceted medication intervention known as the Community Medication Education, Data, & Safety program (C-MEDS) on medication adherence and self?efficacy in medication use [14]. The primary outcomes of this intervention included medication use self-efficacy and select medication adherence measures. Adherence was measured via pill count and via the MedAdhIR tool, a scale that measures the risk for medication non adherence. Marsha et al reported that community-dwelling older adults who received C-MEDS had higher self-efficacy in managing medications ($P<.001$) [14]. Comparing the Medication Adherence Questionnaire (MAQ) to MedAdhIR-ST, MedAdhIR-ST was found to be 67% sensitive and 60% specific for detecting adherence and nonadherence [13]. MAQ also showed 43% sensitivity and 50% specificity in detecting adherence and nonadherence [13]. MedAdhIR-ST is therefore indicated to be reliable, multidimensional, and a valid tool for screening nonadherence to medication [13] Other research using the Morisky 8 item medication adherence scale had also been identified to be 93% sensitive and 53% specific in screening for medication adherence [15].

In Ghana, 6.8% of all admissions and 7.8% of all mortalities are attributable to T2DM at the Korle Bu teaching hospital [16]. Furthermore, diabetes is ranked among the top 10 reasons for hospital admission and mortality at the Tema General Hospital (TGH). According to WHO [17], data gathered from T2DM morbidity cases due to T2DM have increased over the years. For instance, out of the 314,061 total morbidity cases in 2013, T2DM accounted for 16,679 (5.3%) ranking fourth, compared to 161,019 morbidity cases in 2014 when T2DM accounted for 24,645 (15.3%) of cases. Out of 318,100 total morbidity cases in 2015, T2DM accounted for 136,241(42.8%) ranking third among the top 10 cases. However, there was no data on the prevalence of T2DM patients who do not adhere to medication.

Most of the studies on adherence to medication have been carried out in developed countries focusing on the determinants of non-adherence to medication. This has emphasized understanding of the role and decision to follow the required medication dosage. However, some patients still have little or no knowledge of the impact on their decision not to adhere to medication. Hence a gap in knowledge of diabetes management and related factors such as side effects from medication, and pill burden. Irregular visits to the health facility and inadequate information provided by the health practitioners on the disease condition may result also result in low adherence to medication and potentially lead to increased morbidity and mortality in Ghana. Although much effort is being made to help curb T2DM related complications and poor adherence to medications, only a little progress has so far been achieved. The purpose of this study was therefore to determine the prevalence of low adherence among type 2 diabetes mellitus (T2DM) and to assess the factors influencing adherence to medication regimens among patients attending the Tema General Hospital to help inform interventions aimed at improving adherence to medication among patients withT2DM.

Methods

Study area

A cross-sectional study was conducted at the out-patient department of the Diabetes Clinic at the Tema General Hospital (TGH), the largest Public Health Institution in the Tema Metropolis of the Greater Accra Region, Ghana. The Hospital serves as the main referral point for both public and private health facilities in the Metropolis. The diabetes clinic at TGH is the only government facility in the area which serves an average of 850 patients every month. The diabetes clinic has six staff: four nurses, a doctor, and one record officer.

Study Participants

The study targeted patients aged 18 years and above diagnosed with T2DM, who had clinical records in TGH and were on medication. They should have attended the diabetes clinic for at least 6 months.

Inclusion and exclusion criteria

Patients 18 years and above diagnosed with T2DM having clinical records in the hospital and Patients on medication (oral medication and Insulin) to achieve glycemic control, as well as patients attending the diabetic clinic for at least 1 year, were included. And those who were excluded were diabetes patients less than 18 years, patients on admission, and patients with missing HbA1c, FBG from their folders.

Sample size and sampling procedures

Quantitative data

The sample size was determined by using the Cochran formula ($n = (z2p (1-p)/d2)$ where "p" is the proportion of patients non-adherent to medication from previous studies in similar populations (4,16) which was ~ 50%. The "n" is the required minimum sample size, "z" is a standard deviation of 1.96 corresponding to a 95% confidence level, and "d" is the margin of error (8%) = 0.08. From this formula, the estimated minimum sample size was 150. Since the total population was less than 10000 ($N<10000$) the sample size was adjusted using the formula $nf= n/(1 + (n/N))= 150/(1+150/850)= 128$. Where "nf" is the adjusted sample size and "N" is the total number of T2DM patients. Based on an assumed 30% non-response rate, the minimum sample size was increased to 166.

An average of 850 T2DM patients attended the diabetes clinic during the period of the study of which the sample size was derived using systematic random sampling. The first patient was selected on each clinic day by writing down the names of the first two patients each on a separate piece of paper and randomly selecting one. Subsequently, every other patient that is 18 years and above and had clinical records in the hospital for at least 6 months was selected.

Data collection

A semi-structured questionnaire was used to collect data on adherence to T2DM medication using the adopted Medication Adherence scale (MedAdhIR). Data were entered into Microsoft excel 2013, cleaned, and exported to STATA Version 15.0 for analysis. The level of adherence was determined using the number of times the respondent missed

hospital visits and prescribed medications, did not adhere to the prescribed dosage, and did not take medications at all [7]. The level of medication adherence was assessed using the Medication Adherence scale (MedAdhlR): zero (0) was categorized as high adherence, while two (≥ 1) was low adherence.

The Medication Adherence scale (MedAdhIR) is a self-reporting assessment scale. "*The scale is expressed as; each "yes" response to the questions in the MedAdhIR questionnaire score one point and each "no" response score zero point. The patient who scores one or more points is regarded as at risk of poor medication adherence, and potential reasons for poor adherence are identified based on the answers to the questions. Questions 1 and 7 provided information on the patient´s knowledge of medication intake; questions 2, 9, 10, and 11 showed potential memory/forgetfulness problems; questions 3, 4, and 8 showed health beliefs; questions 5, 6 provided information on side effects (potential physical and functional disability); and questions 12 indicated financial concerns*"[18].

Also, the tool included items on socio-demographic characteristics and factors (individual, drug-related, provider, and facility-based) that could influence medication adherence. The questionnaire was self-administered during the diabetes clinic days: Wednesdays, Thursdays, and Fridays, between the hours of 6 am to 11 am. For illiterate participants, the questionnaire was interviewer-administered. Data were collected in May 2016.

Data analysis

Patients´ glycemic control was defined using the WHO accepted range of fasting blood glucose (FBG) levels [14]. The level of FBG between 4.0mmol/1 to 6.0 mmol/1, was defined as agreeable glycemic control. Patients with poor glycemic control were those who had fasting blood glucose > 6.0mmol/1. This was considered in assessing medication adherence. Glycated hemoglobin status was not used since patients could not afford the cost of it. Hence an average of three FBG readings was used for this study.

Descriptive statistics including means and proportions were presented using tables and graphs. The Chi-square test and logistic regression were used to determine the significance and strength of the association between the exposure variables which include; socio-demographical factors, individual factors, facility-based factors, providers factors, drug-related factors, and medication adherence. Statistical significance was set as $p< 0.05$.

Availability of data and materials

All dataset used for this study is in the custody of the corresponding author and will be made available upon reasonable request.

Ethical considerations

This research was approved by the Ethics Review Committee of the Ghana Health service with an ethical clearance number GHS-ERC-07/12/15; Also, institutional approval was obtained from the administration of Tema General Hospital before conducting the survey, and anonymity and confidentiality of responses were ensured.

Results

Social demographic characteristics

In this study, a total of 206 T2DM patients consented to participate in the study. They were between the ages of 24 and 90 years with a mean age of 59.1 ± 1. Participants were predominantly females (82.5%), married (56.8%), and Christians (91.3%). Most of them had completed JHS or Middle School (42.7%) whereas only a few (2.9%) had completed tertiary education. Traders dominated the sample (53.0%) with office workers (5.8%) being the least represented. Over one-third (40.3%) of respondents were hypertensive.

Almost one-half of respondents, 47.6% (95%CI=0.41-0.55) of respondents indicated low adherence to the T2DM medication regimen. Only educational level was found to be significantly associated with adherence (p? =0.017). Most of the poorly adherent patients (43.9%) had completed JHS/Middle school whereas those who completed tertiary education were the least (2.0%) as shown in Table 1.

Prevalence of low medication adherence

Table 5 shows the results from the logistic regression analyses that included variables significantly

associated with adherence from the Chi-square test of independence. After controlling for the effect of other variables, the odds of low adherence to medication reduced by 61% (AOR; 95% CI= 0.39(0.08- 1.85)) and 64% (AOR; 95% CI= 0.36(0.06-2.34)) among those who disagreed and those who did not know that fasting reduces glucose level respectively, compared to those who agreed. Respondents who were on herbal medication (AOR; 95%CI= 5.99(0.21- 171.65)) had the lowest adherence compared to those on insulin followed by insulin + OHA (AOR; 95% CI= 3.15(0.79- 12.53)) and OHA medication (AOR; 95%CI= 1.24 (0.42-3.68)). Among those who reported side effects from medication, the odds of low adherence were 2.9 times compared to those who did not report any side effects (AOR; 95% CI=2.91 (1.16- 7.29)). Also, those who reported that their pill burden affected the continued usage of medication had 8.3 times the odds of low adherence compared to those who did not (AOR; 95% CI=8.25 (2.95, 23.08)). Moreover, an irregular visit to the health facility (AOR; 95% CI=6.71(2.35-19.16)) and the provision of information on the disease condition by the health provider (AOR; 95% CI=1.14 (0.15- 8.75)) were also factors that significantly influenced adherence to the medication regimen.

Factors associated with low medication adherence

Individual factors

The individual factors that were significantly associated with medication adherence included having a family history of diabetes (p< 0.001) and the mode of controlling blood glucose level (p< 0.004). The majority, (65.3%) of participants who had no family history of diabetes had low medication adherence. Also, respondents who strongly agreed that fasting reduces glucose levels and indicated low adherence was 18.4% whereas those who strongly disagreed were 5.1%. A larger proportion of patients (75.5%) who received medication to control glucose levels were not adhering to medication compared to those who exercised or regulated their diet **Table 2**.

Knowledge of lifestyle factors that can cause diabetes

Participants´ knowledge of lifestyle factors that can cause diabetes and their influence on adherence to medication is summarized in **Figure 1**. Most patients with low adherence to medication (83.3%) did not know that hypertension (high blood pressure) is a risk factor for diabetes, followed by family history and an unknown disease (66.7%). However, only a few (29.0%) of these low-adherent patients reported that late eating and an unhealthy diet could cause diabetes. About 18.4% of respondents had an awareness that fasting reduces blood sugar levels and this was significantly associated with adherence to medication (p< 0.001).

Providers and facility-based factors

The study revealed that health providers´ adequate counseling on diabetes conditions (p<0.001), hospital visits (p<0.001), and satisfaction with treatment (p<0.05) significantly influence adherence to the medication regimen. Moreover, the majority of those who were irregular in their hospital visits (69.4%) indicated low adherence and this was the only facility-based factor significantly associated with adherence to medication regimen (p<0.001) as shown in **Table 3**.

Drug-related factors

More than half (56.1%) of respondents were not adhering to the oral hypoglycemic agent (OHA) followed by 30.6% on combination therapy insulin + oral hypoglycemic (OHA) compared to those on herbal medication and insulin; these differences were statistically significant (p =0.009). The affordability of prescribed medication was also significantly associated with adherence to medication (p<0.002). Those who reported prescribed medication as affordable had lower adherence (65.3%) compared to those who could not afford the medication. Also, 59.2% of low adherence patients were those who reported side effects from using prescribed medication (p<0.001). However, those who indicated that side effects did not affect the continued usage of prescribed drugs indicated low adherence (p<0.001). Following prescribed dosage (p<0.001) and pill burden (p<0.001) were also significantly associated with adherence to the medication regimen **Table 4**.

Discussion

This study found that compared to respondents on insulin only, those on OHA only or Insulin+ OHA had higher adherence than respondents who were on

herbal medication. Respondents´ educational status was significantly associated with low adherence to the medication regimen such that medium to high medication adherence was seen among those with some formal education (80.5%). This statistic is comparatively higher than the 50% reported in other studies conducted to identify the challenges associated with non-adherence [1,4,5,11]. Participants who had Junior high school (JHS) education had higher adherence and this can be attributed to the fact that they can at least read and write. As observed by Buysman et al. [3], participants who had no education recorded the lowest level of adherence and this could be due to inadequate knowledge of diabetes management. Moreover, patients who did not know about diabetes occurrence in their families, poorly adhered to medication. This is consistent with the findings of Fallis et al. [19] that patients who did not know about diabetes found it very difficult to adhere to medication.

The present study also found that awareness that fasting could reduce blood glucose levels could influence adherence to medication as the majority of those who disagreed indicated low medication adherence. Also, respondents shared that controlling glucose levels by exercise and healthy diet intake without medication adherence could control diabetes. This finding is inconsistent with an earlier report [20] where exercise and diet, without medication adherence, could be risk factors for diabetes.

Patients who were unable to buy prescribed medication showed low adherence to medication. This is consistent with earlier findings [2,20] which indicated that patients´ financial limitations contributed to low adherence as they could not afford the cost of the medication. This could be because almost one-fifth of participants in our study were unemployed and hence may be financially constrained. Moreover, not all anti-diabetic drugs have been subsidized by the national health insurance scheme (NHIS) so patients may be unable to afford medications not covered by the scheme.

Our results showed that participants who took a large number of pills had higher odds of low medication adherence compared to those who took a smaller number of pills. A similar study in Uganda [8] reported that pill burden had an association with adherence [21]. This may be explained by the patient's discomfort in taking a large quantity of medication. We found that patients who were both diabetic and hypertensive were more likely not to adhere to medication due to pill burden. This finding contrasts with a study in Bangladesh [22] which reported that there was no association between the number of drug types taken, route of drug administration, and medication adherence. On the other hand, reports from Ethiopia indicated that the frequency of medication tends to influence adherence to medication [21]. Additional studies may therefore be warranted to assess whether these factors predict non-adherence in resource-poor settings or if it may be influenced by other secular differences.

Participants who reported that they developed side effects after taking T2DM medication had higher odds of not adhering to the medication regimen in our study. Similar findings have been reported by other studies [19,21] indicating that patients who experienced adverse reactions from medication intake were more likely to discontinue medication intake. This is consistent with the findings by Tewahido et al. [23]where metformin and glibenclamide use were associated with non-adherence because of adverse reactions to both drugs. However, a study by Garber et al. [24] reported contrary that there was no association between experiencing side effects and adherence which could be due to the small proportion of participants experiencing side effects as reported in their study.

We found that irregular visits to the health facility significantly contributed to low adherence as reported elsewhere [11]. It is more likely that those who paid regular visits received constant reminders from health workers to take their medication. Also, patients who received inadequate counseling on their disease condition were found to have low adherence to diabetes medication. This agrees with reports by Tewahido et al. [23] who found a higher risk of medication non-adherence among patients whose primary health care providers do not give them adequate counseling on their disease condition. Inadequate explanation of the disease condition to patients also significantly predicted low adherence in our respondents. When patients do not understand how and when to take their medication,

there is a higher risk of non-adhering to medication [8].

Limitations of the study

There are different screening methods for diagnosing non-adherence to medication for diabetes and interpreting these results. While glycated hemoglobin could have been measured for a better diagnosis of non-adherence to medication, almost all participants could not afford the glycated hemoglobin test (HbA1c) hence our inability to include that laboratory assessment.

This study was cross-sectional and health-facility-based, hence it may not be population representative. Our results can therefore not be generalized to the entire population of diabetic patients. Additionally, no causal links or directions can be concluded as there was no strategic plan by the health professionals to help patients understand their medication regimen to improve their medication adherence at the diabetes clinic. This study was conducted in a specialty health care setting where most diabetic patients around the environs of Tema General Hospital with uncontrolled glucose levels and complications are referred for management. However, participants´ regular interactions with health providers may affect their approaches and insights about adherence to medication during the study period. Another important limitation is the ability to recall past exposures since patients could be sharing inaccurate estimates of their adherence levels when using a self-reporting approach. Although the total number of participants in this study may not be large, our findings can serve as pilot data (generate hypothesis) for future research and efforts to advocate for the effective management of diabetes in low-income uninsured patients. Lastly, the factors contributing to poor adherence explored in this study might not have been comprehensive, hence additional studies are warranted.

Conclusion

The study found a high prevalence of low adherence to the T2DM medication regimen. This was mainly influenced by drug-related, provider and-or facility-based factors including current medication intake, experiencing a side effects from medication, pill burden, irregular visits to the health facility, and adequacy of information provided by health providers on the disease condition.

It is recommended that more innovative ways of promoting health and capacity-building strategies, including print and social media, radio, television, and public seminars, be explored to bring the services closer to T2DM patients to reduce missed appointments. Additionally, one on one counseling and intensified education on diabetes especially by health care providers about patients' disease conditions could encourage them to be adherent to their medication. Finally, the Ghana National Health Insurance Authority could consider an amendment of the insurance package to cover all anti-diabetic medications so that medications are accessible to patients to enhance adherence.

What is known about this topic

- Non-adherence to type 2 diabetes mellitus (T2DM) medication poses a major barrier to the achievement of positive clinical outcomes
- Non-adherence to diabetes medication is also a risk factor for cardiovascular and other chronic diseases
- Especially in low-middle-income countries, some patients with T2DM still have a gap in knowledge regarding the impact on their decision not to adhere to medication regimen

What this study adds

- This study shares findings on the barriers and facilitators of medication adherence among outpatients with T2DM
- Multi-facted and co-ordinated counseling and education programs are needed to comprehensivelyley addressress medication non-adherence in T2DM patients
- The study findings are generalizable to adult patients with T2DM in similar settings

Competing interests

The authors declare no competing interests.

Authors' contributions

Conceptualisation: PEA, AAL. Data collection, analysis, and report writing: PEA, DABB, AAL. Drafting Manuscript: PEA, DABB, EEK, EK, AAL. Finalizing manuscript: PEA, DABB, EEK, EK, AAL.All authors read and approved the final version of this manuscript.

Acknowledgments

The authors would like to thank all the participants involved in the survey at the TGH diabetes clinic who have generously given their time to take part in this study and also acknowledge the invaluable inputs provided by all the lecturers at the Epidemiology and Disease Control Department for their support, School of Public Health, University of Ghana, Legon.

Tables and figures

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Table 1: Socio-demographic characteristics associated with adherence to medication regimen among diabetes mellitus patients at Tema General Hospital				
	Adherence, n (%)			
Characteristic	**Medium-high (n= 108)**	**Low (n= 98)**	**Total (n= 206)**	p-value
Age				0.911
<40	7 (6.5)	4 (4.0)	11(5.3)	
40 – 49	17 (15.7)	13 (13.3)	30 (14.6)	
50 – 59	28 (25.9)	27 (27.6)	55 (26.7)	
60 – 69	36 (33.3)	36 (36.7)	72 (35.0)	
70+	20 (18.5)	18 (18.4)	38 (18.4)	
Sex				0.491
Male	17 (15.7)	19 (19.4)	36 (17.5)	
Female	91 (84.3)	79 (80.6)	170 (82.5)	
Marital status				0.306
Single	2 (1.9)	5 (5.1)	7 (3.4)	
Married	64 (59.3)	53 (54.1)	117 (56.8)	
Divorced	15 (13.9)	9 (9.2)	24 (11.6)	
Widow(er)	27 (25.0)	31 (31.6)	58 (28.2)	
Religion				0.278
Christian	101 (93.5)	87 (88.8)	188 (91.3)	
Muslim Traditionalist	5 (4.6) 2 (1.9)	10 (10.2) 1 (1.0)	15 (7.3) 3 (1.4)	
Educational level				0.017*
Senior High School (SHS)	29 (26.9)	11 (11.2)	40 (19.4)	
Junior High School (JHS)/Middle	45 (41.7)	43 (43.9)	88 (42.7)	
Primary	9 (8.3)	19 (19.4)	28 (13.6)	
No education	21 (19.4)	23 (23.5)	44 (21.4)	
Occupation				0.331
Unemployed	15 (13.9)	25 (25.5)	40 (19.4)	
Trader	60 (55.5)	49 (50.0)	109 (53.0)	
Artisan	14 (13.0)	11 (11.2)	25 (12.1)	
Office worker	8 (7.4)	4 (4.1)	12 (5.8)	
Retired	11 (10.2)	9 (9.2)	20 (9.7)	
Note: *Participants were divided by adherence level as high – medium scored 6-8 on the scale and low scored <6 on the scale. *P-value is statistically significant.*				

Table 2: Medical Characteristics associated with adherence to medication regimen among T2DM patients at Tema General Hospital

	Adherence, n (%)			
Variables	**Medium-high (n =108)**	**Low (n= 98)**	**Total (n= 206)**	**p-value**
Family history of diabetes				0.001*
Yes	46 (42.6)	34 (34.7)	80 (38.8)	
No	62 (57.4)	64 (65.3)	126 (61.2)	
Family members with diabetes (For those with a family history of Diabetes)				0.644
Grandparent	14 (12.9)	5 (5.1)	19 (9.2)	
Parent	50 (46.3)	48 (49.0)	98 (47.6)	
Children	9 (8.3)	5 (5.1)	14 (6.8)	
Siblings	35 (32.4)	40 (40.8)	75 (36.4)	
Controlling of glucose level				0.004*
Exercise	5 (4.6)	10 (10.2)	15(7.3)	
Diet	7 (6.5)	14 (14.3)	21(10.2)	
Medication	96 (88.9)	74 (75.5)	170 (82.5)	
Monitoring of glucose level				0.062
Self- monitored	20 (18.5))	29 (29.6)	49(23.8)	
Laboratory	88 (81.5)	69 (70.4))	157(76.2)	
Duration of diabetes (years)				0.073
< 5	35 (32.4)	17 (17.6)	52(25.2)	
5 - 9	36 (33.3)	34 (34.7)	70(34.0)	
10 - 14	20 (18.5)	21 (21.4)	41(19.9)	
15 - 19	9 (8.3)	10 (10.2)	19(9.2)	
20+	8 (7.4)	16 (16.3)	24(11.7)	
Hypertension status				0.199
Normotensive	69 (63.9)	54 (55.1)	123 (59.7)	
Hypertensive	39 (36.1)	44 (44.9)	83 (40.3)	

Note: *Participants were divided by adherence level as high – medium scored 6-8 on the scale and low scored <6 on the scale. *P-value is statistically significant.*

Table 3: Provider and facility-based factors associated with adherence to medication regimen among T2DM patients at Tema General Hospital

	Adherence, n (%)			
Variables	**Medium-high (n = 108)**	**Low (n = 98)**	**Total (n = 206)**	**p-value**
Health facility visit for medication				0.471
Weekly	4 (3.7)	5 (5.1)	9(4.4)	
Monthly	103 (95.4)	90 (91.8)	193(93.7)	
Quarterly	1 (0.9)	3 (3.1)	4(1.9)	
Missed health facility visit				<0.001*
Yes	27 (25.0)	68 (69.4)	95(46.1)	
No	81(75.0)	30 (30.6)	111(53.9)	
Distance from home to health facility				0.096
Close	12 (11.1)	11 (11.2)	23(11.2)	
Far	46 (42.6)	28 (28.6)	74(35.9)	
Very far	50 (46.3)	59 (60.2)	109(52.9)	
Fasting blood Glucose				0.377
Normal	13 (12.0)	16 (16.3)	29(14.1)	
High	95 (88.0)	82 (83.7)	177(86.0)	
Satisfaction with treatment				<0.05*
Excellent	23(21.3)	36(36.7)	59(28.6)	
Very good	66(61.1)	36(36.7)	102(49.5)	
Good	19(17.6)	25(25.6)	44(21.4)	
Very bad	0(0.00)	1(1.0)	1(0.5)	
Adequate counselling on disease condition				<0.001*
Yes	54(50.0)	21(21.4)	75(36.4)	
No	54(50.0)	77(78.6)	131(63.6)	
Hospital visits				<0.001*
Yes	88(81.5)	57(58.2)		
No	20(18.5)	41(41.8)		

Note: *Participants were divided by adherence level as high – medium scored 6-8 on the scale and low scored <6 on the scale.* **P-value is statistically significant.*

Table 4: Drug-related factors associated with adherence to medication regimen among T2DM patients at Tema General Hospital

	Adherence, n (%)			
Variables	**Medium-high (n = 108)**	**Low (n = 98)**	**Total (n = 206)**	**P-value**
Current medication intake				0.009*
OHA	105 (97.2)	55 (56.1)	160 (77.7)	
Insulin	1 (0.9)	6 (6.1)	7 (3.4)	
Insulin +OHA	1 (0.9)	30 (30.6)	31 (15.0)	
Herbal medication	1 (0.9)	7 (7.1)	8 (3.8)	
Able to buy prescribed Medication				0.002*
Yes	91 (84.3)	64 (65.3)	155(75.2)	
No	17 (15.7)	34 (34.7)	51(24.8)	
Reason for not buying prescribed medication				0.647
Too expensive	78 (72.2)	25 (25.5)	103 (50.1)	
Difficult to find	20 (18.5)	65 (66.3)	85 (41.2)	
Not available	10 (9.3)	8 (8.2)	18 (8.7)	
Side effect of prescribed medication				<0.001*
Yes	29(26.9)	28(59.2)	87(7.8)	
No	79(73.1)	40(40.8)	119(77.2)	
Side effect of medication				0.647
Dizziness	54 (50.0)	40 (40.8)	94(45.6)	
Abdominal discomfort	15 (13.9)	17 (17.3)	32 (15.5)	
Frequency urinating	5 (4.6)	9 (9.2)	14 (6.8)	
Constipation	2 (1.9)	6 (6.1)	8 (3.9)	
Weakness	32 (30.0)	26 (26.5)	58 (28.2)	
Side effect affect continued usage				<0.001*
Yes	8(7.4)	41(41.8)	49(23.8)	
No	100(92.6)	57(58.2)	157(76.2)	
Followed prescribed dosage				<0.001*
Yes	106 (98.1)	83 (84.7)	189(91.7)	
No	2 (1.9)	15 (15.3)	17(8.3)	
Number of pills affect continued usage (pill burden)				<0.001*
Yes	12(11.1)	52 (53.1)	64(31.1)	
No	96(63.9)	46 (46.9)	142(68.9)	

Note: *Participants were divided by adherence level as high – medium scored 6-8 on the scale and low scored <6 on the scale. *P-value is statistically significant.*

Table 5: Association between selected independent variables and adherence among T2DM patients at Tema General Hospital

	Low Adherence to medication regimen			
Variables	**COR (95% CI)**	**p-value**	**AOR (95% CI)**	**p-value**
Current medication				0.009
Insulin	Ref			
OHA	0.51 (0.29, .092)	0.024	1.24 (0.42, 3.68)	0.687
Insulin +OHA	3.41 (1.69, 6.87)	0.001	3.15 (0.79, 12.53)	0.103
Herbal medication	8.23 (1.00, 68.15)	0.051	5.99 (0.21, 146.5)	0.295
Family history of diabetes				0.440
No	Ref			
Yes	2.54 (1.44, 4.46)	0.001	1.59 (0.66, 3.86)	
Fasting reduces glucose level				0.025
Agree	Ref			
Disagree	0.15 (0.07, 0.29)	<0.001	0.39 (0.08, 1.85)	
Don't know	0.35 (0.13, 0.93)	0.035	0.36 (0.06, 2.34)	
Educational level				0.152
None	Ref	0.023		
Primary	1.93 (0.72, 5.18)	0.194	4.17 (0.90, 19.21)	
JHS/Middle	0.87 (0.42, 1.80)	0.712	1.39 (0.48, 4.07)	
SHS	0.35 (0.14, 0.86)	0.023	0.51 (0.14, 1.90)	
Tertiary	0.46 (0.08, 2.75)	0.393	1.01 (0.09, 11.14)	
Missed visit to health facility for medication				<0.001*
No	Ref			
Yes	6.79(3.68, 12.54)	<0.001	6.71(2.35, 19.16)	
Health provider explains disease condition to patient				0.040
Agree	Ref 3.67 (1.99, 6.76)			*
Disagree		<0.001	1.14 (0.15, 8.75)	
Rating of health provider (staff attitude)				0.239
Excellent	Ref			
Very good	0.35 (0.18, 0.68)	0.002	0.56 (0.19, 1.64)	
Good	0.84 (0.38, 1.86)	0.668	1.46 (0.42, 5.12)	
Able to buy prescribed medication	0.35 (0.18, 0.68)	0.002	0.78 (0.26, 2.36)	0.669
Adequate counseling on disease condition				
No	Ref			0.165
Yes	1.38(0.87, 2.20)	<0.001	0.51(0.29, 0.92)	
Counselling of glucose level	0.65(0.22, 1.62)	<0.001	0.75(0.26, 2.20)	0.605
Followed prescribed dosage	0.10 (0.02, 0.47)	0.003	0.42 (0.05, 3.31)	0.414
Number of pills affect continued usage	10.82 (5.16, 22.68)	<0.001	8.25 (2.95, 23.08)	<0.001
Side effect of prescribed medication	3.95 (2.19, 7.09)	<0.001	2.91 (1.16, 7.29)	0.022*
Side effect affects continued usage	8.99 (3.94, 20.51)	<0.001	0.42 (0.12, 1.48)	0.176

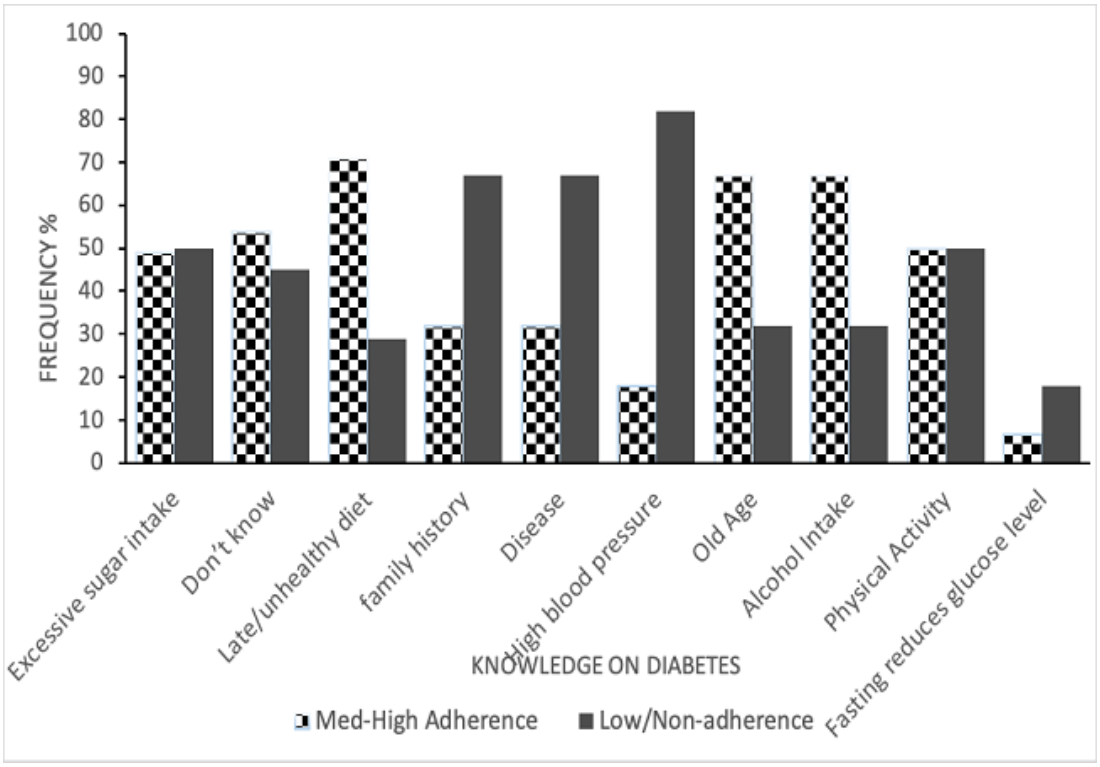

Figure 1: Knowledge of lifestyle factors that can diabetes