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Assessment of Medication Adherence and its Association with Glycemic Control among Type-2 Diabetes Mellitus Patients in Gaza – Palestine

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Abstract

Background: Diabetes mellitus is a serious health problem. It is considered the third leading cause of deaths among chronic diseases in the Gaza Strip, Palestine. Among diabetic patients, T2DM constitute the majority (92.2%). Medication adherence is a key determinant of therapeutic success. No studies have previously investigated medication adherence among T2DM patients in Gaza.

Objectives: To assess medication adherence and its association with glycemic control among T2DM patients. Setting: Al-Rimal Martyr's clinic in Gaza, Palestine.

Methods: A cross-sectional study with a convenience sample of 148 T2DM patients. The study used MMAS-8, last value of the HbA1c test, MDKT and BMQ to assess medication adherence, glycemic control, DM-related knowledge and beliefs about medicines, respectively. Main outcome measures: Level of medication adherence and rate of glycemic control.

Results: The mean age of the patients was 59.4 ± 8.6 years. More than half of the patients (52%) were females. The mean adherence score was 5.5 ± 1.4. Approximately 52.7% of patients were non-adherent. 83 patients (56.1%) were poor glycemic controlled. Poor glycemic control was significantly associated with non-adherence. 95 patients (64.2%) had a low level of knowledge about DM. The mean scores of BMQ scales were 17.8 ± 3.62, 12.4 ± 3.63, 12.5 ± 3.50, 12.3 ± 2.79 for specific-necessity scale, specific-concerns scale, general-harm scale, general-overuse scale, respectively. Medication non-adherence was significantly associated with unmarried status, diet non-compliance status, and education about DM and patients' negative beliefs about medicines as a whole.

Conclusion: Most patients were medication non-adherents and poor glycemic controlled. Improving patients' medication adherence may improve glycemic control.

Keywords: Medication adherence; Diabetes mellitus; Glycemic control

Introduction

Diabetes mellitus (DM) is a common chronic metabolic disorder that affects nearly 8.8% of the total world population [1]. The prevalence of DM in Palestine increases every year and has become one of the main leading causes of morbidity and mortality [2,3]. Reports from the Ministry of Health (MOH) revealed that the prevalence rate of DM among Palestinians in Gaza strip is 1,540 per 100,000 of the population. T2DM patients constitute the majority (92.2%). DM results in serious medical and economic consequences if left uncontrolled. Unfortunately, there is no reliable data about treatment outcomes of DM in Palestine [4]. Optimal glycemic control can reduce morbidity and mortality associated with DM [5]. Achievement of optimal glycemic control depends on the rational use of available anti-diabetic regimen, good adherence to prescribed treatments and successful self-management [6]. Therefore, medication adherence is a key determinant of therapeutic success in diabetic patients.

The Aim of the Study

Few studies on medications adherence among T2DM patients have been published from Palestine [3,7,8]. Yet, glycemic control and its association with non-adherence were not investigated in those studies. Moreover, none of those studies was carried out in the Gaza Strip. Therefore, the aims of this study were to assess of medication adherence, factors affecting it and its potential association with glycemic control. In addition, this study investigated beliefs about medicines and diabetes-related knowledge and their association with medication adherence.

Ethics Approval

The study protocol was approved by the Faculty of Pharmacy, Al-Azhar University-Gaza on May 4, 2015. The study received the ethical approval from the Helsinki committee in Palestinian Health Research Council (No: PHRC/HC/37/15) on June 4, 2015. Permission was also obtained from the MOH to visit Al-Rimal Martyr's clinic and conduct the study. Patients were informed that their participation was voluntary and that they could withdraw from the participation at any

time without consequences. Patients were assured that their responses and their information will be kept confidential.

Method

Study design and patient selection

This cross-sectional study was conducted between June 2015 and September 2015 at Al-Rimal Martyr's clinic in Gaza, Palestine. Al-Rimal Martyr's clinic is one of the main governmental clinics among 54 primary health care (PHC) clinics in Gaza governorates [9]. Inclusion criteria for the study were: (1) Patients diagnosed with T2DM at least one year before; (2) Patients over 18 years of age of both sexes; (3) Patients who had complete medical records; (4) Patients who were on prescribed DM medications for more than three months (to ensure familiarization with DM and the prescribed anti-hyperglycemic medications) and (5) Patients who were not taking any insulin injection therapy. The sample size was calculated based on the following assumptions: rate of medication non-adherence to be 50% based on a previously reported medication non-adherence rates (20%-50%) among Palestinian DM patients [3], an estimated prevalence rate of DM among Palestinians in Gaza 1,540 per 100,000 of population [10], confidence interval width of 10% and confidence limit to be 95%. Therefore, an estimated sample of 96 was needed for this study. A convenience sample of 161 patients met the inclusion criteria and only the 148 patients agreed to participate were included in the study. The questionnaire required for the study was presented and explained during the face to face interview. Moreover, each patient's medical record was screened to complete other demographic and clinical information.

Assessment and measures

Two methods were used to collect data: the first was a questionnaire that includes four sections: demographic and clinical information section, MMAS-8, MDKT and BMQ; the second method was the patient's medical record review.

Medication adherence was measured using the Morisky eight-item Medication Adherence Scale (MMAS-8). MMAS-8 is the latest generic self-reported, medication-taking behaviour scale. The original English-language MMAS-8 and its Arabic version showed acceptable levels of reliability and validity. The MMAS-8 consists of eight questions. Total scores obtained from MMAS-8 range from 0 to 8, with scores of <6, 6 to <8, and 8 indicating low, medium and high adherence, respectively. Patients with total MMAS-8 scores <6 were considered non-adherent, while MMAS-8 scores ≥ 6 were considered adherent [11,12].

Knowledge about DM was measured using the Michigan Diabetes Knowledge Test (MDKT). The general MDKT consists of 14 multiple choice questions and it was used in this study. Total scores ranged from 0-14. MDKT scores were categorized as follows: poor knowledge <7, acceptable knowledge 7-<11 and good knowledge ≥ 11 [10]. Patient beliefs about medicines were measured using the Beliefs about Medicines Questionnaire (BMQ). The BMQ consists of two sections: the BMQ-Specific section and the BMQ-General section. The BMQ-Specific section consists of two scales: Specific-Necessity scale and Specific-Concerns scale. The BMQ-General section has also two scales: General-Harm scale and General-Overuse scale [13]. High scores indicate strong beliefs in the concepts of the scale [3].

Clinical and socio-demographic characteristics were collected from questionnaires and from patients' medical records. These include: age, gender, height, weight, education level, marital status, occupation, smoking status, co-morbidities, major and minor complication, anti-diabetic drugs used, duration of T2DM and recent HbA1c test results (not older than 6 months from patient interview), income, physical activity, diet compliance, type of medications remainder, source of anti-diabetic drugs, education about DM, access to physician, enough time spent with physician, getting instructions about T2DM care, pattern of follow up in the clinic, pattern of home-blood glucose measurement, getting help to remember taking anti-diabetic drugs and knowledge of optimum blood glucose level.

Data entry and analysis

Data were coded to ensure confidentiality for all participants, the SPSS version 22 was used to analyse data.

Numerical data were summarized as means and standard deviations. Categorical data were summarized as frequencies and percentages. Chi-square test was used to study the association between medication adherence state and patients' glycemic control. Factors (independent variables) associated with non-adherence (MMAS-8 score <6) were analysed by binary logistic regression test followed by multiple logistic regression test. The dependent variable was non-adherence. The results obtained from used analyses tests were considered to be statistically significant if P-values ≤ 0.05. Odds ratio (OR) at a 95% confidence interval was used to define the association between non-adherence and a particular variable of interest.

Results

General characteristics of the patients

A convenience sample of 161 T2DM patients met the inclusion criteria. One hundred and forty-eight patients agreed and gave a verbal consent to participate by giving a response rate of 91.9%. Mean age of patients was 59.4 ± 8.6 years. Eighty-six (58.1%) have been diagnosed with T2DM for at least 5 years. Most patients (108, 73%) had co-morbid diseases, mainly hypertension (70, 47.3%). More than half the patients (90, 60.8%) were on combination therapy. Metformin was the most commonly prescribed drug (in 46, 31.2% of patients). Details regarding the demographic and clinical characteristics of patients included in the study are shown in Table 1.

Characteristics	n (%)[a]
Age	
<65	106 (71.6)
≥ 65	42 (28.4)
Sex	
Male	71 (48)
Female	77 (52)
Marital status	
Married	123 (83.1)
Others[b]	25 (16.9)
Level of education	
Illiterate	6 (4.1)

School level	100 (67.6)
University level	42 (28.4)
Household income (Ils)[c]	
Less than 1500	80 (54.1)
Between 1500 and 2500	43 (29.1)
Between 2500 and 3500	15 (10.1)
Between 3500 and 4500	7 (4.7)
More than 4500	3 (2)
Smoking status	
Current	18 (12.2)
Former	30 (20.3)
Never	100 (67.6)
Diet compliance	
Yes	57 (38.5)
No	91 (61.5)
Physical activity	
Yes	96 (64.9)
No	52 (35.1)
Duration of T2DM in years	
<5	62 (41.9)
≥ 5	86 (58.1)
Age at diagnosis	
30-45	34 (23)
46-64	97 (65.5)
≥ 65	17 (11.5)
BMI[d]	
Obese	87(58.8)
Overweight	51 (34.5)
Healthy weight	10 (6.8)
Co-morbidities	
Without any accompanying disease	44 (29.7)
Hypertension	70(47.3)
Hyperlipidemia	24(16.2)
Asthma	7(4.7)
Cancer	3 (2.1)
Complications	
A - Major complications	
Without any major complications	131 (88.5)
Congestive heart failure	12 (8.1)
Coronary heart disease	5 (3.4)
B - Minor complications	
Without any minor complications	120 (81.1)
Retinopathy	17 (11.5)
Neuropathy	4 (2.7)
Nephropathy	7 (4.7)
Anti-diabetic Drugs	
a-Mono-therapy	58 (39.2)
Metformin	46 (31.2)
Glibenclamide	8 (5.04)
Glimepiride	4 (2.8)
b-Combination therapy	90 (60.8)
Metformin and Glibenclamide	68 (46)
Metformin and Glimepride	11 (7.7)
Metformin and Vildagliptin	6 (3.8)
Metformin+Vildagliptin and Glimepride.	5 (3.2)
Source of drugs	
Free from MOH[e]	122 (82.4)
Purchased from community pharmacies	26 (17.6)

Table 1: General characteristics of the patients. n=number of patients. [a](%) percentages are given within parenthesis with the total number of patients (148) as the denominator. [b]Single, widower or divorced. [c] New Israeli Sheqel (commonly used currency in Palestine). [d]Body mass index=weight/height^2 (Kg/m^2). [e]Ministry of Health.

Reported glycemic control, adherence, beliefs and knowledge

Majority of patients (83, 56.1%) are poor glycemic controlled. Seventy eight patients (52.7%) were non-adherent (MMAS-8 score <6) (Figures 1 and 2). The mean adherence score was 5.5 ± 1.4 (Table 2).

Items	**n (%)**[a]
Do you sometimes forget to take your Diabetic pills?	
Yes	69 (46.6)
No	79 (53.3)
People sometimes miss taking their medication for reasons other than forgetting. Thinking over the past two weeks, were there any days when you did not take your diabetic medicines?	
Yes	36 (24.3)
No	112 (75.7)
Have you ever cut back or stopped taking your medication without telling your doctor, because you felt worse when you took it?	
Yes	50 (33.8)

No	98 (66.2)
When you travel or leave home do you sometimes forget to bring along your diabetic medication?	
Yes	59 (39.9)
No	89 (60.1)
Did you take your Diabetic medicine yesterday?	
Yes	135 (91.2)
No	13 (8.8)
When you feel like your diabetes is under control, do you sometimes stop taking your medicines?	
Yes	17 (11.5)
No	131 (88.5)
Taking medication every day is a real inconvenience for some people. Do you ever feel hassled about sticking to your diabetes treatment plan?	
Yes	44 (29.7)
No	104 (70.3)
How often do you have difficulty remembering to take all your medications?	
All the time	1 (0.7)
Usually	57 (38.5)
Sometimes	49 (33.1)
Once in while	29 (19.6)
Never / rarely	12 (8.1)

Table 2: Self-reported medication adherence behaviour of patients as determined by the 8-item Morisky Medication Adherence Scale (MMAS-8). n=number of patients. [a]Percentages are given within parenthesis with the total number of patients (n=148) as the denominator.

The means of the Specific-Necessity subscale scores and Specific-Concerns subscale scores were 17.8 ± 3.62, 12.4 ± 3.63 respectively. Patients strongly believed in their need for the anti-diabetic medication to maintain health now and in the future but they were moderately concerned about the potential negative effects of their anti-diabetic medications. The means of the General-Harm subscale and General-Overuse subscale were 12.3 ± 2.79, 12.5 ± 3.50 respectively. Patients moderately have more negative views about medications as a whole and a tendency to see medications as fundamentally harmful and addictive poisons. In addition, they have more negative views about the way in which medicines are prescribed and beliefs that they were overused by physicians (Table 3).

Scales	Mean ± SD
Specific-Necessity scale	17.8 ± 3.62
Specific-Concerns scale	12.4 ± 3.63
General-Overuse scale	12.3 ± 2.79
General-Harm scale	12.5 ± 3.50

Table 3: Mean scores for each scale in the BMQ.

Analysis of MDKT scores showed that 95 patients (64.2%) had low knowledge (MDKT scores <7). The mean MDKT score was 7.02 ± 1.67 (Figure 3).

Association between patients' medication adherence state and their glycemic status

There was a significant association between patients' medication adherence level and their glycemic status. The majority of non-adherent patients (59, 75.6%) had poor glycemic control state as compared to adherent patients (46, 65.7%) (P-value <0.001).

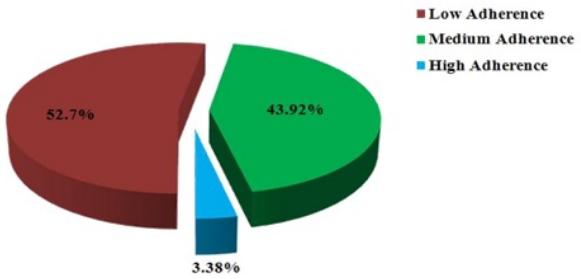

Figure 1: Patients' medication adherence categories according to the MMAS-8 scale. Five patients (3.3%) were classified as high adherent (MMAS-8=8), while 65 (43.9%) patients were medium adherent (6 ≤ MMAS-8>8) and 78 (52.7%) patients were low adherent.

Factors affecting non-adherence

Univariate analysis showed that there was a significant association between non-adherence and marital status, diet compliance status, education about DM and General-Harm scale. Un-married patients were more likely to be non-adherent (OR=2.84; 95% CI of 1.2-6.71). Similarly, patients with negative beliefs about medicines as a whole and a tendency to see medicines as fundamentally harmful and addictive poisons were more likely to be non-adherent (OR=0.87; 95% CI of 0.79-0.96). On the other hand, patients compliant with diet and those who did not get any education about DM were more likely to be adherent (OR=0.65; 95% CI of 0.43-0.98; OR=0.85; 95% CI of 0.77-0.94, respectively) (Table 4).

Variable	Total (N=148)	Non-adherent (N=78)	Adherent (N=70)	Odds ratio with (95% CI)	P- value
Age					
<65	106 (71.62%)	55 (70.51%)	51 (72.85%)	Reference	0.57

≥ 65	42 (28.37%)	23 (29.48%)	19 (27.14%)	1.08 (0.64-1.81)	
Sex					
Male	71 (47.9%)	35 (44.87%)	36 (51.42%)	Reference	0.77
Female	77 (52.02%)	43 (55.12%)	34 (48.57%)	1.13 (0.83-1.55)	
Marital status					
Married	122 (82.43%)	58 (74.35%)	64 (91.42%)	Reference	0.012
Others	26 (17.56%)	20 (25.64%)	6 (8.57%)	2.84 (1.20-6.71)	
Level of education					
University level	42 (28.37%)	20 (25.64%)	22 (31.42%)	Reference	0.44
Non-university	106 (71.62%)	58 (74.35%)	48 (68.57%)	1.08 (0.88-133)	
Household income					
Less than 1500	80 (54.05%)	43 (55.12%)	37 (52.85%)	Reference	0.44
Equal or more than 1500	68 (45.94%)	35 (44.87%)	33 (47.14%)	0.95 (0.67-1.35)	
Smoking status					
Yes	18 (12.16%)	6 (7.69%)	12 (17.14%)	0.44 (0.17-1.13)	0.11
No	130 (87.83%)	72 (92.30%)	58 (82.85%)	Reference	
Diet compliance					
Yes	57 (38.51%)	24 (30.76%)	33 (47.14%)	0.65 (0.43-0.98)	0.003
No	91 (61.48%)	54 (69.23%)	37 (52.85%)	Reference	
Physical activity					
Yes	96 (64.86%)	47 (60.25%)	49 (70%)	0.86 (0.67-1.09)	0.65
No	52 (35.13%)	31 (39.74%)	21 (30%)	Reference	
BMI					
Normal	10 (6.75%)	3 (3.84%)	7 (10%)	Reference	0.16
Abnormal	138 (93.24%)	75 (96.15%)	63 (90%)	1.06 (0.97-1.16)	
Co-morbidities					
Without	44 (29.7%)	22 (28.20%)	22 (31.42%)	Reference	0.72
With	104 (70.3%)	56 (71.80%)	48 (68.57%)	0.85 (0.42-1.73)	
Complications					
Without	103 (69.6%)	51 (65.38%)	52 (74.28%)	0.65 (0.32-1.33)	0.28
With	45 (30.4%)	27 (34.61%)	18 (25.71%)	Reference	
Diabetes knowledge level.c	7.027 ± 1.67	7.025 ± 1.73	7.028 ± 1.61	1.00 (0.82-1.21)	0.97
Specific-Necessity score.c	17.82 ± 3.62	17.51 ± 3.82	18.17 ± 3.38	1.05 (0.96-1.15)	0.25
Specific-Concern score.c	12.45 ± 3.63	12.96 ± 3.43	11.9 ± 3.79	0.92 (0.84-1.00)	0.27
General- Overuse score.c	12.33 ± 2.79	12.76 ± 2.59	11.85 ± 2.94	0.88 (0.78-1.00)	0.07
General- Harm score.c	12.50 ± 3.50	13.25 ± 3.24	11.67 ± 3.60	0.87 (0.79-0.96)	0.05

T2DM duration					
<5	62 (41.89%)	34 (43.58%)	28 (40%)	Reference	0.61
≤ 5	86 (58.10%)	44 (56.41%)	42 (60%)	0.94 (0.71-1.23)	
Age at diagnosis					
<65	131 (88.51%)	69 (88.46%)	62 (88.57%)	0.99 (0.88-1.12)	0.57
≥ 65	17 (11.48%)	9 (11.53%)	8 (11.42%)	1.01 (0.41-2.47)	
The pattern of antidiabetic drug					
Mono-therapy	58 (39.18%)	32 (41.02%)	26 (37.14%)	Reference	0.56
Multi-therapy	90 (60.81%)	46 (58.97%)	44 (62.85%)	0.93 (0.72-1.21)	
The main source of antidiabetic drugs					
Free from clinic	122 (82.43%)	63 (80.76%)	59 (84.28%)	Reference	0.79
Buying it from outpatients pharmacy	26 (17.56%)	15 (19.23%)	11 (15.71%)	1.22 (0.60-2.48)	
Education about DM					
Yes	13 (8.7%)	12 (15.38%)	1 (1.42%)	Reference	0.011
No	135 (91.21%)	66 (84.61%)	69 (98.57%)	0.85 (0.77-0.94)	
Easy access to physician					
Yes	124 (83.78%)	63 (80.76%)	61(87.14%)	Reference	0.54
No	24 (16.21%)	15 (19.23%)	9 (12.85%)	1.49 (0.69-3.20)	
Enough time spent with the physician					
Yes	94 (63.51%)	49 (62.82%)	45 (64.28%)	Reference	0.29
No	54 (36.48%)	29 (37.17%)	25 (35.71%)	1.04 (0.67-1.59)	
Instructions about T2DM care					
Yes	76 (51.35%)	39 (50%)	37 (52.85%)	0.94 (0.69-1.29)	0.91
No	72 (48.64%)	39 (50%)	33 (47.14%)	Reference	
Follow up					
Regular	110 (74.32%)	56 (71.79%)	54 (77.14%)	0.93 (0.77-1.12)	0.84
Irregular	38 (25.67%)	22 (28.20%)	16 (22.85%)	Reference	
The pattern of home blood glucose measurement					
Regular	46 (31.08%)	24 (30.76%)	22 (31.42%)	0.97 (0.60-1.58)	0.21
Irregular	102 (68.91%)	54 (69.23%)	48 (68.57%)	Reference	
Getting help to remember taking anti-diabetic drugs					
Yes	32 (21.62%)	20 (25.64%)	12 (17.14%)	1.49 (0.79-2.88)	0.6
No	116 (78.37%)	58 (74.35%)	58 (82.85%)	Reference	
Knowledge of optimum blood glucose level					
Yes	69 (46.62%)	39 (50%)	30 (42.85%)	Reference	0.36

No	79 (53.37%)	39 (50%)	40 (57.14%)	0.87 (0.64-1.18)	

Table 4: Univariate analysis of factors associated with non-adherence. N=number of patients in each group. [a](%) Percentages are given within parenthesis with the total number of patients in each group as the denominator. [b]Binary logistic regression test was used to analyse factors associated with non-adherence (MMAS-8 score <6), P-values ≤ 0.05 were considered significant. [c]Mean ± standard deviation.

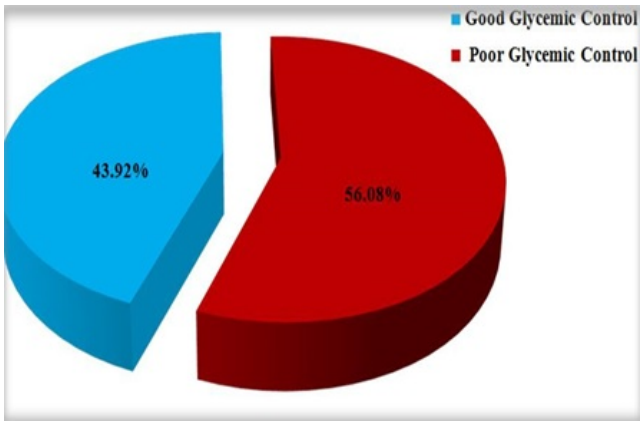

Figure 2: Glycemic Control Level. Patients were classified according to their HbA1c test results into two categories: good glycemic control patients (HbA1c ≤ 7), and poor glycemic control patients (HbA1c >7).

Multivariate analysis was done for factors that showed significant association in univariate analysis. Multivariate analysis showed that the following factors were significantly associated with non-adherence: marital status (unmarried), diet compliance, General-Harm scale, and not getting any education about DM as shown in Table 5.

Variable	B	S.E.	P-value[a]	Odds ratio with 95% CI[b]
Marital status	1.3	0.52	0.013	3.69 (1.31-10.37)
(unmarried)				
Diet compliance	-0.94	0.38	0.014	0.38 (0.18-0.82)
General- Harm scale	-0.133	0.055	0.015	0.87 (0.78-0.97)
Not getting any education about DM	-2.75	1.08	0.011	0.06 (0.008-0.52)

Table 5: Multivariate analysis of factors associated with non-adherence. CI: Confidence Interval, B: Coefficient of predictor variables. S.E.: Standard error. [a]Multiple logistic regression was used to analyse factors appear as significantly associated with non-adherence in Binary logistic regression, P-values ≤ 0.05 were considered significant. [b]Odds ratio (OR) at a 95% confidence interval (CI) was used to analyse the relationship between non-adherence and any particular factor of interest.

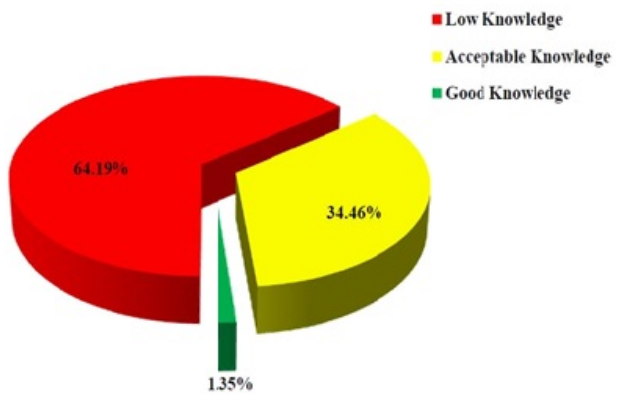

Figure 3: Diabetic knowledge level. Patients classified according to their scores (out of a total score of 14) in MDKT into three categories: patients with low diabetic knowledge level (scores <7), acceptable diabetic knowledge level (scores 7-<11), good diabetic knowledge level (scores ≥ 11).

Discussion

In the current study, medication adherence and its potential association with glycemic control were assessed among T2DM patients. Results showed that the majority of patients (52.7%) were non-adherent. Medication non-adherence was mainly due to unintentional forgetfulness which reported by 46.6% of patients. For some patients, however, medication non-adherence was intentional. One-third of patients reported stopping taking their medications when they felt worse upon taking them. This reported non-adherence rate was in agreement with previous findings reported by Sweileh et al. (42.7%) [3], Jackson et al. (50.2%) [14], Bizu et al. (51%) [15], Abu Bakar et al. (44.8%) [16]. Yet, Jamous et al. reported a lower rate of adherence than our finding (16.9%) [7]. The population of James et al. study was homogenous; just military personnel and their families. Those patients usually receive advanced medical care and medications from their Military Medical Services authorities. Whereas in the current study, patients were from different social groups and received normal medical care. Ashur et al. found that 36.1% of T2DM patients on both insulin and OHG agents were non-adherent [17]. Usually, patients on OHG agents only are more likely to have fewer symptoms and they consider their illness less serious than those on insulin. Therefore, they may stop taking their medicines when symptoms disappear [7]. Thus, patients using insulin are more adherent compared with patients on OHG agents only.

In our study, more than half the patients (56.1%) were poorly glycemic controlled (HbA1c >7). Poor glycemic control was significantly associated with non-adherence (P-value<0.001). Similar findings were also reported in previous studies [17-20]. In contrast to these findings, Ward et al. found that medication adherence was not significantly associated with glycemic control status [21]. The sample size (35 T2DM patients) was too small to detect any significant association between medication adherence and glycemic control.

Other factors might have contributed to poor glycemic control in our study. The majority of patients (93.3%) were obese or overweight and this high BMI was previously reported to be associated with poor glycemic control because of insulin resistance [17,22-24]. Poor glycemic control may be related to long-term DM (more than 5 years) that was reported by most patients (58.1%) in our study. This may be caused by progressive impairment of insulin secretion with time because of ß cell failure, which makes the response to diet alone or oral agents unlikely [24]. Moreover, most patients (61.5%) were non-diet compliant. Diet compliance is considered one of three cornerstones of glycemic control beside medication and exercise [25,26]. People in Palestine especially in the Gaza strip exposed to stressful events continuously like life events, food shortage, job insecurity and wars [27]. Continuous exposure to the traumatic events such as wars was associated with a progressive poor glycemic control [28].

Previous studies from the Middle East region reported lower glycemic control rate than our findings (20%-36%) [24,26,29-31]. Imseeh et al. found that only 20% of T2DM patients were glycemic controlled [2]. In their study, the majority of patients were females (67.8%). Being female is an independent risk factor for poor glycemic control. Usually, females have a high rate of nutritional and psychological problems and they are less adherent to lifestyle changes and to exercise due to traditional and cultural restrictions, especially in Arab countries [32,33]. Similarly, Ashur et al. found that only 21.8% of T2DM patients were glycemic controlled [17]. The majority of patients (61.9%) were on insulin. Usually, insulin usage is a predictor for poor glycemic control because insulin usually serves as adds to therapy for patients who fail to attain the HbA1c target after their initial first-line therapy [34-36].

Most patients in our study (64.2%) had a low level of knowledge about DM (MDKT scores <7). Yet, patients' knowledge was not significantly associated with medication adherence. The poor knowledge level of patients may be related to insufficient patients' education about DM. Only 8.8% of patients reported that they had education about DM. This may be explained by the inadequate implementation of training and counselling programs and insufficient distribution of educational materials related to DM.

Few studies assessed patients' diabetes knowledge by using MDKT [3,37-39]. In our study, 95 patients (64.2%) had low knowledge level (MDKT scores <7). Similar findings to ours were reported in previous studies [40,41]. While, in contrast to our findings, Al-Adsani et al., Politeness et al. and Turk et al., Sweileh et al. found that patients had acceptable diabetic knowledge level [3,37-39]. This may be attributed to the presence of more patients with a family history of DM, high educational background and years of education and long duration of DM in their studies.

Most patients were strongly endorsed that their antidiabetic medications were necessary for their current and future health. This may be explained by the fact that 56.1% of patients were poorly glycemic controlled and 60.8% of patients were prescribed a combination of anti-diabetic therapy. Therefore, patients realized the importance of their anti-diabetic medicines for their current and future health. Moreover, patients had the notion that DM is a chronic disease and diabetic patients require medicines throughout their life. Similar findings were also reported in previous studies [3,7,42,43].

Patients had medium concerns about the adverse consequences of taking anti-diabetic medications on regular basis. This may be related to adverse drug effects that patients experience when taking their medicines and interference of medicines with patients' daily activities. Moreover, healthcare providers might not have addressed patients' concerns about their medicines during counselling sufficiently. Similar

findings were also reported in previous studies [3,7,40,41]. Mean score in Specific-Necessity scale (17.8 ± 3.62) was higher than the mean score in Specific- Concerns scale (12.4 ± 3.63). That would lead one to expect high levels of medications adherence which was not the case. Patients may have other concerns that go beyond side effects such as the unavailability of effective types of medicines and the presence of poor health care quality in the health facilities that follow MOH [30].

Patients had medium negative views about medicines as a whole and a tendency to see medicines as fundamentally harmful and addictive poisons. There was a significant association between medication non-adherence and a General-Harm scale. Moreover, patients had medium negative views about the way in which their medicines were prescribed and beliefs that their medicines were overused by physicians. This was consistent with Sweileh et al. study [3], where the means of the General-Harm subscale and General-Overuse subscale were 10.5 ± 3.7, 12.0 ± 3.3, respectively.

Such beliefs may be associated with the notion that dangerous aspects of medications are linked to their chemical/unnatural origins and that complementary treatments are perceived to be more natural and therefore safer. In addition, these beliefs may be associated with poor patients' experiences with the use of medicines in general, worse experiences acquired from surrounding patients with prior use of medicines, poor patients' knowledge of the purpose of each one of the prescribed medicines in a disease treatment and patients' beliefs that their actions like reducing or avoiding sugar, eating healthy food and practicing exercise can control the disease without need for medicines [40].

Medications non-adherence was significantly associated with marital status, where unmarried patients were more likely to be non-adherent. Usually, family individuals remind and help their patients to perform self-care activities and create an appropriate environment to reinforce adherence such as preparing healthy diet and sharing exercises. This was consistent with previous studies [3,42].

Patients who were compliant with diet were more likely to be adherent to their medications which was consistent with Inbaraj et al. and Al-Majed et al. studies [44,45]. Patients who adhere to and monitor their diet more frequently obtain regular feedback about the positive impact of adherence on their blood glucose levels. This, in turn, may encourage them to adhere to their medications beside diet to obtain more desirable HbA1c results.

An interesting finding in this study is the effect of education on DM on adherence. Patients who did not get any education about DM were more likely to be adherent. A possible explanation is that diabetes' education might have been recommended or used by patients already having difficulties with medication adherence. It is also possible that the quality of offered diabetes' education is low or offered by non-well-trained health care provider, or from audio-visual and social media.

Limitations

Our study has a few limitations. First, it was only undertaken in one public governmental clinic in Gaza. Moreover, the study excluded T2DM patients using insulin. This restricts the applicability of the study's results to a considerable subset of T2DM patients that constitutes 64.5% of them (PHIC-MOH, 2015c). Second, the study used only the most recent HbA1c measures and some of the HbA1c results were from different laboratories outside the clinic. Third, a self-report method was used to assess adherence. This may overestimate adherence in the study sample. Finally, patients' selection method might have created a bias toward positive beliefs since patients who attend the clinic are those who usually care about their health.

Conclusion

Most patients were medication non-adherents and poor glycemic controlled. Medication non-adherence was significantly associated with the poor glycemic control. Factors significantly affecting non-adherence were marital status, diet compliance status, General-Harm scale in BMQ and education about DM. Raising awareness of patients about medication adherence, the consequences of non-adherence and improving communication with health care professionals could improve adherence level.

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