Palestinian Medical and Pharmaceutical Journal (PMPJ). 2022; 7(1): 00-00

Factors Associated with Nonadherence to Life Style Modifications among Type 2 Diabetes Mellitus Patients: A Cross-sectional Study from Palestine†

Rowa' Al-Ramahi [1,]; Sa'ed Zyoud [1,2,3]; Aya Al-haj [1]; Aya Bitar [1]; Diana Bakkar[1]; Mai Bzour[1]; Qamar Maqboul[1] & Sarah Aqqad[1]*

[1]Department of Clinical and Community Pharmacy, College of Medicine and Health Sciences, An-Najah National University, Nablus, Palestine. [2]Poison Control and Drug Information Center (PCDIC), College of Medicine and Health Sciences, An-Najah National University, Nablus, Palestine. [3]Clinical Research Center, An-Najah National University Hospital, Nablus, Palestine

*Corresponding author: rawa_ramahi@najah.edu

Received: (4/9/2020), Accepted: (29/1/2021)

ABSTRACT

The aims of this study were to estimate the frequency and identify reasons for nonadherence to lifestyle modifications among type 2 diabetic patients. A cross-sectional study was conducted using the Summary of Diabetes Self-Care Activities-Arabic instrument and the Arabic version of the Michigan Diabetes Knowledge Test. A convenience sample was collected. The sample included 410 participants. The mean age of the participants was 61 ± 9.70 years. Of the participants, only 95 (23.2%) had a controlled blood glucose level (glycosylated hemoglobin ≤ 7%). The self-management activities from the most practiced to the least practiced (scale range 0-7) were medications (Mean: 6.28 ± 1.64), foot care activities (Mean: 5.04 ± 2.43), diet activities (Mean: 4.44 ± 2.69), exercise activities (Mean: 3.96 ± 1.97), and blood glucose monitoring (Mean: 0.58 ± 1.28). The majority of participants had acceptable knowledge (63.2%, n = 259). Obese, smokers and rural participants were less likely to adhere to the appropriate diet. P values were 0.012, 0.018, and 0.011, respectively. Regarding regular exercise, obese participants and those with uncontrolled blood glucose levels were less engaged in exercise practice (p values were 0.041 and 0.019). The study concluded that lifestyle modifications were found to be accepted in many aspects. However, there is room for improvement. Effective education and counseling strategies are recommended with a focus on the recognized factors.

Keywords: *Adherence, Lifestyle Modifications, Diabetes Mellitus, Palestine*

† This paper was extracted from graduation project of Doctor of Pharmacy students in the Faculty of Medicine and Health Sciences, An-Najah National University, Nablus, Palestine. In 2016 Under the Supervision of Dr. Rowa' Al-Ramahi.

INTRODUCTION

Diabetes Mellitus (DM) is a major international public health problem [1]. This disease is confronted by a complicated care regimen. In the face of this point, it is important to assess and promote adherence to achieve the recommended glycemic goals as well as reducing possible complications and subsequent death. In 2000, the global estimate of adults living with diabetes was 151 million. By 2009, it had grown by 88% to 285 million. Today, it is calculated that 9.3% of adults aged 20–79 years (around 463 million) are living with diabetes. A further 1.1 million children and adolescents under the age of 20 live with type 1 diabetes [2]. In Palestine, in 2019, the newly reported diabetes cases in governmental clinics in the West Bank were 5671 cases with an incidence rate of 210.4 per 100000 [3].

The issue of the high economic burden of diabetes has received considerable attention [4, 5]. Since most of these costs are a result of diabetes complications, effective prevention means more cost-effective healthcare. This may be achieved by trying to delay the onset of diabetes itself (as primary prevention) with appropriate lifestyle modifications. In contrast, the other approach is trying to reduce the immediate and longer-term consequences of that disease (secondary prevention), which includes the early detection and treatment of diabetes [6].

Lifestyle modification is the cornerstone of the treatment strategy for patients with type 2 diabetes mellitus (T2DM) [7], which is defined as changing the daily behaviors of the patient to reach the euglycaemic blood levels to delay or reduce future diabetes complications [8]. The key aspects of these lifestyle measures can be listed as follows: diet, physical activity [9, 10], smoking cessation, knowledge, foot care, and self-monitoring of blood glucose (SMBG) [9].

Diabetes was the 4th leading cause of death, and the total number of newly reported cases was 4,816 in West Bank in 2013 [11]. Although several studies were carried out and published about DM in Palestine [12-16], no study has been conducted to assess adherence to lifestyle modifications among Palestinian T2DM patients. The aims of this study were to estimate the frequency and identify reasons for non-adherence to lifestyle modifications among Palestinian T2DM patients. Because adherence to lifestyle changes affects glycemic control and the patient's overall quality of life, it is hoped that understanding the patient's barriers to lifestyle modification will support the development of educational programs and suitable counseling to improve patients' adherence and glycemic control among diabetic patients.

METHODS

Study Design and Setting

A cross-sectional study was adopted to conduct this observational study. Data collection occurred at Al-Makhfia Governmental Diabetes Primary Healthcare Clinic in Nablus district, which was the main center providing care for patients with governmental insurance at that time.

Sample Size

The mean yearly number of diabetic patients who attend the primary clinic in Nablus city (study area population) was beyond 27,390 [11]. Because this number is considered a large population, 20,000 were used to calculate the sample size needed for this study. We assumed that the response distribution for diabetic patients who visit primary clinics is 50%, and we accepted a 5% margin of error with a 95% confidence interval. Raosoft sample size calculator (http://www.raosoft.com/samplesize.html) was used, the minimum effective sample size calculated for the survey was 377. Therefore, a convenience sample of 410 participants was collected. Participants were recruited while waiting to be seen by their health care providers. Inclusion criteria included adult patients with T2DM who were diagnosed for at least three months.

Data Collection Procedure

The data collection was pretested through a pilot study of 30 patients to check for the comprehension and language clarity of questions. However, these patients were not included in the final analysis. Four hundred and ten patients were interviewed by face-to-face meeting; verbal consent was obtained first.

Ethical issues

The Palestinian Ministry of Health and the Institutional Review Board (IRB)

at An-Najah National University authorized this study before its beginning.

Data Collection Instrument

Data collection instrument was a questionnaire that included two scales. The first one was the Revised Arabic version of the Summary of Diabetes Self Care Activities (A-SDSCA) instrument, which was developed by Toobert *et al*., [17] and translated by Al Johani [9]. The second one was the Arabic version of the Michigan diabetes knowledge test (MDKT) [15]. The first part included the sociodemographic data such as age, gender, weight, height, living place, occupation, marital status, educational level, income, the second part included clinical data as duration of diabetes, other health problems and the HbA1c level that was obtained through checking the patient's profile in the computerized system of the Ministry of Health (MOH).

The SDSCA instrument is a reliable and valid measure of diabetic self-care management that is useful for research and practice. This scale contains two sections: SDSCA and extended SDSCA. The main part of the SDSCA contains five self-care subscales. Four of these subscales include asking the patients to record the number of days during which they performed the specified self-care activities in the last week. These subscales are participant diet (2 items), physical activity (2 items), follow-up with blood glucose testing (2 items), and foot care (2 items). The fifth subscale is smoking (1 item). Information about diabetes treatment including oral hypoglycemic agents or insulin injections and the patient's adherence to such therapy within the last seven days is obtained in the second section. Furthermore, the extended Arabic-SDSCA explores health care counseling provided to T2DM participants by asking them to record the advices they received while visiting the health clinic center regarding diet, exercise, blood glucose testing, smoking and medications. Approval to use the Arabic-SDSCA was obtained from the developer. The final section in the data collection form was the diabetes knowledge test known as Michigan Diabetes Knowledge test (MDKT), which was developed by the Michigan Diabetes Research and Training Center (MDRTC) [18]. It consists of 14 multiple-choice questions with one correct choice for each question. These include general questions designed to assess the patient's knowledge about diabetes, its complications, appropriate healthy diet, and self-care in general. Approval to use the MDKT was obtained from the developer. The Arabic-translated version of MDKT was used in a previous publications in the same population [15].

Data management and Statistical Analysis

The data analysis was undertaken using Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics were expressed as frequencies and percentages for categorical variables and as mean ± standard deviation (SD) for continuous variables. Categorical variables were compared using Chi-square. A p-value of less than 0.05 was considered statistically significant for all analyses.

RESULTS

Socio-demographic characteristics

The sample included 410 participants. Among the surveyed patients, 64.6% were females. The mean age was 61 ± 9.70 years. Most of the participants were married 82.0%. Around 52.0% were obese and 66.3% were unemployed. The monthly income was less than 400 Jordanian Dinar (JD) for most of the patients 72.4%. The highest percentage of participants had a primary school degree 50.7% and 53.2% were diagnosed with T2DM for more than or equal to 8 years. The results for HbA1C ranged from 4.8 to 15.0%. The percentage of participants who had a controlled glucose level was 23.2% only. Table 1 shows some socio-

demographic characteristics of the patients.

Table (1): Socio- demographic characteristics of the participants.

Variable	Number	Percentage %
Age/Years		
less than 38 years	6	1.5
38 - 47 years	34	8.3
48 - 57 years	149	36.3
58 - 67 years	144	35.1
68 - 77 years	61	14.9
78 years and more	16	3.9
Gender		
Male	145	35.4
Female	265	64.6
Marital status		
Single	15	3.7
Married	336	82.0
Widowed	58	14.1
Divorced	1	0.2
Region of Residence		
Village	125	30.5
City	272	66.3
Camp	13	3.2
Income/month		
Low (< 400 JD)	297	72.4
Moderate (400-1000 JD)	102	24.9
High (> 1000 JD)	11	2.7
Education level		
Not educated	65	15.9
Primary school	208	50.7
Secondary school	79	19.3
University graduate	55	13.4
High education	3	0.7
Occupational status		
Employed	109	26.6
Retired	29	7.1
Unemployed	272	66.3
Body Mass Index Category		
Normal weight	63	15.4
Overweight	132	32.2
Obese	215	52.4
T2DM duration/Year		
< 8 years	192	46.8
≥8 years	218	53.2
Blood Glucose(HbA1C)		
Controlled <7%	95	23.2
Uncontrolled ≥ 7%	315	76.8

The A-SDSCA

The self-management activities from the most practiced to the least practiced (scale range 0-7) were medications (Mean: 6.28 ± 1.64); foot care activities (Mean: 5.04 ±2.43); diet activities (Mean: 4.44 ±2.69); exercise activities (Mean: 3.96 ±1.97); and blood glucose monitoring (Mean: 0.58 ±1.28).

When the patients were classified into adherent and non-adherent, a good percentage of patients were adherent to foot care (84.1%, n=345, ≥ 3 days/week), exercise (80.0%, n=328, ≥ 3 days/week), medication (75.9%, n=311, 7 days/week) and diet (73.2%, n=300, ≥ 3 days/week). The participants were least adherent to blood glucose testing (2.2%, n=9, ≥ 5 days/week).

The A-SDSCA extension

Regarding the questions in the A-SDSCA extension, 82.2% (n=337) of participants were instructed to follow a low-fat diet plan by their health care providers and 82.4% (n= 338) were informed about the importance of decreasing sweets in their food. However, 7.8 % (n= 32) of the participants denied receiving any diet recommendations. The majority of participants, 81.0% (n= 332) were advised to engage in low-level exercise such as walking daily. However, exercise recommendations regarding the duration of exercise and engaging in a specific amount, type, and level of exercise were provided to 22.2% (n= 91) and 12.4% (n= 51) of the participants, respectively. In view of blood glucose testing, the government healthcare system provides biannual HbA1c testing services for all diabetic patients. For this reason, the total number of the samples (n= 410) reported testing of blood sugar using a machine. Moreover, a significant percentage 83.7% (n= 343) of participants recorded that they were advised about testing of urine glucose. On the other hand, providing information about self-monitoring blood glucose was recommended for only 19.8 % (n= 81) of participants.

Using medications to control blood glucose is fundamental in diabetes management. Most interviewees (81.5%, n=334) received oral diabetic medication, whereas 41.0% used insulin injections.

Factors associated with nonadherence to medications and lifestyle

Data showed that adherence to medications was significantly poorer in patients < 38 years (P-value = 0.001) and patients having diabetes for < 8 years (P-value = 0.046). Non- adherence to blood glucose monitoring was related to patients' knowledge, those who had good knowledge showed higher commitment level (P-value = 0.036). Statistical tests revealed that obese participants were less likely to adhere to an appropriate diet than normal weight and overweight patients (P-value =0.012). Likewise, smokers scored lower adherence to the appropriate dietary practice than nonsmokers (P-value =0.018). Rural participants were less adherent to the appropriate dietary practice than those from cities (P-value= 0.011). Regarding regular exercise, obese participants were undertaking regular exercise at a lower level (P- value =0.041) than normal weight or overweight participants. Moreover, those with uncontrolled blood glucose levels (HBA1C ≥ 7%) were less engaged in exercise practice (P- value=0.019) than patients with controlled blood glucose levels. Finally, smokers were less likely to be adherent to foot care activities (P-value =0.019).

Michigan Diabetes Knowledge Test

Based on the Michigan Diabetes Knowledge Test, the patients were divided into 3 categories: low knowledge (<7 points),, acceptable (7-10 points) and good knowledge (≥11 points). The majority of participants had acceptable knowledge (63.2%, n=259), whereas 28.8% (n=118) and 8.0% (n=33) had good knowledge and low knowledge

The test conveyed 14 questions about diabetes to assess the participants' knowledge level. Of those, item 9 "what effect does exercise have on blood glucose?" was the most frequent question answered correctly (94.4%, n=387). Subsequently, 88.3% (n=362) of the patients answered item 1 properly. It asked about the definition of the correct diabetes diet. On the other hand, item 4 "Which of the following is a "free sugar food" was the hardest one, only 18.5% (n=76) of participants picked the correct choice.

Knowledge Score

As with the A-SDSCA questionnaire, Chi-square test was used to explore the relationships between participants' characteristics and their knowledge level, which are presented in Table 2. A significant correlation between the level of knowledge and some of socio-demographic variables including age, income, educational level, occupation, and HbA1c readings has been found. Regarding age, the youngest participants (less than 38 years age) got the highest scores in knowledge tests, while the oldest patients (more than 78 years age) recorded an acceptable knowledge level (P- value =0.046). Therefore, far, patients with higher income were more knowledgeable than who had middle and low income (P-value <0.001). In addition, there was a significant association between knowledge and educational level. For instance, good knowledge was coupled with high education. Conversely, those who received no education had a low knowledge level (P<0.001). In terms of occupational impact, the employees had a higher level of knowledge than those who do not have work. On the other hand, retired patients reported an acceptable level of knowledge (P- value =0.001). Comparatively, patients with a good diabetes control (HbA1c <7%) reported higher knowledge levels (P- value=0.002).

Table (2): Factors associated with knowledge score.

	Low knowledge	Acceptable knowledge	Good knowledge	P value
Age/Years				0.046
less than 38 years	1(16.7)	3(50.0)	2(33.3)	
38-47 years	1(2.9)	23(67.6)	10(29.4)	
48 - 57 years	7(4.7)	94(63.1)	48(32.2)	
58 - 67 years	12(8.3)	85(59.0)	47(32.6)	
68 - 77 years	10(16.4)	41(67.2)	10(16.4)	
78 years and more	2(12.5)	13(81.2)	1(6.2)	
Gender				0.864
Male	11(7.6)	90(62.1)	44(30.3)	
Female	22(8.3)	169(63.8)	74(27.9)	
Marital status				0.389
Single	1(6.7)	10(66.7)	4(26.7)	
Married	23(6.8)	212(63.1)	101(30.1)	

	Low knowledge	Acceptable knowledge	Good knowledge	P value
Widowed	9(15.5)	36(62.1)	13(22.4)	
Divorced	0(0.0)	1(100.0)	0(0.0)	
Region Of Residence				0.842
Village	11(8.8)	83(66.4)	31(24.8)	
City	21(7.7)	168(61.8)	83(30.5)	
Camp	1(7.7)	8(61.5)	4(30.8)	
Income/month (JD)				<0.001
Low (< 400)	27(9.1)	197(66.3)	73(24.6)	
Moderate (400-1000)	6(5.9)	60(58.8)	36(35.3)	
High (> 1000)	0(0.0)	2(18.2)	9(81.8)	
Education level				<0.001
Not educated	11(16.9)	43(66.2)	11(16.9)	
Primary school	19(9.1)	141(67.8)	48(23.1)	
Secondary school	1(1.3)	50(63.3)	28(35.4)	
University graduate	2(3.6)	24(43.6)	29(52.7)	
High education	0(0.0)	1(33.3)	2(66.7)	
Occupation				0.001
Employed	2(1.8)	61(56.0)	46(42.2)	
Retired	3(10.3)	20(69.0)	6(20.7)	
Unemployed	28(10.3)	178(65.4)	66(24.3)	
Body Mass Index Category				
Normal weight	5(7.9)	47(74.6)	11(17.5)	0.295
Overweight	10(7.6)	81(61.4)	41(31.1)	
Obese	18(8.4)	131(60.9)	66(30.7)	
T2 DM duration/Year				0.257
<8 years	11(5.7)	123(64.1)	58(30.2)	
< 8 years	22(10.1)	136(62.4)	60(27.5)	
Having Chronic Disease				0.635
Yes	25(7.5)	211(63.2)	98(29.3)	
No	8(10.5)	48(63.2)	20(26.3)	
Smoking Status				0.598
No	29(8.1)	223(62.3)	106(29.6)	
yes	4(7.7)	36(69.2)	12(23.1)	
Blood Glucose(HbA1C)				0.022
Controlled <7%	6(6.3)	51(53.7)	38(40.0)	
Uncontrolled ≥ 7%	27(8.6)	208(66.0)	80(25.4)	

DISCUSSION

The results of the current study found that only 95 (23.2 %) patients had controlled blood glucose levels. Uncontrolled DM increases the risk of diabetic complications. These results are in accordance with recent studies; indicating a high percent of patients with uncontrolled blood glucose among the diabetic Palestinian population. For example, in a study

by Sweileh *et al*., [14], 82.3% of participants (n = 242) had an uncontrolled blood glucose levels. Furthermore, Daoud *et al*. [8] reported that about 71% of patients (n=230) had high blood glucose levels .

In this study, 75.9% of patients were taking their medications as recommended. This result was almost in line with that of Al Johani *et al*., [19] who stated that 75.0% of participants were compliant with the recommended medication regimen. One explanation of our outcome may be associated with patients' belief that if they are committed to their chronic uptake of diabetic medication, it will help control their blood glucose within a normal level [8]. Another explanation may be related to the Palestinian health care services that provide regular medications for patients with governmental insurance, which in turn boosts their adherence to medication.

Regarding diet adherence, the results informed that 73.2% of participants followed their healthful eating habits 3 or more days per week, but only 32.7% of them had a healthy diet for all days of the week. On the other hand, Al Johani *et al*., (2015) reported percentages of 71.0% and 12.0%, respectively. These low optimal percentages may indicate how hard it is to uphold a healthy eating plan in Palestine because over the past few decades, traditional foods were replaced with westernized foods, which have a higher content of fat, cholesterol and sodium [20]. Moreover, Kunafah, which is a famous dessert in Nablus consisting of shredded wheat surface and mild white cheese and covered by sugar syrup, is highly consumed by all Palestinians including our participants.

As far as self-monitoring blood glucose is an integral part of effective diabetes care plan [21], these results, in contrast, recorded the least level among the A-SDSCA items with a 2.2% of participants practiced self –monitoring of blood glucose at home at least 5 days or more during the last week. Similarly, 13.0% of Saudi participants underwent self-blood sugar testing at least 5 days or more over the last week. This is possibly because many patients may do self-monitor blood glucose less than 5 days depending on their health care provider's advice, and by that they will be wrongly categorized as non-adherent to self-glucose monitoring in terms of our scale. The cost of the tests may be another reason because testing strips are not provided by the MOH and the patients need to buy them.

Exercise is another important component in the self-management of the diabetic patients that was measured in this study. Of the 410 participants recruited, 67.8% of the patients were adherent to the optimal exercise practice (seven days a week) for at least 30 minutes. Compared to Saudi participants in Al Johani *et al*. study with 17.4 %, the percent in our study was higher. These outcomes may be justified by Palestinian participants' adequate awareness about the potential aids of exercise. Furthermore, regarding the optimal engagement in specific forms of exercise (such as swimming, walking, biking, etc.) within the last 7 days, the comparison revealed 22.2 % in our study versus 11.4% in Al Johanna's study. These results are apparently low, which may be due to cultural barriers, lack of time, and lack of safe places for biking and walking.

The participants in this study reported practicing foot care activities at a high level. On average, they checked their feet 5.58 days per week (SD = 2.63), whereas the inspection of the insides of

their shoes was performed 4.49 days per week (SD=3.25). On the other hand, Al Johani *et al*. [19] reported 3.7(SD= 2.6) and 3.3 (SD= 2.6), respectively. This high proportion may be due to religious Muslims activity of washing the feet 5 times a day as a preparation for praying, and while washing them, they usually check their feet.

Health-care providers' recommendations concerning diet, exercise, and blood glucose monitoring were assessed through the extension of the A-SDSCA questionnaire. The proportion of patients who had received advice on diet was (92.2%), which corroborates with the results of a Saudi Arabian study (98.0%) [19].

However, a dramatic difference appears between our results and Saudi Arabia regarding exercise and SMBG recommendations. In our study, the proportion of patients who have been counselled on exercise and SMBG were (81.2%) and (19.8%), respectively. Contrariwise (97%) of Saudi Arabia respondents stated receiving advices on exercise, while (95%) of them informed receiving advice on SMBG [19].

Appropriate dietary practice occupies a major part of lifestyle changes in health care provider counseling. However, 55.6% of patients were informed that the health care providers did not encourage them to follow "five day "portions of fruits and vegetables. Moreover, 48.5% of respondents denied the reception of any tip regarding reducing the number of calories to lose weight as the treatment of diabetes itself, which could be associated with more weight gain [22]. These percentages indicate a lack of proper and complete instruction that enable patients to follow healthful eating habits.

With respect to physical activity, the majority of participants (87.6%) were not advised to be involved in a specific amount, type, duration, and level of exercise. Additionally, 77.8% of respondents were not told to exercise for at least 20 minutes three times a week.

Moreover, 81.2% of patients reported that they did not receive advice about engaging in daily routine activities. These reports may actually reflect the poor quality of exercise programs given to patients.

In term of explaining the result of blood glucose testing recommendations, the large crowds of patients in a governmental health care centers shorten time for every doctor-patient meeting which make recommendations for HbA1C and urinalysis tests more appropriate for the physician's intervention in a monthly visits than having the time to educate them about day to day blood glucose testing. Moreover, the high percent of patients (80.2%) who have not received information about testing blood glucose by home glucometer proved the least level of SMBG practice as discussed above in A-SDSCA outcome section.

The analysis of the medication subscale revealed that younger age was linked to nonadherence. The results of our study are consistent with those of Bezie *et al*., [23]. Possible explanations for poorer medication compliance among younger patients could be that they are less aware of their illness and thus more expected to be more non-adherent [24]. Likewise, the analysis showed that the shorter the diabetes duration, the lower the medication adherence. Comparable results were observed from a study among diabetic patients in eastern Uganda, which presented that participants with poor adherence had been on

diabetic treatment for less than three years [25]. They explained that by possible improved disease awareness and regimen comprehension as a function of time, in addition to better communication with health care providers with time [25]. Furthermore, this study documented the low participants' knowledge level as a significant factor negatively affecting blood glucose monitoring practices. These results match those observed in an earlier study conducted by Zgibor and Simmons, [26].

Regarding diet, our study detected that obese participants were less likely to follow an appropriate diet compared to normal weight and overweight patients. In 2013, a study conducted by Shamsi *et al*., that aimed to assess factors influencing dietary practice among T2DM patients, they found that there was a reverse association between dietary practice and BMI. On the other hand, smokers were less adherent to the proper dietary practice. This outcome may be due to the higher energy intake noticed in smoker patients [27].

Additionally, our results indicated obesity and uncontrolled blood glucose levels as the most common barriers to physical activity. Considering the exercise effects on improving insulin sensitivity and blood glucose levels, these outcomes were reasonable [28]. Alternatively, it could be that the adherence to exercise in overweight and obese patients may be more challenging because they are already moving hardly and it could be truly painful. In the same stream, Mier *et al*., [29] had labeled being overweight as one of the obstacles to physical activity.

The assessment of foot care practices linked smoking to low adherence levels. For instance, smokers had fewer foot examination checkups than nonsmokers. This outcome is consistent with that detected by Solberg *et al*., [30].

Diabetes knowledge is critical in improving clinical outcomes and avoiding complications by developing positive attitudes regarding the disease. In our study, the analysis of Michigan Diabetes Knowledge informed an inverse correlation between knowledge level and age. The possible justification to this finding is that younger participants might have a better cognition and education, elevating their enthusiasm toward their disease control [31]. Similar finding was observed from studies conducted among diabetes patients in Malaysia [32] , Kuwait [33] and Nepal [31].

Respondents of our study exhibited better diabetes knowledge with higher degree of education. This is almost in line with the findings reported by Shrestha *et al*.,[31] , who stated that an educated patient may offer a better inquisition while being instructed on diabetes. Moreover, educated patients could collect more facts about diabetes through different means of communication.

High income was significantly associated with knowledge in this study. This finding is congruent with that conveyed by Fenwick *et al*., [34]. Correspondingly, the knowledge level was interrelated considerably with employed patients, which is consistent with the findings of another study in Australia [34]. Furthermore, our results underlined higher HbA1c levels as a significant factor affecting diabetes knowledge. This is also in accordance with the outcomes of Fenwick *et al*., [34].

Educational programs should be planned to instruct diabetic patients about their disease and its management with the best medication use and appropriate life style changes, particularly unemployed

and illiterate patients. Training programs should be directed toward health care providers with the aim of creating a positive, trusting relationship between the patient and the health care providers as well as making them more active in managing the therapeutic care plan. Adequate and specific time should be allowed for each patient to evaluate their perception and understanding of their self-care plan to decide specific and proper recommendations.

The limitations of the study include that it was performed in one clinic only and the answers stated by the participants cannot be certified, but this cannot be avoided in surveys. The cross-sectional design can be a limitation; as this type of study may be unable to identify a causal relationship. Moreover, the use of convenience sampling methods can be a source of bias, which may have led to bias in the conclusions. However, this study can give baseline data which can be useful in education and planning.

CONCLUSIONS

The recommended lifestyle modifications were found to be accepted in many aspects. However, there is room for improvement. The results have identified that: older age, longer duration of the disease, low level of knowledge, obesity, uncontrolled blood glucose, and smoking are barriers that hinder optimal self-care management. Factors that influence diabetic patients' knowledge include younger age, high educational degree, high income, employment, and controlled blood glucose level. Effective education and counseling strategies are recommended to a focus on the recognized factors that may affect adherence.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ACKNOWLEDGEMENT

The project described was supported by Grant Number P30DK020572, awarded by the Michigan Diabetes Research Center (MDRC) from the National Institute of Diabetes and Digestive and Kidney Diseases. As well, we would like to thank the MDRC for permission to use their tools. Permission to use the Summary of Diabetes Self Care Activities (A-SDSCA) was granted by Dr. Deborah J. Toobert (Oregon Research Institute) and we are grateful for her permission.

REFERENCES

1) Tabish SA. Is Diabetes Becoming the Biggest Epidemic of the Twenty-first Century? Int J Health Sci (Qassim). 2007; 1(2): V-viii.

2) IDF Diabetes Atlas 2019 [Internet]. 2019 [cited November 2020]. Available from: https://diabetesatlas.org/en/sections/demographic-and-geographic-outline.html.

3) The Annual Health Report for 2019 [Internet]. 2020 [cited November 2020].

4) American Diabetes Association. Economic Burden of Prediabetes Up 74 Percent Over Five Years 2014 [cited 2015 July 22]. Available from: http://www.diabetes.org/news-room/press-releases/2014/economic-burden-of-prediabetes-up-74-per-cent-over-five-years.html.

5) Dall TM, Yang W, Halder P, Pang B, Massoudi M, Wintfeld N, *et al*. The economic burden of elevated blood glucose levels in 2012: diagnosed and undiagnosed diabetes, gesta-

tional diabetes mellitus, and prediabetes. Diabetes Care. 2014; 37(12): 3172-9.

6) World Health Organization. Diabetes: the cost of diabetes 2015 [cited 2015 July 22]. Available from: http://www.who.int/mediacentre/factsheets/fs236/en/.

7) Nelson KM, Reiber G, Boyko EJ. Diet and exercise among adults with type 2 diabetes: findings from the third national health and nutrition examination survey (NHANES III). Diabetes Care. 2002; 25(10): 1722-8.

8) Daoud N, Osman A, Hart TA, Berry EM, Adler B. Self-care management among patients with type 2 diabetes in East Jerusalem. Health Educ J. 2014; 74(5): 603-15.

9) Al Johani KA. Factors affecting the self-management practices of people with type 2 diabetes in Almadinah, Saudi Arabia: Curtin University, School of Nursing and Midwifery; 2011.

10) Parajuli J, Saleh F, Thapa N, Ali L. Factors associated with nonadherence to diet and physical activity among Nepalese type 2 diabetes patients; a cross sectional study. BMC Res Notes. 2014; 7: 758.

11) Ministry of Health, PHIC. Health Annual Report Palestine 2013 2014 [cited 2015 July 23]. Available from: http://www.moh.ps/attach/704.pdf.

12) Jamous RM, Sweileh WM, Abu-Taha AS, Sawalha AF, Zyoud SH, Morisky DE. Adherence and satisfaction with oral hypoglycemic medications: a pilot study in Palestine. Int J Clin Pharm. 2011; 33(6): 942-8.

13) Sharif NE, Samara I, Titi I, Awartani A. Compliance with and knowledge about diabetes guidelines among physicians and nurses in Palestine. East Mediterr Health J. 2016; 21(11): 791-802.

14) Sweileh WM, Abu-Hadeed HM, Al-Jabi SW, Zyoud SH. Prevalence of depression among people with type 2 diabetes mellitus: a cross sectional study in Palestine. BMC Public Health. 2014; 14:163.

15) Sweileh WM, Zyoud SH, Abu Nab'a RJ, Deleq MI, Enaia MI, Nassar SM, *et al*. Influence of patients' disease knowledge and beliefs about medicines on medication adherence: findings from a cross-sectional survey among patients with type 2 diabetes mellitus in Palestine. BMC Public Health. 2014; 14: 94.

16) Zyoud SH, Al-Jabi SW, Sweileh WM, Arandi DA, Dabeek SA, Esawi HH, *et al*. Relationship of treatment satisfaction to health-related quality of life among Palestinian patients with type 2 diabetes mellitus: Findings from a cross-sectional study. J Clin Transl Endocrinol. 2015; 2(2): 66-71.

17) Toobert DJ, Hampson SE, Glasgow RE. The summary of diabetes self-care activities measure: results from 7 studies and a revised scale. Diabetes Care. 2000; 23(7): 943-50.

18) Fitzgerald JT, Funnell MM, Hess GE, Barr PA, Anderson RM, Hiss RG, *et al*. The reliability and validity of a brief diabetes knowledge test. Diabetes Care. 1998; 21(5): 706-10.

19) Al Johani KA, Kendall GE, Snider PD. Self-management practices

among type 2 diabetes patients attending primary health-care centres in Medina, Saudi Arabia. East Mediterr Health J. 2015; 21(9): 621-8.

20) Abdeen Z, Jildeh C, Dkeideek S, Qasrawi R, Ghannam I, Al Sabbah H. Overweight and Obesity among Palestinian Adults: Analyses of the Anthropometric Data from the First National Health and Nutrition Survey (1999-2000). Journal of Obesity. 2012; 2012:12.

21) Benjamin EM. Self-monitoring of blood glucose: the basics. Clinical Diabetes. 2002; 20(1):45-7.

22) Kyrou I, Tsigos C. Obesity in the elderly diabetic patient: is weight loss beneficial? No. Diabetes Care. 2009; 32 Suppl 2: S403-9.

23) Bezie Y, Molina M, Hernandez N, Batista R, Niang S, Huet D. Therapeutic compliance: a prospective analysis of various factors involved in the adherence rate in type 2 diabetes. Diabetes Metab. 2006; 32(6):611-6.

24) Ahmad NS, Ramli A, Islahudin F, Paraidathathu T. Medication adherence in patients with type 2 diabetes mellitus treated at primary health clinics in Malaysia. Patient Prefer Adherence. 2013; 7: 525-30.

25) Bagonza J, Rutebemberwa E, Bazeyo W. Adherence to anti diabetic medication among patients with diabetes in eastern Uganda; a cross sectional study. BMC Health Serv Res. 2015; 15.

26) Zgibor JC, Simmons D. Barriers to blood glucose monitoring in a multiethnic community. Diabetes Care. 2002; 25(10): 1772-7.

27) Cade JE, Margetts BM. Relationship between diet and smoking--is the diet of smokers different? J Epidemiol Community Health. 1991; 45(4): 270-2.

28) Serour M, Alqhenaei H, Al-Saqabi S, Mustafa AR, Ben-Nakhi A. Cultural factors and patients' adherence to lifestyle measures. Br J Gen Pract. 2007; 57(537): 291-5.

29) Mier N, Medina AA, Ory MG. Mexican Americans with Type 2 Diabetes: Perspectives on Definitions, Motivators, and Programs of Physical Activity. Prev Chronic Dis. 2007; 4(2).

30) Solberg LI, Desai JR, O'Connor PJ, Bishop DB, Devlin HM. Diabetic patients who smoke: are they different? Ann Fam Med. 2004; 2(1): 26-32.

31) Shrestha N, Yadav S, Joshi A, Patel B, Shrestha J, Bharkher D. Diabetes Knowledge and Associated Factors among Diabetes Patients in Central Nepal. Int J Collab Res Intern Med Public Health. 2015; 7(5): 82-91

32) Al Qazaz H, Hassali M, Shafie A, Sulaiman S, Sundram S. The 14 item Michigan Diabetes Knowledge Test: translation and validation study of the Malaysian version. Practical Diabetes Int. 2010; 27(6): 238-41a.

33) Al-Adsani AM, Moussa MA, Al-Jasem LI, Abdella NA, Al-Hamad NM. The level and determinants of diabetes knowledge in Kuwaiti adults with type 2 diabetes. Diabetes Metab. 2009; 35(2): 121-8.

34) Fenwick EK, Xie J, Rees G, Finger RP, Lamoureux EL. Factors associated with knowledge of diabetes in patients with type 2 diabetes using

the Diabetes Knowledge Test validated with Rasch analysis. PLoS One. 2013; 8(12): e80593.