Factors associated with adherence to diet and exercise among type 2 diabetes patients in Hodeidah city, Yemen

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ABSTRACT

Aim: Difficulty in adhering to lifestyle modifications as diet and exercise is a common problem in individuals with type-2 diabetes mellitus. This study aimed to evaluate the factors affecting adherence of diabetic patients towards recommendations of diet and exercise and to assess the effect of patients' adherence on glycated haemoglobin (HbA1c). Methods: A cross-sectional study was conducted from 1st May to 15th November 2016 in Hodeidah City, Yemen. Data were collected through face-to-face interview using a standardized questionnaire. Data were organized, verified and analysed using the Statistical Package for Social Sciences, version 21. Results: A total of 210 participants were included in this study, of them 54.8% were males. The rate of adherence to diet and exercise was 21.0% and 15.2%, respectively. Adherence to diet was significantly higher among urban residents (P=0.012), employees (P=0.006) and those who had a diabetes for a duration ≤5 years (P=0.040). However, adherence to exercise was significantly higher among patients who were under 60 years old (P<0.020), and who were taking oral hypoglycaemic medication (P=0.001). Good glycaemic control (HbA1c<7%) was significantly associated with adherence to dietary regimen (P=0.001) and regular exercise (P=0.032). Conclusion: The rate of adherence to both diet and exercise among type-2 diabetes patients in Yemen was low, and it could be attributed to a combination of several socio-demographic and clinical factors. This poor adherence was reflected on the lack of glycaemic control among patients.

Introduction

Diabetes Mellitus (DM) is a chronic metabolic disorder that occurs when the body cannot produce enough insulin or cannot use it, leading to hyperglycemia. Type 2 Diabetes (T2D) is the most common type of diabetes that accounts for about 90% of all diabetes cases in the world. Mostly, T2D affecting adults as a result of insufficient insulin production or ineffectiveness of produced insulin [1]. The prevalence of T2D had increased dramatically during the last decades. According to the World Health Organization (WHO) estimation in 2014, about 422 million adults (8.5% of the world's population) had DM compared to 108 (4.7%) in 1980 and this would rise to 642 million by 2040 [2].

Life-style changes such as balanced diet and physical exercise are important factors in achieving good controlling on T2D and avoiding its long-term complications [3]. Adherence has been defined as the extent to which a person's behavior–taking medication, following a diet and or executing lifestyle changes–corresponds with agreed recommendations from a health care provider [4].

Healthy dietary habits such as minimizing the consumption of high glycemic foods, fats and carbohydrates will contribute in decreasing the level of blood glucose, which will lead to reduce

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the amount of needed insulin [5]. Physical exercises, also reduces blood glucose levels, thereby reducing the amount of insulin needed and increasing insulin sensitivity [6].

Yemen is not an exception to this trend of sharp increases in the numbers of people developing DM, where the prevalence of T2D among adults in Yemen was reported to be 9.75% [7]. In addition, poor adherence among diabetic patients in the Yemeni community becomes more prevalent than previously thought. Therefore, the burden of this disease may be increasing gradually. Consequently, this study was designed to determine the association between adherence to diet and physical exercises among T2D patients with demographic and clinical factors. It also aims to evaluate the relationship between patients' adherence and the glycated hemoglobin (HbA1c) levels.

Methods

Study population

A cross-sectional study was conducted in the period from 1st May to 15th November 2016. It was carried out in two hospitals in Hodeidah city: The Military Hospital that belongs to the Ministry of Defense and Al-Amal Hospital, which is a private hospital. Hodiedah is a coastal city and port on the Red Sea, which is about 230 km to the west of Sana'a, the capital of Yemen.

The target population was T2D patients who attended to Diabetes clinic in the above-mentioned hospitals during the data collection period. Individuals aged ≥20 years, previously diagnosed with T2D for at least 1 year was recruited. Patients were excluded from the study if they were diagnosed with type 1 or gestational diabetes or if they were disabled.

The sample size was calculated to be 166 using this formula: $N=Z 2 P q/d 2$ (Aroaye, 2003), where Z (standard deviation)=1.96, P (the estimated prevalence of T2D in Yemen)=9.75% [7], q=1-p, d (error margin)=0.05. In addition, a 20% rate was added to compensate for any missing data in the questionnaire.

Study instruments/tools

The study questionnaire was adapted from previous studies after obtaining authors' permission [8,9] This tool included four sections; the first section include information about participants' socio-demographic and clinical characteristics. The second section included 10

close-ended questions used to assess patients' adherence to prescribed dietary regimens during the month preceding the study. Responses were rated on a three point scale according to Likert scale, which sought to determine whether the patients (always=2, sometimes=1 or never=0) followed dietary advice. According to the overall score, which ranged from 0 to 20, the patients' adherence were classified as ''good adherence '' if the score was >15, ''partial adherence'' if the score was between 10 and 15 and '' non-adherence'' if the score was <10. The third section was used to assess the patients' adherence to physical exercise during the month preceding the study. According to their responses, participants were categorized into three groups. Those who reported within recommended levels of exercise (≥30 min/session, for at least 5 days/week) were considered as "good adherence", while those who reported less than recommended levels of exercise (2–4 times/week) were considered as "partial adherence", and who reported exercising less than twice weekly or don't follow at all were considered as "non-adherence". The fourth section included the laboratory parameters of Fasting Blood Sugar (FBS) and HbA1c to assess glycemic control. In addition, patients' height and weight to calculate the Body Mass Index (BMI).

Data collection

Data were collected through face-to-face interview using an Arabic structured questionnaire. The interview of each participant took 10–15 min and 10–15 participants were interviewed daily. Body weight and height were measured by nurses during the time of interviewing. For laboratory investigation, 3 ml of blood sample were drawn from the patient's vein after patients fasting for 8–10 h. FBS was measured directly after sample collection using ACCU-CHECK glucometer, while HbA1c was measured in the laboratory of Al-Aqsa Hospital using SD A1c Care™ Analyzer (Immunochromatography method).

FBS was considered as controlled if its level was ≤140 mg/dl or uncontrolled if its level was >140 mg/dl [10]. For HbA1c, glycemic status was considered as good if HbA1c level was <7% or poor if its ≥7% [11] BMI was categorized according to the WHO classification as normal (<25 kg/m²), overweight (25–29.9 kg/m²), and obese (≥30 kg/m²) [12].

Operational definition of the variables

Independent variables were the socio-demographic variables (sex, age, marital status,

residence, educational level, occupation and khat chewing) and clinical variables (smoking history, duration of disease and type of treatment).

The dependent variable was the patient's adherence to diet and exercise recommendations. Diet refers to the recommended diet for people with DM who should ate small meals spread throughout the day (at least 5/day), ate fruits and vegetables daily, and ate foods high in fibers and whole grain but low in fats, sugars and carbohydrates that have high glycemic index [11]. Exercise refers to bodily movement produced by the contraction of skeletal muscle that requires energy expenditure in excess of resting energy expenditure. For diabetic patients at least 30 min/day of suitable physical activity is recommended [13].

■ Statistical analysis

Data were organized, verified and analyzed using the Statistical Package for Social Sciences (SPSS), version 21. Descriptive statistics were used to determine the prevalence of adherence and to characterization the variables. Pearson's chi-square test was used to investigate the association between the dependent and independent variables. For the quantification of this association the Crude Odds Ratio (COR) was calculated by logistic regression test. A *P-value* <0.05 was considered as statistically significant.

■ Ethical considerations

Ethical approval was obtained from the Research Ethics Committee of the University of Science and Technology (UST) in Yemen. Participants were informed about the purpose of the study, and informed consent was obtained from each participant before data collection. Data confidentiality assured according to the revised Helsinki Declaration of Bioethics.

Results

■ Characteristics of participants

A total of 210 patients were included in this study. Of them, 54.8% were males. The mean age ± SD was 47.6 ± 12.6 years. The majority of participants were married (79%), from urban areas (72.9%) and khat chewers (60.5%). Nearly one-third was illiterate (32.4%) and employees (37.6%). In relation to clinical variables, the majority of participants were taking oral hypoglycemic medications (68.6% *vs.* 23.0% for insulin), had poor glycemic control (79.0%), and non-smokers (71.9%). More than a half of them (51.0%) had DM for ≤5 years and (55.2%) had a BMI of ≥25 kg/m² **(TABLE 1)**.

■ Adherence to diet

In viewing the distribution of the participants among different groups 21.0, 46.7, and 32.4% showed good adherence, partial adherence and non-adherence to the recommended dietary regimen, respectively **(FIGURE 1)**.

There was a significant association between adherence to diet and the variables of present residence, occupation and the duration of DM. Urban residents were two times more likely to adhere to the diet than rural residents [COR (95%

Table 1. Socio-demographic and clinical characteristics of participants (N=210).

| Characteristics		N	(%)	Mean ± SD
Sex	Male	115	54.8	-
	Female	95	45.2	-
Age (Years)		-	-	47.6 ± 12. 6
Marital status	Married	166	79.0	-
	Un-married	44	21.0	-
Residence	Urban	153	72.9	-
	Rural	57	27.1	-
Educational level	Illiterate	68	32.4	-
	Intermediate	42	20.0	-
	Secondary	53	25.2	-
	University& above	47	22.4	-
Occupation	Employed	79	37.6	-
	Manual worker	35	16.7	-
	House wife	64	30.5	-
	Unemployed	32	15.2	-
Khat chewing	Yes	127	60.5	-
	No	83	39.5	-
Smoking	Smoker	59	28.1	-
	Non-smoker	151	71.9	-
Type of treatment	Diet	18	8.6	-
	Oral	144	68.6	-
	Insulin	48	22.9	-
Duration of diabetes (Years)		-		6.8 ± 5.2
	≤ 5	107	51.0	-
	> 5	103	49.0	-
Glycemic control: HbA1c (%)				8.8 ± 2.2
-	Good <7%	44	21.0	-
	Poor ≥ 7%	166	79.0	-
FBS (mg/dl)				194.4 ± 70.1
-	Controlled ≤ 140	50	23.8	-
	Un-controlled >140	160	76.2	-
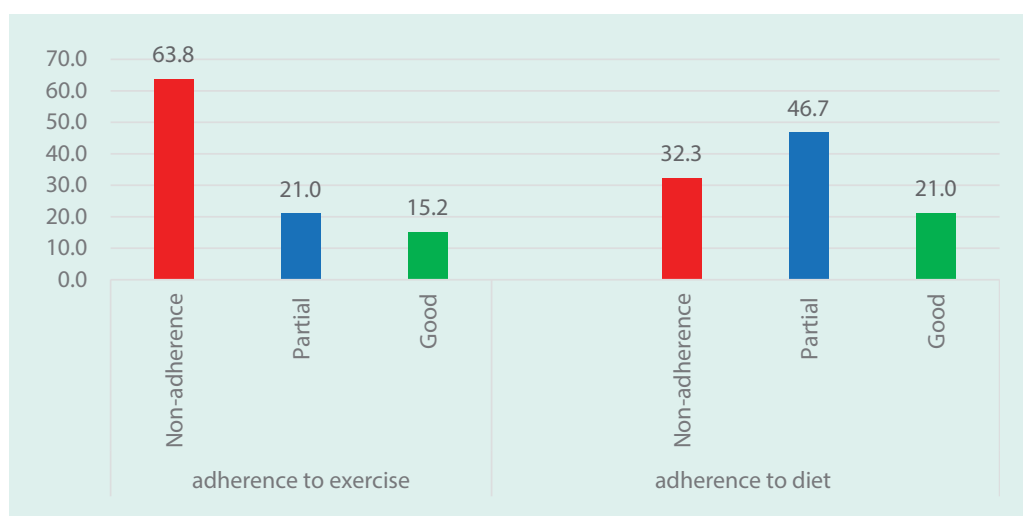
Figure 1: The prevalence rate of adherence to diet and exercise among T2D patients.

CI)=2.2 (1.2-4.2), *P-value*=0.012]. Employees [COR (95% CI)=3.3 (1.4-7.9), *P-value*=0.006] and housewives [COR (95% CI)=3.1 (1.3-7.6), *P-value*=0.012] were three times more likely to adhere to the diet compared with unemployed individuals. Patients who had DM for ≤5 years adhered to diet about two times higher than those who had DM for >5 years [COR=1.8 (1.0 -3.3), *P-value*=0.040] **(TABLE 2)**.

■ Adherence to physical exercise

Only 15.2% of participants reported good adherence to the recommended levels of physical exercise and 21.0% reported partial adherence to the recommended levels of physical exercise, while the majority (63.8%) reported non-adherence to any exercise advices at all **(FIGURE 1)**.

Adherence to exercise was significantly associated with the age category, and type of medication. Patients who were under 60 years old were about four times more likely to be engaged in regular exercise compared with those who were above 60 years [<40 years: COR (95% CI)=3.6 (1.2-10.6), *P-value* 0.019 ; 40-60 years COR (95% CI)=4.1(1.5-11.4), *P-value*=0.006]. Patients who treated with oral hypoglycemic medications adhered to physical exercise about four times more than who treated with insulin injection [COR (95% CI)=4.2 (1.8-10.0), *P-value*=0.001] **(TABLE 3)**.

■ Adherence rate and glycemic control

The results illustrated that only 24.0% of patients had controlled blood sugar (FBS ≤ 140 mg/dl), while almost 21.0% had a good controlled (HbA1c

level of <7%), with relatively high mean FBS level of 194.4 ± 70.1 mg/dl and a mean HbA1c of 8.8 ± 2.2%. Moreover, adherence to diet and physical exercise was significantly associated with HbA1c levels. The chances of patients who followed recommended diet [COR (95% CI)=4.8 (1.8-12.7), *P-value* 0.001] and participated in physical exercise [COR (95% CI)=2.1 (1.1-4.1), *P-value* 0.032] to have a good glycaemic control were almost five and two times higher than the chances of patients who had not adhere to diet and exercise, respectively **(TABLE 4)**.

Discussion

The demographic characteristics of T2D patients in the present study are similar or slightly different from those of Yemeni diabetic patients reported in other studies [14,15]. Most people in Yemen wrongly believe that khat chewing has a beneficial effect on lowering the blood glucose level [14]. This could explain the high percentage (61.5%) of khat chewers in our study.

In the present study, only 21.0% of patients adhered to the recommended diet and 15.0% adhered to regular exercise. These rates are consistent with the findings of similar studies in neighboring countries, where the rate of adherence to diet varied between 10.7 and 36.5% [16-20]. However, the rates of adherence to physical exercise varied between 9.5% and 35.6% [16-21]. In Yemen, most people eat together in groups with the family members and friends, and it may be difficult for such patients to follow their special diet regimen that

Table 2. Association between socio-demographic and clinical factors and adherence to diet among type 2 diabetes patients.				
Factor		**Adherence to diet**		**COR (95% CI)**	**P-value**
		Non-adhere N (%)	**Good/Partial N (%)**	**COR (95% CI)**	**P-value**
Sex	Male	41 (35.7)	74 (64.3)	-	-
	Female	27 (28.4)	68 (71.6)	1.4 (0.8-2.5)	0.265
Age category (Years)	<40	18 (27.7)	47 (72.3)	2.1 (0.9-4.9)	0.249
	40-60	35 (31.5)	76 (68.5)	1.7 (0.8-3.8)	-
	>60	15 (44.1)	19 (55.9)	1.0	-
Marital status	Married	50 (30.1)	116 (69.9)	1.6 (0.8-3.2)	0.174
	Unmarried	18 (40.9)	26 (59.1)		
Present residence	Urban	42 (27.5)	111 (72.5)	2.2 (1.2-4.2)	0.012*
	Rural	26 (45.6)	31 (54.4)	-	-
Educational level	Below secondary (110)	40 (36.4)	70 (63.6)	-	-
	Secondary and above (100)	28 (28.0)	72 (72.0)	1.5 (0.8-2.6)	0.196
Occupation	Employed	20 (25.3)	59 (74.7)	3.3 (1.4-7.9)	0.006*
	Manual worker	14 (40.0)	21 (60.0)	1.7 (0.6-4.5)	-
	House wife	17 (26.6)	47 (73.4)	3.1 (1.3-7.6)	0.012*
	Unemployed	17 (53.1)	15 (46.9)	1.0	-
Smoking	Smoker	24 (40.7)	35 (59.3)	0.6 (0.3-1.1)	0.108
	Non-smoker	44 (29.1)	107 (70.9)	-	-
Khat chewing	Yes	40 (31.5)	87 (68.5)	1.1 (0.6-2.0)	0.735
	No	28 (33.7)	55 (66.3)	-	-
Duration of the disease (Years)	≤5	28 (25.9)	80 (74.1)	1.8 (1.0 -3.3)	0.040*
	>5	40 (39.2)	62 (60.8)	-	-
Type of treatment	Oral	45 (31.2)	99 (68.8)	1.3 (0.7- 2.6)	0.424
	Insulin	18 (37.5)	30 (62.5)		
BMI (kg/m²)	<25	29 (30.9)	65 (69.1)	1.1 (0.6- 2.0)	0.670
	≥25	39 (33.6)	77 (66.4)	-	-
*Statically significant variables					

is different from the rest of the family. It should be taken into consideration that the majority of Yemenis diabetics (71.8%) had a poor score of DM knowledge (92.8%), had a negative attitude score towards DM and 44.3% had a wrong belief that there is no benefit of exercise for DM patients [15]. Moreover, poor adherence to exercise among diabetics in Hodiedah may be partly attributed to that fact that the summer season is long and hot.

In relation to the factors affecting adherence to diet, the results showed that urban residents adhered to diet almost twice higher than rural residents. This finding is in contrast to that concluded among diabetics from Bangladesh [22], where rural patients were three times more likely to adhere to diet than urban patients. This difference may be due to the lack of DM health care services and education in rural areas. The analysis of data according to residential groups showed high illiteracy rate among rural residents compared with urban ones (53% *vs.* 24.8%, respectively). Employed patients and housewives were four times more likely to adhere to diet than the unemployed ones. This finding

Table 3. Association between socio-demographic and clinical factors and adherence to physical exercise among type 2 diabetes patients.

Factor		Adherence to Exercise		COR (95% CI)	P-value
		Non-adhere N (%)	Good/Partial N (%)		
Sex	Male	73 (63.5)	42 (36.5)	-	-
	Female	61 (64.2)	34 (35.8)	1.0 (0.6-1.8)	0.912
Age category (Years)	<40	40 (61.5)	25 (38.5)	3.6 (1.2-10.6)	0.019*
	40-60	65 (58.6)	46 (41.4)	4.1 (1.5-11.4)	0.006*
	>60	29 (85.3)	5 (14.7)	1.0	-
Marital status	Married	110 (66.3)	56 (33.7)	0.6 (0.3- 1.2)	0.150
	Unmarried	24 (54.5)	20 (45.5)	-	-
Present residence	Urban	98 (64.1)	55 (35.9)	1.0 (0.5-1.8)	0.905
	Rural	36 (63.2)	21 (36.8)	-	-
Educational level	Below secondary	70 (63.6)	40 (36.4)	-	-
	Secondary and above	64 (64.0)	36 (36 .0)	1.0 (0.6-1.7)	0.956
Occupation	Employed	47 (59.5)	43 (37.7)	1.0 (0.4-2.3)	0.589
	Manual worker	24 (68.6)	11 (31.4)	0.8 (0.3-1.8)	-
	House wife	44 (68.8)	20 (31.2)	0.7 (0.3-1.6)	-
	Unemployed	19 (59.4)	13 (40.6)	1.0	-
Smoking	Smoker	36 (61.0)	23 (39.0)	1.2 (0.6-2.2)	0.599
	Non-smoker	98 (64.9)	53 (35.1)	-	-
Khat chewing	Yes	78 (61.4)	49 (38.6)	1.3 (0.7-2.3)	0.372
	No	56 (67.5)	27 (32.5)	-	-
Duration of the disease (Years)	≤5	64 (59.3)	44 (40.7)	1.5 (0.9- 2.7)	0.158
	>5	70 (68.6)	32 (31.4)	-	-
Type of treatment	Oral	84 (58.3)	60 (41.7)	4.2 (1.8-10.0)	0.001*
	Insulin	41 (85.4)	7 (14.6)	-	-
BMI (kg/m²)	<25	57 (60.6)	37 (39.4)	1.3 (0.7- 2.3)	0.389
	≥25	77 (66.4)	39 (33.6)	-	-

*Statically significant variables

Table 4. Relationship between patients' adherence to diet and exercise with HbA1c.

Adherence	HbA1c		COR (95% CI)	P-value
	Poor ≥ 7 N (%)	Good <7 N (%)		
Adherence to Diet				
Adherent	103 (72.5)	39 (27.5)	4.8 (1.8-12.7)	0.001*
Non-adherent	63 (92.6)	5 (7.4)	1.0	-
Adherence to Exercise				
Adherent	54 (71.7)	22 (28.9)	2.1 (1.1-4.1)	0.032*
Non-adherent	22 (16.4)	112 (83.6)	1.0	-

*Statically significant variables, HbA1c: Glycated hemoglobin

is consistent with a previous study in Bangladesh [22], where employees were more adherent to diet than unemployed patients. In addition, it is also supported by a study conducted in Oman [23], which revealed that women were more amenable to changing their diet than men. This may be due to differences in knowledge level and economic status, which are usually better among employees. In addition, because cooking in Yemeni society is exclusively done by housewives, it may explain their better adherence to the dietary regimen. Consistent with other studies [18,21], patients with DM duration of ≤5 years in the present study were more adherent to diet than those who had a duration of >5 years.

On the other hand, the investigations indicated that younger age was significantly associated with adherence to physical exercise like other studies [17,22]. In fact, with increasing age, a decline in motor abilities and comorbid disease can occur, that make it difficult to perform routine physical exercises. Patients who were treated with oral hypoglycemic medications were more engaged in physical exercise than those who were treated with insulin. This result is in disagreement with a similar study in Saudi Arabia [19], which found that using insulin was significantly associated with compliance to diet. It seems that there are multiple factors contributing to these findings, which require a further investigation.

Findings related to HbA1c showed a significant association with the rate of adherence to healthy diet and physical exercise, and these findings corroborate those of other studies [20,22-26], indicating that good diabetes control is significantly higher in those following a diet and taking regular exercise. The low rate of adherence to both diet and exercise found in this study may reflect the lack of glycemic control among patients of this study (only 21.0% of patients had HbA1c <7%).

The low adherence rate concluded in this study highlights the need for further research to assess the reasons for this health problem. The long-term relationship of patients with their DM requires ongoing self-care over a lifetime. Health personnel should direct their efforts in health education programs that should highlight the benefits of lifestyle modification in the context of disease treatment, control and reducing its risk factors.

The present study is limited by some selection bias, where the study population was patients attending clinics that may not reflect the population. In addition, dietary assessment was obtained by self-reporting, and this might lead to recall bias.

Conclusion

Adherence to the recommendations of diet and physical exercise among T2D patients in Yemen is still low. Several socio-demographic and clinical factors were associated with patients' adherence. The low adherence rate amongst the study patients was reflected on their level of glycemic control (HbA1c).

Conflict of interest

The authors declare that they have no any conflict of interest in this research.

Disclosure summary

The authors have nothing to disclose.

Acknowledgments

References

1. http://www.who.int/diabetes/publications/diagnosis_diabetes2006/en/

2. http://www.who.int/diabetes/global–report/en/

3. Shrivastava S, Shrivastava PS, Ramasamy J. Role of self–care in management of diabetes mellitus. *J. Diabetes Metab. Disord.* 12(1), 14 (2013).

4. http://www.who.int/chp/knowledge/publications/adherence_Section1.pdf

5. Hamdy O, Laurie J, Edward S. Diet and exercise in type ii diabetes mellitus. *Jos. Diab. Center.* 30(4), 883–907 (2001).

6. Colberg SR, Sigal RJ, Fernhall B *et al.* Exercise and type 2 diabetes. *Diabetes Care.* 33(12), 2692–2696 (2010).

7. Gunaid AA. Prevalence of known diabetes and hypertension in the Republic of Yemen. *East Mediterr. Health J.* 8(2), 374–385 (2002).

8. Ganiyu AB, Mabuza LH, Malete NH *et al.* Non–adherence to lifestyle modification recommendations (Diet

and Exercise) amongst type 2 diabetes mellitus patients. *Afr. J. Prim. Health Care Fam. Med.* 5(1), 457 (2013).

9. Mahfouz EM, Awadalla HI. Compliance to diabetes self–management in rural El–mina, Egypt. *Cent. Eur. J. Public Health.* 19(1), 35–41 (2011).

10. American Diabetes Association. Nutrition recommendations and interventions for diabetes. *Diabetes Care.* 33(8), 1911 (2010).

11. American Diabetes Association. Standards of medical care in diabetes–2015 abridged for primary care providers. *Clin. Diabetes.* 33(2), 97–111 (2015).

12. http://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/

13. Agarwal SK. Cardiovascular benefits of exercise. *Int. J. Gen. Med.* 5(1), 541–545 (2012).

14. Al–Sharafi BA, Gunaid AA. Effect of habitual Khat chewing on glycemic control, body mass index, and age at diagnosis of diabetes in patients with Type 2 diabetes mellitus in Yemen. *Clin. Med. Insights Endocrinal Diabetes.* 8(1), 47–53 (2015).

15. Al–Mualm YK, Abd–Allah M, Bayomi SS *et al.* Knowledge, Attitudes and Practices of patient with Diabetes Mellitus in Mukalla City–Yemen. *Assiut Scientific Nursing Journal.* 3(5), 125–136 (2015).

16. Shokair NF. Pattern and determinants of compliance of diabetes to health care in Alexandria: community–based study. *Bull Alex Fac. Med.* 43(1), 1110–1834 (2007).

17. Alrahbi H. Diabetes self–management (DSM) in Omani with Type–2 Diabetes. *Int. J. Nursing Sci.* 1(4), 352–359 (2014).

18. Ali AT, Yousif MA, Elbur AI. Is knowledge of diabetes and its management influence to exercise, healthy diet and medication? A survey among Sudanese patients in Khartoum state; Sudan. *EJPMR.* 2(1), 437–449 (2015).

19. Khan AR, Al–Abdul Lateef ZN, Al Aithan MA *et al.* Factors contributing to non–compliance among diabetics attending primary health centers in the Al-Hasa District of Saudi Arabia. *J. Fam. Commun. Med.* 19(1), 26–32 (2012).

20. Serour M, Alqhenaei H, Al–Saqabi S *et al.* A cultural factors and patients' adherence to lifestyle Measures. *Br. J. Gen. Pract.* 57(537), 291–295 (2007).

21. El–Abbassy A. Non–adherence to lifestyle modification recommendations of Diet and Exercise amongst diabetic patients. *IOSR–JNHS.* 4(4), 07–18 (2015).

22. Mumu SJ, Saleh F, Ara F *et al.* Non–adherence to life–style modification and its factors among Type 2 Diabetic patients. *Indian J. Public Health.* 58(1), 40–44 (2015).

23. Al–Sinani M, Min Y, Ghebremeskel K *et al.* Effectiveness of and adherence to dietary and lifestyle counselling–effect on metabolic control in type 2 diabetic Omani patients. *Sultan Qaboos Univ. Med. J.* 10(3), 341–349 (2010).

24. Al–Kaabi J, Al–Maskari F, Saadi H *et al.* Assessment of Dietary Practices among Diabetic patients in the UAE. *Rev. Diabet. Stud.* 5(2), 110–115 (2008).

25. Lafta RK, Faiq U, AL–Kaseer AH. Compliance of diabetic patients in Iraq. *MMJ.* 8(1), 17–22 (2009).

26. Shamsi N, Shehab Z, AlNahash Z *et al.* Factors influencing dietary practice among type 2 diabetic patients in Bahrain. *Bahrain Med. Bull.* 35(3), 1–14 (2013).