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Medication Adherence in Patients with Diabetes Who Are Being Treated in a University Hospital Endocrinology Department

ABSTRACT

Objective: This study aims to investigate knowledge and motivation levels of diabetic patients related to medication adherence, and the factors effecting medication adherence.

Methods: Study sample in this descriptive type of study consists of 85 patients who applied to Endocrinology outpatient clinic of a university hospital, have been diagnosed with diabetes mellitus at least one year before and volunteered to participate in the study. A survey questioning personal information, socio-demographical properties and daily habits, and "Modified Morisky Adherence Scale" were performed on all patients by face-to-face interview. Analysis of data was carried out on SPSS 15.0 software using chi-square, Fischer's exact chi-square and Student t tests.

Results: Mean age of the participants was 55.58 ± 13.35 ; fifty six (65.9%) of them were women. Fifty five (65.9%) patients stated they were paying attention to eat regular meals and balanced diet, 30 (35.3%) patients stated they were exercising regularly. For medication adherence, 64 (75.3%) patients were determined to have high motivation level, 76 (89.4%) patients were determined to have high knowledge level. Those who paid attention to regular meals and balanced diet had significantly higher motivation and knowledge levels.

Conclusions: Since diabetes medications require dietary regulation, it is important that patients are encouraged to pay attention for eating regular meals and have balanced diet. Education of patients and their relatives to enhance their motivation would be beneficial for developing habits to adhere to their medications.

Keywords: Diabetes Mellitus, Medication Adherence, Motivation, Knowledge.

Bir Üniversite Hastanesinin Endokrinoloji Bölümünde Tedavi Gören Diabetli Hastalarda İlaç Uyumu

ÖZET

Amaç: Bu araştırma, diyabetli hastaların ilaç uyumu konusunda bilgi ve motivasyon durumlarını ve ilaç uyumlarını etkileyen faktörleri incelemeyi amaçlamaktadır.

Gereç ve Yöntem: Tanımlayıcı tipteki bu araştırmanın örneklemini bir üniversite hastanesinin Endokrinoloji polikliniğine başvuran en az bir yıldır diyabet tanısı olan ve araştırmaya katılmayı kabul eden 85 hasta oluşturmuştur. Hastalara kişisel bilgiler, sosyo-demografik özellikler, yaşam alışkanlıklarını içeren anket formu ve 'Modifiye Morisky İlaç Uyum Ölçeği' yüz yüze görüşme tekniğiyle uygulanmıştır. Verilerin analizinde, SPSS 15.0 programı ile, Ki-kare, Fisher'in kesin ki kare ve Student t testi yöntemleri kullanılmıştır.

Bulgular: Katılımcıların yaş ortalaması 55.58 ± 13.35 olup, 56 (%65.9)'sı kadındır. 56 (%65.9) kişi düzenli ve dengeli beslenmeye dikkat ettiğini, 30 (%35.3) kişi ise düzenli egzersiz yaptığını belirtmiştir. İlaç uyumu konusunda 64 (%75.3) kişinin motivasyonu yüksek, 76 (%89.4) kişinin ise bilgi düzeyi yüksek olarak saptanmıştır. Düzenli ve dengeli beslenmeye dikkat eden hastaların motivasyon ve bilgi düzeyleri anlamlı olarak yüksek bulunmuştur.

Sonuç: Diyabet ilaçlarının bir beslenme düzenine göre kullanılması gerektiğinden, uyumu arttırmak için düzenli ve dengeli beslenmenin teşviki önemlidir. Hastalara ve yakınlarına motivasyonu artırıcı eğitimler verilmesinin, düzenli ilaç kullanma alışkanlığı geliştirme konusunda faydalı olacağı düşünülmektedir.

Anahtar Kelimeler: Diabetes Mellitus, İlaç Uyumu, Motivasyon, Bilgi

INTRODUCTION

Diabetes mellitus (DM) is a chronic disease caused by insulin resistance and/or impairment in insulin secretion; its prevalence is progressively increasing, it requires continuous medical care and it can cause severe organ dysfunctions and early mortality (1).

It was estimated that number of patients with diabetes would reach 300 million by 2025 (2), and 366 million by 2030 in the whole world (3); however, it has exceeded these estimates and reached 382 million in 2013, and it is estimated to reach 592 million worldwide by the year 2035 (4). World Health Organization (WHO) described diabetes as an "epidemic" due to high rate of increase in its prevalence in the recent years (5).

According to Turkey Diabetes, Hypertension, Obesity and Endocrinology Diseases Prevalence study conducted in 2010 (TURDEP-II), prevalence of diabetes in adult population was 13.7% (6). According to TURDEP-I study in 1998 (7), at least 10% of the population over the age of 45-49 years had diabetes, whereas in TURDEP-II, diabetes prevalence that is over 10% starts from the age interval of 40-44 years. Based on this result, it can be stated that diabetes disease in Turkey starts at least 5 years earlier than in 1998 (6).

Diet, exercise and medical applications are the main constituents of treatment program in diabetes patients. Medical treatment is very effective in control of diabetes (8); however, studies show medication adherence in diabetes patients is below requirements (9,10). A meta-analysis conducted in 2014 reported that medication adherence rates in person with diabetes showed a wide range of distribution (11).

The aim of this study is to investigate the correlation of knowledge and motivation level of person with diabetes related to medication adherence with socio-demographical properties, dietary regulation, exercising, used medications, disease duration, complications and comorbidity status, BMI and HbA1c levels.

MATERIAL AND METHODS

This descriptive study was conducted on patients who applied to Endocrinology outpatient clinic of a university hospital between May 1-June 30, 2014. During the specified dates, 348 person with diabetes applied to the clinic. In order to calculate sample size of the study, expected medication adherence in person with diabetes was determined as 50%, according to results of previous studies. The smallest sample size was calculated with Epi info Statcalc software with 95% confidence interval and 10% error margin as 75 subjects. Patients who were diagnosed with DM at least one year before were enrolled in the study; newly diagnosed patients, patients with gestational

diabetes, patients who did not will to participate in the study were not enrolled in the study. The study included 85 patients who had been diagnosed with diabetes at least one year before.

The study was approved by local Clinical Research Ethics Committee on April 3, 2014 with decision number 2014/1. In addition, all study participants were informed about the study and their verbal approval was obtained. As a means for data collection tool, a survey form including personal information, socio-demographical properties and daily habits and "Modified Morisky Scale" were used. Height and weight of all patients were recorded, and HbA1c level analyzed with HPLC (High Performance Liquid Chromatography) method were used as indicators of metabolic control. The survey form and "Modified Morisky Scale" were performed via face-to-face interview method. Validity and reliability studies of "Modified Morisky Scale" in Turkey were carried out by Vural et al. and it was determined that allows evaluation of motivation and knowledge level separately (12).

Statistical analysis of the data were carried out on SPSS version 15 software. Evaluation of difference between groups were analyzed with chi-square or Fisher test accordingly. Continuous variables were analyzed with Student t test, conditions were accepted as statistically significant when p levels were below 0.05.

RESULTS

Mean age in 85 patients participating in the study was 55.58 ± 13.35 years, 56 (65.9%) of them were women, 74 (87.1%) were married, 46 (54.1%) were housewives, 43 (50.6%) were primary school graduates. 47 (55.3%) patients stated that they perceived their income as equal to their expenditures. Distribution of the participants according to their socio-demographical properties are given in Table 1.

Fifty six (65.9%) of the participant patients thought they paid enough attention to regular meals and balanced diet. When their eating habits were questioned, 36 (42.4%) patients stated they consumed all food groups in balance, 30 (35.3%) patients stated that they consumed fruits and vegetables more. Thirty (35.3%) patients stated they exercised regularly.

Distribution of the participants according to some DM-related properties are given in Table 2. There were 37 (43.5%) patients who had disease duration of 5 years or below, and there were 23 (27%) patients who had disease duration between 6-10 years; mean disease duration was 9.58 ± 8.69

Table 1. Distribution of some socio-demographical properties in participants

Property		n	%
Age (Years)	21-40	17	20.0
	41-60	35	41.2
	>60	33	38.8
Sex	Woman	56	65.9
	Man	29	34.1
Marital Status	Married	74	87.1
	Single	4	4.7
	Widow	7	8.2
Educational Status	Not graduated	19	22.3
	Primary school	43	50.6
	Secondary school	6	7.1
	High school	7	8.2
	University	10	11.8
Occupation	Housewife	46	54.1
	Retired	13	15.3
	Working	16	18.8
	Farmer	7	8.2
	Other	3	3.6
Perceived income level	Income < expenditures	30	35.3
	Income = expenditures	47	55.3
	Income > expenditures	8	9.4
Family type	Basic	68	80.0
	Large	15	17.6
	Alone	2	2.4
Total		85	100

years. There were 62 (72.9%) participants who had at least one relative with diabetes. Thirty nine (45.9%) patients measured their blood glucose daily, 47 (55.3%) patients visited their physician at

least once in three months. Thirty seven (43.5%) patients used oral antidiabetics, 27 (31.8%) patients used insulin, and 21 (24.7%) patients used both oral antidiabetic and insulin.

Table 2. Distribution of participants according to some DM-related properties

Property		n	%
Diabetes duration (years)	≤5	37	43.5
	6-10	23	27.1
	11-15	9	10.6
	16-20	9	10.6
	>20	7	8.2
Diabetes in relatives	Yes	62	72.9
	No	23	27.1
Frequency of blood glucose measurement	Daily	39	45.9
	Once a week	29	34.1
	Irregular	9	10.6
	Not measuring	8	9.4
Frequency of control by physician	One a month	21	24.7
	Once in three months	26	30.6
	Once in six months	7	8.2
	Once in a year	8	9.4
	When needed	23	27.1
Total		85	100

Sixty six (77.6%) of the participants stated they knew about diabetes complications, and 29 (34.1%) stated they had at least one complication. Most frequently observed complication was diabetic retinopathy with a ratio of 93.1%. Sixty eight (80%) of the participants stated they had at least one comorbid disease other than diabetes, 65 (76.5%) stated they used at least one medication other than the medication for diabetes. When comorbidities in participants were questioned, most frequent comorbidity accompanying diabetes was found to be hypertension with a ratio of 77.9%, followed by hyperlipidemia with 29.4%, cardiovascular disease with 20.6% and hypothyroidism with 14.7%.

Mean Modified Morisky Scale motivation level score of the participant patients was 1.75 ± 0.43 , and mean knowledge level score was 1.89 ± 0.31 . For medication adherence, 64 (75.3%) patients were found to have high motivation level and 76 (89.4%) patients were found to have high knowledge level.

There was no statistically significant correlation between participant's motivation and knowledge levels and their age, sex, marital status, perceived income status, their family type, medication used, disease duration, complication and comorbidity status ($p > 0.05$ for each) (Table 3 and Table 4).

Table 3. Distribution of participants' Modified Morisky Scale Motivation scores according to some properties

Property			Low Motivation Level		High Motivation Level		χ^2	p
			n	%	n	%		
Age (Years)	21-40		5	29.4	12	70.6	0.26	0.88
	41-60		8	22.9	27	77.1		
	>60		8	24.2	25	75.8		
Sex	Woman		12	21.4	44	78.6	0.95	0.33
	Man		9	31.0	20	69.0		
Regular Diet	Paying attention		9	16.1	47	83.9	6.58	0.01
	Not paying attention		12	41.4	17	58.6		
Exercise frequency	Regular		5	16.7	25	83.3	1.61	0.2
	Irregular		16	29.1	39	70.9		
Medication used	OAD		11	29.7	26	70.3	2.09	0.35
	Insulin		4	14.8	23	85.2		
	OAD+Insulin		6	28.6	15	71.4		
Disease duration	≤5 years		12	32.4	25	67.6	2.1	0.15
	>5 years		9	18.7	39	81.3		
Complication	Yes		9	31.0	20	69.0	0.95	0.33
	No		12	21.4	44	78.6		
Comorbidity	Yes		15	22.1	53	77.9	-	0.35 (Fisher test)
	No		6	35.3	11	64.7		

Of the 56 participants who stated that they paid attention to regular meals and balanced diet, 47 (83.9%) were found to have high motivation level and 53 (94.6%) were found to have high knowledge level. Difference between the groups is statistically significant ($p=0.01$; Fisher test $p=0.04$). However, there was no statistically significant correlation between regular exercising status and motivation and knowledge levels ($p > 0.05$) (Table 3 and Table 4).

Since 80% of the participant patients had BMI at or above 25 kg/m², they were regarded as being overweight or obese, and 20% of the patients were regarded as having normal weight. 75 % of

the patients with high motivation were over-weight or obese, whereas 95.2% of the patients with low motivation level were overweight or obese; the difference between groups is statistically significant (Fisher test $p=0.036$). There was no significant correlation between knowledge level and BMI (Fisher test $p=0.255$).

70.6% of the participants had HbA1c levels above 7%. Mean HbA1c level in participants with high motivation level was $8.68 \pm 2.32\%$, whereas mean HbA1c level in participants with low motivation level was $9.07 \pm 2.49\%$; mean HbA1c level in participants with high knowledge level was $8.64 \pm 2.22\%$, whereas mean HbA1c level in

Table 4. Distribution of participants' Modified Morisky Scale Knowledge level scores according to some properties

Property		Low Level	Knowledge	High Knowledge	x ²	p
		n	%	n		
Age (Years)	21-40	3	17.6	14	1.62	0.45
	41-60	4	11.4	31		
	>60	2	6.1	31		
Sex	Woman	5	8.9	51	-	0.48 (Fisher test)
	Man	4	13.8	25		
Regular diet	Paying attention	3	5.4	53	-	0.04 (Fisher test)
	Not paying attention	6	20.7	23		
Exercise frequency	Regular	1	3.3	29	-	0.15 (Fisher test)
	Irregular	8	14.5	47		
Medication used	OAD	4	10.8	33	1.39	0.50
	Insulin	4	14.8	23		
	OAD+Insulin	1	4.8	20		
Disease Duration	≤5 years	6	16.2	31	-	0.17 (Fisher test)
	>5 years	3	6.3	45		
Complication	Yes	2	6.9	27	-	0.71 (Fisher test)
	No	7	12.5	49		
Comorbidity	Yes	7	10.3	61	-	1.00 (Fisher test)
	No	2	11.8	15		

participants with low knowledge level was 9.91 ±3.19%. There was no statistically significant difference between the groups (t=0.651, p=0.517; t=1.535, p=0.129).

DISCUSSION

DM is a chronic disease that requires continuous compliance to the treatment. In this study in which we examined treatment compliance in person with diabetes using a scale, two thirds of the randomly selected sample group were women, more than two thirds of the patients were over the age of 40, and mean age was 55.58. High ratio of women in our randomly selected participant group may be due to higher prevalence of diabetes in women. In fact, in TURDEP-II study conducted by Satman et al., prevalence of diabetes was found higher in women in Turkey (6). The reason why most of the patients in the study were at advanced age is thought to be increased frequency of diabetes with age (6).

Lifestyle changes like dietary regulation and physical activity is very important for the control of diabetes. Medical dietary treatment and exercise lowers insulin resistance, and especially prevents development of diabetes in high risk patients (13-15). In this study, healthy diet ratio was found to be high, however similar to the results of previous

studies regular exercising ratio was quite low (16,17). This condition is mostly related to patients being at older age so that they have limited physical activities.

For medication adherence, although knowledge level scores of the participants were high, motivation level scores of the participants were relatively low. This result indicates participants are aware of their disease, but they have relatively less sentiment towards their disease.

Results of the studies that investigate the relation between demographical properties and treatment compliance are controversial. There are studies which report women are more compliant than men (18,19), and again, there are studies which report men are more compliant (20,21). However, similar to our results, no significant correlation has been found between sex and medication adherence in many studies (11,16,17,22). Studies report medication adherence generally increases with age and younger patients are less compliant than older ones (18,23,24,25); however, there are also studies reporting that treatment compliance decreases with age (20). In this study and some previous studies, there was no significant correlation of age with medication adherence (11,16,17,22). These differences may be originating from the cultural differences between

countries and the fact that older people in our country are receiving family support in general.

Although there are studies reporting that treatment adherence is higher in married patients (26,27), similar to our results, there are studies reporting that marital status does not effect medication adherence (11,16-18,28).

In one study by Arslan, there were evidences indicating education increases medication adherence (16), on the contrary, in one study conducted in South Asia and in one study by Peyrot et al., there was a negative correlation between education level and medication adherence (24,28). However, results of the previous studies in general together with our results show that there is no correlation between education level and medication adherence (11,18).

Studies investigating the relation between income level and medication adherence show that as income level increase, medication adherence either decreases (29) or does not change (11,17,18). In this study, there was no relation between income level and medication adherence.

Most of the participants in this study had at least one diabetic relative. Similar to results of other studies conducted in Turkey, there was no relation of family history with medication adherence in person with diabetes (16,17). This condition may be due to patients being used to the disease because of their relatives.

Medication adherence was found to be significantly higher in patients who stated that they paid attention to regular and balanced nutrition. This finding may be due to requirement that diabetic medications be used according to a diet.

In one study by Davies et al. (30), adherence rate to insulin treatment was lower than adherence to oral antidiabetics and combined medication therapies. However in many studies, similar to our results, medication adherence rates did not differ according to insulin or oral antidiabetic use (11,18,22).

In this study, complication rate was found to be low. Similar to Arslan's study, the most frequently observed complication was diabetic retinopathy, and the most frequent comorbid disease accompanying diabetes was hypertension (16). Arslan reported that complication development increased medication adherence (16), Egede et al. reported presence of comorbid disease increased medication adherence (20), and Aikens et al. reported presence of comorbid disease did not have an effect on medication adherence (22). In this study, presence of complications or comorbid disease were not related to medication adherence. Similar to the result in Arslan's study, 80% of participants in our study were overweight or obese (16). Arslan and Cohen et al. reported that there was no correlation between BMI and medication adherence (16,18). In this study, there was negative correlation between motivation level and BMI. This

may be explained by patients who have good motivation for medication adherence being more careful about weight control. There was no significant relation between knowledge level and BMI, which may be because patients did not reflect their knowledge and experience to their lifestyle and most of the patients had limited physical activities due to being at advanced age.

In 70.6% of the participants, HbA1c level was above 7%. This reflects the fact that diabetes was not under control in most of the patients. Although there was negative correlation between medication adherence score and HbA1c level, it was not statistically significant. Arslan and Cohen et al. reported there was not significant correlation between HbA1c level and medication adherence (16,18). Egede et al. reported low levels of HbA1c was related with non-adherence to the medications (20). Aikens et al. reported glycemic control was better in younger patients, men, patients using insulin and patients with comorbid disease, however, medication adherence was not related with age, sex, medication used and comorbid disease (22). This shows that medication adherence and glycemic control are not correlated. It can be thought that patients who are compliant with their treatment but can not achieve glycemic control do not receive appropriate treatment. Different results obtained in different studies may be originating from the differences in measurement parameters.

CONCLUSION

One of the most important principles in treatment of diabetes is that patients should adhere to their prescribed treatment. In this study, medication adherence scores were found to be above the average reported in literature. However, motivation levels were relatively lower compared to knowledge level. In order to bring patients to adhere with their medications, they should be educated with information on their disease, but they should also be informed on how to reflect these information in their behaviors. It is thought that educating relatives as well as patients would make lifestyle changes easier. In this study, patients who were following a regular and balanced diet had higher knowledge and motivation related to adherence. Since diabetic medications have to be used according to a dietary regulation, it is important that regular meals and balanced nutrition is encouraged in order to improve adherence. Medication adherence in diabetes did not correlate with socio-demographical properties, exercising status, medication used, disease duration, presence of complication and comorbid disease, HbA1c and FBG levels. In patients who adhere to their treatment but can not achieve glycemic control, it would be appropriate to review and adjust the treatment as necessary. Results of the studies that investigate medication adherence are controversial. For this reason, similar studies need to be repeated with larger number of patients.

REFERENCES

1. Atilla S, Bağıcı Bosi AT. Toplum Beslenmesi, Güler Ç, Akın L, (eds) Halk Sağlığı Temel Bilgiler. Hacettepe Üniversitesi Yayınları, Ankara 2012:1210-1348
2. King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025: Prevalance, numerical estimates, and projections. *Diabetes Care*. 1998;21:1414-1431.
3. Wild S, Roglic G, Green A, et al. Global Prevalence of Diabetes: Estimates for the year 2000 and projections for 2030. *Diabetes Care*. 2004;27(5):1047-1053.
4. International Diabetes Federation (IDF) Diabetes Atlas. Sixth edition. 27 May 2013 <http://www.idf.org/diabetesatlas>.
5. World Health Organization. Media Centre. Diabetes. 2015;312. Jan 2015 <http://www.who.int/mediacentre/factsheets/fs312/en/>.
6. Satman I, Omer B, Tutuncu Y, et al. Twelve-year trends in the prevalence and risk factors of diabetes and prediabetes in Turkish adults. *Eur J Epidemiol*. 2013;28:169-180. doi:10.1007/s10654-013-9771-5
7. Satman I, Yılmaz T, Sengül A, et al. Population-Based Study of Diabetes and Risk Characteristics in Turkey: Results of the Turkish Diabetes Epidemiology Study (TURDEP). *Diabetes Care*. 2002;25:1551-1556.
8. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998;352:837-853.
9. Cramer JA. A systematic review of adherence with medications for diabetes. *Diabetes Care*. 2004;27:1218-1224.
10. Rubin RR. Adherence to pharmacologic therapy in patients with type 2 diabetes mellitus. *Am J Med* 2005;118(5):27-34 doi:10.1016/j.amjmed.2005.04.012
11. Krass I, Schieback P, Dhippayom T. Adherence to diabetes medication: a systematic review. *Diabet Med*. 2014. doi:10.1111/dme.12651
12. Vural B, Acar ÖT, Topsever P, et al. Reliability and Validity of Turkish Version of Modified Morisky Scale. *Turkish Family Physician*. 2012;3(4):17-20.
13. American Diabetes Association. Nutrition Recommendations and Interventions for Diabetes: A position statement of the American Diabetes Association. *Diabetes Care*. 2007;30:48-65. doi:10.2337/dc07-S048
14. Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346:393-403.
15. T.C. Sağlık Bakanlığı. Erişkin Diyabetli Bireyler İçin Eğitimci Rehberi. 2014;945. <http://beslenme.gov.tr/content/files/diyabet/DiyabetliBireylerIcinEgitimciRehberi.pdf>
16. Arslan E. Tip 2 Diabetes mellituslu hastaların tedaviye uyumlarını etkileyen faktörler. Uzmanlık tezi, Diyarbakır: Dicle Üniversitesi Tıp Fakültesi, Halk Sağlığı Bölümü, 2011.
17. Gün İ, Günay O, Naçar M, et al. Adherence of Diabetic Patients to the Recommendations on Diabetes in Kayseri. *Türkiye Klinikleri J Med Sci*. 2010;30(6):2004-2010.
18. Cohen HW, Shmukler C, Ullman R, et al. Measurements of medication adherence in diabetic patients with poorly controlled HbA1C. *Diabet Med*. 2010;27:210-216. doi:10.1111/j.1464-5491.2009.02898.x
19. Parada H, Horton LA, Cherrington A, et al. Correlates of medication nonadherence among Latinos with type 2 diabetes. *Diabetes Educ*. 2012;38:552-561. doi:10.1177/0145721712445215
20. Egede LE, Gebregziabher M, Hunt KJ, et al. Regional, geographic, and ethnic differences in medication adherence among adults with Type 2 diabetes. *Ann Pharmacother*. 2011;45:169-178.
21. Lerman I, Diaz JP, Ibarguengoitia ME, et al. Nonadherence to insulin therapy in low-income, type 2 diabetic patients. *Endocr Pract*. 2009;15:41-46.
22. Aikens JE, Piette JD. Longitudinal association between medication adherence and glycaemic control in Type 2 diabetes. *Diabet Med*. 2013;30:338-344. doi:10.1111/dme.12046
23. Peeters B, Van Tongelen I, Boussery K, et al. Factors associated with medication adherence to oral hypoglycaemic agents in different ethnic groups suffering from type 2 diabetes: a systematic literature review and suggestions for further research. *Diabet Med*. 2011;28:262-275. doi:10.1111/j.1464-5491.2010.03133.x
24. Peyrot M, Rubin RR, Kruger DF, et al. Correlates of insulin injection omission. *Diabetes Care*. 2010;33:240-245. doi:10.2337/dc09-1348
25. Uzoma CU, Feldman RH. Psychosocial factors influencing inner city black diabetic patients' adherence with insulin. *Health Educ*. 1989;20:29-32.
26. Shams MEE, Barakat EAME. Measuring the rate of therapeutic adherence among outpatients with T2DM in Egypt. *Saudi Pharm J*. 2010;18:225-232. doi:10.1016/j.jsps.2010.07.004
27. Raum E, Kramer HU, Ruter G, et al. Medication non-adherence and poor glycaemic control in patients with type 2 diabetes mellitus. *Diabetes Res Clin Pract*. 2012;97:377-384.
28. Bean D, Cundy T, Petrie KJ. Ethnic differences in illness perceptions, self-efficacy and diabetes self-care. *Psychol Health*. 2007;22:787-811. doi:10.1080/14768320600976240
29. Aikens JE, Piette JD. Diabetes patients' medication underuse, illness outcomes, and beliefs about antihyperglycemic and antihypertensive treatments. *Diabetes Care*. 2009;32:19-24. doi:10.2337/dc08-1533

30. Davies MJ, Gagliardino JJ, Gray LJ, et al. Real-world factors affecting adherence to insulin therapy in patients with Type 1 or Type 2 diabetes mellitus: a systematic review. *Diabet Med.* 2013;30:512-524. doi:10.1111/dme.12128