Type II DM Medication Non-Adherence in Adama Hospital Medical College, Central Ethiopia

Wayu Kusa[1], Daniel Tolessa[2], Tilahun Abdeta[3*]

[1]Department of Medicine, Chiro District Hospital, Chiro, Ethiopia
[2]Department of Psychiatry, Adama Hospital Medical College, Adama, Ethiopia
[3]Department of Psychiatry, School of Nursing and Midwifery, College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia

Abstract

Background: Type II Diabetes Mellitus is a significant and growing health problem worldwide. In Ethiopia, a limited number of studies have tried to investigate treatment non adherence and associated factors among type II Diabetes Mellitus patients. Therefore, this study was aimed to determine the magnitude of medication non-adherence and its associated factors among type II Diabetes Mellitus patients in Adama hospital medical college, central Ethiopia.

Methods: A facility based cross-sectional study was conducted among 140 Type II Diabetes Mellitus patients in Adama Hospital Medical College, central Ethiopia. We used consecutive sampling method, in which every subject meeting the criteria of inclusion is selected until the required sample size is achieved. A standardized Patient Health Questionnaire (PHQ-9) and Morisky Medication Adherence Scale-8 (MMAS-8) were used to identify the major depressive disorder and medication non adherence, respectively. Data were entered into a computer using EpiData 3.1 then exported to SPSS software version 20 for analysis. Logistic regression analysis was used to identify factors associated with medication non-adherence.

Results: The magnitude of type II Diabetes Mellitus drug non-adherence was 58.6% (95% CI: 54.7, 62.4). Individuals having major depressive disorders (AOR=2.3; 95% CI: 1.1, 5.8), experiencing one or more complications (AOR= 3.3; 95% CI: 1.9, 9.0), and average income greater than 1000 birr (AOR= 0.4; 95% CI: 0.1, 0.9) were found to be independent predictors of medication non-adherence.

Conclusion: In this study, the magnitude of medication non-adherence was relatively high among type II Diabetes Mellitus patients. Therefore, health professionals should early screen for diabetes associated complications and comorbid major depressive disorder and treat them early in order to enhance Type II Diabetes Mellitus patients' medication adherence.

Keywords: *Medication Non-Adherence, Type II Diabetes Mellitus, Adama, Ethiopia*

How to cite: Kusa, W., Tolessa, D., and Abdeta, T. 2019. Type II DM Medication Non-Adherence in Adama Hospital Medical College, Central Ethiopia. *East African Journal of Health and Biomedical Sciences*, Volume 3(1): 31-38.

Introduction

Type II Diabetes Mellitus (DM) became a very common and serious health problem worldwide. In Sub-Saharan Africa, its magnitude is highly increasing (Hall *et al*., 2011). It is commonly associated with dietary changes, rapid cultural and social changes, increasing urbanization, reduced physical activity, ageing populations and other unhealthy behaviors (Kasper *et al*., 2018).

Among patients with chronic illnesses like Diabetes Mellitus, cancer, HIV/AIDS, and cardiovascular disease, medication non adherence has been recognized to be a major problem (Hall *et al*., 2011).

Studies in India and the United States showed that adherence to diabetes medication ranges from 23 to 77% (McCabe, 2003; Shobhana *et al*., 1999). Previous studies revealed different factors associated with type II DM medication non-adherence. Socio-demographic variables like (advanced age, gender, educational status, and low monthly income) (Africa, 2006, Gimenes *et al*., 2009, Kalyango *et al*., 2008); preexisting diabetes complications (Tiv *et al*., 2012), and depression (Goldman *et al*., 2004) were some of the reported associated factors of medication non adherence among type II DM patients.

In Ethiopia, despite the presence of medication treatments for diabetes mellitus, there is still a very large

Corresponding Author; Email: tilahunabdeta@gmail.com
Haramaya University, 2019
ISSN 2519-917X

number of diabetic patients die every year. Medication non adherence was the main underlined cause and remains a challenge for the medical professions (Gebre, 2013).

In Ethiopia, diabetes care is given at general outpatient clinics or hospitals and the Ethiopian Diabetes Association has tried to share its part in diabetes care, prevention, and treatment (Gebre, 2013). Despite the fact that diabetic care is given as an outpatient service in Ethiopia, adhering to their medication is still difficult in type II diabetic patients. Even though there are few available studies in Ethiopia about medication non adherence, still the coverage is not enough. Little is also known about the adherence status and associated factors in the study area. Therefore, this study was aimed to determine the magnitude of medication non-adherence and its associated factors among Type II Diabetes Mellitus patients in Adama Hospital Medical College, central Ethiopia.

Materials and Methods

Study setting and design

A facility-based cross-sectional study design was employed among type II DM patients who have had follow up care at the diabetes clinic at Adama Hospital Medical College, in East Showa, Oromia Regional State, Ethiopia, from September to October, 2016. Adama is located 99 km to southeast of Addis Ababa, the capital city of Ethiopia. The Adama Hospital Medical College was established in 1946 G.C. by Italian missionaries and was formerly called the Haile Mariam Mammo Memorial Hospital (Habtamu *et al*., 2014). It teaches new innovative medicine, specialty in obstetrics and gynecology, general surgery, pediatrics, internal medicine, emergency surgery, and anesthesia. This hospital is proving services to about 5 million people in the east and southern parts of Oromia, Afar, Somali region, and Southern Nation, Nationalities and Peoples' Region (SNNP) (Habtamu *et al*., 2014). During study period, according to the data obtained from hospital administer, the hospital has an average of 199 type II DM patients attending the diabetes clinic on a monthly basis for follow-up.

Population

All recorded individuals who fulfilled the following inclusion criteria: being diagnosed with type II DM and at least 18 years old and who were taking diabetes medication for the past 6 months and engaged in regular follow up at Adama Hospital Medical College, diabetes clinic, were considered as study population.

Sample size determination and sampling technique

The sample size was calculated using single population proportion formula taking the proportion of non-adherence to type II DM from a previous study in Jamaica (0.34) (Swaby *et al.*, 2001) with a marginal error of 5% and a 95% confidence level. Since at our study facility, the total number of type II DM patients expected to attend the diabetes clinic each month was less than 10,000, we used the finite population correction formula to calculate the final sample size. Finally, by adding a 10% non-response rate, the final sample size was determined to be 140. We used consecutive sampling method in which every subject meeting the criteria of inclusion is selected until the required sample size is achieved.

Data collection instrument and technique

Data were collected using an adapted structured questionnaire and reviewing patients' record. The questionnaire comprised of patients' socio-demographic characteristics, clinical related factors and medication adherence rating scale. We used a PHQ-9 standardized questionnaire with cut point 10 to identify the major depressive disorders. A PHQ-9 threshold score of 10 was validated to diagnose major depressive disorders in eastern Africa and also among Ethiopian adults (sensitivity= 86% and specificity=67%) (Gelaye *et al*., 2013, Arroll *et al*., 2010). We used the standardized MMAS-8 with cut point 5 for drug non-adherence since it has been validated and used in previous Ethiopian studies (Abate, 2019). The questionnaire initially prepared in English, then translated into local languages (Afan Oromo and Amharic); further it was re-translated back to English to maintain its consistency. The data were collected by face-to-face interviews and some data like glycemic control and experiencing one or more complications were collected by reviewing patients' record.

Data quality control

Before beginning data collection, the questionnaire was pre-tested on 5% of the total sample size to assess the feasibility of the questionnaires. The pre-test was conducted at Zewditu Memorial Hospital in Addis Ababa, Ethiopia. The standardized and widely utilized MMAS-8 and a validated PHQ-9 for depression screening and diagnosis were used in our study. Interviewers and supervisors were trained and properly instructed prior to conducting the survey. The collected data were checked for completeness and consistency before data entry.

Data analysis

To check the association between medication non-adherence and independent variables, we employed a logistic regression analysis. Characteristics of the study population were described by descriptive statistics. Odds ratio with a 95% confidence interval was calculated to assess the magnitude of association and statistical significance. Those variables with a p-value ≤0.25 in the bivariate analysis were entered in to multivariable logistic regression analysis to control for potential confounders and to calculate adjusted odds ratios. Finally, variables with a p-value <0.05 in the multivariable logistic regression were considered as significantly associated with medication non adherence.

Operational definitions

Major depressive disorder: A patient is considered as having a major depressive disorder if he/she answers ≥10 points in the PHQ-9 standardized questionnaire (Arroll *et al*., 2010).

Medication non adherence: A patient is considered as medication non adherent if he/she answers <5 points on the MMAS-8 (Culig and Leppée, 2014).

*Good glycemic control: G*ood glycemic control is considered as type II DM patients' fasting blood sugar control ≤140 mg/dL in the last two months.

Poor glycemic control: Poor glycemic control is considered as type II DM patients' fasting blood sugar control >141 mg/dL in the last two months.

Ethical clearance

Ethical clearance was obtained from the Institutional Research Committee of Adama Hospital Medical College. Before data collection, verbal consent was obtained from each participant. All information obtained from study participants was treated confidentially. Respondents who were found having major depressive disorder in this study were referred to the Adama Hospital Medical College, psychiatry unit for further evaluation.

Results

Socio-demographic characteristics of the respondents

A total of 140 type II DM patients who have been taking diabetes medication in the last 6 months and have been engaged in regular follow up were included in this study. Of the participants, 51.8% were male, 48.9% were married, and 39% had an average monthly income of 500-1000 ETB. The mean (SD) age of participants was 46.5 (±9.45) ranging from 18 to 75 years **(Table 1).**

Table 1: Socio-demographic characteristics of type II DM patients on follow up visits at Adama hospital medical college, central Ethiopia, 2016.

Characteristics	Frequency (N)	Percent (%)
Sex		
Male	73	51.8
Female	67	48.2
Marital status		
Married	69	48.9
Single	36	25.5
Widowed/divorced	35	25.5
Educational status		
No formal education	36	26.2
Primary school	42	29.8
Secondary school	39	27.7
College/university	21	14.9
Average monthly income		
≤ 500 ETB	48	34.0
501-1000 ETB	56	39.0
Above 1000 ETB	36	25.5
Age		
18-40	16	11.43
41-59	84	60.0
≥ 60	40	28.57

ETB- Ethiopian Birr

Clinical characteristics of the respondents

Out of the total respondents, 24.8% had experienced one or more complications (like hypertension, diabetic foot ulcer and retinopathy) and 74.3% had a fasting blood sugar level of ≤140 mg/dL in the past two months. A 37.9% of participants were determined to have major depressive disorder **(Table 2)**.

Table 2: Clinical characteristics of type II DM patients on follow up visits at Adama hospital medical college, central Ethiopia, 2016.

Characteristics	Frequency (N)	Percent (%)
Glycemic control (mg/dL)		
≤140	104	74.3
≥141	36	25.7
Experiencing complications		
Yes	34	24.8
No	106	75.2
Major depressive disorder		
No	87	62.1
Yes	53	37.9

The magnitude of medication non-adherence

In this study, the magnitude of medication non-adherence among type II DM patients was 58.6% (95% CI: 54.7, 62.4).

Factors associated with medication non-adherence among type II DM patients

First, we checked the association of each independent variable with anti-diabetic medication non-adherence using bivariate analysis. Variables including average monthly income, experiencing complications, and major depressive disorders were significantly associated with anti-diabetic medication non-adherence **(Table 3).**

The final model, multivariable logistic regression analysis showed that experiencing one or more complications (like HTN, Diabetic foot ulcer and retinopathy), having monthly income above 1000 birr and having major depressive disorder had a statistically significant association with non-adherence to the anti-diabetic medication.

Patients with major depressive disorders were 2.3 times more likely to have non-adherence to the anti-diabetic drug therapy than those with no major depressive disorders (AOR=2.3; 95% CI: 1.1, 5.8). Patients who had experienced one or more complications (like HTN, Diabetic foot ulcer, Retinopathy) were 3.3 times more likely to have non-adherence to anti-diabetic medication than who did not experience complications (AOR=3.3; 95% CI: 1.9, 9.0). However, patients with an average monthly income of above 1000 ETB were 60% less likely to be non-adherent to anti-diabetic medication as compared to those with an average monthly income of 500 ETB or less (AOR= 0.4; 95% CI: 0.1, 0.9) **(Table 3).**

Table 3: Factors associated with medication non-adherence among type II DM patients on follow up visits at Adama hospital medical college, central Ethiopia, 2016.

Characteristics	Adherent	Non-adherent	COR (95% CI)	AOR (95% CI)
Sex				
Male	28 (38.4)	45 (61.6)	1	
Female	29 (43.3)	38 (56.7)	0.82 (0.42, 1.6)	
Marital status				
Married	30 (43.5)	39 (56.5)	1	
Single	13 (36.1)	23 (63.9)	1.36 (0.59, 3.12)	
Widowed/divorced	14 (40)	21 (60)	1.15 (0.5, 2.63)	
Educational status				
Unable to read and write	16 (44.4)	20 (55.6)	1	1
Primary school	15 (35.7)	27 (64.3)	1.4 (0.57, 3.58)	2.21 (0.81, 5.99)
Secondary school	20 (51.3)	19 (48.7)	0.76 (0.3, 1.88)	0.73 (0.31, 1.68)
College/University	6 (28.6)	15 (71.4)	2.0 (0.62, 6.33)	2.62 (0.62, 10.89)
Age				
18-40	9(56.25)	7(43.75)	1.18 (0.58, 2.36)	
41-59	30(35.71)	54(64.29)	2.70 (1.92, 5.28)	
≥ 60	18(45.0)	22(55.0)	1	
Average monthly income				
≤ 500 ETB	16 (33.3)	32 (66.7)	1	1
501-1000 ETB	21 (37.5)	35 (62.5)	0.83 (0.31, 1.86)	0.83 (0.31, 1.86)
Above 1000 ETB	20 (55.6)	16 (44.4)	0.4 (0.16, 0.97)*	0.4 (0.16, 0.97)*
Experiencing complications				
Yes	9 (26.5)	25 (73.5)	0.43 (0.18, 0.99)*	3.3 (1.9, 9.0)*
No	48 (45.3)	58 (54.7)	1	1
Glycemic control (mg/dL)				
≤140	40 (38.5)	64 (61.5)	1	
≥140	17 (47.2)	19 (52.8)	0.69 (0.32, 1.5)	
Major depressive disorder				
No	42 (48.3)	45 (51.7)	1	1
Yes	15 (28.3)	38 (71.7)	2.4 (1.13, 4.9)*	2.3 (1.13, 5.8)*

ETB - Ethiopian birr **(statistically significant)*

Discussion

This study was designed to determine the magnitude of type II DM medication non-adherence and its associated factors. The magnitude of anti-diabetic medication non-adherence was found to be 58.6% (95% CI: 54.7, 62.4), and factors including major depressive disorders, experiencing complications, and average income greater than 1000 birr were significantly associated with medication non-adherence.

In this study, the magnitude of medication non-adherence was found relatively higher than that of the earlier Indian studies (Divya and Nadig, 2015, Shobhana *et al*., 1999) which reported 30% and 50% non-adherence rates respectively. In this study, more than thirty percent of the respondents reported major depressive disorder, which was found to be associated with medication non-adherence. The other possible justification for the higher medication non-adherence in this study is, the magnitude of patients who are unable to read and write (36%), since the level of education was one of the confirmed associated factors for medication non-adherence in previous studies. Patients who are unable to read and write were more than five times more likely to be non-adherent to their medication than those who completed grades 1-6 (Abebaw *et al*., 2016).

The magnitude of medication non-adherence in this study was also lower than the results of some previous studies (Grant *et al*., 2003, Inbaraj *et al*., 2016, Schectman *et al*., 2002, Abate, 2019), which revealed 68.8%, 70%, 79.7%, and 95.7% non-adherence rates respectively. This could be due to the improved community awareness on chronic illnesses such as diabetes, the availability of better treatments, and good therapeutic communication between medical professionals and patients.

In our study, type II DM patients who had major depressive disorder were more likely to be medication non-adherent as compared to patients who had no major depressive disorder. This result is in line with previous studies (Lin *et al*., 2004, Sweileh *et al*., 2014, Gelder *et al*., 2004, Kaplan, 2016). Previous study also indicates that depression causes poorer diabetes self-care (Gonzalez *et al*., 2008). This finding is one of the very important indications for interventions to decrease the magnitude of medication non-adherence. Having early screening and providing appropriate treatments for major depressive disorders is fundamental to enhance treatment adherence among patients with type II DM (Gonzalez *et al*., 2008).

The results of this study indicated that, patients with an average monthly income of above 1000 ETB were 60% less likely to have medication non-adherence as compared to those with an average monthly income of < 500 ETB. This result is in line with previous studies (Gimenes *et al*., 2009; Schectman *et al*., 2002).

This study also, found that patients who had experienced one or more complications had higher odds of medication non-adherence as compared to who had not experienced complications. This result is supported by a previous study (MuKherjee *et al*., 2013). In this study, about 24.8% of DM patients developed one or more complications like Hypertension (HTN), Diabetic foot ulcer, Retinopathy in the last two months. This complication also need additional management which can complicates the quality of life of DM patients.

Limitations of the study

The study was conducted using face to face interview which could have a social desirability bias and an under-reporting of the magnitude of type II DM medication non-adherence. This study also used cross-sectional study design which could not identify the cause and effect relationships between independent variables and medication non-adherence. Additionally, the independent factors included in the current study were not comprehensive enough.

Conclusion

The magnitude of medication non-adherence was relatively high among type II DM patients. Factors including major depressive disorders, experiencing complications, and average income greater than 1000 birr were significantly associated with medication non adherence. Therefore, this study recommends that the health professionals who are treating type II DM patients should early screen DM associated complications and comorbid major depressive disorder and treat them in order to enhance type II DM patients' medication adherence.

Acknowledgement

We would like to acknowledge Adama hospital medical college for financial support and thank the study participants, data collectors, and supervisors.

Conflict of interests

The authors declare that they have no any conflict of interests.

Contribution of authors

WK and DT designed the research, conducted the analysis and reviewed the manuscript. TA contributed in designing the research, conducting the analysis, drafting the manuscript, reviewing and approving the manuscript for publication. All authors read and approved the final manuscript.

References

Abate, T. W. G. 2019. Medication non-adherence and associated factors among diabetes patients in Felege Hiwot Referral Hospital, Bahir Dar city administration, Northwest Ethiopia. *BMC research notes*, 12(175):1-6.

Abebaw, M., Messele, A., Hailu, M. & Zewdu, F. 2016. Adherence and associated factors towards antidiabetic medication among type II diabetic patients on follow-up at University of Gondar Hospital, Northwest Ethiopia. *Advances in nursing*, 16(2016):1-7.

Africa, I. 2006. Diabetes declaration and strategy for Africa. *International Diabetes Federation* 5(6): 17-89.

Anderson, R. J., Freedland, K. E., Clouse, R. E. & Lustman, P. J. 2001. The prevalence of comorbid depression in adults with diabetes: a meta-analysis. *Diabetes care*, 24(6):1069-1078.

Arroll, B., Goodyear-Smith, F., Crengle, S., Gunn, J., Kerse, N., Fishman, T., Falloon, K. & Hatcher, S. 2010. Validation of PHQ-2 and PHQ-9 to screen for major depression in the primary care population. *The Annals of Family Medicine*, 8(4):348-353.

Culig, J. & Leppée, M. 2014. From Morisky to Hill-bone; self-reports scales for measuring adherence to medication. *Collegium antropologicum*, 38(1):55-62.

Divya, S. & Nadig, P. 2015. Factors contributing to non-adherence to medication among type 2 diabetes mellitus in patients attending tertiary care hospital in South India. *Asian Journal of Pharmacutical and Clinical Research*, 8(23): 274-6.

Gebre, M. W. 2013. Diabetes mellitus and associated diseases from Ethiopian perspective: Systematic review.*Ethiopian Journal of Health Development*, 27(3):249-253.

Gelaye, B., Williams, M. A., Lemma, S., Deyessa, N., Bahretibeb, Y., Shibre, T., Wondimagegn, D., Lemenhe, A., Fann, J. R. & Vander Stoep, A. 2013. Validity of the patient health questionnaire-9 for depression screening and diagnosis in East Africa.*Psychiatry research*, 210 (2):653-661.

Gelder, M., Juan, J. & Nancy, A. 2004. *New Oxford textbook of psychiatry, Vol 1 & 2*, Oxford: Oxford university press.

Gimenes, H. T., Zanetti, M. L. & Haas, V. J. 2009. Factors related to patient adherence to antidiabetic drug therapy. *Revista latino-americana de Enfermagem*, 17(1):46-51.

Goldman, D. P., Joyce, G. F., Escarce, J. J., Pace, J. E., Solomon, M. D., Laouri, M., Landsman, P. B. & Teutsch, S. M. 2004. Pharmacy benefits and the use of drugs by the chronically ill. *Journal of american medical association*, 291(19):2344-2350.

Gonzalez, J. S., Peyrot, M., Mccarl, L. A., Collins, E. M., Serpa, L., Mimiaga, M. J. & Safren, S. A. 2008. Depression and diabetes treatment nonadherence: a meta-analysis. *Diabetes care*, 31(12):2398-2403.

Grant, R. W., Devita, N. G., Singer, D. E. & Meigs, J. B. 2003. Polypharmacy and medication adherence in patients with type 2 diabetes. *Diabetes care*, 26(5):1408-1412.

Hall, V., Thomsen, R. W., Henriksen, O. & Lohse, N. 2011. Diabetes in Sub Saharan Africa 1999-2011: epidemiology and public health implications. A systematic review. *BMC public health*, 11(564):1471-2458.

Inbaraj, L. R., Georg, C. E., Kham, N. L. & Norman, G. 2016. Prevalence, perceptions and practices associated with non-adherence to diabetes medications in primary care setting: A cross sectional study in urban Bangalore. *Asian Journal of Medical Sciences*, 7(6): 107-120.

Kalyango, J. N., Owino, E. & Nambuya, A. P. 2008. Non-adherence to diabetes treatment at Mulago Hospital in Uganda: prevalence and associated factors. *African health sciences*, 8(2):1-13.

Kaplan, B. J. 2016. Kaplan and Sadock's Synopsis of Psychiatry: Behavioral Sciences/Clinical Psychiatry. *Tijdschrift voor Psychiatrie*, 58(4),:78-79.

King, H., Aubert, R. E. & Herman, W. H. 1998. Global burden of diabetes, 1995–2025: prevalence, numerical estimates, and projections. *Diabetes care*, 21(9):1414-1431.

Lin, E. H., Katon, W., Von Korff, M., Rutter, C., Simon, G. E., Oliver, M., Ciechanowski, P., Ludman, E. J., Bush, T. & Young, B. 2004. Relationship of depression and diabetes self-care, medication adherence, and preventive care. *Diabetes care*, 27(9):2154-2160.

Lustman, P. J., Anderson, R. J., Freedland, K. E., De Groot, M., Carney, R. M. & Clouse, R. E. 2000. Depression and poor glycemic control: a meta-analytic review of the literature. *Diabetes care*, 23(7):934-942.

Martin, B. C. & Mcmillan, J. A. 1996. The impact of implementing a more restrictive prescription limit on Medicaid recipients: effects on cost, therapy, and out-of-pocket expenditures. *Medical Care*,72(1):686-701.

Mccabe, B. A. 2003. Barriers to adherence in a free medication program for low income individual with type 2 diabetes. https://digitalcommons.lsu.edu/gradschool_dissertations/3679.

Mukherjee, S., Sharmasarkar, B., Das, K. K., Bhattacharyya, A. & Deb, A. 2013. Compliance to anti-diabetic drugs: observations from the diabetes clinic of a medical college in kolkata, India. *Journal of clinical and diagnostic research*, 7(4):661–665

Rwegerera, G. M. 2014. Adherence to anti-diabetic drugs among patients with Type 2 diabetes mellitus at Muhimbili National Hospital, Dar es Salaam, Tanzania-A cross-sectional study. *The Pan African Medical Journal*, 17(254):1-45.

Schectman, J. M., Nadkarni, M. M. & Voss, J. D. 2002. The association between diabetes metabolic control and drug adherence in an indigent population. *Diabetes care*, 25(6): 1015-1021.

Shobhana, R., Begum, R., Snehalatha, C., Vijay, V. & Ramachandran, A. 1999. Patients' adherence to diabetes treatment. *The Journal of the Association of Physicians of India*, 47(12)**:** 1173-1175.

Swaby, P., Wilson, E., Swaby, S., Sue-Ho, R. & Pierre, R. 2001. Chronic diseases management in the Jamaican setting: HOPE worldwide Jamaica's experience. *Papua New Guinea Medical Journal*, 44 (3-4):171-175.

Sweileh, W. M., Abu-Hadeed, H. M., Al-Jabi, S. W. & Sa'ed, H. Z. 2014. Prevalence of depression among people with type 2 diabetes mellitus: a cross sectional study in Palestine. *BMC public health*, 14 **(**163): 1471-2458

Tiv, M., Viel, J.-F., Mauny, F., Eschwege, E., Weill, A., Fournier, C., Fagot-Campagna, A. & Penfornis, A. 2012. Medication adherence in type 2 diabetes: the ENTRED study 2007, a French Population-Based Study. *PLoS One*, 7(3): e32412.