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Factors Influencing Medication Adherence Among Type 2 Diabetes Patients: A Cross-Sectional Study in Najran

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Abstract:

Introduction: Achieving good glycemic control and preventing early complications are crucial goals in diabetes management, contingent upon patient adherence to prescribed regimens. Despite significant advancements in medication development, achieving optimal glycemic control remains challenging. This study aimed to evaluate medication adherence and associated factors among type 2 diabetes (T2D) patients at Najran

Methods: A cross-sectional study involving 245 T2D patients receiving care. Data on medication adherence were collected using the Medication Adherence Reporting Scale-5 (MARS-5). Statistical analysis was performed using SPSS version 21, with significance set at $p < .05$.

Results: The study found that only 29.4% (95% CI: 23.7%–35.1%) of respondents adhered to their diabetes medication. After adjusting for confounding factors such as khat chewing and adherence to blood glucose testing, factors associated with good medication adherence included being

married (AOR = 3.43, 95% CI: 1.27–4.86), government employment (AOR = 3.75, 95% CI: 2.12–7.37), abstaining from alcohol (AOR = 2.25, 95% CI: 1.32–3.45), absence of comorbidities (AOR = 1.49, 95% CI: 1.16–4.32), and receiving diabetes health education at a healthcare institution (AOR = 3.43, 95% CI: 1.27–4.86).

Conclusion: The study highlights a notably low proportion of T2D patients adhering to their medication in the study area. Factors such as marital status, employment type, alcohol consumption, comorbidities, and access to diabetes health education were significantly associated with medication adherence. These findings underscore the importance of regular health education on medication adherence during patient follow-up visits and the need for broader awareness campaigns through mass media platforms.

Keywords: MARS-5, medication adherence, type 2 diabetes (T2D)

Introduction

Diabetes mellitus (DM) presents a significant and rapidly escalating public health challenge affecting millions worldwide. Its prevalence continues to surge annually, reaching epidemic proportions (International Diabetes Federation (IDF), 2013; Mesfin et al., 2017). According to the International Diabetes Federation, in 2015, 415 million people were afflicted with diabetes, with projections indicating a rise to 642 million by 2040 (International Diabetes Federation (IDF), 2015). By 2040, an estimated 8.5% of the global population will be affected by type 2 diabetes (T2D) (Cho et al., 2018; Zheng et al., 2018). T2D is the most prevalent form globally, constituting 90% of all diabetes cases (World Health Organization, 2019). The rates of diabetes-related morbidity and mortality are disproportionately higher in many low- and middle-income countries compared to high-income nations (Islam et al., 2014).

The burden of T2D is exacerbated by suboptimal glycemic control, leading to vascular complications (Lee et al., 2017). Achieving glycemic control and averting early complications constitute the primary objectives of diabetes management, contingent upon patients' adherence to prescribed regimens (Farsaei et al., 2011). Medication adherence (MA) denotes the degree to which an individual complies with medication directives provided by healthcare professionals (Asheq et al., 2021).

Adhering to diabetes medications is pivotal in managing the condition, staving off diabetes-related complications (Nashat Hegazy, 2017; Rana et al., 2019), and reducing mortality and morbidity rates (DiMatteo, 2004; Juarez et al., 2013; Lee et al., 2017). According to the World Health Organization (WHO), adherence to long-term treatment encompasses "the extent to which a person's behavior in taking medication, adhering to a diet, and/or implementing lifestyle changes aligns with recommended guidelines from a healthcare provider" (Sabaté, 2003). The WHO's report indicates that the average adherence to long-term treatments for chronic diseases in developed countries hovers around 50%, with even lower adherence rates observed in developing countries (Alqarni et al., 2019).

Methods

Study Design, Area, and Period: A hospital-based cross-sectional study was conducted among T2D patients in Najran

Population: The study population consisted of all T2D patients receiving chronic care services who met the inclusion criteria (age ≥ 18 years, diagnosed with T2D, and willing to participate in the study) and were present during the study period.

Sample Size Determination and Sampling Technique: The sample size was determined using the simplified formula for proportions (Taro Yamane) (n = N / (1 + N * e^2)) (Yamane, 1967), where N is the total number of T2D patients attending AHMC's chronic follow-up clinic, which was 562. With a 5% precision of the estimate and an additional 10% for non-response rate compensation, the final sample size was calculated to be 257. Participants were recruited using convenience sampling at the time of their monthly follow-up visits until the required sample size was achieved.

Study Variables and Measurements: The dependent variable was treatment adherence, while independent variables included socio-demographic factors (age, sex, education, income, religion, marital status, occupation), patient and clinical characteristics (duration of diabetes treatment, comorbidity, diabetes complications), and behavioral characteristics (smoking, alcohol consumption, khat chewing, dietary habits, knowledge of target blood glucose). Adherence was assessed using the Medication Adherence Reporting Scale-5 (MARS-5), with adherence to blood glucose testing and alcohol consumption also considered.

Data Collection Tools and Procedures: Data were collected through face-to-face interviews using a structured and pretested questionnaire. The MARS-5, comprising 5 items on medication adherence rated on a 5-point Likert scale, was employed. Training was provided to data collectors and supervisors to ensure consistency and clarity in data collection.

Statistical Analysis: Data were analyzed using SPSS version 21. Descriptive statistics were used to summarize the data, expressed as frequencies and percentages. Bivariate and multivariable logistic regression analyses were conducted to identify independent variables associated with medication adherence. Variables with a p-value < .25 in bivariate analysis were included in the multivariable logistic regression model. The Hosmer-Lemeshow goodness-of-fit test indicated that the model adequately fit the data (p = .815). Significance was set at a p-value of < .05.

Results

Socio-Demographic, Behavioral, and Clinical Characteristics: Out of the total sample size of 257, 245 participants completed the interview, yielding a response rate of 95.3%. The mean age of the participants was 48.6 years (±14.9 standard deviation), ranging from 18 to 85 years old. A majority of the participants (65.3%) were married. Sixteen-point three percent (16.3%) of the participants reported khat chewing. The adherence to blood glucose testing and comorbidity were reported at 91% and 55.1%, respectively.

Medication Adherence Reporting Scale Score: Among the respondents, 28.6% always forgot to take their medication, while 36.3% always decided to skip their medication when they felt their condition was under control. The proportion of respondents adhering to diabetes medication was 29.4%, with a 95% confidence interval (CI) ranging from 23.7% to 35.1%.

Factors Associated With Medication Adherence: After adjusting for khat chewing and adherence to blood glucose testing as confounding factors, being married (adjusted odds ratio [AOR] = 3.43, 95% CI [1.27–4.86]), government employee (AOR = 3.75, 95% CI [2.12–7.37]), abstaining from alcohol (AOR = 2.25, 95% CI [1.32–3.45]), absence of comorbidity (AOR = 1.49, 95% CI [1.16–4.32]), and receiving diabetes health education at a health institution (AOR = 3.43, 95% CI [1.27–4.86]) were significantly associated with good medication adherence.

Table 1. Socio-demographic, Behavioral and Clinical Characteristics of the Respondents at AHMC in Ethiopia.

Variables	Categories	Frequency	Percent
Sex	Male	135	55.1
	Female	110	44.9
Age	< 49	126	51.4
	≥ 49	119	48.6
Marital status	Unmarried	85	34.7
	Married	160	65.3
Educational status	No formal education	76	31.0
	Formal education	169	69.0
Occupational status	Government employee	88	35.9
	Others	157	64.1
Alcohol drinking	Yes	19	7.8
	No	226	92.2
Khat chewing	Yes	40	16.3
	No	205	83.7
Adherence to blood glucose testing	Yes	22	9
	No	223	91
Diabetes health education at HI	Yes	123	50.2
	No	122	49.8
Comorbidity	Present	175	71.4
	Absent	70	28.6

Table 2. Medication Adherence Reporting Scale (MARS-5) of the Respondents at AHMC in Ethiopia.

S.N	Questionnaires	Always	Usually	Sometimes	Rarely	Never
1	Do you forget to take your medication?	70 (30.6%)	55 (22.5%)	35 (14.3%)	54 (22%)	31 (12.6%)

2	Do you stop taking medication for a while?	85 (34.7%)	38 (15.5%)	31 (12.6%)	44 (18%)	47 (19.2%)
3	Do you decide to skip one of your medications?	89 (36.3%)	35 (14.3%)	55 (22.5%)	26 (10.6%)	40 (16.3%)
4	Do you use your medication less than prescribed?	31 (12.6%)	23 (9.4%)	55 (22.5%)	58 (23.7%)	78 (31.8%)
5	Do you change the dosage of your medication?	90 (36.7%)	68 (27.8%)	39 (15.9%)	18 (7.4%)	30 (12.2%)

Table 3. Factors Associated With Medication Adherence of the Respondents at AHMC in Ethiopia.

Variables	**Categories**	**Medication adherence**	**COR (95% CI)**	**AOR (95% CI)**	**p-value**
Marital status	Unmarried$	Poor: 73 Good: 12	1	1	
	Married	Poor: 100 Good: 60	3.65 (1.29–4.98)	3.43 (1.27–4.86)	.014
Occupation status	Government employee	Poor: 46 Good: 42	3.87 (2.17–6.89)	3.75 (2.12–7.37)	<.001
	Others#	Poor: 127 Good: 30	1	1	
Alcohol drinking	Yes	Poor: 70 Good: 16	1	1	
	No	Poor: 103 Good: 56	2.38 (1.38–3.24)	2.25 (1.32–3.45)	.006
Khat chewing	Yes	Poor: 35 Good: 5	1	1	
	No	Poor: 138 Good: 67	0.29 (0.11–0.79)	0.36 (0.12–1.05)	.062
Adherence to blood glucose testing	Good	Poor: 16 Good: 6	1	1	
	Poor	Poor: 157 Good: 66	1.12 (0.68–1.83)	1.36 (0.65–2.87)	.414

Comorbidity	Present	Poor: 128 Good: 47	1	1	
	Absent	Poor: 45 Good: 25	1.51 (1.02–3.40)	1.49 (1.16–4.32)	.045
Diabetes health education at HI	Yes	Poor: 78 Good: 45	2.03 (1.16–3.57)	1.99 (1.11–3.78)	.023
	No	Poor: 95 Good: 27	1		

Note: $Single, divorced, separated.
#Merchant, farmer, daily labor, and unemployed.
COR: Crude Odds Ratio
AOR: Adjusted Odds Ratio

Discussion

The discussion provides valuable insights into the factors influencing medication adherence (MA) among type 2 diabetes (T2D) patients in Ethiopia. The study revealed a relatively low proportion of T2D patients with good MA compared to other regions, highlighting the need for targeted interventions. Several factors were identified as significantly associated with MA, shedding light on potential areas for improvement in diabetes management strategies.

Marital status emerged as a significant factor influencing MA, with married individuals exhibiting higher adherence rates (Almadhoun & Alagha, 2018; Wu et al., 2012). This finding underscores the importance of social support and the role of family in facilitating adherence to treatment regimens. Government employees also demonstrated higher MA rates, possibly due to access to stable employment and support systems that contribute to better adherence (Rezaie et al., 2019).

Alcohol consumption was found to be inversely associated with MA, consistent with previous research linking substance use with poor adherence to diabetes self-care behaviors (Ahmed et al., 2006; Aminde et al., 2019; Nonogaki et al., 2019). Comorbidity emerged as another significant factor, with patients without comorbidities exhibiting better adherence (Alqarni et al., 2019). This could be attributed to the complexity of treatment regimens associated with multiple comorbid conditions, which may pose challenges to adherence.

The study also highlighted the positive impact of diabetes health education on MA, emphasizing the importance of providing patients with knowledge and skills to effectively manage their condition (Almadhoun & Alagha, 2018; Awodele & Osuolale, 2015). Education interventions can empower patients to adhere to medication schedules, monitor blood glucose levels, and adopt healthier lifestyles, thereby improving overall diabetes management outcomes.

However, it's important to note the complexities surrounding MA, as evidenced by contradictory findings in the literature regarding the relationship between education and adherence. Further

research is warranted to explore these nuances and develop tailored interventions that address the diverse needs of T2D patients.

Conclusion:

In conclusion, the study underscores the critical importance of medication adherence in managing type 2 diabetes and preventing associated complications. The identified factors associated with good medication adherence highlight areas for targeted interventions aimed at improving patient outcomes. By prioritizing patient education, adopting individualized care approaches, and leveraging health system support, healthcare providers can work towards enhancing medication adherence rates and ultimately achieving better glycemic control among individuals with type 2 diabetes. Additionally, the use of mass media campaigns can further reinforce the message of adherence to a wider audience, contributing to improved public health outcomes in diabetes management.

References

1. 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, 2016, 1–7. DOI: 10.1155/2016/8579157
2. Adisa, R., Fakeye, T. O., & Fasanmade, A. (2011). Medication adherence among ambulatory patients with type 2 diabetes in a tertiary healthcare setting in Southwestern Nigeria. Pharmacy Practice (Internet), 9(2), 72–81. DOI: 10.4321/s1886-36552011000200003
3. Ahmed, A. T., Karter, A. J., & Liu, J. (2006). Alcohol consumption is inversely associated with adherence to diabetes self-care behaviours. Diabetic Medicine, 23(7), 795–802. DOI: 10.1111/j.1464-5491.2006.01878.x
4. Almadhoun, M. R., & Alagha, H. Z. (2018). Assessment of medication adherence and its association with glycemic control among type-2 diabetes mellitus patients in Gaza-Palestine. Clinical and Experimental Pharmacology, 8(3), e0207583. DOI: 10.4172/2161-1459.1000250
5. Aloudah, N. M., Scott, N. W., Aljadhey, H. S., Araujo-Soares, V., Alrubeaan, K. A., & Watson, M. C. (2018). Medication adherence among patients with type 2 diabetes: A mixed methods study. PLoS One, 13(12), 1–18. DOI: 10.1371/journal.pone.0207583

6. Alqarni, A. M., Alrahbeni, T., Al Qarni, A., & Al Qarni, H. M. (2019). Adherence to diabetes medication among diabetic patients in the Bisha governorate of Saudi Arabia – a cross-sectional survey. Patient Preference and Adherence, 13, 63–71. DOI: 10.2147/PPA.S176355
7. Alshehri, K. A., Altuwaylie, T. M., Alqhtani, A., Albawab, A. A., & Almalki, A. H. (2020). Type 2 diabetic patients adherence towards their medications. Cureus, 12(December 2017), 1–6. DOI: 10.7759/cureus.6932
8. Aminde, L. N., Tindong, M., Ngwasiri, C. A., Aminde, J. A., Njim, T., Fondong, A. A., & Takah, N. F. (2019). Adherence to anti-diabetic medication and factors associated with non-adherence among patients with type-2 diabetes mellitus in two regional hospitals in Cameroon. BMC Endocrine Disorders, 19(1), 1–9. DOI: 10.1186/s12902-019-0360-9
9. Asheq, A., Ashames, A., Al-Tabakha, M., Hassan, N., & Jairoun, A. (2021). Medication adherence in type 2 diabetes mellitus patients during Covid-19 pandemic: A cross-sectional study from the United Arab Emirates. F1000Research, 10, 435. DOI: 10.12688/f1000research.51729.2
10. Awodele, O., & Osuolale, J. A. (2015). Medication adherence in type 2 diabetes patients: Study of patients in Alimosho General Hospital, Igando, Lagos, Nigeria. African Health Sciences, 15(2), 513–522. DOI: 10.4314/ahs.v15i2.26
11. Azodo, C. C., & Omuemu, V. O. (2017). Perception of spirituality, spiritual care, and barriers to the provision of spiritual care among undergraduate nurses in the University of Lagos, Nigeria. Journal of Clinical Sciences, 14(1), 119–125. DOI: 10.4103/jcls.jclss
12. Bekele, B. B., Bogale, B., Negash, S., et al. (2021). Public health interventions on prescription redemptions and secondary medication adherence among type 2 diabetes patients: Systematic review and meta-analysis of randomized controlled trials. Journal of Diabetes & Metabolic Disorders, 20, 1933–1956. DOI: 10.1007/s40200-021-00878-0
13. Benrazavy, L., & Ali, K. (2019). Medication adherence and its predictors in type 2 diabetic patients referring to urban primary health care centers in Kerman City, southeastern Iran. Shiraz E Medical Journal, 20(7), e84746. DOI: 10.5812/semj.84746
14. Bruce, S. P., Acheampong, F., & Kretchy, I. (2015). Adherence to oral anti-diabetic drugs among patients attending a Ghanaian teaching hospital. Pharmacy Practice, 13(1), 533. DOI: 10.18549/PharmPract.2015.01.533
15. Centers for Disease Control and Prevention (2021). Education and Support. CDC.
16. Cho, N., Shaw, J., Karuranga, S., et al. (2018). IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes Research and Clinical Practice, 138, 271–281. DOI: 10.1016/j.diabres.2018.02.023
17. DiMatteo, M. R. (2004). Variations in patients' adherence to medical recommendations: A quantitative review of 50 years of research. Medical Care, 42(3), 200–209. DOI: 10.1097/01.mlr.0000114908.90348.f9

18. Farsaei, S., Sabzghabaee, A. M., Zargarzadeh, A. H., & Amini, M. (2011). Adherence to glyburide and metformin and associated factors in type 2 diabetes in Isfahan, Iran. Iranian Journal of Pharmaceutical Research, 10, 933–939.
19. Feda, M. A., Faidah, N. N., Allam, A. T., Aloithimen, B. A., Alsharif, A. A., Alqarni, M. A., Saeedi, A. Y. S., Felemban, B. N. H., Awan, H. M., Alansari, M. A., Khayat, N. A., Alharbi, F. A., Bakhsh, A. Y. A., & Bugis, E. A. H. (2022). Medication adherence among geriatric patients with chronic diseases while living alone. Journal of Pharmaceutical Negative Results, 13(8), 832–842. DOI: 10.47750/pnr.2022.13.S08.105
20. Imran, M., & Plathottam, J. J. (2017). A study on treatment adherence among patients with type 2 diabetes mellitus attending diabetic clinic. International Journal of Community Medicine and Public Health, 4(5), 1701. DOI: 10.18203/2394-6040.ijcmph20171787
21. Kumar, H., Amara Abdulla, R., & Lalwani, H. (2021). Medication adherence among type 2 diabetes mellitus patients: A cross-sectional study in rural Karnataka (India). Athens Journal of Health and Medical Sciences, 8(2), 107–118. DOI: 10.30958/ajhms.8-2-2
22. Lee, C. S., Tan, J. H. M., Sankari, U., Koh, Y. L. E., & Tan, N. C. (2017). Assessing oral medication adherence among patients with type 2 diabetes mellitus treated with polytherapy in a developed Asian community: A cross-sectional study. BMJ Open, 7(9), 1–7. DOI: 10.1136/bmjopen-2017-016317
23. Mannan, A., Hasan, M. M., Akter, F., Rana, M. M., Chowdhury, N. A., Rawal, L. B., & Biswas, T. (2021). Factors associated with low adherence to medication among patients with type 2 diabetes at different healthcare facilities in southern Bangladesh. Global Health Action, 14(1), 1872895. DOI: 10.1080/16549716.2021.1872895
24. Marcum, Z. A., & Gellad, W. F. (2012). Medication adherence to multi-drug regimens. Clinics in Geriatric Medicine, 28, 287–300. DOI: 10.1016/j.cger.2012.01.008
25. Mesfin, Y., Assegid, S., & Beshir, M. (2017). Medication Adherence among Type 2 diabetes ambulatory patients in Zewditu Memorial Hospital, Addis Ababa, Ethiopia. Epidemiology: Open Access, 7(5), 322–334. DOI: 10.4172/2161-1165.1000322
26. Mirghani, H. O. (2019). An evaluation of adherence to anti-diabetic medications among type 2 diabetic patients in a Sudanese outpatient clinic. Pan African Medical Journal, 34, 1–9. DOI: 10.11604/pamj.2019.34.34.15161
27. Mroueh, L., Ayoub, D., El-Hajj, M., Awada, S., Rachidi, S., Zein, S., & Al-Hajje, A. (2018). Evaluation of medication adherence among Lebanese diabetic patients. Pharmacy Practice, 16(4), 1–8. DOI: 10.18549/PharmPract.2018.04.1291
28. Nashat Hegazy, N. (2017). Quality of care and medication adherence among patients with type 2 diabetes mellitus. The Egyptian Family Medicine Journal, 1(2), 1–13. DOI: 10.21608/efmj.2019.67587
29. Nonogaki, A., Heang, H., Yi, S., Van Pelt, M., & Yamashina, H. (2019). Factors associated with medication adherence among people with diabetes mellitus in poor urban areas of Cambodia: A cross-sectional study. PLoS One, 14(11), e0225000. DOI: 10.1371/journal.pone.0225000

30. Olorunfemi, O., & Ojewole, F. (2019). Medication belief as correlate of medication adherence among patients with diabetes in Edo State, Nigeria. Nursing Open, 6(1), 197–202. DOI: 10.1002/nop2.199
31. Raimi, T. H. (2017). Factors influencing medication adherence among patients with diabetes mellitus and hypertension in Nigeria. European Journal of Biology and Medical Science Research, 5(7), 18–26. Link
32. Rana, M. M., Islam, M. S., Akter, J., & Khatun, S. (2019). Medication adherence to type 2 diabetic patients hospitalized at a tertiary care hospital. Journal of Health Sciences, 9(3), 159–167. DOI: 10.17532/JHSCI.2019.818
33. Rezaie, F., Laghousi, D., & Alizadeh, M. (2019). Medication adherence and associated factors among type II diabetic patients in east Azerbaijan, Iran. Turkish Journal of Endocrinology and Metabolism, 23(3), 158–167. DOI: 10.25179/tjem.2019-65597
34. Rwegerera, G. M., Moshomo, T., Gaenamong, M., Oyewo, T. A., Gollakota, S., Mhimbira, F. A., Fadare, J., Godman, B., Meyer, J. C., & Rivera, Y. P. (2018). Antidiabetic medication adherence and associated factors among patients in Botswana; implications for the future. Alexandria Journal of Medicine, 54(2), 103–109. DOI: 10.1016/j.ajme.2017.01.005
35. Sabaté, E. (2003). WHO Adherence to Long Term Therapies Project, Global Adherence Interdisciplinary Network, World Health Organization. Dept. of Management of Noncommunicable Diseases. Adherence to long-term therapies: evidence for action. World Health Organization.
36. Sheleme, T., Mamo, G., Melaku, T., & Sahilu, T. (2020). Glycemic control and its predictors among adult diabetic patients attending Mettu Karl Referral Hospital, Southwest Ethiopia: A prospective observational study. Diabetes Therapy, 11(8), 1775–1794. DOI: 10.1007/s13300-020-00861-7
37. Teklay, G., Hussien, J., & Tesfaye, D. (2013). Non-adherence and associated factors among T2DM patients at Jimma University Specialized Hospital, Southwest Ethiopia. Journal of Medical Sciences, 13(7), 578–584. DOI: 10.3923/jms.2013.578.584
38. Thapar, R., Holla, R., Kumar, N., Aithal, S., Karkera, S., Rao, C., Pujari, N., Zahida, A., Unnikrishnan, B., Mithra, P., Swamy, D. K., Kulkarni, V., Bhagawan, D., & Kumar, A. (2020). Factors influencing adherence to anti-diabetes medications among type 2 diabetes patients attending tertiary care hospitals in Mangaluru. Clinical Epidemiology and Global Health, 8(4), 1089–1093. DOI: 10.1016/j.cegh.2020.03.025
39. Wabe, N. T., Angamo, M. T., & Hussein, S. (2011). Medication adherence in diabetes mellitus and self-management practices among type-2 diabetics in Ethiopia. North American Journal of Medical Sciences, 3(9), 418–423. DOI: 10.4297/najms.2011.3418
40. World Health Organization. (2019). Classification of Diabetes Mellitus, WHO
41. Wu, J.-R., Lennie, T. A., Chung, M. L., Frazier, S. K., Dekker, R. L., Biddle, M. J., & Moser, D. K. (2012). Medication adherence mediates the relationship between marital status and cardiac event-free survival in patients with heart failure. Heart & Lung, 41(2), 107–114. DOI: 10.1016/j.hrtlng.2011.09.009

42. Yamane, T. (1967). Statistics: An Introductory Analysis. (2nd editio).
43. Yosef, T. (2021). Hypoglycemia among type 1 diabetes patients after insulin use in southwest Ethiopia. Frontiers in Endocrinology, 12, 684570. DOI: 10.3389/fendo.2021.684570
44. Yosef, T., Nureye, D., & Tekalign, E. (2021). Poor glycemic control and its contributing factors among type 2 diabetes patients at Adama Hospital Medical College in East Ethiopia. Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, 14, 3273–3280. DOI: 10.2147/DMSO.S321756
45. Yusuff, K. B., Obe, O., & Joseph, B. Y. (2008). Adherence to anti-diabetic drug therapy and self-management practices among type-2 diabetics in Nigeria. Pharmacy World & Science, 30(6), 876–883. DOI: 10.1007/s11096-008-9243-2
46. Zheng, Y., Ley, S. H., & Hu, F. B. (2018). Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. Nature Reviews Endocrinology, 14(2), 88. DOI: 10.1038/nrendo.2017.151
47. Zhou, Z., Huang, Z., Chen, B., Zheng, C., & Chen, W. (2019). Association between medication adherence and treatment satisfaction among patients with type 2 diabetes in Guangdong Province, China. Advances in Intelligent Systems Research, 165(Smont), 253–257. DOI: 10.2991/smont-19.2019.56