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Research Article

Factors Associated with Antidiabetic Medications and Dietary Recommendation Adherence Among Patients with Type 2 Diabetes

Godwin Gideon Kwaku Dorvlo,[1] Augustine Kumah,[2] Samuel Kwabena Ofosu,[3] Stephen Henry Afakorzi,[3] Yvette Eyram Avorgbedor,[4] Emmanuel Obot,[5] Chinwe Nnenna Nwogu,[6] Malik Abdul Rahman,[7] Henry Okorie Ugorji,[8] Lawrencia Antoinette Aidoo,[9] Anthony Bless Dogbedo,[10] Abdul - Razak Issah,[11] Abigail Abiba Fuseini,[12] Deborah Terkperkie Kanamitie,[2] Gustav Boni[13]

[1]Department of Internal Medicine, St Anthony's Hospital, Dzodze, Ghana
[2]Quality Directorate, Nyaho Medical Centre, Accra, Ghana
[3]Department of Population and Reproductive Health, School of Public Health, University of Port Harcourt, River State, Nigeria
[4]Department of Public Health, Kintampo Health Research Centre, Ghana
[5]Department of Anesthesia, 37 Military Hospital, Accra, Ghana
[6]Department of Healthcare Management, University of Kyiv Mohyla Academy, Ukraine
[7]Department of Diabetes and Hypertension, St Anthony's Hospital, Dzodze, Ghana
[8]Department of Global Health, College of Public Health, Oregon State University, Corvallis, OR, USA
[9]Outpatients Department, Elmina Polyclinic, Elmina, Ghana
[10]Clinton Health Access Initiative (CHAI), Accra – Ghana
[11]Department of Health Information Management, College of Health, Yamfo, Ghana
[12]Emergency Department, Nyaho Medical Centre, Accra, Gha
[13]Department of Public Health, Adidome Government Hospital, Adidome, Ghana

Address correspondence to: Augustine Kumah (augustinekumah@gmail.com).

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ABSTRACT

Introduction: Diabetes mellitus is a global noncommunicable disease epidemic of public concern. Adherence poses a challenge to patients due to the long-term management of type 2 diabetes. This study assessed the factors associated with antidiabetic medications and dietary recommendation adherence among patients with type 2 diabetes in Ghana. **Methods:** A hospital-based, cross-sectional study design was used to assess self-reported factors associated with antidiabetic medications and dietary recommendation adherence among 165 recruited type 2 diabetes patients who visited diabetic clinics of two selected municipal hospitals in the Volta region of Ghana. A structured questionnaire consisting of closed-ended questions was used. Phone calls were used to collect responses from participants using the structured questionnaire, which included the United Kingdom Diabetes Diet Questionnaire and Morisky Adherence Scale. Data collected were entered into a Microsoft Excel sheet and exported to STATA software (version 15) to analyze variables. Binary logistic regression was run to determine the association between the level of adherence (outcome variable) and the independent variables. A CI of 95% with a p-value of < 0.05 was statistically significant. **Results:** Self-reported factors were as follows: forgetfulness ($p = 0.0001$), taking medication ($p = 0.006$), difficulty remembering to take medication ($p = 0.001$), worry about long-term intake of drugs ($p = 0.0001$), choice of high-fiber diet ($p = 0.037$), intake of processed or refined carbohydrate ($p = 0.049$) alcohol intake ($p = 0.033$), age ($p = 0.015$), occupation ($p = 0.009$), and patient waiting time ($p = 0.020$) were found to have contributed to medication/dietary nonadherence among the participants. **Conclusion:** Patient adherence was low. Health authorities in the two selected hospitals should develop strategies to reduce the problem of poor adherence.

Keywords: adherence, antidiabetic medications, dietary recommendation, patients with type 2 diabetes, Ghana

INTRODUCTION

Diabetes mellitus is a chronic noncommunicable disease characterized by chronic high blood sugar and pancreatic beta-cell dysfunction.[1] Among the types of diabetes, type 2 diabetes mellitus (T2DM) is the most common, occurring in the older population and accounting for 90% of all cases.[2] Diabetes mellitus is diagnosed based on clinical features and laboratory investigations. Fasting or random blood sugar tests, oral glucose tolerance tests, and glycated hemoglobin (HbA1c) are the most common diagnostic investigations.[3] The most typical symptoms of diabetes are polyuria, polydipsia, polyphagia, weight loss, numbness, easy tiredness, and blurred vision.[3] The patient achieves glycemic control if HbA1c is less than 7% throughout medical management.[4]

Diabetes is a growing global public health concern.[5] This is because the diabetes burden has increased globally, with higher prevalence in developing countries like Ghana.[6] The age-adjusted prevalence of diabetes has almost doubled from 4.7% in 1980 to 8.5% globally, including Ghana.[1] In 2011, 366 million people had diabetes, with 4.6 million dying globally.[1] This figure increased in 2014 when 422 million people had diabetes mellitus globally.[1] Furthermore, in 2017, global expenditure on diabetes care alone was $850 billion, highlighting the huge economic burden.[7]

In Ghana, 6.8% of hospital visits are attributable to T2DM.[8] The prevalence of T2DM in Ghana among adults (20–79 years) increased from 0.2% (1958) to 3.33% in 2014,[9] indicating increasing prevalence over the years.[8] The increase in the prevalence of T2DM initially thought to be a disease of the rich, can be attributed to poor dietary habits (high-calorie and fatty foods) in most developing countries.[10] Socioenvironmental influences, such as the upsurge of restaurants and fast food establishments, contribute to the dietary transition, leading to increased obesity and overweight.[11] Obesity and being overweight are, therefore, risk factors for the prevalence of T2DM.[5]

Management of T2DM involves the combination of medication, dietary and lifestyle changes, adherence counseling, smoking and alcohol cessation, and blood sugar monitoring.[5] Owing to the long-term management of T2DM, adherence poses a challenge to patients.[12] The challenge of adapting to a lifestyle or habit needed to ensure glycemic control in the long term is difficult for most patients.[9] Adherence to medication and dietary recommendations (advice) among patients with chronic diseases (like diabetes) is a global public health issue.[9] Globally, more than half of these patients with T2DM are nonadherent to medication, dietary lifestyle recommendations, exercise, and self-monitoring of glucose.[7] The World Health Organization (WHO) considers adherence as a major strategy for delaying microvascular and macrovascular diabetes complications like kidney failure, retinopathy, nonhealing gangrenous ulcers, and neuropathies among diabetic patients.[7]

Adherence is defined as the "behavior/attitude of a patient to comply with health care providers recommendations based on collective agreement on medication intake, diet, exercise, lifestyle to ensure good health outcome."[13] Medication and dietary adherence are pivotal in managing diabetes.[14] Hospital-based, cross-sectional adherence studies have shown nonadherence to medications and dietary advice as a primary reason for poor sugar control and early avoidable complications in diabetic patients globally.[15] The few cross-sectional adherence studies in Ghana show nonadherence to medication and dietary recommendations among patients with T2DM.[6] In the Volta and Oti regions, adherence to medication and dietary advice is reported to be 47.75%, according to a recent cross-sectional study of 300 patients.[16] Nonadherence to medication and dietary advice has been associated with prolonged hospitalization, high economic costs, and high disability-adjusted life years (DALY).[17] In the United States, healthcare costs associated with poor medication adherence and prolonged admissions were $100-300 billion in 2017.[18] A cross-sectional study showed that a quarter of diabetic patients reported complications to the Ho Municipal Hospital.[5] Another similar study in Hohoe Municipality (Volta region) found that 78.6% of hospital patients had uncontrolled blood sugars due to nonadherence to medication and dietary advice.[19] Records from St. Anthony's Hospital's annual report (southern Volta) indicate that T2DM accounted for 68.1% and 70% of chronic gangrenous foot ulcers and lower-limb amputations in 2019 and 2020, respectively. These complications were associated with nonadherence to medication and dietary advice. Nonadherence, therefore, predisposes patients to poor health outcomes.[8] Therefore, reducing the diabetes (noncommunicable disease) burden and prolonging life is one of the priorities in the WHO's 2030 Agenda for Sustainable Development Goals (SDG).[20] As a result, medication adherence and dietary habits among diabetic patients have been identified as areas to tackle to achieve health promotion and well-being (SDG3).[16] To tackle medication and dietary adherence, the various factors that influence adherence must be explored.[20] This is because adherence is a complex and multifactorial problem.[21] Research studies show that several factors are associated with medication adherence and dietary advice.[22] These are grouped into patient-related factors, health system and provider-related factors, and sociodemographic factors.[23] The rationale for the study was to assess the level of adherence to antidiabetic medication and dietary recommendations (advice) and to determine peculiar contributory factors of nonadherence (i.e., patient-related, health system, and provider-related factors) among patients with T2DM who attend two selected municipal hospitals in the southern part of the Volta

region of Ghana. This will potentially help to develop adherence strategies to improve health outcomes among patients with diabetes in (the Keta and Ketu-North Municipalities) southern part of the Volta region.

METHODS

Ethical Considerations

Ethical clearance and approval were sought from the UHAS Research Ethics Committee and Leeds Beckett University, UK. In addition, gatekeeper permission was sought from St. Anthony's Hospital and Sacred Heart Hospital management to allow participants (patients) access via telephone for data collection.

Patient participation in this study was strictly voluntary. Verbal informed consent was sought and recorded via phone call. Participants who willingly consented verbally to participate in the study were included. Participants were not forced and had the right to withdraw from answering questions while responding to the questionnaire. The general aim of the study was explained well to the recruited participants before they responded to the questionnaires.

Study Design

A hospital-based, cross-sectional study design was used to assess the level of adherence and identify self-reported factors that contribute to nonadherence to oral antidiabetic medications and dietary recommendations (advice) among patients with T2DM who visited the diabetic clinics of two selected municipal hospitals (St. Anthony's Hospital, Dzodze, and Sacred Heart Hospital, Abor) in the Volta region between July 2021 and October 2022.

Study Population

The study population consisted of adults ($\geq$ 18 years) diagnosed with T2DM for at least 6 months. Six months is enough time for the patient to adjust and adapt to the disease condition and dietary regimen following health education. These were registered patients of the OPD diabetes clinic of Sacred Heart Hospital and St Anthony's Hospital.

Sample Size and Sampling Technique

The list of registered patients with T2DM (sample frame) from the Sacred Heart Hospital and St. Anthony's Hospital who were expected to report for review during the data collection period were taken from the clinic register. A total of 165 participants were recruited using the sample frame (list) of 154 patients from St Anthony's Hospital and 148 patients from Sacred Heart Hospital, respectively. The sample size distribution between the two study sites was done using the proportionate formula to calculate the sample size for each facility. The proportion determined for each facility was used. A total of 84 and 81 participants from St Anthony's Hospital and Sacred Heart Hospital, respectively, were recruited for the study. The surnames of the participants (154 and 148) per each facility were arranged alphabetically and assigned numbers from first to the last. These numbers were written on paper, placed into a bowl, and mixed thoroughly. The numbers were picked randomly from the bowl (lottery method) to determine the proportion of sample size per facility. Recruited patients who declined phone calls were replaced using the same balloting process.

Data Collection

A structured questionnaire consisting of closed-ended questions was used to collect data on the sociodemographic characteristics, patient-related factors, and health system/healthcare provider–related factors that contribute to adherence among patients with T2DM. Face-to-face data collection was not done because of the need to adhere to COVID-19 protocols (Leeds Beckett University guideline). As a result, phone calls were used as a medium to collect responses from participants using the structured questionnaire. The Morisky Adherence Scale[14] was adapted to assess the level of adherence. The United Kingdom Diabetes and Diet Questionnaire (UKDDQ) was also adapted to determine the dietary habit adherence of diabetic patients. Questions on the type of food eaten were modified to include Ghanaian foods. A structured questionnaire was used to assess patient-related factors, healthcare providers, and health system factors, and it was influenced by other research studies such as those by Arifulla et al.[12] Participants who did not understand English were helped by translating the questions into the local language (Ewe, Twi).

Data Analysis

Data collected were entered into a Microsoft Excel sheet exported to STATA software (version 15) for analysis of variables. Mean and SD were used to present continuous variables. Categorical variables were presented as frequencies and tables (descriptive statistics). Binary logistic regression was run to determine the association between the level of adherence (outcome variable) and the independent variables (sociodemographic factors, patient-related factors, health system/provider factors, and diet). The binary variable was the level of adherence (either adherent or nonadherent). A CI of 95% with a p-value of < 0.05 was statistically significant. The 8-item Morisky adherence scale was scored on a scale of 1 to 8. Participants who scored less than 6 were classified as nonadherent, while those who scored 6 and above were considered adherent to their medications. The outcome variable was coded 0 (nonadherent) and 1 (adherent).

Table 1. Association between sociodemographic characteristics and level of adherence ($N = 165$)

Variables	Nonadherence	Adherence	Total	χ^2	p-value
Age, y				7.894	0.048
< 30	0 (0.0)	1 (100.0)	1 (0.6)		
30–59	76 (83.5)	15 (16.5)	91 (55.2)		
60–89	65 (90.3)	7 (9.7)	72 (43.6)		
≥ 90	1 (100.0)	0 (0.0)	1 (0.6)		
Sex				3.555	0.059
Male	30 (76.9)	9 (23.1)	39 (23.6)		
Female	112 (88.9)	14 (11.1)	126 (76.4)		
Educational level				7.830	0.098
No formal education	41 (89.1)	5 (10.9)	46 (27.9)		
Primary	41 (85.4)	7 (14.6)	48 (29.1)		
JHS/Middle	44 (88.0)	6 (12.0)	50 (30.3)		
SHS	11 (91.7)	1 (8.3)	12 (7.3)		
Tertiary	5 (55.6)	4 (44.4)	9 (5.5)		
Occupation				10.608	0.031
Unemployed	18 (90.0)	2 (10.0)	20 (12.1)		
Farmer	27 (93.1)	2 (6.9)	29 (17.6)		
Trader	77 (86.5)	12 (13.5)	89 (53.9)		
Formal	6 (54.5)	5 (45.5)	11 (6.7)		
Others	14 (87.5)	2 (12.5)	16 (9.7)		
Marital status				0.897	0.826
Single	4 (80.0)	1 (20.0)	5 (3.0)		
Married	94 (84.7)	17 (15.3)	111 (67.3)		
Widow	35 (89.7)	4 (10.3)	39 (23.6)		
Divorced	9 (90.0)	1 (10.0)	10 (6.1)		
Religious affiliation				3.436	0.330
Traditionalist	27 (81.8)	6 (18.2)	33 (20.0)		
Islam	4 (66.7)	2 (33.3)	6 (3.6)		
Christian	106 (87.6)	15(12.4)	121 (73.3)		
Others	5 (100.0)	0 (0.0)	5 (3.0)		
Health facility attended				3.486	0.062
SAH	73 (91.3)	7 (8.7)	80 (48.5)		
SHH	69 (81.2)	16 (18.8)	85 (51.5)		

JHS: Junior High School, SHS: Senior High School, SAH: St Anthony's Hospital, SHH: Sacred Heart Hospital.

RESULTS

Association Between Sociodemographic Characteristics and Antidiabetic Medication Adherence

A total of 165 participants were recruited for the study. Age was a statistically significant factor ($p = 0.048$) influencing medication and dietary advice among the participants. There was also a statistical significance between the participants' adherence and occupation ($p = 0.031$). Variables such as educational level, sex, marital status, and religion were not statistically significant. See Table 1 for details.

Association Between Health System/Care Provider–Related Factors and Adherence

A statistically significant association existed between participants' hospital waiting time ($p = 0.020$) and nonadherence. Copayment, staff attitude, information, availability of drugs, and understanding of drug regimen were not statistically significant to medication nonadherence. See Table 2.

Association Between Patient-Related Factors and Adherence

The type of antidiabetic medication the participants took ($p = 0.028$) was the only variable with a statistically significant association with adherence. Variables such as comorbid conditions, use of herbal preparation, distance to facility, perception of orthodox medicine, and disease duration were not statistically significant. See Table 3 for details.

Dietary Adherence and Associated Factors

The choice of a high-fiber diet ($p = 0.037$) was a statistically significant variable related to dietary nonadherence. There was statistical significance between intake of processed carbohydrates (cassava) ($p = 0.049$) and dietary nonadherence, while alcohol intake ($p = 0.033$) was also statistically significant. See Table 4 for details.

Medication Adherence and Associated Factors

There was a statistically significant association between forgetfulness ($p = 0.0001$), missing medication ($p = 0.006$),

Table 2. Association between health system/care provider–related factors and adherence ($N = 165$)

Variables	Nonadherence	Adherence	Total	χ^2	*p*-value
The participant feels free to ask questions about medication and their health				0.002	0.963
Yes	81 (86.2)	13 (13.8)	94 (57.0)		
No	61 (85.9)	10 (14.1)	71 (43.0)		
Reasons participants did not ask questions about their medications and health				3.514	0.319
Feels shy	11 (91.7)	1 (8.3)	12 (16.9)		
Poor attitude of staff	5 (100.0)	0 (0.0)	5 (7.0)		
No privacy	19 (76.0)	6 (24.0)	25 (35.2)		
Time constraints	26 (89.7)	3 (10.3)	29 (40.9)		
Participants were given enough information about their disease condition				1.202	0.548
Yes	133 (85.3)	23 (14.7)	156 (95.7)		
No	3 (100.0)	0 (0.0)	3 (1.8)		
Sometimes	4 (100.0)	0 (0.0)	4 (2.5)		
Understand medication regimen				2.892	0.236
Yes	125 (84.5)	23 (15.5)	148 (90.2)		
No	4 (100.0)	0 (0.0)	4 (2.5)		
Sometimes	12 (100.0)	0 (0.0)	12 (7.3)		
Participants receive a monthly stock of antidiabetic medicine per each visit				0.718	0.397
Yes	43 (82.7)	9 (17.3)	52 (31.5)		
No	99 (87.6)	14 (12.4)	113 (68.5)		
Reasons participants did not receive medicines				1.383	0.710
Medicines not available	90 (86.5)	14 (13.5)	104 (92.0)		
No staff to serve me medicines	2 (100.0)	0 (0.0)	2 (1.8)		
Diabetic clinic closed	4 (100.0)	0 (0.0)	4 (3.5)		
Others	3 (100.0)	0 (0.0)	3 (2.7)		
Participants comfortable with a copayment for medications				2.620	0.270
Yes	24 (85.7)	4 (14.3)	28 (17.0)		
No	99 (88.4)	13 (11.6)	112 (67.9)		
Sometimes	19 (76.0)	6 (24.0)	25 (15.1)		
Waiting hours to be attended to in the hospital				7.855	0.020
< 1	11 (91.7)	1 (8.3)	12 (7.3)		
1–2	34 (73.9)	12 (26.1)	46 (27.9)		
> 2	97 (90.6)	10 (9.4)	107 (64.8)		
Participants describe healthcare workers' attitudes toward them as:				1.100	0.777
Friendly	119 (85.0)	21 (15.0)	140 (84.8)		
Arrogant	3 (100.0)	0 (0.0)	3 (1.8)		
Rude	12 (92.3)	1 (7.7)	13 (7.9)		
Unwelcoming	8 (88.9)	1 (11.1)	9 (5.5)		

difficulty remembering to take medication ($p = 0.0001$), and long-term intake of medication ($p = 0.001$) after binary logistic regression. Factors such as (stop taking medication when no longer experiencing symptoms) and (stop intake of medication without telling the clinician) were not significantly associated with nonadherence. See Table 5.

Multivariable Analysis of Factors Influencing Adherence to Antidiabetic Medication

There was some statistical significance after multivariable analysis of all the factors. Forgetfulness ($p = 0.015$) and missing medication intake ($p = 0.009$) showed a statistically significant association with medication and dietary nonadherence. Details are in Table 6.

DISCUSSION

Patient-Related Factors and Sociodemographic Characteristics Associated with Adherence

Research findings associated several factors with medication/dietary advice adherence.[22] The sociodemographic characteristics of participants with a statistically significant association with nonadherence were age ($p = 0.048$) and occupation ($p = 0.031$). Participants of younger age (30–59 years) (55.2%) had a prevalence of nonadherence compared with those above 60 years (43.6%). This could be because participants younger than age 60 years were within the working class and were occupied with work activities. This could make them either forget to take their medications or miss a dose of their medication. They also tend to skip meals

Table 3. Association between patient-related factors and adherence (bivariate analysis [$N = 165$])

Variables	Nonadherence	Adherence	Total	χ^2	*p*-value
Comorbid conditions				6.224	0.183
Hypertension	114 (88.4)	15 (11.6)	129 (78.7)		
Asthma	2 (66.7)	1 (33.3)	3 (1.8)		
Sickle cell disease	6 (100.0)	0 (0.0)	6 (3.7)		
None	17 (73.9)	6 (26.1)	23 (14.0)		
Others	2 (66.7)	1 (33.3)	3 (1.8)		
Reasons participants are unable to buy medications when hospital stocks are unavailable				0.299	0.861
Expensive	7 (87.5)	1 (12.5)	8 (18.2)		
Money constraint	13 (86.7)	2 (13.3)	15 (34.1)		
Difficult to find	17 (80.9)	4 (19.1)	21 (47.7)		
Use of traditional/herbal preparations				0.403	0.818
Yes	32 (88.9)	4 (11.1)	36 (21.8)		
No	79 (85.9)	13 (14.1)	92 (55.8)		
Sometimes	31 (83.8)	6 (16.2)	37 (22.4)		
Reasons some participants prefer traditional/herbal medicines to orthodox medicines				4.500	0.105
Yes	6 (100.0)	0 (0.0)	6 (16.7)		
No	14 (77.8)	4 (22.2)	18 (50.0)		
Sometimes	12 (100.0)	0 (0.0)	12 (33.3)		
Participants perception that orthodox medicines effectively control their blood sugar levels				3.952	0.139
Yes	31 (91.2)	3 (8.8)	34 (20.6)		
No	88 (82.2)	19 (17.8)	107 (64.9)		
Sometimes	23 (95.8)	1 (4.2)	24 (14.5)		
Travel time to a health facility for medications, hr				0.724	0.696
< 1	68 (86.1)	11 (13.9)	79 (.47.9)		
1	53 (84.1)	10 (15.9)	63 (38.2)		
> 1	21 (91.3)	2 (8.7)	23 (13.9)		
Time participants have been diagnosed with diabetes				5.080	0.166
6–11 mo	10 (83.3)	2 (16.7)	12 (7.3)		
1–2 y	24 (92.3)	2 (7.7)	26 (15.8)		
3–5 y	11 (68.7)	5 (31.3)	16 (9.7)		
> 5 y	97 (87.4)	14 (12.6)	111 (67.2)		
Worried about long-term intake of medicines				5.866	0.053
Yes	74 (87.1)	11 (12.9)	85 (51.5)		
No	32 (76.2)	10 (23.8)	42 (25.5		
Sometimes	36 (94.7)	2 (5.3)	38 (23.0)		
Being worried often affects how participants take medication				1.897	0.387
Yes	29 (93.5)	2 (6.5)	31 (36.5)		
No	23 (82.1)	5 (17.9)	28 (32.9)		
Sometimes	22 (84.6)	4 (15.4)	26 (30.6)		
Receive support from friends and families				4.750	0.093
Always	60 (80.0)	15 (20.0)	75 (45.4)		
Sometimes	28 (87.5)	4 (12.5)	32 (19.4)		
Never	54 (93.1)	4 (6.9)	58 (35.2)		
Number of pills taken in a day				0.310	0.958
1	9 (90.0)	1 (10.0)	10 (6.1)		
2	31 (83.8)	6 (16.2)	37 (22.4)		
3	12 (85.7)	2 (14.3)	14 (8.5)		
≥ 4	90 (86.5)	14 (13.5)	104 (63.0)		
Type of antidiabetic medication being taken				7.157	0.028
Oral	125 (88.0)	17 (12.0)	142 (86.1)		
Insulin	3 (50.0)	3 (50.0)	6 (3.6)		
Both oral and insulin	14 (82.4)	3 (17.6)	17 (10.3)		

or eat any food they come across because of their busy work schedules. This finding is consistent with a cross-sectional study in Nigeria, Sudan, South Africa, and the United States, where younger age was associated with medication and dietary nonadherence.[24] A similar study in Iran (Middle East) also corroborates this finding.[25] Age influences perceptions and beliefs, which affect the tendency of a person to change behavior underpinned in the health belief model.[26] The perception of wellness (absence of symptoms) and few or no complications among patients with T2DM who are younger can make them nonadherent, hence

Table 4. Dietary adherence and associated factors ($N = 165$)

Variables	Nonadherence	Adherence	Total	χ^2	*p*-value
Number of times participants eat in a day				2.140	0.544
Once	3 (100.0)	0 (0.0)	3 (1.8)		
Twice	23 (92.0)	2 (8.0)	25 (15.1)		
Thrice	104 (83.9)	20 (16.1)	124 (75.2)		
More than three times	12 (92.3)	1 (7.7)	13 (7.9)		
Number of times participants eat vegetables (gboma, kontonmire, cabbage, cassava leaves, garden eggs, ademe)				2.907	0.714
Never	5 (100.0)	0 (0.0)	5 (3.0)		
Once a week	13 (92.9)	1 (7.1)	14 (8.5)		
2–4 times a week	62 (84.9)	11 (15.1)	73 (44.2)		
5–6 times a week	57 (85.1)	10 (14.9)	67 (40.6)		
1–2 times a day	3 (100.0)	0 (0.0)	3 (1.8)		
≥ 3 times a day	2 (66.7)	1 (33.3)	3 (1.8)		
Number of times participants eat a portion of fruit				8.140	0.149
Never	13 (86.7)	2 (13.3)	15 (9.1)		
Once a week	51 (94.4)	3 (5.6)	54 (32.7)		
2–4 times a week	39 (76.5)	12 (23.5)	51 (31.0)		
5–6 times a week	32 (86.5)	5 (13.5)	37 (22.4)		
1–2 times a day	4 (100.0)	0 (0.0)	4 (2.4)		
≥ 3 times a day	3 (75.0)	1 (25.0)	4 (2.4)		
Number of times participants eat or drink sugary food/drinks				1.721	0.886
Never	79 (87.8)	11 (12.2)	90 (54.6)		
Once a week	41 (83.7)	8 (16.3)	49 (29.7)		
2–4 times a week	17 (80.9)	4 (19.1)	21 (12.7)		
5–6 times a week	2 (100.0)	0 (0.0)	2 (1.2)		
1–2 times a day	2 (100.0)	0 (0.0)	2 (1.2)		
≥ 3 times a day	1 (100.0)	0 (0.0)	1 (0.6)		
Number of times participants often choose high fiber				11.877	0.037
Never	1 (100.0)	0 (0.0)	1 (0.6)		
Once a week	34 (97.1)	1 (2.9)	35 (21.2)		
2–4 times a week	52 (91.2)	5 (8.8)	57 (34.6)		
5–6 times a week	41 (74.5)	14 (25.5)	55 (33.3)		
1–2 times a day	12 (80.0)	3 (20.0)	15 (9.1)		
≥ 3 times a day	2 (100.0)	0 (0.0)	2 (1.2)		
Time participants eat supper				1.390	0.499
5–6 pm	116 (84.7)	21 (15.3)	137 (83.0)		
7–8 pm	24 (92.3)	2 (7.7)	26 (15.8)		
9–10 pm	2 (100.0)	0 (0.0)	2 (1.2)		
Number of times participants eat cassava product				9.552	0.049
Never	31 (72.1)	12 (27.9)	43 (26.1)		
Once a week	53 (91.4)	5 (8.6)	58 (35.2)		
2–4 times a week	39 (90.7)	4 (9.3)	43 (26.1)		
5–6 times a week	18 (90.0)	2 (10.0)	20 (12.1)		
1–2 times a day	1 (100.0)	0 (0.0)	1 (0.6)		
Complies with dietary advice				5.592	0.061
Yes	13 (68.4)	6 (31.6)	19 (11.5)		
No	71 (88.7)	9 (11.3)	80 (48.5)		
Sometimes	58 (87.9)	8 (12.1)	66 (40.0)		
Reasons participants do not comply with dietary advice				0.196	0.907
Difficult to comply	60 (88.2)	8 (11.8)	68 (85.0)		
No money	10 (90.9)	1 (9.1)	11 (13.7)		
No reason	1 (100.0)	0 (0.0)	1 (1.3)		
Number of times participants drink alcohol				6.838	0.033
Never	128 (85.9)	21 (14.1)	149 (90.3)		
Once a week	14 (93.3)	1 (6.7)	15 (9.1)		
2–4 times a week	0 (0.0)	1 (100.0)	1 (0.6)		
Number of times participants eat fast food				2.836	0.586
Never	1 (50.0)	1 (50.0)	2 (1.2)		
Once a week	103 (87.3)	15 (12.7)	118 (71.5)		
2–4 times a week	36 (83.7)	7 (16.3)	43 (26.1)		
5–6 times a week	1 (100.0)	0 (0.0)	1 (0.6)		
1–2 times a day	1 (100.0)	0 (0.0)	1 (0.6)		

Table 5. Medication adherence and associated factors ($N = 165$)

Variables	Nonadherence	Adherence	Total	χ^2	*p*-value
Forget to take medication sometimes				28.657	<0.0001
Yes	101 (97.1)	3 (2.9)	104 (63.0)		
No	41 (67.2)	20 (32.8)	61 (37.0)		
Miss taking medication				7.643	0.006
Yes	46 (97.9)	1 (2.1)	47 (28.5)		
No	96 (81.4)	22 (18.6)	118 (71.5)		
Forget to carry medication when traveling				0.177	0.674
Yes	9 (81.8)	2 (18.2)	11 (6.7)		
No	133 (86.4)	21 (13.6)	154 (93.3)		
Taking medication every day is a real inconvenience				10.686	0.001
Yes	113 (91.1)	11 (8.9)	124 (75.1)		
No	29 (70.7)	12 (29.3)	41 (24.9)		
Have difficulty remembering to take all medications				14.841	<0.0001
Yes	80 (96.4)	3 (3.6)	83 (50.3)		
No	62 (75.6)	20 (24.4)	82 (49.7)		

the variation of adherence between the age groups.[22] Also, most of the comorbidities like hypertension, heart failure, kidney failure, and retinopathy are more prominent in older ages.[22] Of this, there is a high level of perception of risk/severity of complications, which makes older people (> 60 years) more adherent to their medication and dietary advice.[27] It also enhances their "self-efficacy"[26] because there is the belief that being adherent can improve their health (perception of benefit). A high perception of severity and high self-efficacy have been found to influence adherence, where patients with diabetes who had a high perception of seriousness and high efficacy were more adherent than others in Korea.[27] Dietary choices are influenced by age, according to Doherty et al.[28]

The choice of fiber ($p = 0.037$) and intake of processed carbohydrates ($p = 0.049$) were statistically significant with nonadherence to dietary advice. The primary occupation of the student areas is predominantly farming, with most farm produce being carbohydrates, which explains the choice of carbohydrate intake. This was consistent with a similar study in Tamale, where most participants did not consume fruits and vegetables daily.[9] It is, however, evident that people of younger age prefer more refined carbohydrates, such as fried rice and indomie (noodles),[28] which are not recommended dietary regimens for diabetic patients.[25] This can also explain the reasons for poor adherence to dietary advice among younger age groups (30–59 years) in this current study. In this study, more than half of the participants were younger than 60 years. This is consistent with a similar cross-sectional survey in Korle-Bu Teaching Hospital (Accra) and Nigeria.[10] However, the study in the middle and northern parts of the Volta region showed (that 50%) of the participants were patients with T2DM.[6] The difference is not significant as it shows that the prevalence of T2DM is gradually increasing among people of younger ages (< 60 years). "Nutritional transition" can be attributed to the rise in T2DM.[29]

The occupation was equally significantly associated with medication and dietary nonadherence, compared with the same finding in Nigeria based on a cross-sectional study of 370 patients with diabetes.[10] Traders (the majority of the participants) are busy people who travel to different towns on market days; as a result, making the right choices of food and medication intake is a problem. In a similar study, occupation was not significantly associated with adherence in Korle-Bu Teaching Hospital (Accra).[8] Even though the income level was not assessed in the study, it can be related to occupation because a person's income can be determined by occupation. The income level contributed to adherence in other studies in Korea[27] and South Africa.[30] Most of the participants in this study were traders and farmers, while 12.1% were unemployed. This could suggest some socioeconomic reasons for nonadherence to medication and dietary advice. Studies in the middle and

Table 6. Multivariable analyses of factors influencing adherence to antidiabetic medication

Variables	COR	*p*- value	95% CI	AOR	*p*-value	95% CI
Forget to take medication sometimes						
Yes	1.00			1.00		
No	16.42	0.000	4.63–58.28	13.46	0.015	1.65–109.65
Miss taking a dose of medication						
Yes	1			1.00		
No	10.54	0.023	1.38–80.64	51.98	0.009	2.67–1013.97

COR: crude odds ratio; AOR: adjusted odds ratio.

Northern Volta (including Oti region)[6] and Northern Ghana[9] found significant associations between the education level and nonadherence. However, this study did not find a significant association between education level and nonadherence. Moreover, female sex was also seen as an associated factor contributing to adherence in Tamale (Northern Ghana)[9] based on a similar study, but sex ($p = 0.059$) was not found to be significant in this study. The variation in the findings may be due to the different study settings.

Patient-related factors such as forgetfulness, taking medication, worry about long-term intake of drugs, and difficulty remembering medication were factors found statistically significant after binary analysis. Based on multivariable regression analysis, forgetfulness ($p = 0.015$) and missed taking medication ($p = 0.099$) were statistically significant factors associated with nonadherence. It suggests that forgetfulness is the participants' major contributor to medication/dietary nonadherence. The finding is consistent with the same study in the middle and northern parts of the Volta Region and Oti Region[6] Dormaa Government Hospital (Bono Region),[31] Cameroon,[15] and United Arab Emirates.[12] Forgetfulness is typical in the elderly due to early signs of dementia (anterograde or retrograde). As a result, they are prone to miss their medication intake and forget their dietary recommendations. Family/psychological support did not contribute to nonadherence in this study. Still, it contributed to a similar survey in Dormaa Hospital (Bono region, Ghana).[31] It shows that good support from family (significant others, friends) can be useful in helping patients not forget their medications and dietary plans. It will also be prudent to consider strategies to remind patients of their medication and dietary plan. The worry of long-term medication intake ($p = 0.0001$) had a strong association with nonadherence in the binary logistic regression analysis. More than half of the study participants noted that long-term medication intake creates inconvenience. As a result, a quarter of them do not adhere to their medication regimen. This finding is inconsistent with other studies in the Volta and Oti region, Accra, and Tamale. Instead, the duration of diagnosis was found significant in another study in Uganda.[32] More than half of the participants were diagnosed more than 5 years ago. Patients who have been on medication for more than 5 years should be able to adjust to the treatment and dietary regimen. A similar study in Uganda showed that people diagnosed more than 3 years ago were more adherent. Still, the disease duration contrasted with this current study and was not statistically significant. Could the worry of long-term medication intake be a peculiar factor in the southern part of the Volta region?

The choice of high-fiber, processed food intake, and alcohol intake were contributory factors to dietary nonadherence. This was consistent with a similar study in Sri Lanka[33] and Nepal.[34] The type of antidiabetic medication, either injectable or oral, was significantly associated with medication nonadherence. This was consistent with similar studies in Uganda[32] and Cameroon.[16] Participants on insulin are more likely to be nonadherent because of cost and availability. Only (41.4%) of the participants were able to buy medications when they were unavailable at the hospital. Alcohol intake was a contributory factor to dietary nonadherence. This finding was also consistent with the study in Cameroon.[16]

Health System/Healthcare Provider Factors Associated with Adherence

Patient waiting time was the study's most significant variable associated with health system/care provider factors. Most participants spent more than 2 hours at the hospital before being attended to. This is due to the manual medical records systems, which sometimes make locating patients' folders (files) difficult. The facilities also lack adequate medical staff; thus, patients must wait for doctors to attend to inpatients on the morning rounds before attending to them at the outpatient department. More than half of the participants were busy traders, especially on significant market days (as stated earlier). Thus, they may want to spend little time at the hospital, which affects their hospital visit. This invariably contributes to nonadherence to medication and dietary plans among the participants. This is because patients who could not wait longer at the hospital due to their work or business schedule either left, which they saw, or were in a hurry to leave and did not pay attention to their dietary or medication instructions. This finding is the same as those of the Uchenna et al.[10] research study, which found that patients' time wasted at the hospital contributes to nonadherence. A busy work schedule was considered a contributory factor to nonadherence in a similar study in Tamale.[35]

Even though most of the participants noted that they were uncomfortable with copayment as it affected their hospital visits. There was no statistically significant association between copayment and nonadherence in this study. This was consistent with similar studies in Ghana (Middle and Northern Volta, Oti region, Bono region, and Tamale),[8,31] where copayment contributed to nonadherence. The study in Accra was undertaken at the major tertiary teaching hospital in Ghana compared with the other district hospitals. This may account for the variation in the findings. It also underpins the socioeconomic factor associated with nonadherence, as mentioned earlier.

Some studies associated health worker attitudes and medication availability with nonadherence.[36] However, these findings were different from those of this study. The conceptual framework (Fig. 1) describes how several factors are interlinked with nonadherence[37] and underpins the complexity of the problem of adherence behavior among diabetic patients. Based on the findings, an

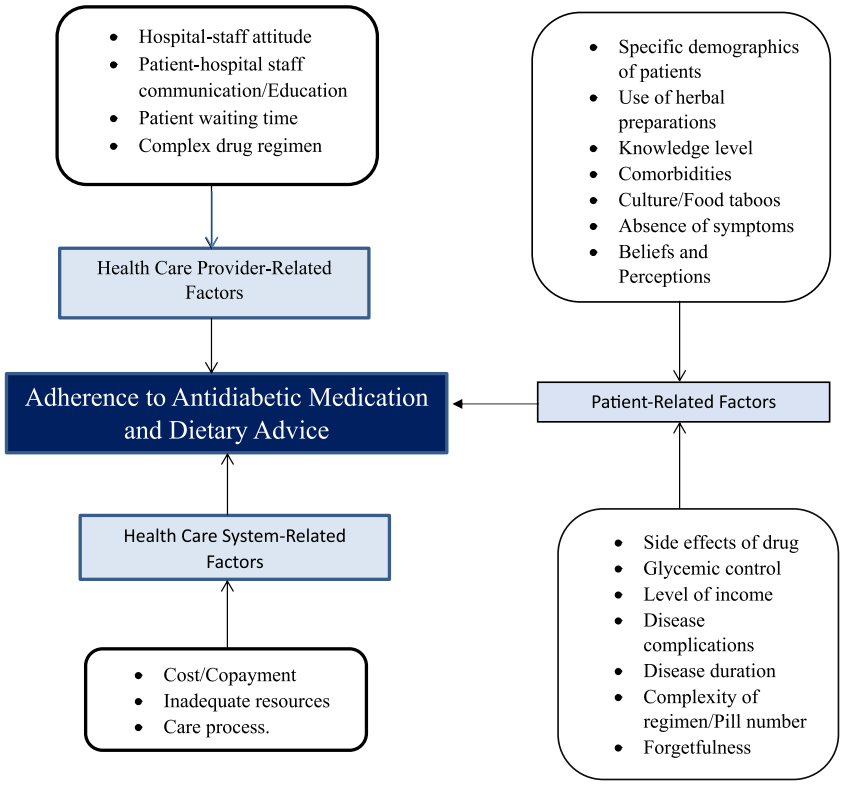

Figure 1. Conceptual framework on factors associated with adherence to antidiabetic medication and dietary advice.

intervention toward adherence behavior requires a collaborative effort.

Effect of Nonadherence to Medication and Dietary Recommendations on Patients' Disease Outcomes

Continuous treatment for T2DM is essential for preventing diabetes-related complications. Poor medication adherence makes achieving reasonable glycemic control difficult, which is believed to affect the onset of diabetic microangiopathy (retinopathy, nephropathy, and neuropathy) and increase the risk of diabetic complications.[38] An observation made during the data collection was that most of the patients who had uncontrolled blood sugar (HbA1c > 7%) were patients who did not adhere to their medication or dietary recommendations. Nonadherence to medication and dietary recommendations could contribute to increased cost of treatment and frequent hospitalization or hospital use. Several studies have shown a correlation between medication adherence and health outcomes, such as blood glucose and glycosylated hemoglobin levels, high tangible and nontangible treatment costs, and many physician visits among patients with T2DM.[39–42] Other studies reported a higher mortality rate among patients who do not adhere to their treatments (medication and dietary recommendations) than other patients.[43]

Some studies suggested the design and use of appropriate promotive family-based interventions using health promotion theories to ensure adherence to medication and dietary recommendations.[42] There should be continued education between the patient and the care team, which should align with disease progression.[44]

Limitations

The study involved only two district hospitals in the southern part of the Volta region that run specialist diabetes clinics. Adequate financial resources could have included more district hospitals to provide more comprehensive coverage (bigger sample size) or representation. Also, recall/response bias is likely to be a limitation because some of the participants may like to give responses to please the researcher. The study did not examine culture or religion as a possible influencing factor on adherence, measure quantities and serving sizes concerning their glycemic index effect, or measure factors contributing to good adherence. Also, the study did not compare the results of controlled and uncontrolled patients. Because the study has two outcomes (adherence and nonadherence) of focus, a binary logistic regression was used instead of a multiple regression analysis to examine the relationship between the dependent variable and independent variables. We recommend more comprehensive research in this area that will address the limitations of this study.

Recommendations

Noting that forgetfulness is a significant factor contributing to medication nonadherence, the health authorities must explore technologically inclined strategies to remind patients of the medication in the two hospitals and the southern part of the Volta region. A patient problem-centered approach, individual medication, and dietary adherence counseling must be routine and involve family or significant others. Significant others influence a patient's tendency to adopt health-protecting behavior underpinned by the theory of reason action. Most participants were married; their considerable others served as their support system in adhering to medication and dietary advice.

CONCLUSION

The self-reported patient-related factors that contributed to medication nonadherence among the participants were forgetfulness, difficulty remembering to take medication, and worry about long-term intake of drugs. After a multivariable logistic regression, forgetfulness and missing medicines were the most common factors contributing to nonadherence among the participants. These findings concern public health as they have a rippling effect on patient health outcomes. Most of the patients had uncontrolled blood sugar (HbA1c $>$ 7%), which can be linked to a low level of adherence. This predisposes them to diabetic complications, leading to hospital admissions and high hospital expenditure.

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