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Factors associated with disease knowledge and attitude among ambulatory patients with type 2 diabetes – a multicenter study

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Abstract

Background Diabetes is a multifactorial disease state that requires adequate patient monitoring for improved health outcomes. Diabetes knowledge and attitude, and associated factors such as medication adherence, medication discrepancy, health literacy, and glycemic control were evaluated in this study. The selected factors were also compared with diabetes knowledge and attitude.

Methods A cross-sectional study was carried out among ambulatory diabetes patients in three tertiary healthcare facilities in Nigeria. An interviewer-administered semi-structured questionnaire was utilized for data collection. Data was analysed using descriptive and inferential statistics with the level of significance set at $p < 0.05$.

Results A total of 188 diabetes patients participated in the study; 51 (27.1%) at the Federal Medical Center, Abeokuta, 69 (36.7%) at the University College Hospital, Ibadan, and 68 (36.2%) at the University of Ilorin Teaching Hospital, Ilorin. One hundred and twelve (59.6%) female patients participated in the study and patients' average age was 58.69 ± 13.68 years. Medication discrepancy was observed among 101 (53.7%) patients. One hundred and three (54.8%), 47 (25.0%) and 38 (20.2%) had high, medium, and low medication adherence, respectively. Ninety-one (48.4%) had high health literacy. Mean diabetes knowledge score was 14.64 ± 2.55 points out of a maximum obtainable score of 18 points. Mean diabetes attitude of patients was 62.50 ± 6.86 points out of a maximum obtainable score of 70 points. Significant positive association was observed between diabetes knowledge and health literacy (Beta = 0.021, $p = 0.029$). Diabetes knowledge was higher in patients with higher level of formal education ($p = 0.046$), higher diabetes attitude ($p < 0.001$) and high health literacy ($p = 0.002$). Patients' diabetes attitude was higher in individuals older than 60 years of age ($p = 0.029$), and those with high health literacy ($p = 0.005$).

Conclusions The diabetes patients displayed good disease knowledge, attitude and medication adherence. Average levels of health literacy and medication discrepancy was observed among the patients. Significant differences were observed between patients' diabetes knowledge and level of formal education, diabetes attitude, health literacy and age. Patients' health literacy was significantly associated with diabetes knowledge.

Keywords Diabetes, Health literacy, Medication adherence, Diabetes knowledge and attitude, Medication reconciliation, Medication discrepancy, Ambulatory care

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Introduction

Diabetes is a foremost reason for death and life expectancy reduction in humans [1–3]. It is also a key universal health concern which poses a heavy challenge to public health and socio-economic progress [4]. The prevalence of diabetes is on the increase, especially in low- and middle-income countries [5]. The worldwide burden of diabetes has soared recently, and this trend may continue [2].

Diabetes knowledge includes patients' understanding of risk factors, worsening factors and complications of diabetes while diabetes attitude involves patients' thoughts and behavior towards diabetes. There are lots of variables interfering with the management process of diabetes. Disease knowledge and attitude of diabetes patients have been found to impact their disease prognosis and quality of life [6–8]. Previous studies in Nigeria reported varying levels of disease knowledge and attitude among this cohort of patients. While a study in North-Western Nigeria reported good diabetes knowledge and attitude [9], another study carried out in the same zone reported a below-average diabetes knowledge and average diabetes attitude [10]. Also, a study in South-Southern Nigeria revealed poor disease knowledge and average attitude displayed by diabetes patients [11] while yet another study in South-Western Nigeria reported good knowledge and attitude among the diabetes patients [12].

Aside from diabetes knowledge and attitude assessment, it is important to evaluate other associated variables such as medication adherence, level of education and health literacy which may play vital roles in disease control. Adequate adherence to medication, diet and exercise are a *sine qua non* to effective disease control and improved therapeutic outcomes among diabetes patients [13]. Studies have shown a positive association between patients' level of formal education and diabetes management [9, 14].

Consistent medication adherence plays a major role in glycemic control and in improving health outcomes of patients [15]. Clifford and colleagues [16], in a systematic review, stated that self-report and medication possession ratio are two widely used methods of medication adherence assessment. Another review also reported that medication adherence was associated with better glycemic control, lesser visits to emergency departments, reduced hospitalisations, and reduced medical costs [17]. In addition, the review also identified that health training, point-of-care testing, pharmacists' involvement, case managers, and phone interventions were some of the factors which enhance patients' medication adherence.

Health literacy is an important factor for accessing healthcare and making informed health-related decisions [18]. Inadequate health literacy is related to poor health outcomes, inefficient access to healthcare services and inadequate understanding of health-related information [19]. Association between health literacy level and medication discrepancies were reported by previous studies [20]. High health literacy has been reported to increase glycemic control in diabetes patients [21].

However, there is dearth of literature on comparing disease knowledge and attitude among ambulatory type 2 diabetes patients and the related factors in Nigeria. Also, the interactions between the variables could have important implications for consideration by healthcare professionals. Therefore, this study assessed associations and comparison of diabetes knowledge and attitude with selected variables such as medication adherence, medication discrepancy, glycemic control and health literacy.

Methods

Study design, setting and participants

A cross-sectional study was carried out in three tertiary healthcare facilities in Nigeria. The study sites were the University College Hospital, Ibadan (950-bed healthcare facility), the University of Ilorin Teaching Hospital, Ilorin (650-bed healthcare facility), and the Federal Medical Center, Abeokuta (250-bed healthcare facility). These healthcare facilities are key referral centers and accredited for undergraduate and postgraduate education for pharmacists, physicians, physiotherapists, nurses, and other healthcare practitioners. Ambulatory diabetes patients above eighteen years of age who were on at least one medication for diabetes were recruited for the study. Patients who were unconscious, pregnant or did not give their consent were excluded from the study.

Sample size calculation was based on disease prevalence [22] which according to the International Diabetes Federation is 3.7% in Nigeria [23]. With 5% precision and 95% confidence interval, the minimum sample size for each study center was 55 patients, making 165 in total. 10% nonresponse rate was factored in to make a total of 188 patients.

Data collection tools

The diabetes knowledge and attitude assessment scales for patients were developed by the authors sequel to extensive literature search. The diabetes knowledge assessment scale is an 18-item scale with three options – "yes", "no" and "don't know". Each correct response was assigned "1" point while each incorrect response was assigned "0" point. The diabetes attitude assessment scale is a 14-item scale with a Likert response ranging from 'strongly disagree' to 'strongly agree'. The Likert responses were assigned one to five points based on the expected response to questions asked. Both scales were subjected to content validation by four faculties in the Department of Clinical Pharmacy and Pharmacy Administration, Faculty of Pharmacy, University of Ibadan.

Face validation was done by pretesting the scales among twenty ambulatory diabetes patients at Catholic Hospital, Oluyoro in Ibadan. Cronbach Alpha reliability test was conducted to ascertain the internal consistency of the knowledge and attitude scales. Cronbach alpha for diabetes knowledge and attitude assessment scales were 0.70 and 0.83, respectively. Each participant's scores for both scales were summed, converted to percentages, and categorized as follows: poor = 0–49.9%, fair = 50–69.9%, good = 70–89.9%, and excellent ≥ 90%.

The validated 18-item Short Assessment Health Literacy–English (SAHL-E) scale was utilised for patients' health literacy evaluation [24]. Patients with 0–14 points were categorized to have low health literacy and those with 15–18, high health literacy. Patients' self-reported medication adherence was evaluated using the validated 4-item Morisky, Levine, Green scale [25] used with permission from Professor Donald E. Morisky. Responses were coded "yes" and assigned a score of "0" while "no" was assigned a score of "1". High adherence was defined as a total score of zero, medium adherence as 1 and low adherence as > 1.

Medication reconciliation was carried out for the recruited patients. Information on whether or not they had their medication packs with them was noted. Medication discrepancies, defined as inconsistencies between prescribed medications, including the dosage regimen and the medications taken by the patients [26], were also documented. For the purpose of this study, geriatric patients were ≥ 60 years.

The semi-structured questionnaire was divided into five sections. Sections A was for sociodemographic data, while Sections B to E were for diabetes knowledge, diabetes attitude, health literacy and medication adherence assessments, respectively. The participants were approached while waiting to see their physicians on clinic days. The purpose of the study was explained to them before their informed consent was obtained. The questionnaire, which took about 20–30 min to complete, was then administered to the patients who were consecutively sampled. The questionnaire was translated to Yoruba language (the local language) for patients who did not understand English language.

Glycemic control was defined as a fasting blood glucose ranging from 70 to 130 mg/dL [27]. Fasting blood glucose value at the clinic on the day of clinic appointment was documented.

Data analysis

Data was analyzed using SPSS for Windows Version 20.0 (IBM Corp, New York, USA). Descriptive statistics was summarized with frequency counts, percentages, and mean ± standard deviation. Negatively worded questions were reversed during analysis.

Standard multiple regression analysis was carried out to assess associations between diabetes knowledge and attitude with gender, medication discrepancy, educational qualification, health literacy, age, glycemic control, and medication adherence. Independent-samples t-test evaluated the difference between means scores of patients' diabetes knowledge and attitude scores among categorical variables such as gender, health literacy, glycemic control and medication discrepancy. One-way analysis of variance compared patients' diabetes knowledge and attitude with level of formal education and medication adherence.

Results

A total of 188 diabetes patients, 51 (27.1%) at Federal Medical Center, Abeokuta, 69 (36.7%) University College Hospital, Ibadan, and 68 (36.2%) University of Ilorin Teaching Hospital, Ilorin participated in the study. There were 112 (59.6%) females who participated in the study. Mean age of the patients was 58.69 ± 13.68 years. Further details on participants' sociodemographic characteristics are shown in Table 1. Medication discrepancy was observed among 101 (53.7%) patients. Self-reported medication adherence of the participants showed that 103 (54.8%), 47 (25.0%) and 38 (20.2%) had high, medium and low medication adherence, respectively. Ninety-one (48.4%) were found to have high health literacy while 97 (51.6%) had low health literacy.

Majority, 167 (88.8%) knew that diabetes is not contagious. Only 52 (27.7%) knew that untreated diabetes does not lead to typhoid fever. One hundred and twenty-six (67.0%) knew that diabetes is incurable. Average diabetes knowledge score was 14.64 ± 2.55 out of a maximum obtainable score of 18. Majority of the patients, 91 (48.4%) and 61 (32.4%) had "good" and "excellent" diabetes knowledge score, respectively (Table 2). Eighty-five (45.2%) participants strongly disagreed with the statement that "It is not important to have a self-monitoring blood glucose meter". One hundred and sixty-nine (89.9%) believed strongly that taking their medications would make them live long. Majority, 53 (28.2%) and 126 (67.0%) had "good" and "excellent" attitude to diabetes, respectively. A mean score of 62.50 ± 6.86 out of a maximum obtainable score of 70 was obtained for diabetes attitude assessment (Table 3). Cronbach alpha for diabetes knowledge and attitude assessment scales were 0.70 and 0.83, respectively.

Participants' diabetes knowledge was higher among those with higher level of formal education ($p = 0.046$), higher diabetes attitude ($p < 0.001$) and high health literacy ($p = 0.002$). For diabetes attitude, individuals older than 60 years of age ($p = 0.029$), with higher diabetes knowledge ($p < 0.001$) and high health literacy ($p = 0.005$) had significantly higher values.were significantly different

Table 1 Sociodemographic and clinical characteristics of study participants

Variables		Frequency (%)
Gender	Female	112 (59.6)
	Male	76 (40.4)
Religion	Christianity	117 (62.2)
	Islam	71 (37.8)
Age distribution	18–29	5 (2.7)
	30–39	11 (5.9)
	40–49	31(16.5)
	50–59	44 (23.4)
	60–69	55 (29.3)
	70–79	30 (16.0)
	80–89	12 (6.4)
Age category	Adults (< 60 years)	91 (48.4)
	Geriatric (≥ 60 years)	97 (51.6)
Occupation	Business	59 (31.4)
	Retiree	55 (29.3)
	Civil servant	45 (23.9)
	Artisan	17 (9.0)
	Student	5 (2.7)
	Clergy	4 (2.1)
	Farmer	2 (1.1)
	Housewife	1 (0.5)
Level of formal education	None	24 (12.8)
	Primary	43 (22.8)
	Secondary	44 (23.4)
	Tertiary	77 (41.0)
Glycemic control	Controlled	116 (61.7)
	Uncontrolled	72 (38.3)
Medication adherence	Low	38 (20.2)
	Medium	47 (25.0)
	High	103 (54.8)
Medication discrepancy	Not observed	87 (46.3)
	Observed	101 (53.7)
Health literacy	Low	97 (51.6)
	High	91 (48.4)

Details on the comparisons between diabetes knowledge and attitude with some selected variables are given in Table 4. Significant positive association was observed between diabetes knowledge and health literacy (Beta = 0.021, $p = 0.029$) (Table 5).

Discussion

The study revealed significant associations between type 2 diabetes patients' diabetes knowledge and health literacy. Significant differences were observed between disease knowledge and educational level, disease attitude and health literacy, while disease attitude was significantly different when compared with age and disease knowledge. Disease knowledge, attitude, level of formal education, health literacy, patient's age, number of medications taken by patients, medication adherence, medication discrepancy, and glycemic control were all evaluated in this study. It is important to consider these variables during the management of diabetes patients to achieve better health outcomes.

Majority of the patients had good diabetes knowledge with only two having less than 50% knowledge score. While a study carried out in North-western Nigeria had a similar observation [9], on the contrary, other studies in North-Western [10], and South-Southern Nigeria [11] reported poor diabetes knowledge among diabetes patients. While patients' knowledge in the study is commendable, there is need for regular knowledge update. Also, another study in South-Western Nigeria reported good knowledge and attitude among the diabetes patients [12]. Many studies carried out in other developing nations such as Bangladesh, Ethiopia Mongolia and Zimbabwe observed inadequate knowledge of diabetes among patients [28–31]. Studies carried out in Bangladesh [32], and Sri Lanka [33] and the United Arab Emirates [34] however reported good diabetes knowledge

Table 2 Study patients' diabetes knowledge assessment

Questions	Correct response Frequency (%)
Someone can have diabetes by touching another person who has diabetes	167 (88.8)
Obesity can predispose (is a risk factor) to diabetes	120 (63.8)
Drinking alcohol regularly can reduce blood glucose level	175 (93.1)
Diabetes can be cured (that is, after some time, there will be no need to take drugs again)	126 (67.0)
Not taking drugs regularly can make diabetes worse	185 (98.4)
Diabetes patients should not eat foods rich in carbohydrate at all (e.g., bread, potato, rice, yam)	179 (95.2)
Diabetes patients should only take foods rich in protein (e.g., beans, meat, egg, milk)	178 (94.7)
It is only fat people that can have diabetes	170 (90.4)
Diabetes can be inherited from parents	131 (69.7)
Regular exercise helps to improve the state of health of a diabetes patient	184 (97.9)
People who eat lots of sugar will have diabetes	135 (71.8)
People who take carbonated (soft) drinks (e.g., Coke®, Fanta®, Maltina®, Mountain Dew®, Pepsi®) will have diabetes	138 (73.4)
If diabetes is not treated, it can lead to blindness	175 (93.1)
If diabetes is not treated, it can lead to kidney failure	174 (92.6)
If diabetes is not treated, it can lead to typhoid fever	52 (27.7)
Taking "bitters" (e.g., Alomo®, FIJK®, Ruzu®, Swedish® and Yoyo® bitters) helps to reduce blood glucose	127 (67.6)
Herbal preparations work better than the prescribed drugs to reduce blood glucose	161 (85.6)
Suspending/stopping the use of drugs occasionally is good because it helps to clean the body of the harmful effect of drugs	181 (96.3)
Diabetes knowledge score categories	
Poor (0–49.9%)	2 (1.1)
Fair (50–69.9%)	34 (18.1)
Good (70–89.9%)	91 (48.4)
Excellent (90–100%)	61 (32.4)

Table 3 Assessment of patients' attitude to diabetes

Questions	SD *n* (%)	DA *n* (%)	DK *n* (%)	AG *n* (%)	SA *n* (%)
I want to live long, so I take my drugs regularly	1(0.5)	0(0)	0(0)	18(9.6)	169(89.9)
It is not important to have a personal glucometer since I can check my blood glucose on hospital appointment days	85(45.2)	10(5.3)	0(0)	22(11.7)	71(37.8)
I always keep a personal record of my glucose readings	35(18.6)	25(13.3)	0(0)	25(13.3)	103(54.8)
Diabetes has reduced my dignity (self-worth); I am no longer who I used to be	81(43.1)	41(21.8)	0(0)	23(12.2)	43(22.9)
The medications for my disease are overwhelming; it is difficult to take it daily	74(39.4)	49(26.1)	0(0)	21(11.2)	44(23.4)
I am ashamed of this diabetes	74(39.4)	47(25.0)	0(0)	24(12.8)	43(22.9)
I stop taking my drugs whenever I get tired of taking it	78(41.5)	44(23.4)	0(0)	15(8.0)	51(27.1)
I really don't think that taking my drugs regularly will improve my health	76(40.4)	45(23.9)	0(0)	17(9.0)	50(26.6)
What will be will be, irrespective of how much I follow health practitioners' instructions about this diabetes	73(38.8)	47(25.0)	0(0)	10(5.3)	58(30.9)
I don't have to bother myself about regular exercise to improve my health	84(44.7)	39(20.7)	0(0)	21(11.2)	44(23.4)
I prefer to use herbal drugs rather than the prescribed drugs for my diabetes	78(41.5)	46(24.5)	1(0.5)	13(6.9)	50(26.6)
I take "bitters" (e.g., Alomo®, FIJK®, Ruzu®, Swedish® and Yoyo® bitters) to lower my blood glucose	78(41.5)	50(26.6)	0(0)	8(4.3)	52(27.7)
I take my "bitters" (e.g., Alomo®, FIJK®, Ruzu®, Swedish® and Yoyo® bitters) and my diabetes drugs	83(44.1)	45(23.9)	0(0)	8(4.3)	52(27.7)
I believe water therapy works better than drugs for my diabetes	87(46.3)	34(18.1)	0(0)	11(5.9)	56(29.8)
Diabetes attitude score categories					
Poor (0–49.9%)	2(1.1)				
Fair (50–69.9%)	7(3.7)				
Good (70–89.9%)	53(28.2)				
Excellent (90–100%)	126(67.0)				

SD = Strongly disagree, DA = Disagree, DK = Don't know, AG = Agree, SA = Strongly agree

Table 4 Comparison between patients' diabetes knowledge and attitude and some selected variables

	Knowledge			Attitude		
Variables	***N***	**Mean ± SD**	***p* value**	***N***	**Mean ± SD**	***p* value**
Age						
Adults (< 60 years)	91	14.71 ± 2.40	0.694[a]	91	61.37 ± 7.82	0.029 [a]*
Geriatrics (≥ 60 years)	97	14.57 ± 2.70		97	63.56 ± 5.65	
Medication adherence						
High	103	14.54 ± 2.66	0.612[b]	103	62.79 ± 6.62	0.683 [b]
Medium	47	14.96 ± 2.67		47	61.74 ± 6.30	
Low	38	14.50 ± 2.10		38	62.66 ± 8.16	
Level of formal education						
None	24	13.46 ± 2.48	0.046 [b]*	24	61.29 ± 5.70	0.589 [b]
Primary	43	14.65 ± 2.98		43	62.02 ± 7.58	
Secondary	44	14.45 ± 2.65		44	62.30 ± 6.64	
Tertiary	77	15.10 ± 2.14		77	63.26 ± 6.92	
Diabetes knowledge						
Poor	2	10.50 ± 0.71	< 0.001 [b]*	2	62.00 ± 4.24	< 0.001 [b]*
Fair	7	12.57 ± 2.07		34	57.74 ± 10.08	
Good	53	13.96 ± 2.81		91	62.92 ± 6.01	
Excellent	126	14.64 ± 2.55		61	64.54 ± 4.32	
Gender						
Female	112	14.58 ± 2.69	0.707 [a]	112	62.23 ± 6.97	0.517 [a]
Male	76	14.72 ± 2.35		76	62.89 ± 6.71	
Health literacy						
High	91	15.36 ± 2.05	0.002 [a]*	91	63.88 ± 5.54	0.005 [a]*
Low	97	13.84 ± 3.10		97	60.44 ± 7.40	
Medication discrepancy						
None	87	14.85 ± 2.37	0.291[a]	87	62.30 ± 8.17	0.718 [a]
Observed	101	14.46 ± 2.70		101	62.67 ± 5.52	
Glycemic control						
Controlled	115	14.64 ± 2.62	0.998[a]	115	62.50 ± 7.13	0.887[a]
Uncontrolled	73	14.64 ± 2.46		73	62.64 ± 6.40	

[a] Test statistics = Independent-samples t-test, [b] Test statistics = One-way analysis of variance,

* Statistically significant, SD = Standard deviation

Table 5 Regression analysis for diabetes knowledge and attitude and selected variables

Variables	**Diabetes knowledge**		**Diabetes attitude**	
	Beta	***p* value**	**Beta**	***p* value**
Medication discrepancy	0.034	0.804	-0.046	0.738
Glycemic control	-0.008	0.934	-0.056	0.561
Health literacy	0.210	0.029*	0.165	0.085
Gender	-0.002	0.984	-0.020	0.836
Educational level	0.095	0.348	0.083	0.414
Age	0.184	0.266	0.156	0.348
Medication adherence	0.318	0.857	-0.030	0.763

Test statistics: Standard multiple regression analysis

among majority of the patients. It is worthy to note that different diabetes knowledge assessment tools were used for these studies.

Dearth of effectively trained healthcare practitioners is a factor that might be responsible for the poor diabetes knowledge among the patients [10, 35]. Healthcare practitioners need to consistently educate patients on diabetes-related knowledge as it is vital in diabetes management [36]. In the study setting, diabetes patients are jointly educated by nurses on each clinic appointment before their appointment with the physicians. The ambulatory diabetes patients also have association in each hospital, where they come together monthly for peer group discussion. Peer support has been found to aid learning and adaptations for self-management among diabetes patients [37, 38], thereby complementing information

provided by the physicians on self-management of the disease.

Interestingly, two thirds of the participants believed that taking "bitters" such as Swedish bitters helps to reduce blood sugar. There is a general belief that bitters could be good for elevated blood sugar level. A study carried out in India and another in Saudi Arabis reported the misconception among diabetes patients [39, 40]. Some diabetes patients may rely on these preparations instead of adequately adhering to the prescribed medications thereby worsening their disease condition. Also, about 15% believed that herbal remedies were more effective than prescribed medications at managing blood glucose level. It will not be a surprise if this 15% abandon their medications for herbal remedies. Consumption of herbal remedies could lead to diabetic kidney disease which in turn could affect glycemic control [41].

With a third of the study participants not knowing that diabetes is incurable, and that they will have to be on medications indefinitely, the need for improved patient education becomes glaring. Patients need to be educated on the fact that they will be on medications indefinitely. Some patients have been known to stop their medications once they feel better [42, 43] and stopping the medications could predispose to developing complications of diabetes.

Some of the participants were not aware that obesity is a risk factor for diabetes. For diabetes, adequate adherence to exercise, diet and medications is required for improved patient outcomes. Obesity causes insulin resistance [44] and there is need for patients to be aware of it. Also, some of the participants were not aware that diabetes could be genetic, and this may expose their offspring to higher risks. Such children could be educated by their parents to minimize their risks for type 2 diabetes.

On the other hand, almost of the participants were knowledgeable about diet requirement and exercise. Although, such knowledge of such health benefits does not guarantee adherence to the practice, it places the patient at a good vantage. Many of the patients were also aware of the complications of diabetes such as blindness and kidney disease. However, some of them believed that diabetes could lead to typhoid fever.

Level of formal education, diabetes attitude and health literacy were associated with diabetes knowledge in this study. As expected, patients with high health literacy, better diabetes attitude, as well as those with higher formal educational qualification had better diabetes knowledge. Level of formal education was significantly associated with diabetes knowledge and attitude [11]. A related study in Netherland observed a significant association between poor diabetes knowledge and attitude [45]. Herath and colleagues in Sri Lanka [33], Gautam and colleagues in Nepal, Salem and colleagues in Riyadh, and Phoosuwan and colleagues in Thailand observed better diabetes knowledge among patients with higher educational level [46–48].

Average health literacy was observed among the patients. Level of formal education was significantly different with health literacy level. Teach back technique is a method that would help to simplify communications, where patients are asked to explain what they were told by healthcare practitioners in their own words [49]. It helps to address low health literacy.

Majority of patients displayed good attitude towards diabetes. This is similar to the study by Sadiq et al. in North-Western Nigeria [9], but unlike what was reported among diabetes patients in North-western Nigeria where poor attitude was reported [10]. Diabetes attitude was found to be poor among majority of patients in a study carried out in Sri Lanka [33], and average in Palestine [50]. While majority of the diabetes patients displayed excellent attitude in this study, it is needful to keep educating them in order to encourage positive attitudes and not resign to fate or other alternative practices.

There was no significant association observed in this study between diabetes knowledge and medication adherence. A cross-sectional studied carried out among diabetes patients also reported no significant association between diabetes knowledge and medication adherence [51]. High medication adherence was observed among majority of the patients. Medication adherence was not found to be significantly different when compared with age, educational level, diabetes knowledge or attitude. Even though polypharmacy, due to comorbidities, is a risk for poor medication adherence, the present study and a similar study [52] showed that medication adherence for diabetes patients does not decline with increase in medications taken.

Glycemic control had no significant association with diabetes knowledge and attitude in this study. Another study carried out in Enugu State, Nigeria also found no significant association between diabetes attitude and glycemic control but found a significant association between diabetes knowledge and glycemic control [53]. Glycemic control was significantly different with patients' age, medication adherence and level of formal education. Geriatric patients are more likely to have comorbidities that could impact on their glycemic control. However, the geriatric patients in this study showed a significantly better attitude to diabetes which could explain their better glycemic control, despite the likelihood of comorbidities. Similar studies also reported that glycemic control was associated with formal education and medication adherence [54, 55]. However, a study by Al-Rasheedi found no association between glycemic control and level of educational qualification [56].

A major limitation to this study was that glycemic control was assessed using fasting blood glucose instead of glycated hemoglobin (HbA1c) which is the gold standard. Also, data on level of income and duration of diabetes were not included in the study.

Conclusion

The diabetes patients displayed good disease knowledge and attitude. Level of health literacy and medication discrepancy was average among the patients, while a high proportion showed high medication adherence. Patients' health literacy was significantly positively associated with diabetes knowledge. The determinants of diabetes knowledge are level of formal education, diabetes attitude, health literacy, and age; while the determinants of diabetes attitude are health literacy, age and diabetes knowledge.

While the patients displayed good disease knowledge and attitude, it is important to ensure that this does not decline. The average level of health literacy should be put into consideration when passing medical information to the patients so as to ensure that they are able to appropriately interpret and comprehend the instructions.

Abbreviations

SAHL-E Short Assessment Health Literacy–English
SPSS Statistical Package for Social Sciences

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Author contributions

Dr. Akinniyi A. Aje: Principal investigator and corresponding author. Contributions: Study design, data collection and analysis, manuscript writing. Professor Titilayo O. Fakeye: Study design, manuscript review.

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Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Approval for the study was granted by the Federal Medical Center, Abeokuta Health Research Ethics Committee (FMCA/470/HREC/06/2014), the University of Ilorin Teaching Hospital Ethics Research Committee (ERC/PAN/2018/08/1814) and the joint University of Ibadan/University College Hospital Health Research and Ethics Committee (UI/EC/15/0308). The study was explained to the type 2 diabetes patients. Informed consent to participate was obtained from the participants included in this study. Only those who gave informed consent were recruited for this study. The research was carried out in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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