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MEDICATION ADHERENCE AND ITS DETERMINANTS AMONG PATIENTS WITH TYPE-2 DIABETES ATTENDING UNIVERSITY OF PORT HARCOURT TEACHING HOSPITAL

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ABSTRACT

Introduction: The study ascertains the prevalence of medication adherence and its determinant among patients with type 2 diabetes attending University Teaching Hospital Diabetic Clinic. **Method:** Questionnaire method was used. The study population includes diabetic patients that attend University of Port Harcourt Diabetic Clinic. Correlation design was employed. Four research questions were answered and hypotheses were tested in the study at 0.05 level of significance. Instrument for data collection is the Morisky medical adherence scale. The data obtained was analyzed using descriptive statistic of frequency count, and percentage proportions while non parametric statistics of chi square and Kendull tau-b correlation were utilized for test of significance at 0.05 alpha levels. All procedure was approved by University of Port Harcourt Ethics Committee and the researcher followed Covid-19 infection prevention protocol**. Results:** The findings of the study showed that a high level of medication adherence 57 (48.7%) was found among the patients, cost of medication was statistically significance (fb= -0.330, p = 0.000) found to be one barrier to medication adherence among the study group. 72 out of 117 (61.5%) of the patients have a high level of HbA1c. **Conclusion:** The study recommends establishments of counseling unit for diabetic patient, development of a follow up strategy to help them adhere to their medication. Alternative treatments like food low in carbohydrates and fats but rich in vitamins are modern day healthy options for management of T2DM

KEYWORDS: Medication Adherence, Type-2 Diabetes, Patients, University of Port Harcourt Teaching Hospital.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by a high blood glucose concentration (hyperglycemia/fasting plasma glucose) of >7.0mmol/1 or plasma glucose >11.1mmol/12hour after meal) – caused by insufficient insulin or unresponsive cells to insulin or an outright insulin deficiency.[1]

Hyperglycemia occurs because of uncontrolled hepatic glucose output and reduced uptake of glucose by skeletal muscle with reduced glycogen synthesis. When the renal threshold for glucose reabsorption is exceeded, glucose spills over into the urine (glycosuria) and causes an osmotic diuresis (polyuria) which in turn, results in dehydration and increase drinking (polydipsia). Diabetes mellitus affect both young and older individual in developing countries such as Nigeria. People living with type-2 diabetes are more vulnerable to varied forms of both short and long-term complications which often lead to their premature depth. It leads to increased morbidity and mortality in patients with type-2 diabetes and because of the commonness of this type of diabetes, its insidious onset and late recognition result in patients' vulnerability, especially in a developing country like Nigeria.[2] Adherence is a major challenge with anti-diabetic medication treatment. The complexity of treatment is affected by the nature of treatment, cost of medication and side effects.[3,4] Adhering to medication is one of the ways in which patients will be able to manage their illnesses. Many patients with chronic illness find it difficult to follow recommended treatment; therefore compliance to long term treatment averages 50%.[5] This study seeks to examine the prevalence of medication adherence and its determinant among patient

with type-2 diabetes or there is a need to investigate the health risk of diabetes in patient with type-2 diabetes.

METHODOLOGY

Study Area: This study was carried out in University of Port Harcourt Teaching Hospital, Port Harcourt, Rivers State, Nigeria.

Experimental Design: In this study for determining the prevalence of medication adherence and its determinants among type 2 diabetes, questionnaire method was used. The study population includes diabetic patients that visited diabetic clinic of University of Port Harcourt Teaching Hospital, Port Harcourt, Rivers State of South-South Nigeria.

Inclusion Criteria

1. Patient must have been on drug treatment for at least 6 months.
2. Newly diagnosed type 2 diabetic patient
3. Patients aged 18 and above with ability to give informed consent

Exclusion Criteria

Subject with deformities of the theoretic cage vertebral column, gross anaemia, malignancy drug addicts were excluded.

1. In patients
2. Inability to give consent
3. On non-prescription medication or herbal remedies

Sampling Method and Sample Size: One hundred and ninety patients visited the clinic over a period of about 12 weeks. A total of 140 diabetic patients were used in the study.

Experimental Procedures

On each clinic days, patients were randomly selected from the total population of patients that visited the Diabetes Centre. The importance of the study was explained to them and their consent to participate in the study was sought and given. All basic covid-19 protocols were followed.

Instrument for Medical Adherence

Questionnaires were administered to some of them and to a larger number, the question were read out to them and filled. The instrument for data collection is the Morisky Medical Adherence Scale (MMAS) which is used to measure the level of non-adherence (low adherence) to medication.[6] The following scoring and interpretation method was adopted as recommended by the scale developer. Response choices are "YES" or "NO" for items 1 through 7 and item 8 has a five-point Likert response scale. Each "NO" response is rated as 1 and each "YES" response is rated as 0 except for item 5, in which each "YES" response is rated as 1 and each "NO" response is rated as 0. For item 8, the code (0-4) has to be standardized by dividing the result by 4 to calculate a summated score. Total scores on the MMAS-8 range from 0 to 8, with scores of 8 reflecting high adherence, 7 or 6 reflecting medium adherence, and <6 reflecting low adherence.[7]

Principles of Procedure for HbA1c Test

The Clover Alc® self system is a fully automated boronate affinity assay for the determination of the percentage of Hemoglobin Alc (HbAIc %) in whole blood. The test cartridge is composed of a cartridge and a reagent pack containing the reagents necessary for the determination of haemoglobin A1c, with a sample collecting area for blood sample collection. The reagent pack is pre-filled with reaction solution and washing solution. The reaction solution contains agents that lyses erythrocytes and bind haemoglobin specifically, as well as a boronate resin that binds cis-diols of glycated hemoglobin. The blood sample (4uL) is collected at the sample collecting area of the reagent pack, then the reagent pack is inserted into the cartridge, where the blood is instantly lysed releasing the hemoglobin and the boronate resin binding the glycated hemoglobin. The reagent pack containing the blood sample is inserted in CLOVER ALc® Self Analyzer (in which the cartridge has been placed). The cartridge is automatically rotated, placing the blood sample in the measuring zone. The total hemoglobin is photometrical measured by the diffused reflectance of the optical sensor composed of both a LED (Light Emitting Diode) and a PD (Photo Diode). Then, assembled cartridges are rotated and the rinsing solution washes out non-glycated hemoglobin from the blood sample, enabling photometrical measurement of glycated haemoglobin. The ratio of glycated Hemoglobin and total hemoglobin is calculated.

$$HbA1c\% = A\ x\ \left[\frac{HbA1c}{Total\ Hemoglobin} x100\right] + B$$

Apparatus Used for HbA1C Test

- CLOVER A1c® Test-Analyser
- CLOVER A1c® Test cartridge
- Gloves
- Syringes or lancet
- Catton balls
- Lancing devices
- Methylated spirit

HbA1C Test Procedure

Blood Sample: The capillary blood taken from a fingertip or venous blood collected in a tube with K2–K3 EDTA, lithium heparin, sodium citrate or sodium fluoride/oxalate as anticoagulants can be used for the CLOVER Alc® Self test.

Step 1:	When the power is connected, the display shows 'Warming Up' until the device is ready for test.
Step 2:	When 'open the lid' is shown in stand-by mode, open the lid.
Step 3:	Tear the pouch open on the side with serrated edge.
Step 4:	Gently insert the cartridge into the cartridge compartment when 'Insert Test Cartridge' is shown.
Step 5:	The display will show the 'Apply sample to sample area' and 'insert Reagent Pack'
Step 5.1:	Gently mix the reagent pack 5-6 times before applying blood sample.
Step 5.2:	Apply the blood sample at the sampling area by carefully touching the blood drop. Ensure the sampling area is completely filled.

Sample Collection and Handling: Capillary whole blood from fingertip and venous whole blood can be used for HbA1c testing. A 4µL blood sample is needed.

Use of Capillary Blood: Puncture the fingertip to get minimum 4µL of capillary blood, touch the blood sample with the capillary tip of the Reagent Pack (sampling area). The blood is automatically drawn up. Ensure that the sampling area is completely filled.

Used of Venous Blood: Venous whole blood collected in tubes with K2 – K3 EDTA lithium heparin, sodium citrate or sodium fluoride/oxalate as anticoagulants can be used.

Venous whole blood can be stored at 2-8^{0}C for 7 days with unbroken seal (only 3 days when seal is broken) and at 20-25^{0}C for 3 days.

Allow blood samples to reach room temperature. Anti-coagulated blood should be mixed well prior to testing. Remove the stopper from the holder and take out a drop of blood sample on a clean container. Softly touch the sampling area of the reagent pack on the blood sample, and wait until the sampling area is completely filled.

Step 6: Insert the reagent pack into the cartridge compartment of the analyzer. The 'Close the lid' is shown.
Step 7: The test starts automatically when the lid is closed.
Step 8: The measuring time is 5 minutes and the test result will be displayed (in % or mmol/mol).
Step 9: After the test is completed, open the analyzer lid. 'Remove cartridge' will be shown. Remove the test cartridge from the analyzer by gently pushing it to the left and pulling it out.

Samples were taken from HbA1c assay and clover Alc® Self Test Cartridge was used to analyze the sample. Anthropometric data such as weight, height, waist circumference were also taken.

Method of Data Analysis
The results were computed statistically using Statistical Package of Social Science (SPSS) software version 23. Data were analysed using descriptive statistics of frequency counts and percentages proportions while, non-parametric statistics of chi-square and Kendall tau-b correlation were utilized for test of significance at 0.05 alpha level.

Ethical Approval: This study was approved by the ethical review committee of the University of Port Harcourt Teaching Hospital UPTH (UPTH (UPTH/ADM/90/S.II/Vol XI/1260); and University of Port Harcourt (UPH/CEREMAD/REC/MM71/001)

RESULTS

Research Question one: What is the Socio-Demography of Patients with type 2 diabetes attending University of Port Harcourt Teaching Hospital diabetic clinic?.

The table below highlights the socio-demographic characteristics of patients with type 2 diabetes attending University of Port Harcourt Teaching Hospital diabetic clinic. As such the following characteristics are highlighted below; Age, sex, occupation, marital status, literacy and family history.

Table 1: Presentation of Demographic data of the Participants.

Age	**Frequency**	**Percent (%)**
25-34	15	12.8
35-44yrs	24	20.5
24-54yrs	27	23.1
55yrs and above	51	43.6
Total	**117**	**100.0**
Sex	**Frequency**	**Percent (%)**
Male	52	41.0
Female	65	51.3
Total	**117**	**100.0**
Occupation	**Frequency**	**Percent (%)**
Student	6	5.1
Unemployed	30	25.6

Government employed	27	23.1
Self-employed	36	30.7
Private employed	17	14.5
Total	**117**	**100**.0
Marital Status	**Frequency**	**Percent (%)**
Single	9	7.7
Married	102	87.2
Divorced	3	2.6
Widow/Widower	3	2.6
Total	**117**	**100.0**
Literacy	**Frequency**	**Percent (%)**
Unable to read &Write	21	18.0
Able to read &Write	96	82.0
Total	**117**	**100.0**
Family History	**Frequency**	**Percent (%)**
Yes	69	59.0
No	48	41.0
Total	**117**	**100.0**

However, further analysis was carried out to determine the association between medical adherence and socio-demography. The result is shown in Table 2 below.

Table 2: Correlation between socio-demography and Medication Adherence in patients.

			MMAS	Age	Gender	Literacy	Occupation
Kendall's tau-b	MMAS	Correlation Coefficient	1.000	-0.006	-0.016	-0.113	-0.044
		Sig. (2-tailed)	-	0.941	0.854	0.205	0.595
		N	117	117	117	117	114

**. Correlation is significant at the 0.01 level (2-tailed). While P (sig 2-tailed) less than 0.05 is not significant

Kendall's tau-b correlation was run to determine the relationship between demography and Medication Adherence amongst 117 participants. The result showed that there was no significant correlation between socio-demography (age, gender, occupation and literacy) and Medication Adherence.

Research Question Two: What percentage of patients with type 2 diabetes attending University of Port Harcourt Teaching Hospital diabetic clinic are non-adherent?

To answer this research question, frequency counts and percentages was employed. To answer the research question on the level of non-adherence (low adherence) to medication, the following scoring and interpretation method was adopted as recommended by the scale developer.[6] The interpretation was given thus;
Low adherence (Non-adherence) – below 6
Moderate Adherence (Adherent) – between 6 to 7
High Adherence (Adherent) – 8

Table 3: Level of adherence to Medication among Patients.

Level of Adherence	Frequency	Percent (%)
Low	45	38.5
Moderate	57	48.7
High	15	12.8
Total	**117**	**100.0**

The above result revealed that 38.5% of patients had low adherence (non-adherent), 48.7% showed moderate adherence (poor adherence) and 12.8% showed high adherence to medication among patients attending University of Port Harcourt Teaching Hospital diabetic clinic. The result showed an overwhelming evidence of poor adherence (87.2%).

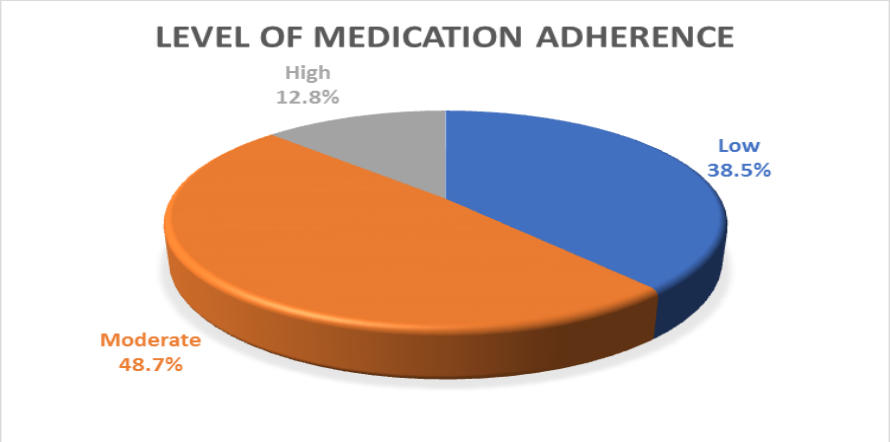

Figure 1: Showing Level of Medical Adherence.

Research Question Three: What type of non-adherence to medication is prevalent among patients attending University of Port Harcourt Teaching Hospital diabetic clinic?.

To answer this research question, frequency counts and percentages was employed.

Table 4: Percentage of Intentional non-adherent patients.

S/N	Intentional Non-Adherence	Yes	%	No	%	Decision
1	Fear of taking drug	3	2.6	114	97.4	Reject
2	Inconvenience in taking it outside home	30	25.6	87	74.4	Reject
3	Fear of taking too many drugs	27	23.1	90	76.9	Reject
4	Busy studying	18	15.4	99	84.6	Reject
5	Unpleasant taste	15	12.8	102	87.2	Reject
6	Problematic side effects	15	15.4	102	87.2	Reject
7	Malingering (pretending to be sick or pretending to be well	18	12.8	99	84.6	Reject
8	Unavailability of health worker in clinic bay	15	15.4	102	87.2	Reject
S/N	**Unintentional Non-Adherence**	**Yes**	**%**	**No**	**%**	**Decision**
1	Forgetfulness	30	25.6	87	74.4	Reject
2	Cost	51	43.6	66	56.4	**Accept**
3	Unavailability of prescribed drugs	33	28.3	84	71.8	Reject
4	Unavailability of nearby pharmacy	21	17.9	96	82.1	Reject

The results from Table 3 showed the types of non-adherence to medication prevalent among patients attending University of Port Harcourt Teaching Hospital diabetic clinic. There are two types of non-adherence covered in this study, namely- *intentional* and *unintentional* non-adherence. Thus, the result affirmed that only cost (an unintentional) was the likely barrier to adherence among patients used in this study. However, further analysis was carried out to determine the association between medical adherence and cost of treatment. The result is shown in Table 5 below.

Table 5a: Correlation between Cost of treatment and Medication Adherence in patients.

			Medical Adherence
Kendall's tau-b	Cost of treatment	Corr. Coefficient	**-0.330****
		Sig. (2-tailed)	.000
		N	117

*. Correlation is significant at the 0.05 level (2-tailed).

Kendall's tau-b correlation was run to determine the relationship between cost of treatment and Medication Adherence amongst 117 participants. There is a negative association between cost of treatment and Medication Adherence, which was statistically significant ($\tau b = -0.330$, $p = 0.000$). This implies that the level of medical adherence is negatively associated with cost of treatment. As such patients who affirmed that cost of treatment is a barrier had low adherence to medication (because they could not afford or maintain their routine medication) whereas patients who did not see cost as a barrier had high adherence to medication (as the drugs where affordable and available for use). More so, the above

claim is better proven using a chi-square 3 by 2 contingency table.

Table 5b: Relationship between Cost of treatment and Medication Adherence in patients.

			Cost of treatment		Total
			NO	YES	
Medical Adherence	Low	Count	18	27	45
		% within Cost of treatment	27.3%	52.9%	
	Moderate	Count	33	24	57
		% within Cost of treatment	50.0%	47.1%	
	High	Count	**15**	0	15
		% within Cost of treatment	22.7%	0.0%	
Total		**Count**	**66**	**51**	**117**
			56.4%	43.6%	100%

X^2 (2) = 16.57, P> .001, **Significant**

Research Question Four: What is the correlation between HbA1c result and Medication Adherence in patients with type 2 diabetes attending University of Port Harcourt Teaching Hospital diabetic clinic?.

Kendall's τ correlation was used to measure the association betweenHbA1c result and Medication Adherence in patients; this is because the variables were in an ordinal scale of measurement.

Table 6: Correlation between HbA1c and Medication Adherence in patients.

			Medical Adherence
Kendall's tau_b	HBA1C	Corr. Coefficient	**-0.222***
		Sig. (2-tailed)	0.016
		N	117

*. Correlation is significant at the 0.05 level (2-tailed).

Table 7: HBA1C Result.

Level	Frequency	Percent
Normal	45	38.5
Abnormal	72	61.5
Total	117	100.0

Kendall's tau-b correlation was run to determine the relationship between HbA1c and Medication Adherence amongst 117 participants. There was a low negative correlation between HbA1c and Medication Adherence, which was statistically significant (τb = -0.222, p = 0.016). This implies that the higher the level of medical adherence by type 2 diabetes patients the lower their HBA1C result.

Hypothesis Testing

Hypothesis 1: The result showed that there was no significant correlation between socio demographic (age, gender, occupation and literacy and medication adherence).

Hypothesis 2: The result showed as overwhelming evidence of medication adherence.

Hypothesis 3: The result affirmed that only cost (unintentional was likely a barrier to adherence among patients used in this study.

Hypothesis 4: There was a low negative correlation between HbA1C and medication which was statistically significant (tb= -0.222, p = 0.016).

DISCUSSION

The respondents' age range is between 15 and above 55 years. The majority 51(43.6%) of the patients were in 55years and above, but there were fewer respondents 15 (12.8%) within the 25 to 34years range. Diabetes is one disease that people come down with as they progress in age. However, these days it is becoming common to see young people being diagnosed with diabetes. 65 (51.3%) were females while 52 (41.2%) were male, so there was more female who suffered from diabetes in the study group. Mirghani.[8] study found 70.6% of women with type 2 diabetes Other researchers have found more females with type two diabetes mellitus patients than males.[9,10] However, other studies found otherwise.[11,12]

There were more than 36 (30.7%) of the respondents who were self-employed than any other occupation and out of the 117 sampled patients, 102 (87.2%) were married. The majority 96 (82%) of them were literate-able to read and write. Also from the findings, 69 (59.0%) of the patients who participated in the study had a family history of type two diabetes mellitus suggesting that people who had relatives that suffered or are

suffering from diabetes are more likely to suffer the disease than people who do not.

On the test of hypothesis, no significant correlation was found between socio-demography (age, gender, occupation, and literacy) and Medication Adherence. Mirghani's.[8] findings compare well with this one. He reported no significant differences among diabetes patients on medication adherence based on demographics such as gender, occupation, educational level, and financial problems (income), except for age where the younger patients were less adherent compared to the older patients. Likewise, Olufunsho *et al*.[13] found no statistically significant difference based on the educational levels of patients. This result does not align with the findings of Kirkam.[14] who reported medication adherence to be associated with higher education, male sex, older patients, and occupations with higher income earners. Olufunsho *et al*.[13] findings revealed that medication adherence differed based on the age and gender of patients. Adnan *et al.*,[15] found a significant difference in gender as male patients were fewer adherents to medication than their female counterparts.

This result is against the researcher's expectations. One would expect that at least literacy and age will correlate with medication adherence. Chances are highly literate has more information compared to another who is not. This, however, depends on the educational qualifications of the individual. Shakya *et al*.[16] found a positive association between formal education and medication adherence 2.4 (95% CI: 1.34, 4.39). Fatima *et al*.[17] findings showed that medication adherence increased with educational levels. David *et al*.[18] also found that medication adherence among patients differed based on their educational status.

This result may be very true given that literacy (ability to read and write) is not the same as health literacy. One study found a significant difference among four clusters of health literacy levels with medication adherence based on self-efficacy, concern beliefs, and perceived barriers.[10] The point is, health literacy does not automatically translate to medication adherence. Rather, with other barriers such as belief and self-efficacy been a positive level of adherence tends to increase when health literacy is high. Fatima *et al*.[17] opined that adherence significantly increased with patients' belief of efficacy and drug compliance. This implies that patients must believe a given medication works and that he or she has the personal ability to duly follow a given treatment regimen and with the right support before he or she can adhere very well to medication. This is not only true for drug medications but other therapy as well.

The findings of this research do not also agree with Opara.[9] who found that age is associated with medication adherence ($p = 0.006$, CI: 0.025-0.544). For the obvious reason that people become more responsible as they grow older (not the very old people who have reached their peak in life and are beginning to retard), the same should apply to medication adherence. Younger patients would tend to be a little careless about their medication with the mentality that they can handle the conditions their way. They may even fall into the trap of thinking that drug therapy is cagey or even living in denial of the disease. Middle-aged patients are expected to be more adherent as they are more likely to have more responsibility- more persons to live and care for. Hence, they would take their health seriously.

From the result presented in table 3 the level of medication adherence among the respondents was low (87.2%). Although this shows that the majority of the patients adhered to their medication, this is not a very encouraging result as only 15 (12.8%) had a high level of adherence, 57 (48.7%) of them adhered moderately while 45 (38.5%) had a low level of adherence to their medication. Comparing the number of respondents who had moderate adherence and low adherence levels, it is clear that there is not much difference. The findings of 87.2% level of adherence compare well with findings from other studies done in Nigeria by Adisa *et al*.[19] in southern Nigeria - 60% and Opara.[9] at UNTH Enugu - 57.5%, and the 69% by Kirkam *et al*.[14] and 60.9% by Shakya *et al*.[16] studies done outside Nigeria. A study in Eastern Nigeria reported 50% of medication adherence among type 2 diabetes patients (David *et al*. 2019). In contrast to the above high level of medication adherence the findings of Garcia-Perez *et al*.,[20] Mirghani,[8] Huang and Shiyanbola,[10] Adnan *et al.*,[15] and Mishra *et al*.[12] where the low level of medication adherence of less than 50%, 43.4%, 37.3%, 46.3%, and 44% respectively among patients with type 2 diabetes mellitus. The mixed-method employed in these studies may have contributed to the difference in the result.

What this implies is that majority of the type 2 diabetes patients attending the University of Port Harcourt Teaching Hospital diabetes clinic are well aware of what adhering or not adhering to their medication will result in. However, the fewer number of persons with high levels of adherence to medication calls redoubling of effort by physicians, other health caregivers, and health counselors of diabetes patients to increase compliance to drug medications. Further, the difference in findings with other studies calls for a more robust method of researching into the issue of medication adherence such as using questionnaires alongside interviews and group discussions to reduce response faking and increase reliability. Furthermore, better monitoring or follow-up plan of patients is also implied given that nearly half 48.11% of the patients who did not report high adherence had low adherence to their medication.

The type of non-adherence to medication that seemed to be prevalent among the respondents was unintentional non-adherence. Cost of medication is the only item (factor) that was accepted by the respondents as a cause of non-adherence to medication. Adisa *et al*.[19] also

found financial constraints (34.4%) as a barrier to optimal medication adherence among patients with type 2 diabetes. Garcia-Perez *et al*.[20] and Kirkam *et al*.[14] also reported in their study findings that the cost of medication is one of the main barriers to medication adherence. There was a negative association found between the cost of treatment and Medication Adherence, which was statistically significant (τb = -.330, p = .000).

Among the respondents, cost of medication is seen as a likely barrier to medication adherence- 27 (52.9%) of 45 of who had poor adherence to medication and 24 (47.1%) of 57 who had moderate adherence to their medications in the correlation result shown in table 5b agreed that cost of medication is a major factor leading to non-adherence to the medication of diabetes. In a similar study carried out in Lagos, Nigeria by Olufunsho *et al*.[13] 51.32% of patients with type 2 diabetes patients agreed that the high cost of medication was a major barrier to medication adherence. This is right because the cost of diabetes medication is not cheap. The high cost of the drugs has a serious economic impact on the patients especially for low-income earners and for the unemployed. Nigeria is a developing country and in southern Nigeria where the study was carried out the cost of living is high and many live below the poverty line. Not many can afford good meals. Why buy drugs when there is no food. It will be best to spend the little available income on food than to spend it on medication that does not guarantee a cure for the disease but only a management strategy.

The negative association between cost of treatment and Medication Adherence, which was statistically significant (τb = -0.330, p = 0.000) implies that the level of medication adherence is negatively associated with the cost of treatment. As such patients who affirmed that cost of treatment is a barrier had low medication adherence (because they could not afford or maintain their routine medication) whereas patients who did not see cost as a barrier had high adherence to medication (for them the drugs are affordable and available for use).

Almost 26% of the respondents' in this current study were unemployed and a study by Jaja *et al*.[21] demonstrated that Health facility preference was mostly for good treatment outcome and accessibility; cost was also a cardinal reason for the lower class individual not to routinely attend for health care need. What this means is that if the drugs are cheap and effective, the patients may adhere more to their medications. These findings may have implications for diabetes interventions in form of funding (whether fully funded or subsidized funding) and distribution of diabetic drugs by both governments' agencies and non-governmental organizations. Also sourcing for materials locally for possible production of diabetes drugs within will make drugs cheaper and more available. Most patients try to afford the drugs at the initial stage of treatment but are not able to sustain them. Therefore, other diabetes management strategies especially lifestyle modifications should be seriously emphasized in such areas where most people cannot afford the drugs. This will be more comprehensive and effective. While there may be pharmacological therapies out there, scholars should not be detracted from adopting new options that will mitigate T2DM prevalence noting that prevention is most cost effective especially in our low socioeconomic environment like ours and the very high predicted rise in the burden of T2DM in our developing world.[22]

From the result in table 6, 45 (38.5%) of the respondents had a normal level of HbA1c while a majority of them 72 (61.5%) had abnormal HbA1c levels. The result of the correlation between HbA1c and medication adherence in patients in table 6 showed a low negative correlation. Although this was low, the result was significant (τb = -0.222, p = 0.016) meaning that those who had higher medication adherence were more likely to control their blood sugar level better than those with lower adherence levels. This corresponds with the findings of Huang and Shiyanbola.[10] who reported a positive association of HbA1c with better medication adherence (r = 0.324 at p<0.001) and Adisa *et al*.[19] who found lower fasting blood glucose levels of more adherent patients when compared to their non-adherent counterparts (137.09 mg/dL for adherents versus 143.92mg/dL for non-adherents). Aloudah *et al*. (2018) also reported the association of lower HbA1c levels with a high level of OHAs.

The implication is that adherence to HbA1c can have good (positive) results in improving the health of the patients if they would strictly adhere to their medications. The higher the adherence, the lower the level of HbA1c in the patient; considering the 61.5% claim of adherence to medication by the respondents one would expect that majority of them would have relatively normal levels of HbA1c, but this is not so. More than half, 72 out of 117 (61.5%) of the patients have an abnormal level of HbA1c. The significant correlation found between high medication adherences with lower HbAlc levels of patients did not noticeably influence the participants' HbA1c levels.

CONCLUSIONS

The study on medication adherence and its determinants among type 2 diabetes patients attending the University of Port Harcourt Teaching Hospital was an interesting one and worth researching. Diabetes is one of the diseases that have continued to challenge world of medicine not only for a permanent cure but in the cost of managing the disease as well. Strategies for managing the disease include increasing public awareness, proper medical diagnosis, lifestyle modifications- Predominately Whole plant based diet, exercise, sleep- and other therapies which are geared towards reducing blood sugar levels to normal. Proper diabetes testing such as a glycated haemoglobin test (HbA1c) which tells

a person's blood sugar level over the past three months is key to monitoring the progress of diabetes patients' medications. With current thinking, strict adherence to lifestyle can lower a diabetes patient's HbA1c level can be reduced to normal. Although a good level of medication adherence was found among the patients, the high cost of medication was found to be one barrier to medication adherence among the study group. This calls for intervention from health organizations, government agencies, and other non-governmental organizations to put resources together towards making lifestyle intervention more effective patients especially in this part of the world.

Contribution to Knowledge

This research has revealed the prevalence of adherence to medication among Type 2 diabetes patients attending University of Port Harcourt Teaching Hospital. It has also shown that cost of medication is a determining factor to anti-diabetic medication adherence and made it recommended self-management skills to improve medication adherence among patients with type 2 diabetes attending diabetes clinic in University of Port Harcourt Teaching Hospital. The study also demonstrated that a high HbA1c result is highly suggestive of poor medication adherence.

Recommendations

Following the study findings, the following recommendations were made:

1. It was found that despite the considerable prevalence of medication adherence a greater percentage (72%) of the study group had abnormal levels of HbA1c. This study recommends a diabetes treatment regimen that will not only be drug based should be considered and adopted as evidences from lifestyle intervention showed reduced incidence of diabetes by 58% and metformin reduced the incidence of diabetes by 31%, as compared with the placebo in a knower and friends study in 2002. This will work better to lower HbA1c level of diabetic patients.
2. Establishments of a counseling unit for diabetic patients: such a unit will be helpful in making diabetic patients to better understand the implication of medication adherence. It will also give patients the needed cue to adherence. Also with such a friendly unit patients can confidently and comfortably confide to healthcare providers on real issues militating against medication adherence.
3. Science has demonstrated in recent times that an increase in insulin dosing is associated with increased risk for cancer, CVD, and weight gain (LMBRC; Madonna 2004). This present study joins Van *et al*., (2018) to recommend implementation of lifestyle options necessitating personalized and sustained lifestyle adaptations, which can only be established by a systems approach, including all relevant aspects (personalized diagnosis and diet, physical activity and stress management, self-empowerment, motivation, participation and health literacy, all facilitated by blended care)
4. Partnership for intervention: the hospital management should pursue partnerships deals with Nutraceutical companies, health and non-health organizations to pursue massive campaigns for intervention on diabetic medications to make them available and accessible at an affordable rate.

This study therefore recommends further studies in current trends of managing diabetes that are inexpensive and have been shown to have greater successes with managing type 2diabetes, moving it into remission.

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