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Medication Adherence to Antidiabetic Agents in Selected Rural (Barangay Patubig, Marilao, Bulacan) and Urban Communities (Bagong Barangay, Pandacan, Manila)

INTRODUCTION

Diabetes mellitus (DM) is one of the leading causes of mortality in the Philippines. The World Health Organization has named it the 4th leading cause of death in the country in the year 2012. In a data presented by the International Diabetes Federation in 2015, there has been a Diabetes Mellitus prevalence of 6.1% in adults (20-79 years) in the Philippines, and a total of 51,127 deaths were caused by the disease. It is a national health issue that needs serious monitoring and control as it has caused substantial economic loss to citizens, health systems, and national economies through medical costs and loss of work and wages (IDF, 2015).

The Philippines is among the top 15 for diabetes prevalence worldwide. A comparison of the prevalence of pre-diabetes and diabetes in the urban and rural communities in the Philippines shows a greater number of both conditions in the urban areas (Jimeno, Kho, Matawaran, Duante, & Jasul, 2008). Most Filipinos would travel long distances to visit large scale hospitals to seek diabetes care and education and this brought about a health center project. This occurred in Davao City in 2013 that aimed to bring diabetes care more accessible. This expanded in local cities in the southern Philippines resulting to increased access to quality and multidisciplinary diabetes care (Carleton, 2015).

Oral drug therapy with hypoglycemic agents is used for patients that have failed to achieve glycemic control through diet and exercise. Although drug therapy has been

proved efficacious in the control of diabetes, different studies have shown poor patient adherence to prescribed medications. Numerous reasons have been given regarding poor medication adherence. These include age, social and psychological factors, education and a lack of understanding of the long-term benefits of treatment, the complexity of the medication regimen, cost of medication and negative treatment perceptions (Garcia-Perez, Alvarez, Dilla, Gil-Guillen & Orozco-Beltran, 2013).

MEDICATION ADHERENCE

Several studies regarding medication adherence to oral hypoglycemic agents show generally poor results. In a cross-sectional study that used the Morisky Medication Adherence Scale (MMAS) conducted in an urban health care center in Malaysia, a medication adherence rate of 48% was obtained among elderly Type 2 DM patients, and sociodemographic characteristics were not statistically significantly associated with adherence (Manan et al., 2014). Another research conducted in a teaching hospital in Ghana has shown 38.5% adherence rate for patients. In this study, there has been a positive significant association between the level of education and adherence (Bruce et al., 2015). Moreover, a study has presented that 35.3% of the respondents have shown low therapeutic adherence and that education, marital status, and age are significant factors in patients' medication adherence (Shaimol, Biju, Anilasree, Jayakrishnan, & Babu, 2014).

Place of residence is also an important factor in medication adherence. It was found out in a study conducted in India that 37.14% patients of urban communities showed higher rate of adherence compare to the rural areas. A study in Egypt showed an adherence rate of 41.9% in urban areas and 34.4% in rural areas (Sajith, Pankaj, Pawar, Modi, & Sumariya, 2014).

In a longitudinal cohort study of a national sample of veterans diagnosed with diabetes conducted by Egede et al. (2011), regional, rural/urban, and racial/ethnic differences in medication adherence was studied. Annual medication possession ratio (MPR) for each veteran was calculated and results showed that MPR was lower among non-Hispanic blacks (NHBs) and Hispanics relative to non-Hispanic whites (NHWs). Also, MPR was 2.0% higher in rural veterans compared to urban veterans. Significant race/ethnicity and

urban/rural interaction was observed. In NHWs and NHBs, MPR was found to be 1.91% and 2.00% higher, respectively, in rural veterans when compared to urban veterans. In contrast, MPR was 1.0% lower in rural veterans when compared to urban veterans for Hispanics.

Sajith et al. (2014) conducted a prospective study to evaluate self-reported medication adherence and to identify factors associated with poor adherence. Place of residence was found to be an important determinant where 37.14% patients from the urban community showed higher adherence rates than patients from the rural community. A study by Albuquerque, Correia and Ferreira (2015) utilized the HbA1c clinical parameter to assess directly the adherence levels of patients to treatment. Further analysis found that patients who exhibited lower HbA1c levels were residents from urban areas, thus showed that they have higher adherence.

In Korea, a cross-sectional study by Kim et al. (2016) was performed to identify and compare possible risk factors associated with medication adherence to antidiabetic medications in two different community-based populations. Data on diabetic patients from the rural and urban areas were analyzed and adherence was found to be greater in the rural (52.43%) than in the urban (36.70%) group. A comparative analysis by Magnabosco et al. (2014) also had similar results wherein medication adherence was found to be higher in rural areas than in urban areas.

Although findings in some studies have shown higher adherence rates in urban community while some have shown higher adherence rates in rural community, according to the World Health Organization, the comparison in place of residence, whether in an urban or rural community, has not been associated with permanent adherence. Murphy et al. (2015) found no relationship between medication adherence and place of residence. In earlier studies by Mandelwoo et al. (2014) and Kaszinicki (2007), socio-demographic factors and non-adherence were analyzed and similar results were shown. Adherence was found to be not associated with place of residence. Whether the patient resides in a rural or an urban community, this does not affect adherence to medications.

Poor medication adherence poses serious consequences to patients with diabetes. In an

analysis on the relationship between inconsistency in the use of diabetes drugs and risk of complications over a 7-year period in community-dwelling older Mexican Americans, 36% of the patients had inconsistent use of diabetic medications; 34% of 461 subjects on oral hypoglycemic drugs only, and 38% of 447 subjects on insulin (with or without oral hypoglycemic drug). There were significant relationships toward all-cause mortality and diabetes-related mortality in subjects with poor consistency in the usage of diabetic medications. Although there was no significant association between the inconsistent use of diabetes medications and risk of eye and circulation problems, there is, however, an association between the inconsistency of medication intake and increased risk of kidney problems and death over the 7-year period of this study (Yong-Fang et al., 2003).

It was shown that majority of the patients diagnosed with type 2 diabetes in Southwest Ethiopia are prescribed with oral hypoglycemic agents. The prescribing strategy has only achieved glycemic control for less than half of the patients since the remaining patients do not meet the recommended blood glucose target because of poor adherence to the medication regimen and poor understanding of self-management behaviors (Wabe, Angamo and Hussein, 2011).

The study of Sajith et al. (2014) demonstrated that the blood glucose control was significantly higher among diabetic patients that adhered to the therapy compared to the non-adherent patients. Thus, if diabetic patients adhere with the anti-diabetic therapy, glycemic outcome will eventually improve.

In a prospective drug utilization study of oral hypoglycemic patients, results showed that there should be measures that need to be taken to improve patient's adherence to prescribed medication. This can be enhanced by comprehensive patient management which includes lifestyle changes, diet control, and prevention of cardiovascular complications. It can be achieved through counseling and patient education for rational use of anti-diabetic medications and regular check-ups or examinations (Khan et al., 2014).

This study investigated the medication adherence of patients diagnosed with diabetes mellitus in both urban and rural communities. It correlated the adherence of each commu-

nity to the usual glucose monitoring parameters of out-patients: capillary blood glucose using a glucometer, and urine glucose level using dipsticks. It also identified the factors associated with non-adherence to medications.

MEDICATION ADHERENCE SCALE BY MORISKY

Morisky Medication Adherence Scale (MMAS) is composed of 8 questions which measures a specific behavior. The scores for the eight-item questionnaire will then be added according to the answers that the patient chooses. Total scores will also be classified to different degrees of medication adherence, such as low, medium and high adherence. The score from the sum of all the answers will indicate the degree of adherence.

The total score on MMAS-8 ranges from 0 to 8, in which a score of "8" will likely indicate best adherence to medications and a score of "0" indicating poor adherence to medications. If the total score is less than 6 points (<6 points), it's interpreted as low adherence.

The 8-Item Morisky Medication Adherence Scale

1. Do you sometimes forget to take your medicine?	No=1, Yes=0	
2. People sometimes miss taking their medicines for reasons other than forgetting. Over the past 2 weeks, were there any days when you did not take your medicine?	No=1, Yes=0	
3. Have you ever cut back or stopped taking your medicine without telling your doctor because you felt worse when you took it?	No=1, Yes=0	
4. When you travel or leave home, do you sometimes forget to bring your medicine?	No=1, Yes=0	
5. Did you take all your medicine yesterday?	No=1, Yes=0	
6. When you feel like your symptoms are under control, do you sometimes stop taking your medicine?	No=1, Yes=0	
7. Taking medicine every day is a real inconvenience for some people. Do you ever feel hassled about sticking to your treatment plan?	No=1, Yes=0	
8. How often do you have difficulty remembering to take all your medicine? (A) Never/rarely (B) Once in a while (C) Sometimes (D) Usually (E) All of the time	(A)=4, (B)=3, (C)=2, (D)=1, (E)=0	Divide score by 4
Score: <6=Low adherence; 6-<8=Medium adherence; 8=High adherence		

THEORETICAL FRAMEWORK

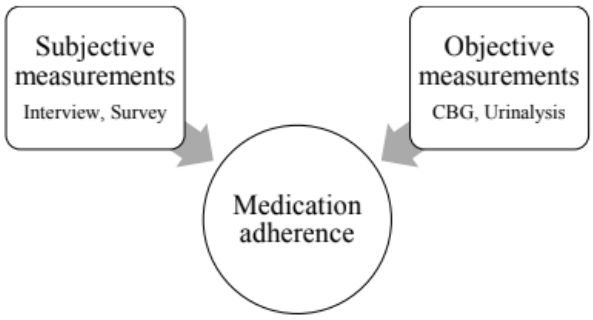

Figure 1. Measurements of Medication Adherence

WHO categorized the measurements of medication adherence as subjective and objective measurements (Lam and Fresco, 2015). Subjective measurements are those that require patient's evaluation of their behavior in taking their medications. Self-report and healthcare professional assessments are most commonly used in this category. The disadvantage of this type of measurement is the underreporting of non-adherence of the patients. Objective measures include pill counts, electronic monitoring, secondary database analysis and biochemical tests, and are said to show an improvement over subjective measurements. Objective measures should be used to validate and correlate the subjective measures (Lam and Fresco, 2015).

METHODOLOGY

Participants

Diabetes mellitus patients who were taking anti-diabetic medications from Bagong Barangay, Pandacan Manila, and Patubig, Marilao, Bulacan were the respondents of this study. Patients were of both gender, and are 30 years old and above, and were diagnosed with diabetes. They were receiving treatment by taking anti-diabetic medications, either oral, insulin shots, or both. Patients who were only on dietary and lifestyle modifications and exercise, and patients with cognitive impairments or severe health problems were not included in the study.

The participants were not chosen at random by the researchers as the health centers did not provide a list of diagnosed patients; instead, the health officers were the one who contacted the patients. Only patients who have given consent were enrolled in the study.

SAMPLE SIZE DETERMINATION

A total of 64 respondents were used in the study, at 5% precision with 95% confidence interval in detecting the true rate of adherence of the population of the study. This sample size was based on the result of the study by Grant, R., Devita, N., Singer, D., & Meigs, J. (2003). Epitools was used in the sample size calculation.

ETHICAL CONSIDERATION

Ethical approval was obtained from the Ethics Review Board of the University of Santo Tomas-Faculty of Pharmacy. Permission was asked from the city health officer of both cities. Consent forms written in both Filipino and English were provided to patients before enrolling them in the experiment.

STUDY INSTRUMENTS

Questionnaires

A demographics questionnaire translated in Filipino was used for the data gathering. This gathered the needed information from the patients including their name, date of birth, address, age, gender, marital status, occupation, educational background, and income. In the second part of this questionnaire, the patients were asked about the history of their disease: year of diagnosis, other diseases, medications taken for the Diabetes and other medications they were taking. The last part of the questionnaire was provided for the researchers to input the data collected for the blood glucose screening and urinalysis.

Medication Adherence Survey

Medication adherence was assessed using a Morisky-based 11-item Likert-type questionnaire written in Filipino. Ten of these questions measure non-adherence, hence, worded negatively; while the last question measures adherence affected by pharmacist intervention, which was scored reversibly (an answer of "Never" will be scored 4, instead of 0). All questions were scored using a five-point scale (0=Never, 1=Rarely, 2=Sometimes, 3=Oftentimes, 4=Always).

The scores ranged from a maximum of 44 to a minimum of 0. A score of 44 to 23 means non-adherence to medications; while a score 22 to 0 means adherence.

The questionnaire was made in such a way that the first five questions pertains to the un-

intentional non-adherence factors (e.g. Forgetting to take the medication, forgetting to bring the medications with them as they go to another place, complexity of the medication regimen, and being unable to consult to the doctor due to some reasons) that the patient was experiencing; while the next five questions pertains to the intentional non-adherence factors (e.g. Distance of the pharmacy from their houses, price of the medication, inconvenience of going to the health center, experiencing side effects, and feeling of getting well). The last question pertains to the patients' intentional adherence with the medication after the pharmacist's counseling/intervention.

Validation of the questionnaire was done through a pilot testing on 10 diabetes mellitus patients. These ten patients are not included in the partner community and their adherence rate was excluded from the data analysis.

CAPILLARY BLOOD GLUCOSE

The patients' capillary blood glucose (CBG) were taken using Accu-Chek® Activ glucometers and glucose strips.

The following range by the American Diabetes Association (2016) was used in classifying the level of blood glucose in the patients' blood samples:

Table 1. Range of Capillary Blood Glucose (American Diabetes Association, 2016)

Random Blood Glucose		Fasting Blood Glucose	
<140 mg/dL	Normal	<100 mg/dL	Normal
140-200 mg/dL	Impaired	100-125 mg/dL	Impaired
>200 mg/dL	Diabetic	>125 mg/dL	Diabetic

Urine Glucose

Urine sample of every patient was collected and tested using Surgitech® reagent strips for urinalysis. Color change in the strips was observed and the amount of glucose in the urine was determined based on the observed change of color.

Table 2. Dipstick Color Chart

	Amount of Glucose in Urine (mg/dL)	Equivalent Sign	Color
NORMAL	0	-	
TRACE	5	±	
	15	+	
	30	++	
	60	+++	
	110	++++	

DATA COLLECTION

The data collection for the rural setting was conducted on the 7th day of November, 2016. The patients were asked to come to the rural health unit of Marilao, Bulacan located in Barangay Patubig. The data collection for the urban setting was performed on the 17th day of November, 2016 at the health center of Bagong Barangay, Pandacan, Manila. Demographics questionnaires were distributed and were answered by the patients. Patients who needed assistance in reading and writing were helped by the researchers.

Figure 2. Data Collection in the Rural Community

Capillary blood glucose levels were assessed. After the assessment of CBG, sterile urine canisters were given to the patients and urine samples were assessed. Personal protective equipment was used by the researchers.

Figure 3. Data Collection in the Urban Community

The patients were asked to answer the adherence questionnaire. Patients who had a hard time reading the questionnaires were assisted by the researchers. Counseling was done after, and pill boxes and information pamphlets were then given to the patients as token for participating.

DATA INTERPRETATION

Fisher's Exact Test of Independence and Spearman Correlation were used to assess the relationship and correlation of the gathered data. Analysis was performed using the Statistical Analysis System (SAS) software.

RESULTS AND DISCUSSIONS

PATIENT DEMOGRAPHICS

The study included 64 patients, 32 from each community, with a median age of 60. Fifty of the respondents were females. More than half of the patients (n=46, 71.88%) were married.

Table 3. Characteristics of Diabetic Patients in Both Communities

Median Age	60
Sex	
Female	78.13%
Male	21.88%
Civil Status	
Single	6.25%
Married	71.88%
Widowed	20.31%
Separated	1.56%
Employment Status	
Employed	34.38%
Unemployed	65.63%
Highest Educational Attainment	
Grade School	21.88%
High School	48.44%
Vocational	7.81%
College	21.88%
Polypharmacy	
1	21.88%
2	48.44%
3	18.75%
4	9.38%
5	0.00%
6	1.56%

Most were unemployed (n=42, 65.63%). 31 were high school graduates, 14 were grade school graduates, and another 14 were college graduates. Majority were only taking 2 medications (n=31, 48.44%).

MEDICATION ADHERENCE

The research involved 64 participants which have been diagnosed with diabetes mellitus. The patients were asked to accomplish questionnaires regarding their adherence to the medication that was prescribed by physicians. After the collection of data, the information obtained from the participants was analyzed. Based on the group's statistical findings, the adherence rate of the sample is shown to be generally high.

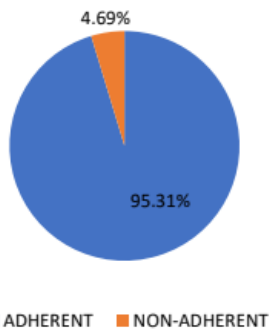

Figure 4. Adherence and Non-Adherence Rates of the Respondents

The data obtained from the questionnaires show that most of the respondents, which represent 95.31% of the population, adhere to the medication advised to them. The remaining 4.69% consists of participants which were non-adherent to the medication prescribed to them.

Similar to this finding, a cross-sectional study in Nigeria by Adisa et al. (2009) reported nearly all respondents to be adherent to their prescribed medications with an adherence rate of 99.2% and in another cross-sectional study, Grant et al. (2003) showed that self-reported adherence rate of diabetic patients was 95.7%.

In comparison to this, there have been other studies that documented lower adherence rates. The prevalence of adherence to anti-diabetic medications in the study by Abebaw et al. (2015) and Arifulla et al. (2014) were reported to be 85.1% and 84%, respectively. Similar study was done by Gimenes (2009) in Brazil and findings revealed 78.3% patient adherence to drug therapy for diabetes management.

Studies with poor adherence have also been reported. Khan et al. (2014) observed that more than half of the diabetic patients in the study population had poor adherence, with only 48.3% of patients adhering with the prescribed therapy. In a retrospective cohort study by Huber and Reich (2016), patient adherence was also found to be poor in which 40% of the study population attained good adherence to medications. Another findings showed that only 23.36% of patients were shown to be adherent to medication regimens (Abdulazeez et al, 2014).

Inconsistency in adherence rates of conducted studies may be attributed to differences in

the assessment of medication adherence, socio-economic factors, and health care settings. Selected urban and rural communities in the study have health centers that actively provide services, consultations and free medications for patients. Patients from both communities were found to actively participate in the health centers, hence, the high adherence rate in the study.

RURAL COMMUNITY

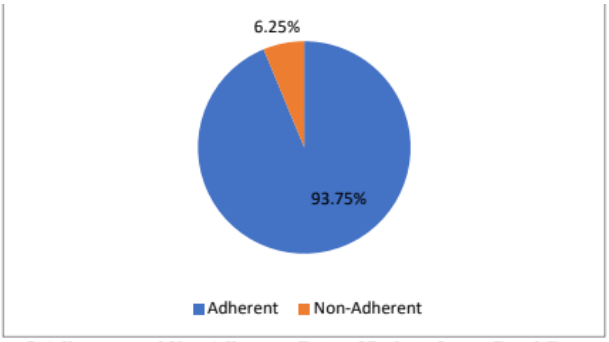

Figure 5. Adherence and Non-Adherence Rates of Patients from a Rural Community

Results are comparable to a study in eastern Uganda conducted by Boganza, et al (2015), in which 83.3% of the respondents were found to be adherent to prescribed antidiabetic medications based on an adherence index of 80% from self-reports. The higher percentage of adherence rate in Bulacan compared to that in eastern Uganda may be due to differences in the assessment for medication adherence and in socioeconomic factors. Adherence information in Uganda was based on patient's ability to recall how they had been taking their prescribed medication, specifically, if they had missed doses on a day-to-day basis over the past week before the conducted interview. Self-reports were found to overestimate adherence of patients (Kalyango et al, 2008). Thus, actual adherence rate of patients in Uganda may be lower than what was reported. Furthermore, rural areas in Uganda, wherein population was generally poor, had less access to health care institutions with the increasing number of diabetic patients.

The high adherence rate of the rural community is hypothesize based on the existence of a community health center that actively provides check-ups and free medications to diabetic patients. Geographic location of selected rural community is proximal to an urban community where healthcare institutions are more accessible and where resources are

more readily available.

URBAN COMMUNITY

The data obtained from the participants residing in Manila show that most of the patients, which comprise 96.88% of the sample population, adhere to the medications which were prescribed by physicians. Contrarily, the remaining 3.13% consists of participants which failed to adhere to the recommended medications. The situation suggested that the adherence rate of the population from the urban community is high.

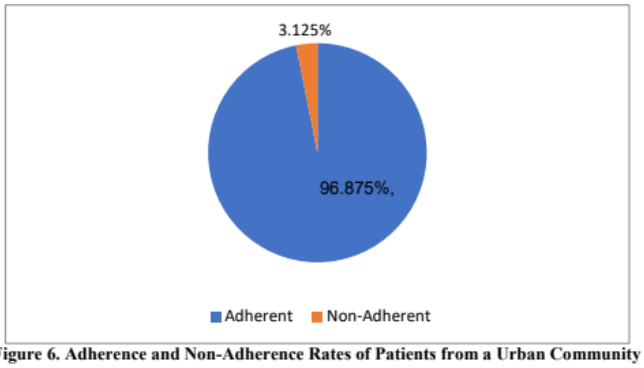

Figure 6. Adherence and Non-Adherence Rates of Patients from a Urban Community

Findings are similar to the study by Adisa, et al. (2009) that showed an adherence rate of 99.2%, in which it was carried out in a healthcare facility in the largest city in Southwestern Nigeria. The hospital where the study was conducted had physicians in different specialties, nurses, medical technologists, pharmacists, physical therapists and other ancillary health workers. It was also equipped with services for the treatment and management of different health conditions, which included diabetes. Diabetes clinic day was available every week in the hospital during Mondays.

Similarly, the adherence rate in the selected urban community of the study was 96.88%, which is also considered high. Although the study was only conducted in a community health center, physicians, nurses and other health workers are present to provide services such as free consultations and provision of medications to patients with health conditions. Every Thursday of the week is the designated diabetes clinic day and patients in the community were found to be active participants.

However, findings are comparable to a study conducted by Inbaraj et al. (2016) in urban Bangalore, in which an adherence rate of 70% was determined. This is higher as compared to an earlier study in Karnataka performed by Divya et al. (2015) with an

adherence rate of only 50%. Discrepancy in adherence rates may be due to differences in assessment of medication adherence or health care setting and socioeconomic variables.

Regarding our study, the high adherence rate of the urban community may be attributed to the improved health care services provided to diabetic patients in the community health center where free consultations, glucose level monitoring, and available medications are given to patients. Also, the support of the existing health club of the community may influence the patients to participate in health activities that may serve as an intervention for the provision of better health outcomes.

RELATIONSHIP AND CORRELATION OF MEDICATION ADHERENCE IN THE RURAL AND URBAN COMMUNITIES

Fisher's Exact Test of Independence was used, since the research involved nominal variables such as Urban or Rural, relating to the location; and Adherent or Non-Adherent, pertaining to the adherence of the patients.

Table 4. Contingency Table for the Sample Population

		Adherence		
	Location	**Adherent**	**Non-adherent**	**TOTAL**
Frequency	**1 (Rural)**	30	2	32
Percent		46.88	3.13	50.00
Row Percent		93.75	6.25	
Column Percent		49.18	66.67	
Frequency	**2 (Urban)**	31	1	32
Percent		48.44	1.56	50.00
Row Percent		96.88	3.13	
Column Percent		50.82	33.33	
	TOTAL	61	3	64
		95.31	4.69	100.00

Table 4 shows that 30 out of the 32 patients from the rural community, and 31 out of 32 patients from the urban community, were adherent. Given that the number of non-adherent patients was too small and 2 out of the 4 given frequencies did not reach 5 observations, it was also more appropriate to use the Fisher's Exact Test of Independence. Based from figures 5 and 6, adherence rate for the urban community is 96.88% while adherence rate for the rural community is 93.75%. Findings indicate that adherence rate is slightly higher in respondents from the urban community as compared to the rural community. This is similar to a study conducted by Sajith et al. (2014) in which 37.14% patients of urban community had shown higher rate of adherence than patients of rural

community. Albuquerque et al. (2015) also reported that a higher rate of adherence was prevalent in the urban community.

However, this is inconsistent with the findings of some studies. Cohort study of Egede et al. (2011) on diabetic veterans found that adherence was 2.0% higher in rural patients than in urban patients. Also, findings in the cross-sectional study by Kim et al. (2016) reported that adherence rate of 52.43% was found in the rural area, while 36.70% was the adherence rate in the urban area.

Table 5. Fisher's Exact Test of Independence for Adherence and Location

Cell (1,1) Frequency	30
Left-sided Pr <= F	0.5000
Right-sided Pr <= F	0.8810
Table Probability	0.3810
Two-sided Pr <= P	1.000

Based on this result, it can be said that there is no sufficient evidence to conclude that adherence is associated with whether the patient is from a rural or an urban community (p = 0.3810).

Table 6. Correlation of Location and Adherence

Spearman Correlation Coefficients, n=64 Prob > |r| under H0: Rho=0		
	Location	**Adherence**
Location	1.00000	-0.17064 0.1776
Adherence	-0.17064 0.1776	1.00000

Spearman's Correlation test show that the medication adherence and the community classification namely, rural and urban, have no significant relationship. The p-value at 0.1776 deduces an insignificant relationship between the two variables. With a correlation coefficient of -0.17064, it also shows a very weak, indirect relationship between the two variables. As the rural community was tagged as "location 1", and the urban community as "location 2", the test has shown that a shift from location 1 (rural) to location 2 (urban) can lead to garnering lower scores in the medication adherence questionnaire, thus having higher chances of adherence.

Results are parallel to the study conducted by Mandelwoo et al. (2014) in which factors that influence non-adherence to therapy of diabetes were determined. Socio-demographic factors and non-adherence were analyzed. Initial bivariate analysis denoted no statistically significant relationship between adherence and place of residence. An earlier study by Kaszinicki (2007) investigated factors affecting adherence of patients and evaluation of analyzed parameters on adherence to drug treatment also indicated that there is no significant relationship between adherence and place of residence. Whether the patient resides in a rural or an urban community, this does not influence adherence to medications.

However, findings can be compared to the study regarding medication adherence of diabetic patients by Albuquerque et al. (2015). There was no statistically significant relationship between adherence and area of residence. However, further analysis showed that patients who are more adherent were from the urban community. Socio-demographic and clinical characteristics of the patients were considered. A multidimensional scale with Likert type responses was utilized and measurement of HbA1c was also resorted to directly assess adherence. Considering the influence of residence area, residents from urban areas were found to be more adherent based on having lower HbA1c levels or adequate glycemic control.

Our study only obtained capillary blood glucose (CBG) and urine sample for the assessment of glucose levels.

Measurement of HbA1c levels was not utilized. Analysis using HbA1c levels may be performed to determine glycemic control in diabetic patients. This can be used as an additional parameter in the assessment of medication adherence.

MEDICATION ADHERENCE AND CAPILLARY BLOOD GLUCOSE LEVEL

Rural Community

As observed in Table 7, 13 patients from the rural community were still with diabetic capillary blood glucose levels, two of which were the only non-adherent patients from the rural community respondents.

Table 7. Contingency Table of Adherence by CBG Levels in Rural Community

		CBG Level			
	Adherence	**Diabetic**	**Impaired**	**Normal**	**TOTAL**
Frequency	**Adherent**	11	10	9	30
Percent		34.38	31.25	28.13	93.75
Row Percent		36.67	33.33	30.00	
Column Percent		84.62	100.00	100.00	
Frequency	**Non-**	2	0	0	2
Percent	**Adherent**	6.25	0.00	0.00	6.25
Row Percent		100.00	0.00	0.00	
Column Percent		15.38	0.00	0.00	
	TOTAL	13	10	9	32
		40.63	31.25	28.13	100.00

10 patients were classified under impaired CBG and 9 already had normal CBG.

Table 8. Correlation of Adherence and CBG in Rural Community

Spearman Correlation Coefficients, n=32
Prob > |r| under H0: Rho=0

	CBG Levels	**Adherence**
CBG Levels	1.00000	0.62069 0.0002
Adherence	0.62069 0.0002	1.00000

This leads to the idea that as the scores in the survey increase, CBG levels also increases; therefore, high capillary blood glucose levels were observed from non-adherent respondents (p = 0.0002).

This result is similar to a study by Pascal, et al. (2012) in which the study showed that blood glucose control rate was significantly higher among patients that adhered to prescribed antidiabetic medications compared to non-adherent patients. Therefore, if diabetic patients adhere with prescribed anti-diabetic medication, glycemic outcome can be improved.

Urban Community

18 patients have been observed with diabetic CBG in the urban community; 17 of them were adherent and the only non-adherent patients is included in the diabetic CBG classification.

10 patients had impaired CBG levels, and only 4 had normal levels.

Table 9. Contingency Table of Adherence by CBG Levels in Urban Community

		CBG Level			
	Adherence	**Diabetic**	**Impaired**	**Normal**	**TOTAL**
Frequency	**Adherent**	17	10	4	31
Percent		53.13	31.25	12.50	96.88
Row Percent		54.84	32.26	12.90	
Column Percent		94.44	100.00	100.00	
Frequency	**Non-**	1	0	0	1
Percent	**Adherent**	3.13	0.00	0.00	3.13
Row Percent		100.00	0.00	0.00	
Column Percent		5.56	0.00	0.00	
	TOTAL	18	10	4	32
		56.25	31.25	12.50	100.00

Results from Spearman Correlation Coefficient in the urban area showed that patients' medication adherence and capillary blood glucose levels have no significant relationship (p = 0.5549). The risk of developing chronic complications of diabetes mellitus is not completely prevented by adequate blood glucose control but it is important for clinicians attending to diabetic patients to be aware of the variability of the blood glucose control rates to decide appropriate interventional strategies since poor glycemic control results to risk factor for diabetic complications. Thus, prescribing anti-diabetic medications to diabetic patients is not enough but regular assessment of the level of glycemic control should also be performed (Pascal et al., 2012).

MEDICATION ADHERENCE AND URINE GLUCOSE LEVELS

Rural Community

As presented in Table 11, 19 out of the 32 patients did not have any presence of glucose in their urine, 2 had traces of glucose, and 8 had triple positive amount of glucose.

Table 10. Correlation of Adherence and CBG in Urban Community

Spearman Correlation Coefficients, n=32 Prob > |r| under H0: Rho=0		
	CBG Levels	**Adherence**
CBG Levels	1.00000	0.10839 0.5549
Adherence	0.10839 0.5549	1.00000

Single positive, double positive and quadruple positive each had 1 observed patient. The two non-adherent patients in the rural community were classified under single and triple positive.

Table 11. Contingency Table of Adherence by Urine Glucose Levels in Rural Community

		Urine Glucose Level						
	Adherence	(-)	(±)	(+)	(++)	(+++)	(++++)	**TOTAL**
Frequency	**Adherent**	19	2	0	1	7	1	30
Percent		59.38	6.25	0.00	3.13	21.88	3.13	93.75
Row Percent		63.33	6.67	0.00	3.33	23.33	3.33	
Column Percent		100.00	100.00	0.00	100.00	87.50	100.00	
Frequency	**Non-**	0	0	1	0	1	0	2
Percent	**Adherent**	0.00	0.00	3.13	0.00	3.13	0.00	6.25
Row Percent		0.00	0.00	50.00	0.00	50.00	0.00	
Column Percent		0.00	0.00	100.00	0.00	12.50	0.00	
	TOTAL	19	2	1	1	8	1	32
		59.38	6.25	3.13	3.13	25.00	3.13	100.00

Higher scores in the adherence survey had direct relationship to the urine glucose levels of patients; thus, non-adherence means more chances of glucose being present in the urine in patients from the rural community (p = 0.0087).

Table 12. Correlation of Adherence and Urine Glucose Levels in Rural Community

Spearman Correlation Coefficients, n=32 Prob > |r| under H0: Rho=0		
	Urine Glucose Levels	**Adherence**
Urine Glucose Levels	1.00000	0.45590 0.0087
Adherence	0.45590 0.0087	1.00000

Urban Community

The only non-adherent patient in the urban community was classified under double positive glucose presence, along with another one who was adherent.

Table 13. Contingency Table of Adherence by Urine Glucose Levels in Urban Community

		Urine Glucose Level						
	Adherence	(-)	(±)	(+)	(++)	(+++)	(++++)	**TOTAL**
Frequency	**Adherent**	25	0	0	1	4	1	31
Percent		78.13	0.00	0.00	3.13	12.50	3.13	96.88
Row Percent		80.65	0.00	0.00	3.23	12.90	3.23	
Column Percent		100.00	0.00	0.00	50.00	100.00	100.00	
Frequency	**Non-**	0	0	0	1	0	0	1
Percent	**Adherent**	0.00	0.00	0.00	3.13	0.00	0.00	3.13
Row Percent		0.00	0.00	0.00	100.00	0.00	0.00	
Column Percent		0.00	0.00	0.00	50.00	0.00	0.00	
	TOTAL	25	0	0	2	4	1	32
		78.13	0.00	0.00	6.25	12.50	3.13	100.00

No trace of glucose was found from the urine samples of 25 patients. 4 patients had triple positive glucose presence while only 1 had quadruple positive.

Table 14. Correlation of Adherence and Urine Glucose Levels in Rural Community

Spearman Correlation Coefficients, n=32 Prob > |r| under H0: Rho=0		
	Urine Glucose Levels	**Adherence**
Urine Glucose Levels	1.00000	0.36760 0.0385
Adherence	0.36760 0.0385	1.00000

This is parallel with the results from the rural community which also shows significant correlation between the parameters. It can be concluded that in both communities, an increase in the adherence scores, which means non-adherence of patients, leads to increased urine glucose levels ($p = 0.0385$).

CAPILLARY BLOOD GLUCOSE AND URINE GLUCOSE LEVELS

The first observation of the association between blood and urine glucose was in the 18th century by Matthew Dobson, an English physician. Glucosuria or glycosuria, is the excretion of glucose in the urine. This result from the glomerular filtration of more glucose than the renal tubule can absorb. High levels of glucosuria is caused by either an elevated blood glucose, an impaired renal absorptive capacity, or it can be both. Measurement of glucosuria is an indirect measure of blood glucose concentration and in the past years, urine glucose testing was the primary method used in monitoring glucose levels of diabetic patients (Cowart and Stachura, 1990).

However, the usefulness of urine glucose measurements in diabetes management is dependent to its accuracy in reflecting the blood glucose concentration. The two measures of glucose concentration are not constantly related as urine glucose levels will be influenced by several factors, namely, the urine volume, the renal threshold for glucose, and the peak blood glucose levels reached between bladder voidings. Also, these factors can be altered by the patient's fluid intake, variation in activity, and general health and well-being. (Griffin et al, 1979).

Nevertheless, blood glucose levels can be reflected in urine levels and both are parameters which can be used in the determination and monitoring of glucose levels in diabetic patients for the management and control of the disease.

Rural Community

Table 15 shows that 8 patients who still had diabetic levels of glucose in their blood had triple positive presence of glucose in their urine.

Table 15. Contingency Table of CBG by Urine Glucose Levels in Rural Community

		Urine Glucose Level						
	Adherence	(-)	(±)	(+)	(++)	(+++)	(++++)	**TOTAL**
Frequency	**Diabetic**	1	1	1	1	8	1	13
Percent		3.13	3.13	3.13	3.13	25.00	3.13	40.63
Row Percent		7.69	7.69	7.69	7.69	61.54	7.69	
Column Percent		5.26	50.00	100.00	100.00	100.00	100.00	
Frequency	**Impaired**	9	1	0	0	0	0	10
Percent		28.13	3.13	0.00	0.00	0.00	0.00	31.25
Row Percent		90.00	10.00	0.00	0.00	0.00	0.00	
Column Percent		47.37	50.00	0.00	0.00	0.00	0.00	
Frequency	**Normal**	9	0	0	0	0	0	9
Percent		28.13	0.00	0.00	0.00	0.00	0.00	28.13
Row Percent		100.00	0.00	0.00	0.00	0.00	0.00	
Column Percent		47.37	0.00	0.00	0.00	0.00	0.00	
	TOTAL	19	2	1	1	8	1	32
		59.38	6.25	3.13	3.13	25.00	3.13	100.00

9 negative glucose presence in their urine had impaired glucose levels and another nine also had normal glucose levels.

Table 16. Correlation of CBG and Urine Glucose Levels in Rural Community

Spearman Correlation Coefficients, n=32 Prob > |r| under H0: Rho=0		
	Urine Glucose Levels	**CBG Levels**
Urine Glucose Levels	1.00000	0.81338 <.0001
CBG Levels	0.81338 <.0001	1.00000

Table 16 shows that there is a direct relationship of capillary blood glucose levels increase, urine glucose levels also increase among its rural subjects ($p < 0.0001$).

Urban Community

Table 17 shows that 12 patients with diabetic glucose levels had negative urine glucose levels, 2 double positive urine glucose levels, and 4 triple positive urine glucose levels.

Table 17. Contingency Table of CBG by Urine Glucose Levels in Urban Community

		Urine Glucose Level						
	Adherence	(-)	(±)	(+)	(++)	(+++)	(++++)	**TOTAL**
Frequency	**Diabetic**	12	0	0	2	4	0	18
Percent		37.50	0.00	0.00	6.25	12.50	0.00	56.25
Row Percent		66.67	0.00	0.00	11.11	22.22	0.00	
Column Percent		48.00	0.00	0.00	100.00	100.00	0.00	
Frequency	**Impaired**	9	0	0	0	0	1	10
Percent		28.13	0.00	0.00	0.00	0.00	3.13	31.25
Row Percent		90.00	0.00	0.00	0.00	0.00	10.00	
Column Percent		36.00	0.00	0.00	0.00	0.00	100.00	
Frequency	**Normal**	4	0	0	0	0	0	4
Percent		12.50	0.00	0.00	0.00	0.00	0.00	12.50
Row Percent		100.00	0.00	0.00	0.00	0.00	0.00	
Column Percent		16.00	0.00	0.00	0.00	0.00	0.00	
	TOTAL	25	0	0	2	4	1	32
		78.13	0.00	0.00	6.25	12.50	3.13	100.00

9 patients with impaired glucose levels had negative urine glucose levels, and 1 had quadruple positive. In the urban community, only 4 patients had normal glucose levels with negative presence of glucose in the urine.

Table 18. Correlation of CBG and Urine Glucose Levels in Urban Community

Spearman Correlation Coefficients, n=32 Prob > |r| under H0: Rho=0		
	Urine Glucose Levels	**CBG Levels**
Urine Glucose Levels	1.00000	0.50279 0.0034
CBG Levels	0.50279 0.0034	1.00000

Table 18 confirms that as capillary blood glucose levels increase, there is a higher chance of getting increased presence of glucose in the urine among the urban subjects (p = 0.0034).

MEDICATION ADHERENCE AND PATIENT DEMOGRAPHICS

Table 19 shows the distribution of adherent and non-adherent patients to the different demographics classification.

Table 19. Demographics Distribution of Adherent and Non-Adherent Patients in Both Communities

	Adherent	Non-Adherent
Median Age	60	58
Sex		
Male	21.88%	0.00%
Female	73.44%	4.69%
Civil Status		
Single	6.25%	0.00%
Married	67.19%	4.69%
Widowed	20.31%	0.00%
Separated	1.56%	0.00%
Employment Status		
Unemployed	62.50%	3.13%
Employed	32.81%	1.56%
Residence		
Rural	46.88%	3.13%
Urban	48.44%	1.56%
Highest Educational Attainment		
Grade School	20.31%	1.56%
High School	21.88%	0.00%
Vocational	45.31%	3.13%
College	7.81%	0.00%
Polypharmacy		
1	18.75%	3.13%
2	46.88%	1.56%
3	18.75%	0.00%
4	9.38%	0.00%
5	0.00%	0.00%
6	1.56%	0.00%

Adherent patients had a higher median age of 60 compared to the median age of non-adherent patients which is 58. All non-adherent patients were married female diabetics; two of them were unemployed while the other one was employed. Also, two of these non-adherent patients could finish vocational courses while the other finished grade school. Although only taking one medication, two patients were non-adherent to their

medication, while the other patient was taking two medications.

Age

Table 20 confirms that there is no significant correlation between medication adherence and age (p = 0.0668).

Table 20. Test of Independence for Adherence and Age in Both Communities

Table Probability (P)	0.0668
Pr <= P	0.3012

According to Shams and Barakat, a non-significant lower rate of adherence was found in the elderly and middle-aged patients than the younger patients. Elderly patients tend to have memory problems because of their age or diseases like dementia and Alzheimer's disease. In addition, older patients have vision and hearing problems that can be a cause of medication errors. Polypharmacy is also common with the elderly because of multiple diseases. Thus, they tend to take several drugs at the same time which might cause confusion.

Sex

There is no enough indication showing the association between medication adherence and gender as shown in Table 21 (p = 0.4704).

Table 21. Test of Independence for Adherence and Sex in Both Communities

Table Probability (P)	0.4704
Pr <= P	1.0000

This result is parallel to the study of Shams and Barakat in 2010 where it was found that there is no significant relationship found between medication adherence and sex. However, some studies found out that males are more adherent than females (Sajith, Pankaj, Pawar, Modi, & Sumariya, 2014), while some studies showed otherwise (Lertmaharit et al., 2005).

Civil Status

Table 22 shows that there is no significant association between medication adherence and civil status (p = 0.3463).

Table 22.Test of Independence for Adherence and Civil Status in Both Communities

Table Probability (P)	0.3643
Pr <= P	1.0000

This result is contradictory to the study of Shams and Barakat wherein married patients showed significant higher rate of adherence than single, widowed or divorced patients. As stated by Cooper et al, marital status might positively influence patient's compliance because of the help and support from a spouse.

Employment Status

Table 23. Test of Independence for Adherence and Employment Status in Both Communities

Table Probability (P)	0.4546
Pr <= P	1.0000

Table 23 shows that there is no significant association between medication adherence and employment status (p = 0.4546). This is contrary to the study of Sajith et al. where educated patients adhere more to their therapy. Moreover, several studies found that patients with higher educational level might have higher compliance, while some studies did not find any association (Jin, Sklar, Min Sen Oh, & Chuen Li, 2008)

Educational Background

Table 24 shows no significant correlation between medication adherence and educational background (p = 0.1562).

Table 24. Test of Independence for Adherence and Educational Background in Both Communities

Table Probability (P)	0.1562
Pr <= P	1.0000

This result is contrary to the study of Sajith et al. where educated patients adhere more to their therapy. Moreover, several studies found that patients with higher educational level might have higher compliance, while some studies did not find any association (Jin, Sklar, Min Sen Oh, & Chuen Li, 2008).

Polypharmacy

Table 25 shows that there is no significant association between the two variables (p = 0.0677).

Table 25. Test of Independence for Adherence and Polypharmacy in Both Communities

Table Probability (P)	0.0677
Pr <= P	0.4769

This is contradictory to the study of Shams and Barakat where it showed an inverse relationship between polypharmacy and adherence. However, in the study of Grant et al. in 2003, it has shown that diabetic patients reported very high medication adherence rates regardless of number of medicines prescribed to them.

Regression

None of the variables in table 26 show significant effect to medication adherence.

Table 26. Type 3 Analysis of Effect for Medication Adherence and Patient Demographics

Effect	DF	Wald Chi-Square	Pr > Chi-Square
Gender	1	0.3202	0.5715
Civil Status	3	0.0481	0.9972
Employment Status	1	0.2583	0.6113
Age	3	0.3154	0.9571
Educational Background	3	0.4445	0.9309
Polypharmacy	1	0.2717	0.6022

Therefore, with the collected data, there is no significant association between medication adherence and patient demographics in the selected urban and rural communities.

SUMMARY OF FINDINGS

Profile of Respondents

The demographic profile of the patients showed that median age for the whole population was 60 years old. Out of the 64 respondents, 50 were female and 14 were male. Regarding the civil status of the participants, 46 are married, 13 are widowed, 6 are single, and only 1 is separated. Most patients are unemployed. With respect to the educational attainment of the participants, 31 were high school graduates, 14 patients were grade school graduates, another 14 were college graduates, and 5 patients were vocational courses graduates. In addition, most patients (n=31) were taking 2 medications, while only 1 patient was taking 6 medications; 14 patients were taking 1 medication, 12 patients were taking 3 medications, and 6 were taking 4 medications. Only 13 patients had controlled their capillary blood glucose levels to the normal level, while 31 participants still had diabetic levels. Furthermore, more than half of the patients still had negative results in the testing for glucose presence in the urine.

MEDICATION ADHERENCE

Medication adherence was found to be high at 95.31% in the combined data for rural and urban communities. A slightly higher adherence was observed from the selected urban community at 96.88% compared to that of the 93.75% adherence rate of the selected rural community patients.

Computed p-value for the association of location and adherence was found to be 0.3810 leading to the rejection of the null hypothesis that there is a significant relationship between the medication adherence and residence of the patients. Correlation, on the other hand, has shown an indirect relationship between adherence questionnaire scores and patients' location of residence; wherein as patients from location 1 (rural) move to location 2 (urban), a higher possibility of getting lower scores from the questionnaire is presented.

CORRELATION OF MEDICATION ADHERENCE AND CAPILLARY BLOOD GLUCOSE

Results showed that the medication adherence and CBG has strong, significant correlation in the rural community while a very weak, non-significant correlation was observed from the urban community.

CORRELATION OF MEDICATION ADHERENCE AND URINE GLUCOSE LEVELS

A moderate, significant relationship was found from the correlation test for the two variables in the rural community while a weak, significant relationship was found from the data of urban patients.

CORRELATION OF CAPILLARY BLOOD GLUCOSE AND URINE GLUCOSE LEVELS

A very strong correlation between the capillary blood glucose and urine glucose levels of the patients was found in the rural community, while a moderate correlation between the two variables was found in the urban community.

ASSOCIATION OF MEDICATION ADHERENCE AND DEMOGRAPHICS PROFILE

Medication adherence was not found to be associated to age, sex, employment status, civil status and educational attainment. Polypharmacy was also found to have no association with medication adherence.

CONCLUSION

Based from the results and insights obtained in the study, the researchers conclude that the urban patients have higher tendency of adhering to their medications compared to rural patients. Furthermore, increased capillary blood glucose does not necessarily mean that the patients are not adherent to their medications. Non-adherence to medications can lead to high urine glucose levels. Moreover, uncontrolled increase in capillary blood glucose can further lead to presence of glucose the urine. In addition, the researchers infer that medication adherence is not associated with age, sex, employment status, educational attainment, and civil status. The number of medications taken has also no effect on the adherence of patients to their medication.

RECOMMENDATIONS

The researchers have the following recommendations for the study:

- The researchers recommend to future researchers interested in this topic to choose a strictly rural area away from a very urbanized community. Although Patubig, Bulacan is a rural community, it is proximal to an urban community and this can be a factor why the results of medication adherence in both communities are close.
- Researchers recommend conducting the study in a site where there is no intervention being performed yet. The existence of health clubs is a factor for the respondents' medication adherence for there is a group managing their glucose levels. Thus, it can be a factor to yield higher medication adherence.
- In choosing 2 study sites for comparison of adherence, both study sites should be receiving the same services to more accurately assess adherence. The urban community in the study has an active diabetes health club while the rural community did not. Hence, this can be why the urban community had higher adherence.
- The researchers also recommend to future researches to strictly use the fasting blood glucose for both communities so that the relationship can be identified through the data that will be collected.
- There should be a baseline data of the diabetic patients to compare previous and current glucose levels to assess adherence.

- Diet of the patients should be taken into consideration as this can possibly affect the management of disease in the patients.
- Financial status of patients may also be considered as a factor of medication adherence.
- As an innovation to this study, the researchers recommend to future researchers to focus on respondents with same economic class.

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