Adherence To Antihypertensive Medications Among Primary Care Centre Attendees in Trinidad: A Cross-Sectional Study

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ABSTRACT
Objective: To determine the adherence levels to antihypertensive medications and its associated factors among primary care attendees in Trinidad.

Methods: A cross-sectional study was carried out whereby an interviewer-administered questionnaire was administered to public primary care attendees throughout Trinidad. Non-pregnant hypertensive adults, attending chronic disease clinic on anti-hypertensive medications for at least 1 year were eligible.

Results: Of 225 participants (92% response rate), 58% displayed a low level of adherence to anti-hypertensive medications and 73.3% had uncontrolled hypertension, both independent of age, gender and ethnicity. Experiencing adverse effects to prescribed medications ($P=0.003$) and self-reported use of herbal/alternative treatment ($P=0.024$) for hypertension were significantly associated with higher rates of low adherence. Having too many pills to take and fear about the potential effects of these medications on the body were both correlated with low adherence ($P<0.001$). Obtaining antihypertensive medications from a national chronic disease assistance program was inversely correlated with low adherence ($P=0.03$). There were no statistically significant associations between adherence and average systolic blood pressure ($P=0.20$), home self-monitoring ($P=0.75$), daily dosing frequency ($P=0.53$) or daily number of pills ($P=0.68$)

Conclusion: Most primary care hypertensive patients who attended chronic disease clinics at primary care health centers around Trinidad were found to have uncontrolled hypertension along with low adherence to antihypertensive medications. Education, screening for herbal use and improvements to the existing national medication program, are discussed as interventions to improve adherence in this setting.

Keywords: Hypertension, Adherence, Antihypertensive medications, Primary Care
**INTRODUCTION**

Hypertension is one of the most common chronic diseases affecting greater than 1 billion people globally according to the WHO. Hypertension is a major risk factor for both cardiovascular disease and cerebrovascular accidents. Early diagnosis and effective treatment with antihypertensives are important to prevent significant morbidity and mortality in patients. Adherence to prescribed antihypertensives is important in the effective management of hypertension. Ensuring patient adherence to antihypertensives is a challenge due to a lack of patient education, adverse effects of medication, complex medication regimens and the need to continue treatment indefinitely due to the chronic nature of the disease. Poor adherence to antihypertensive medications has been identified as one of the leading causes of failed treatment. This subsequently leads to worsening uncontrolled hypertension which further predisposes the patient to various hypertension related comorbidities, cardiovascular and cerebrovascular events and frequent changes in medication regimens.

In Trinidad and Tobago, the prevalence of hypertension according to the Noncommunicable Disease Risk Factors Survey is approximately 26 percent. Consequently, it is not surprising that the Pan American Health Organization has listed cardiovascular disease as the leading cause of mortality in Trinidad and Tobago. There exist very few studies in our setting that have examined medication adherence in chronic disease management. Two studies performed in Trinidad have examined cardiovascular medication adherence and have reported an overall poor adherence to medication. These studies, however, were conducted in cardiology secondary care settings. Most hypertensive patients however seek care at the primary care level and there has been a paucity of such surveys in this population. This study aims to determine the level of adherence to antihypertensives and associated risk factors in patients attending local health centers.

**METHODS**

**Study design, setting and sampling**

This study was performed by utilising a cross-sectional study design and was conducted across primary care health centres in three of the four major Regional Health Authorities (RHAs) located in the island of Trinidad during the period March to May 2018. The study population for this study was limited to adult hypertensive outpatients who attended chronic disease clinics in primary care health centres in Trinidad exclusively. A random sample of health centres was selected from each of three of the four RHAs. Eligible participants were chosen via convenience sampling and included non-pregnant adults 18 years and over who were prescribed antihypertensive medications for at least 1 year. Based on an estimated low adherence rate of 20%, a 5% margin of error and a 95% confidence limit, the target sample size was calculated at 246.

**Data collection and Instrument Development**

Data were primarily collected from outpatients attending the chronic disease clinic at primary care health centres in Trinidad via questionnaires using compliance questions first described by Morisky et al. in 1986 with additional questions obtained from a review of literature. Based on several adherence questions participants obtained either a score of 0 indicating a low degree of adherence or a positive score which indicated a high degree of adherence to antihypertensive medications. Low adherence was 0-1, Moderate adherence 2-3, and High adherence was equal to a score of 4. The questionnaire is shown in Appendix 1. For the purpose of analyses, adherence was treated as a dichotomous variable i.e. low adherence vs. moderate/high adherence. Additional variables measured included accessibility, number, costs, frequency and class of antihypertensive medications. Data on accessibility to clinic, appointment timing, prior hypertensive comorbidities, herbal usage and history of adverse events were also collected. The questionnaire was pilot tested before use to ensure that the necessary data were acquired and to ensure that its content and wording was appropriate. Questionnaires were administered via face-to-face interviews after written informed consent was obtained and blood pressure was measured on the day of the interview using a validated electronic monitor. The electronic monitors were calibrated, and the same monitors were used for all patients to ensure that all readings were standardized. Patients' charts were then
accessed for the two most recent blood pressure readings and an average of all three readings was recorded.

**Statistical analysis**
Data were inputted and analysed using the statistical package for social sciences 24 (SPSS, Chicago, IL, USA). Data was presented using descriptive statistics including means with standard deviations and proportions. Data were also analysed using chi squared testing for categorical and ordinal variables, and t-testing for comparison of means. Statistical significance was accepted at $P< 0.05$. Binary logistic regression analysis was employed to determine predictors of adherence.

**Ethical Issues**
Patients who participated in this study and were identified with elevated blood pressure and who were non-compliant were provided with their blood pressure readings and asked to visit their clinic or keep their follow up appointments. Similarly, patients who sought alternative treatment methods or experienced side effects were asked to relay this information to their usual primary care provider at the clinic. Permission was sought from the ethics committee of the University of the West Indies, St. Augustine and the participating RHAs before conducting the study. No proprietary or copyrighted instruments were used in this study.

**RESULTS**

**Demographics**
A total of 244 eligible participants were approached, of whom 225 participants responded with a response rate of 92%. The average age of the study population was 64.0 years. The majority of the study population who responded were female (74.2%), of East Indian descent.

| Variable | N=225 |
|----------|-------|
| Age (mean±SD) | 64.0±10.7 |
| Gender | | |
| Male | 58 (25.8%) |
| Female | 167 (74.2%) |
| Ethnicity | | |
| African | 93 (41.3%) |
| East Indian | 103 (45.8%) |
| Mixed/Caucasian/Other | 29 (12.9%) |
| Highest Level of Education | | |
| Primary | 129 (57.3%) |
| Secondary | 74 (32.9%) |
| Tertiary | 10 (4.4%) |
| Advanced Degree | 9 (4.0%) |
| Professional Certification | 3 (1.3%) |
| Employment Status | | |
| No | 172 (76.4%) |
| Yes | 53 (23.6%) |
| Regional Health Authority* | | |
| ERHA | 91 (40.4%) |
| NCRHA | 84 (37.3%) |
| NWRHA | 50 (22.2%) |
From our study it was found that the majority (58%) of the respondents had a low degree of adherence to antihypertensive medications. There were no statistically significant associations between adherence and age, gender, ethnicity, education or employment level as seen in Table 2. The North Central RHA health centres showed a significantly higher rate of low adherence compared to the other RHA’s (45% vs. 27%, \(P=0.012\)). Additionally, in analyses where adherence rates were examined by health centre, there was no significant association between any sociodemographic variable and adherence levels.

**Table 2 Relationship between adherence levels and socio-demographic variables**

| Sociodemographic variable | Low Adherence n= 130 | Moderate/High Adherence n=95 | \(P\) value |
|---------------------------|----------------------|-----------------------------|-------------|
| Age (mean±SD) years       | 63.4±10.9            | 64.51±10.3                  | 0.503       |
| Gender                    |                      |                             |             |
| Male                      | 101 (77.7%)          | 66 (69.5%)                  | 0.169       |
| Female                    | 29 (22.3%)           | 29 (30.5%)                  |             |
| Ethnicity                 |                      |                             |             |
| African                   | 53 (40.8%)           | 40 (42.1%)                  | 0.979       |
| East Indian               | 60 (46.2%)           | 43 (45.3%)                  |             |
| Mixed/Caucasian/Other     | 17 (13.1%)           | 12 (12.6%)                  |             |
| Highest Education Level   |                      |                             |             |
| Primary                   | 75 (57.7%)           | 54 (56.8%)                  | 0.437       |
| Secondary                 | 45 (34.6%)           | 29 (30.5%)                  |             |
| Tertiary/advanced degree/professional certificate | 10 (7.7%) | 12 (12.6%) |             |
| Employed                  |                      |                             |             |
| No                        | 96 (73.8%)           | 76 (80.0%)                  | 0.341       |
| Yes                       | 34 (26.2%)           | 19 (20.0%)                  |             |
| Regional Health Authority*|                      |                             |             |
| ERHA                      | 48 (36.9%)           | 43 (45.3%)                  | 0.219       |
| NCRHA                     | 58 (44.6%)           | 26 (27.4%)                  | 0.012       |
| NWRHA                     | 24 (18.5%)           | 26 (27.4%)                  | 0.144       |

*ERHA-Eastern Regional Health Authority, NCRHA- North Central Regional Health Authority, NWRHA -North West Regional Health Authority*
Predictors of Low Adherence

Table 3 shows the predictors of low adherence.

Table 3 Predictors of low adherence

| Predictor variable                                                                 | Unadjusted Odds Ratio for LOW ADHERENCE (95% Confidence Intervals) | P-value |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------|---------|
| Average Systolic BP                                                              | 1.01 (0.995 - 1.025)                                                 | 0.198   |
| Average Diastolic BP                                                             | 1.04 (0.99 – 1.04)                                                   | 0.180   |
| Do you monitor your BP at home?                                                   |                                                                     |         |
| No                                                                                |                                                                     |         |
| Yes                                                                               | 0.910 (0.514-1.611)                                                  | 0.747   |
| Are Health Centres easily accessible?                                            |                                                                     |         |
| No                                                                                |                                                                     |         |
| Yes                                                                               | 1.41 (0.54-3.69)                                                     | 0.488   |
| Time between appointments (months)                                                | 1.007 (0.84-1.21)                                                    | 0.940   |
| Able to visit clinic outside appointment times?                                  |                                                                     |         |
| No                                                                                |                                                                     |         |
| Yes                                                                               | 1.309 (0.74-2.314)                                                   | 0.354   |
| Do you usually obtain your medications from the health centres?                   |                                                                     |         |
| No                                                                                |                                                                     |         |
| Yes                                                                               | 0.89 (0.41-1.92)                                                     | 0.764   |
| Sometimes                                                                         |                                                                     |         |
| Where do you usually get your medications?                                       |                                                                     |         |
| I buy them                                                                        | 1                                                                   |         |
| I obtain through CDAP*                                                            | 0.47 (0.27-0.93)                                                     | 0.03    |
| How much do you pay for your medications?                                        |                                                                     |         |
| Less than 100$                                                                   | 1                                                                   |         |
| 100-200$                                                                          | 0.783 (0.30-2.07)                                                    | 0.622   |
| 300-400$                                                                          | 0.373 (0.13-1.10)                                                    | 0.073   |
| >500$                                                                             | 0.68 (0.14-3.34)                                                     | 0.634   |
| Number of pills taken daily                                                       | 1.06 (0.81-1.40)                                                    | 0.678   |
| How frequent are you supposed to use your BP medicines?                           |                                                                     |         |
| Once per day                                                                      | 1                                                                   |         |
| Twice per day                                                                     | 1.20 (0.69-2.06)                                                    | 0.531   |
| I have too many tablets to take so I only take the ones I think work              |                                                                     |         |
| Strongly Agree                                                                    | 0.714 (0.25-2.06)                                                    | 0.533   |
| Agree                                                                             | 0.206 (0.06-0.67)                                                    | 0.009   |
| Neutral                                                                           | 0.358 (0.15-0.86)                                                    | 0.022   |
| Disagree                                                                          | 0.152 (0.06-0.371)                                                   | <0.001  |
| Strongly Disagree                                                                 |                                                                     |         |
I am afraid to take my medicines because I do not know what they do to my body
Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree

Do you believe your BP medications are working?
Strongly Agree
Agree
Neutral
Disagree
Strongly Disagree

Have you ever experienced any side effects from prescribed medications?
No
Yes

Do you use any herbal/alternative medicines for your high BP?
No
Yes
Sometimes

| Statement | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|-----------|---------------|-------|---------|----------|------------------|
| I am afraid to take my medicines because I do not know what they do to my body | 1 | 0.529 (0.16-1.69) | 0.207 (0.06-0.70) | 0.199 (0.07-0.59) | 0.146 (0.05-0.43) |
| Do you believe your BP medications are working? | 1 | 1.04 (0.59-1.85) | 2.29 (0.83-6.31) | - | 2.15 (0.40-11.6) |
| Have you ever experienced any side effects from prescribed medications? | 1 | 2.50 (1.35-4.62) | | | |
| Do you use any herbal/alternative medicines for your high BP? | 1 | 2.02 (1.10-3.71) | 1.20 (0.56-2.60) | |

#Referent category for categorical independent variables. *Chronic disease assistance programme

Several factors were significantly associated with a reduced odds of low adherence. Obtaining medication on the Chronic Disease Assistance Programme (CDAP) appeared to be protective against low adherence compared to those who bought their blood pressure medication. In this study 96 (43%) of respondents bought their medicines compared to 52 (23%) who obtained their medicines through CDAP. In the subset of patients who bought medicine, adherence was independent of the amount of money spent. Disagreement with statements “I am afraid to take my medicines because I do not know what they do to my body” and “I have too many tablets to take so I only take the ones I think work” were also associated with a reduced odds of low adherence.

Two factors, however, correlated significantly with an increased risk of low adherence. Experiencing side effects from blood pressure medications and use of herbal treatments for hypertension were each positively correlated with low adherence.

In further adjusted analyses the above associations persisted after inclusion of RHA in the logistic regression models. There were no associations (P values > 0.05) with specifically listed herbal remedies (garlic, lemongrass (fever grass), saffron, bitter melon (carailii) and spices) and low adherence. There were also no associations (all P values > 0.05) between adherence and side effects of fever, nausea, vomiting, diarrhea, headaches, cough, weakness, skin rashes and weight change. Of note there were no significant associations between adherence and blood pressure levels, self-monitoring at home, appointment times and access to clinic. Frequency, number of antihypertensives used daily, antihypertensive drug class and medication costs were also independent of adherence level. Self-reported comorbidities of stroke, heart attacks, renal disease and heart failure were also unrelated to adherence (P > 0.05 for all non-significant relationships).

Blood pressure control and correlates
The mean duration of hypertension was 12.0 years (SD 9.8) while the average of the three most recent blood
pressure readings was 151.5mmHg and 83.8mmHg for systolic and diastolic blood pressure respectively. Using systolic and diastolic cut-offs of 140mmHg and 90mmHg respectively, as defined by the WHO for diagnosis of hypertension, 165 subjects (73.3%) had uncontrolled hypertension defined either as an elevated systolic or diastolic BP. In this study 56% (66/119) reported use of garlic. Respondents who used garlic were less likely to have uncontrolled hypertension (OR 0.38, 95%CI; 0.16-0.89). This association remained significant when adjusted for age and adherence with BP medications (OR 0.33, 95%CI; 0.13-0.80). Demographics, blood pressure medication class, adherence level and a history of the comorbidities mentioned above were not associated with uncontrolled hypertension (P> 0.05).

**DISCUSSION**

In this study, we focused on the prevalence and predictors of low adherence to antihypertensive medications in Trinidad. Adherence to antihypertensive medication is a problem both globally as well as in our population in Trinidad and Tobago as evidenced by two cardiovascular studies that were carried out in Trinidad which showed low to medium adherence of 75% and 78.3% respectively. Patients who report strict adherence to their antihypertensive medication regimen have reported significantly lower systolic and diastolic blood pressure as compared to those patients who have ever reported a momentary lapse in adherence. From our study, we found two-fifths of the patients were found to have high adherence to antihypertensives. While some countries have found adherence levels ranging from 44.8% to 88.6%, this low adherence level is in keeping with that highlighted in a 2017 meta-analysis. This review revealed an adherence level of 45.2% with 83.7% of those patients having uncontrolled hypertension. The only demographic predictor of low adherence in this study was RHA. This may reflect differences in patient characteristics based on geography or variations in practice and medications accessibility based on region.

Non-adherence or poor adherence to antihypertensives has shown an increased risk for developing uncontrolled hypertension which subsequently increases the risk of cardiovascular mortality and strokes which then leads to an increase in hospitalization rates and cost of care. However, in our study, there was no significant association between blood pressure greater than 140/90 and adherence level. Many variables apart from adherence may contribute to blood pressure control. Measurement techniques, inadequate or inappropriate drug therapy and secondary causes are some of these reasons. A 2012 study that looked at adherence in over 1000 subjects concluded that only a small proportion of blood pressure variability can be explained by adherence.

From our study, we found that adverse effects to antihypertensive medications were a key factor associated with low adherence, a finding in keeping with other studies. Patients taking multiple medications for their condition are also at an increased risk of non-adherence due to the complexity of their regimens and the increased likelihood of experiencing side effects in patients on polypharmacy. This was in contrast to the findings of our study, however, which did not show associations between number of pills or frequency and adherence level.

Another significant factor that contributed significantly to low antihypertensive adherence in our study was the use of herbal or complementary alternative medicines (CAM). One study found that CAM use resulted in decreased levels of adherence to antihypertensives amongst female participants while another study reported that older black adults who used CAM had lower levels of adherence to antihypertensives compared to their white counterparts. Similarly, in our study CAM use was associated with low adherence. One particular alternative remedy that has been extremely popular amongst the global hypertensive population is the use of garlic. Garlic was commonly used as an alternative remedy and we found that patients who used garlic in our study population had hypertension that was better controlled compared to non-users. A meta-analysis of 11 randomized control trials that was recently published showed that garlic was better at reducing blood pressure when compared to a placebo. Garlic contains multiple active sulfur compounds leading to BP reduction via vasorelaxation. In addition, we found that the use of garlic and its effect on hypertension was independent of adherence to antihypertensives. This finding was reported in other studies where patients tend to use CAM, in this...
case garlic, as a supplement rather than a replacement because they did not believe that CAM was better than conventional medication with one study showing that up to 79% believed that the use of both CAM and conventional medicine was superior when compared to using only one method.\textsuperscript{30}

We found that patients were more likely to be adherent to their prescribed drug regimen when they received assistance in obtaining medication through the Chronic Disease Assistance Program (CDAP). This was in comparison with patients who purchased their medicine. CDAP is a program administered by the Government of Trinidad and Tobago that provides free chronic disease medication including antihypertensives.\textsuperscript{31} The association between adherence and obtaining medications without costs has been highlighted by past reviews.\textsuperscript{32} Since a significant proportion or two fifths of the patients in this study reported purchasing their medicine, there may be a role for the expansion of the CDAP programme. In 2019, the Ministry of Health launched the TT Global Hearts Initiative for hypertension in an effort to reduce mortality rates from hypertension related cardiovascular and cerebrovascular comorbidities in part by utilizing evidence-based protocols and improving access to essential medicines.\textsuperscript{33} The evidence-based protocols as laid down by the HEARTS initiative included the use of angiotensin receptor blockers (ARBs) and highlighted the benefits of using single pill combination drugs across several categories.\textsuperscript{34} At the time of this study, such drugs were not available via the CDAP. As such, inclusion of ARBs and single pill combination drugs could potentially improve both access and low adherence to antihypertensive medications.

Strengths and Limitations.
The strengths of our study are that this is the first study of its kind to measure adherence in the hypertensive primary care population of our nation. Several noteworthy associations were found which has implications for interventions. Limitations of this study were its cross-sectional nature and lack of causal inferences, and response bias. The participants selected by convenience at each clinic may not have been representative of all hypertensive patients even within each RHA. The original Morisky adherence tool used in this study has undergone refinements to better validated tools, namely MMAS4 and MMAS8, however the costs of institutional licenses for these tools were beyond the budget of this study. A better validated tool may have resulted in associations that this study failed to show. This study did not examine adherence in patients who sought care at the Southwest Regional Health Authority (SWRHA) or privatized settings.

Next steps
Future studies should measure adherence in the SWRHA and private sector. Variations in adherence by RHA and geographic locations also warrant further exploration. With the launch of the TT Global Hearts Initiative it is also worth investigating its impact on adherence in the future to gauge its effectiveness and patient acceptance. Research into patient education and knowledge of hypertension may also reveal a gap making room for educational interventions regarding antihypertensive medications, mechanism of action, side effects and herbal misuse. Enhancement of the existing CDAP with newer agents may also improve access and adherence, and blood pressure control.
CONCLUSIONS
Adherence to antihypertensive medications in the study population was found to be very low. We were able to identify several factors that may explain the variation in adherence level with antihypertensives in this survey. These areas offer opportunity for interventions to educate patients and improve the existing national formulary of anti-hypertensives. Further research into patient knowledge of hypertension, private sector practices and all RHAs are needed to monitor trends in antihypertensive adherence.

Ethical Approval statement: All procedures performed in studies involving human participants were in accordance with the ethical standards of the University of the West Indies, St. Augustine campus (approval number: CEC415/12/17), the Northwest Regional Health Authority (NWRHA), the North Central Regional Health Authority (NCRHA), Eastern Regional Health Authority (ERHA) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Ethics approvals from the South-West Regional Health Authority (SWRHA) were sought but could not be granted in time for the data collection period of the survey.

Conflict of Interest statement: The authors declare that there are no competing interests.

Informed Consent statement: Informed written consent was obtained from all individuals who were approached.

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**Appendix 1**
The Self-Reported Medication-taking Scale*
1. Do you ever Forget to take your medicine?
2. Are you careless at times about taking your medicine?
3. When you feel better do you sometimes stop taking your medicine?
4. Sometimes if you feel worse when you take the medicine, do you stop taking it?

*Morisky D, Green L, Levine D. Concurrent and Predictive Validity of A Self-Reported Measure of Medication Adherence. Medical care. 1986 Feb 1;24:67–74.
