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Relationship of an adherence score with blood pressure control status among patients with hypertension and their determinants: Findings from a nationwide blood pressure screening program

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Abstract

This study aimed to examine the relationship of adherence with blood pressure (BP) control and its associated factors in hypertensive patients. This cross-sectional nationwide BP screening study was conducted in Malaysia from May to October 2018. Participants with self-declared hypertension completed the Hill-Bone Compliance to High Blood Pressure Therapy Scale (Hill-Bone CHBPTS) which assesses three important domains of patient behavior to hypertension management namely medication taking, appointment keeping and reduced salt intake. Lower scores indicate better compliance while higher scores indicate otherwise. Participant's body mass index and

seated BP were measured based on standard measurement protocol. Determinants of adherence to treatment were analyzed using multiple linear regression. Out of 5167 screened subjects, 1705 were known hypertensives. Of these, 927 (54.4%) answered the Hill-Bone CHBPTS and were entered into analysis. The mean age was 59.0 ± 13.2 years, 55.6% were female and 42.2% were Malays. The mean Hill-Bone CHBPTS score was 20.4 ± 4.4 (range 14-47), and 52.1% had good adherence. The mean systolic BP and diastolic BP were 136.4 ± 17.9 and 80.6 ± 11.6 mmHg, respectively. BP was controlled in 58.3% of those with good adherence compared to 50.2% in those with poor adherence (p = .014). Based on multiple linear regression analysis, female gender (β = −0.72, 95% confidence interval [CI] −1.30, −0.15, p = .014), older age (β = −0.05, 95% CI −0.07, −0.03, p < .001), and individuals with primary or lower educational level (β = −0.91, 95% CI −1.59, −0.23, p = .009) had better adherence to BP management. Interventional programs targeted at the less adherent groups are needed in order to improve their adherence and BP control.

1 | INTRODUCTION

Hypertension affects a quarter of the world's population with prevalence ranging from 26.4% to 31.1% worldwide and is expected to increase over the years.[1,2] Hypertension is the major contributor of mortality and continues to contribute significantly to the increase of cardiovascular diseases, renal failure, and mortality.[1,3,4] Around 61.3% to 77.2% of hypertensive patients from developed countries receive treatment in contrast to 18%-41.1% in several low- and middle-income countries in Asia.[2,5,6] Even in several countries in Asia where treatment rates are high (69.7%-81%), control of blood pressure (BP) is only achieved in less than 50%, for example in Malaysia, 83.2% of patients with hypertension received treatment but control of hypertension is only 37.4% while in many other low- and middle-income countries in Asia, the control rates are even lower with several below 20%.[6,7]

Although guidelines on hypertension emphasize the need to address treatment adherence throughout the world and also in Malaysia, just over half adhere to their medication.[8-11] Poor BP control remains a global concern. Uncontrolled hypertension leads to multiple complications which increases the burden to the individual and healthcare system.[12]

Many factors that contribute to poor BP control have been identified, the commonest being poor patient adherence to medication.[13] Besides medication adherence, adherence to lifestyle modification, reduction of salt intake, follow-up appointment, and medication refilling are also important contributors to poor BP control.[13,14] Understanding the contributing factors is important in improving overall adherence to prevent target organ damage such as strokes and myocardial infarctions; thus, more targeted interventions may be implemented to improve the control of hypertension.[15] To date, there are limited studies that examine the level of adherence beyond medication taking. However, as reiterated earlier, it is important to study other factors that contribute to better control of hypertension. Hence, this nationwide study aimed to examine the level of adherence to hypertension management among patients with hypertension, using the Hill-Bone Compliance to High Blood Pressure Therapy Scale (Hill-Bone CHBPTS) which has 3 domains of medication adherence, salt reduction, and appointment keeping.

2 | MATERIAL AND METHODS

2.1 | Study design and setting

This cross-sectional study was conducted throughout Malaysia during a worldwide BP screening campaign in conjunction with World Hypertension Day 2018. The study was conducted over 5 months from May 1, 2018, to October 31, 2018. The screening program was carried out at various centers including health clinics, hospitals, universities, community centers, shopping malls, family day events, and health runs in Peninsular Malaysia and 2 other sites in East Malaysia. Twenty-five investigators from the 22 centers were briefed on the use of a standardized protocol.[16,17] Ethics approval was granted by the National Medical Research Register (NMRR-18-876-40691) and University of Malaya Medical Centre (MREC ID NO:2018320-6146).

2.2 | Sample size calculation

As this is a public screening programme, the sample size was not calculated. All adults aged 18 years and above were eligible for the study.

2.3 | Sampling method and process

All eligible individuals were invited to participate in this study. Participants were given a questionnaire, and their body weight and height were measured. All BP monitors that were used have been validated by various international bodies (International Society of Hypertension, International Society of Hypertension, and British Society of Hypertension). Seated BP was measured three times based on the standard procedure of BP measurement using automated and validated BP devices (Microlife-BP-A2-Basic, Omron JPN1, Omron HEM-7121, Omron HBP-1300, and Beurer BM28).[18] Following the usual clinical practice, only the first two BP measurements were used in our analysis.

2.4 | Data collection

During the BP screening, a self-administered questionnaire that captured the sociodemographic characteristics and relevant past medical history were distributed by researchers. Participants also completed the Hill-Bone Compliance to high blood pressure therapy Scale (Hill-Bone CHBPTS) questionnaire. Both the validated English and the translated Bahasa Malaysia, the national language version of this scale, were used.[19]

2.5 | Instruments used: The Hill-Bone Compliance to High Blood Pressure Therapy Scale

We chose to use the Hill-Bone CHBPTS as it captures not only adherence to medication but also salt reduction and keeping with appointments.[20] This Hill-Bone CHBPTS was developed by the John Hopkins University, School of Nursing in 1999.[20] The questionnaire consists of 14 items with 3 domains (1) reducing sodium intake; (2) appointment keeping; and (3) medication taking, with each item rated on a 4-point Likert scale (1 = all of the time, 2 = most of the time, 3 = some of the time, and 4 = none of the time). The score ranges from a minimum of 14 to 56 (maximum). The sodium domain consists of 3 items to assess dietary intake of salty foods; the appointment keeping domain consists of 3 items to assess appointments for doctor visits and prescription refills, and the medication-taking domain consists of 8 items to assess medication-taking behavior. The Hill-Bone CHBPTS was self- or interviewer-administered in our study. It takes about 5 minutes for the participants to complete this questionnaire. The Cronbach alpha for this scale were 0.74 and 0.84 as reported by the authors who develop this scale as the reliability testing of this scale was conducted at 1-year and 3-year follow-up.[17] The higher the mean score in Hill-Bone CHBPTS, the poorer the adherence. A lower compliance scale score using this tool has been shown to be significantly associated with higher BP readings.[20] For this study, we defined good adherence as a score that is less than the group mean Hill-Bone CHBPTS score and poor adherence as a score that is equal to or greater than the group mean score.

2.6 | Operational definitions

Ethnicity was defined as Malay, Chinese, Indian, or others. Education level was defined according to the respondents' self-reported highest attained level of education as no formal education, primary school, secondary school, or tertiary education (diploma/university). Smoking status was defined as whether the patient was a current smoker, non-smoker, or ex-smoker. Body Mass Index (BMI) was calculated as the weight in kg divided by the square of height in meter and classified according to the Asian population.[21] Hypertension was defined as systolic BP ≥ 140 and/or diastolic BP ≥ 90 mmHg or on treatment for hypertension or is a known case of hypertension.[22] BP was defined as controlled if both systolic BP was <140 mmHg and diastolic BP was <90 mmHg or uncontrolled if either one or both were elevated.

2.7 | Data analysis

Statistical Package for Social Sciences (SPSS) version 24 was used for the statistical analysis in this study. We used descriptive analysis, for example, frequencies, percentages, median, and interquartile range (IQR) to describe the characteristics of the participants. Independent *t* test was used to determine the association for continuous data, that is, Hill-bone CHBPTS score and BP readings and chi-squared test for categorical data, that is, percentage with controlled BP and adherence category. Multiple linear regression was used to identify the determinants of the total Hill-bone CHBPTS score. We ensured that the assumptions of multiple linear regression analysis were met before running the regression model.[23] All variables with a *p* Value <.05 in the univariate analysis were entered into the multiple linear regression. The dependent variable was the total Hill-Bone CHBPTS score. The independent variables are sociodemographic factors (age, gender, level of education, marital status, occupation, smoking status, and alcohol consumption status) and clinical profiles (presence of diabetes, ischemic heart disease, stroke, and body mass index).

3 | RESULTS

Out of 5167 participants screened, 1705 (33%) were hypertensive. Out of these, 927 (54.4%) participants answered the Hill-Bone CHBPTS questionnaire and were entered into this analysis. Table 1 shows the sociodemographic and clinical characteristics of the participants with hypertension. The mean age was 59.0 ± 13.2 years. More than half of the participants were female (55.6%, *n* = 515) and 58.2% were housewives, students or retired. The largest ethnic group was Malay (42.2%) with nearly half of them having had at least secondary level of education (48.3%). Majority of them were married (90.4%) and never consumed alcohol (92.4%). Only 11.5% of them were smokers. The main co-morbidities were diabetes (38.5%), followed by ischemic heart disease (7.7%) or stroke (4.5%). The mean BMI was 27.7 ± 5.5 kg/m^2.

TABLE 1 Sociodemographic and clinical characteristics of the study respondents (*N* = 927)

Variable	Frequency *N* (%)	Mean ± SD
Age, years		59.0 ± 13.2
Gender		
Male	414 (44.4)	
Female	515 (55.6)	
Ethnicity		
Malay	390 (42.2)	
Chinese	275 (29.7)	
Indian	116 (12.5)	
Others	144 (15.6)	
Education Level		
No formal education	34 (3.7)	
Primary school	185 (20.1)	
Secondary school	445 (48.3)	
College/University	257 (27.9)	
Employment status		
Unemployed	532 (58.2)	
Employed	382 (41.8)	
Marital status		
Married	832 (90.4)	
Single	88 (9.6)	
Smoking		
Yes	104 (11.5)	
No	799 (88.5)	
Alcohol		
Never	857 (92.4)	
1-3 times /month	55 (5.9)	
At least once/ week	15 (1.7)	
Co-morbidity		
Stroke	42 (4.5)	
Heart attack	71 (7.7)	
Diabetes	357 (38.5)	

The mean Hill-Bone CHBPTS score was 20.4 ± 4.4 (range 14-47) and the correlation between HB score and systolic BP was not significant (r = .032, p =.337) but the correlation between HB score with diastolic BP was significant (r = .163, p < .001). Based on the Hill-Bone CHBPTS, 52.1% (n = 482) had good adherence. Table 2 shows the adherence score for the group as a whole and compares the adherence sub-scales between controlled and uncontrolled hypertension. The total score and the sub-scales of medication taking show a statistically significant difference in those with controlled and uncontrolled BP (p < .05), while there were no differences in the sub-scales of salt intake and appointment keeping. The mean SBP (systolic blood pressure) and DBP (diastolic blood pressure) of the hypertensive participants were 136.4 ± 17.9 and 80.6 ± 11.6 mmHg, respectively. Table 2 also shows the proportion of those with controlled BP was 54.4%. The control rate of diastolic BP was higher than systolic BP.

Table 3 shows the comparison of the mean SBP and DBP and control rates in those with good and poor adherence. There is statistically significant difference between the control rates of those with good and poor adherence (58.3% vs 50.2%, respectively, and p = .014).

Table 4 shows the sociodemographic and clinical characteristics associated with total Hill-bone CHBPTS score using simple and multiple linear regression analysis. In the multiple linear regression analysis, it was found that female participants (β = −0.72, 95% confidence interval [CI] = −1.30, −0.15, p = .014), older aged (β = −0.05, 95% CI = −0.07, −0.03 p < .001), and patients with background of primary education level and below (β = −0.91, 95% CI = −1.59, −0.23, p = .009) had lower Hill-bone CHBPTS score, indicating they had better adherence to BP therapy medication, salt intake and appointment keeping.

4 | DISCUSSION

Our study showed that individuals with hypertension who were older, being female and with a lower educational level were more adherent to BP management. Our findings are comparable to and consistent with other studies where patients with hypertension aged between 65 to 80 years had better treatment adherence compared to younger hypertensive patients (<50 years) or much older patients (>80 years old).[24-27] However, there was a study that reported younger adults had better adherence.[28]

Our study also showed that females have better adherence than males. This was in line with other studies where gender affects the behavior toward medication adherence.[29-31] Female patients demonstrated better and more active health-seeking behavior when empowered.[32] They tend to seek substantial physical and mental health support and advice from their clinicians as compared to males.[33] Thus, designing, implementing, and evaluating intervention programs to improve adherence should not be "one size fits all" but rather take into consideration the role gender plays in decision making on treatment adherence.

A surprising finding was that those with a lower educational level had a better adherence. This differs from two other studies that showed that participants with a lower educational level associated with a lower income and lower health literacy generally reported lower adherence to antihypertensive medications.[34,35] This may be due to those with higher education who may be using alternative strategies like better weight control, more exercise, less smoking or consumption of alcohol or complementary medications to reduce their BP which are relevant parameters that are not captured in the Hill-Bone CHBPTS score.[36] However, we also need to consider there may be a selection bias as there were fewer participants with higher education (51.0%) answering the scale versus 69.5% of those with a lower educational level who did so.

In our study, there was no association of adherence with a history of stroke. This is in contrast to a study, which showed that those with co-morbidities had better adherence.[37] This could be due to the fact

TABLE 2 Adherence score and comparison of sub-scales between controlled and not controlled hypertension (*N* = 926)

Hill-Bone CHBPTS score	Overall	Controlled *n* = 504 (54.4%)	Not controlled *n* = 422 (45.6%)	*p*
Total score (mean ± SD)	20.4 ± 4.4	20.0 ± 3.7	20.9 ± 5.0	.001
Sub-scales				
Medication taking (mean ± SD)	10.3 ± 3.0	9.9 ± 2.5	10.8 ± 3.4	<.001
Salt intake (mean ± SD)	5.7 ± 1.4	5.7 ± 1.3	5.7 ± 1.4	.998
Appointment keeping (mean ± SD)	4.4 ± 1.6	4.3 ± 1.5	4.4 ± 1.6	.302
BP measurements				
SBP, mmHg (mean ± SD)	136.4 ± 17.9	124.8 ± 9.8	153.6 ± 12.5	<.001
DBP, mmHg (mean ± SD)	80.6 ± 11.6	76.4 ± 8.1	97.3 ± 7.5	<.001
SBP and DBP combined, mmHg (mean ± SD)	—	SBP 124.1 ± 9.8 DBP 74.7 ± 8.2	SBP 151.0 ± 13.9 DBP 87.6 ± 11.2	<.001 .001
Pulse rate, bpm (*n* = 899) (mean ± SD)	77.5 ± 12.9	75.9 ± 11.1	107.4 ± 8.3	<.001

TABLE 3 Comparison of adherence and blood pressure control (*N* = 926)

		Hill-bone CHBPTS score category				
Measurements (*n* = 926)	Overall mean	Good adherence *n* = 482 (52.1%)	Poor adherence *n* = 444 (47.9%)	Mean difference	Standard error	*p*
SBP, mmHg (mean ± SD)	136.4 ± 17.9	136.1 ± 17.2	136.7 ± 18.6	−0.6	1.2	.615
DBP, mmHg (mean ± SD)	80.6 ± 11.6	79.3 ± 10.5	82.1 ± 12.6	−2.9	0.8	<.001
PR, bpm (mean ± SD)	77.5 ± 12.9	76.9 ± 13.0	78.1 ± 12.8	−1.2	0.9	.116
Controlled BP (*n*, %)	—	281 (58.3)	223 (50.2)	—	—	.014

that those with stroke had difficulty in keeping their appointment, which is a subscale captured in the Hill-bone CBPTS while other studies on the adherence probably have not included this domain.

This study showed that BP control rates were higher in those with good adherence. Our finding is consistent with other studies, and this emphasizes again the importance of adherence to achieve good BP control.[20,38] Knowledge of factors associated with adherence to hypertension management will help us plan and focus more on those who are less adherent to achieve better BP control.

A sub-analysis of the determinants of DBP control was done. For the multiple logistic regression for determinants of DBP control are those with an older age, being Chinese, females, skilled worker, receiving lower education level, underlying diabetes, and having good adherence (Table S1). This is consistent with the determinants of the good adherence. Thus, this explains why the diastolic blood pressure is better controlled among those hypertensives with a good adherence.

In addition, older population appeared to be one of the determinants of the good diastolic blood pressure control. This could be explained by the fact that the low adherence is more prevalent in the young population and worsens control of diastolic blood pressure.[39]

The strengths of this study are the large sample size of participants who closely resemble the overall socio-demography of Malaysia. This study was also conducted in a wide variety of sites, including rural and urban health clinics as well as screening in community halls and universities. The main limitation was that this study was a cross-sectional study design which may limit causality. Another limitation was that we used an indirect measurement of adherence with self-reported questionnaire while the "gold standard" remains as the measurements of metabolites of antihypertensive drugs in the blood or urine.

Another limitation is the lower validity and reliability score of the Malay version of this Hill-Bone CHBPTS as reported in a previous local study.[19] However, we have decided to use this score as it measures more than one domain of adherence, and hence, this should be taken into consideration. There may also be respondent bias as only 54.4% of hypertensive participants answered the Hill-Bone

TABLE 4 Determinants of total Hill-bone score among patients with hypertension using multiple linear regression (n = 927)

Variables (and Hill-Bone CHBPTS score)		Simple Linear Regression		Multiple Linear Regression	
		Crude β (95% CI)	*p* Value	Adjusted β (95% CI)	*p* Value*
Age		−0.05 (−0.07, −0.03)	<.001	−0.05 (−0.07, −0.03)	<.001
Female gender					
Male	22.0 ± 4.4	−0.61 (−1.17, −0.04)	.035	−0.72 (−1.30, −0.15)	.014
Female	21.6 ± 3.6				
Marital Status (married)					
Married	20.4 ± 4.3	0.36 (−0.61, 1.32)	.468	—	
Single/Never married	20.7 ± 5.1				
Employment status (employed)					
Employed	20.8 ± 4.4	0.69 (0.12,1.26)	.017	—	
Non employed	20.1 ± 4.3				
Education Level					
Primary and below	19.7 ± 3.6	−0.94 (−1.60, −0.28)	.005	−0.91 (−1.59, −0.23)	.009
Secondary education	20.5 ± 4.4	0.27 (−0.29, 0.83)	.351	—	
Tertiary education	20.7 ± 4.7	0.44 (−0.19, 1.06)	.173	—	
Smoking Status					
Yes	21.1 ± 4.4	−0.71 (−1.61, 0.18)	.118	—	
No	20.3 ± 4.4				
Alcohol consumption					
Yes	20.1 ± 4.0	−0.50 (−1.32, 0.33)	.235	—	
No	20.4 ± 4.4				
Diabetes status					
Yes	20.0 ± 4.1	0.66 (0.11, 1.21)	.018	—	
No	20.7 ± 4.5				
Heart attack					
Yes	19.7 ± 2.9	0.80 (−0.19, 1.79)	.112	—	
No	20.5 ± 4.4				
Stroke					
Yes	21.6 ± 5.4	−0.67 (−1.89, 0.55)	.280	—	
No	20.3 ± 4.3				

*Significant value only.

CHBPTS. Nevertheless, by adjusting for cofounders in the multivariate analysis, the authors have managed to identify the true determinants of adherence using this scale.

5 | CONCLUSION

Our study findings have shown that those older, being female and of a lower educational level were more adherent to hypertension management. Furthermore, as adherence to reduction in salt intake, medication taking and appointment keeping have been associated with better BP control among patients with hypertension, it is essential for clinicians to engage and educate the patients about the importance of adherence through identifying the correlated factors of non-adherence in improving BP control.

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CONFLICT OF INTEREST

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AUTHOR CONTRIBUTIONS

YCC conceptalised the study, YCC, NKD, SMC, PBO, MTC, HML, and HCB wrote the paper, collected the data, performed statistical analysis, revised the manuscript critically for important intellectual content, and gave final approval of the manuscript. BNC, MM, ASO, HSH, AHMG, DH, PSK, CLT, PFW, and HH collected the data, revised the manuscript critically for important intellectual content, and gave final approval of the manuscript. For the revision, YCC, NKD, SMC, and MTC drafted the revision and all authors finalized and approved the revised article.

DISCLOSURE

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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