Barriers to achieving better drug adherence in patients with uncontrolled hypertension in primary care clinics

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Abstract

Background: Poor drug adherence is one of the leading causes of uncontrolled hypertension. Little is known about the barriers to attaining good drug adherence among Chinese patients in primary care setting.

Methods: Cross-sectional questionnaire survey of patients with uncontrolled hypertension was performed in five primary care clinics in Hong Kong in 2016. Patients who attended regularly for hypertension follow-up, with office systolic blood pressure (SBP) > 140 mmHg &/or diastolic BP > 90 mmHg in recent 2 clinic visits were invited to participate. Structured questionnaire was designed to collect personal and clinical parameters. Drug adherence was assessed by the validated 8-item Morisky's Medication Adherence Scale (MMAS-8). Health literacy was assessed by the Chinese Health Literacy Scale for Chronic Care (CHLSCC). Prescriptions, medical history and biochemical results were collected from electronic record system. Multi-variate logistic regression using low drug adherence as dependent variable was performed.

Results: Two hundred and ninety one (291) participants were successfully interviewed. The male to female ratio was 0.65. The mean age was 67.0 (S.D. 9.9). More than 80% of them reported good to moderate drug adherence while 13.7% of them had low drug adherence. More than half of them had inadequate health literacy. The mean number of years since hypertension diagnosed was 9.65 (S.D. 8.73). Almost 40% of them had hypertension less than 5 years. The most popular prescription was once-daily regimen, with 2 or more type of anti-hypertensive drugs. Calcium channel blockers were most commonly prescribed. In the logistic regression model predicting low drug adherence, only diagnosis of HT less than 5 years was statistically significant (adjusted OR = 2.32, 95% C.I. 1.12-4.80, p = 0.02). There was no statistical significance in sex, older age, educational level, health literacy, occupation, number of types of antihypertensive drugs and daily frequency of drugs.

Conclusion: In primary care setting, patients with uncontrolled hypertension reported satisfactory drug adherence. They would have lower drug adherence if their hypertension were diagnosed less than 5 years.

Abbreviations: BP: Blood Pressure; EHS: European Hypertension Society; HBPM: Home Blood Pression Monitoring; HL: Health Literacy; RCT: Randomized Controlled Trial; SBPM: Self-blood Pressure Monitoring.

Background

More than one third of adult population worldwide suffer from hypertension [1]. When the elevated blood pressure is higher than the recommended level, uncontrolled hypertension occurs and causes significant increase in the risk of cardiovascular morbidity and mortality [2]. Uncontrolled hypertension, which is defined as systolic blood pressure (SBP) > 140 mmHg and/or diastolic blood pressure (DBP) > 90 mmHg in at least 2 office measurements [3], is common among hypertensive population. Worldwide, there are 46.3% of them did have controlled blood pressure [4], however, patients from low- and middle-income countries have particularly worse control than those from high-income countries. Their discrepancies have been widening in recent years [5]. Various international guidelines have highlighted different strategies for blood pressure control in order to reduce morbidity and mortality in different populations [6,7]. The American "Healthy People 2020" campaign suggests a comprehensive hypertension management which includes hypertension diagnosis (awareness), use of anti-hypertensive medication (treatment), and achievement of a satisfactory

SBP and DBP with treatment (control) [8]. Among all the management modalities, antihypertensive drugs are the single most important intervention to lower blood pressure.

Poor drug adherence is associated with less BP control [9]. The World Health Organization's definition of adherence is "The extent which a person's behaviour—taking medication, following diet, and/or executing lifestyle changes—corresponds with agreed recommendations from a healthcare providers". Non-adherence to antihypertensive treatment refers to patients who do not take anti-hypertensive as prescribed. It has been identified as one of the major causes attributed to the failure of controlling high blood pressure [10]. Primary care patients with lower drug adherence were found to be correlated with higher cardiovascular mortality [11]. Therefore, it is vital to identify patients with low drug adherence and subsequently

offer interventions to modify patient's behaviour. Low drug adherence can be measured by various methods, such as indirect method using pills count, pharmacy drug-refill records or lab test; direct method such as MMAS-8. While indirect method is costly and labour intensive, self-reporting for medication adherence may carry risk of invalid results caused by the pattern of socially desirable responses.

There were known socioeconomic factors and clinical factors affecting adherence or non-adherence to anti-hypertensive treatment. Clinical factors included number of comorbidities, hyperlipidemia, taking CCB, duration on medication and duration of hypertension being diagnosed. Examples of socioeconomic factors could be sex, age, duration of cigarette consumption, occupation and educational level [12]. Patients with higher educational level usually have better health knowledge, therefore have better self-care. The underlying reasons may be attributable to one's intellectual ability and capability to process and execute medical information. It could be indirectly measured by years of formal education or the level of education attained. In recent years, the concept of Health Literacy (HL) has been developed to understand whether a patient's health literary competence makes to health discipline. Health Literacy is defined as "The degree to which individuals have the capacity to obtain, process, and understand basic information and services needed to make appropriate decisions regarding their health" [13]. It is suggested that patients with low HL may have difficulty to adhere to medical advices, including drug adherence. It may be a contributing factor to their worse health outcome [10]. A previous study demonstrated that low HL level was associated with greater knowledge deficits and less adherence to oral anticoagulants treatment [14]. Nevertheless, based on current evidence, it is still unable to validate a definite association between HL & medication adherence in older adults' group with cardiovascular disease (CVD) or diabetes mellitus (DM) [15]. The relationship of HL level and drug adherence to anti-hypertensive treatment appears to be vague.

As revealed in Systematic meta-review by Geboers et al. [16] some adherence interventions focusing on education and on lowering the health literacy demands of adherence instructions were found to be effective among older adults. The conclusion may be applicable to health care services targeting at older adults. In Hong Kong, 17.8% of the population have hypertension, which is the most prevalent chronic health condition. There is a high proportion of older patients attending public outpatient clinics for health problem [17], particularly for chronic health condition [18]. Lee at al. [19] studied primary care patients with hypertension in a single outpatient clinic in Hong Kong. It was found that younger age, shorter duration of antihypertensive agents used as well as job status being employed were negatively associated with drug adherence. The study of patients' health literacy level, comparison of different types of anti-hypertensive drugs, frequency of drug administration was not included.

Aim and objectives

The aim of this study is to demonstrate the sociodemographic and the clinical factors associated with both the good to moderate drug adherence and the low drug adherence in patients with uncontrolled hypertension. Details of their HL and the anti-hypertensive drugs are being collected and analysed. Those factors are able to identify various modifiable risk elements for targeted intervention. The identified demographic factors can also provide further opportunities to enhance health care service planning.

Methods

Study design and setting

The study protocol was approved by the Research Ethics Committee, Kowloon West Cluster, Hospital Authority of Hong Kong S.A.R. (Reference number: KW/EX-15-115(88-14). The study clinics were government-funded community outpatient clinics in Kwai Chung and Tsing Yi District of the Hong Kong S.A.R. This study was part of a cluster randomized controlled trial (RCT) recruiting primary care patients with uncontrolled hypertension. The RCT compared uncontrolled hypertension patients undergoing either educational intervention and provision of validated home blood pressure devices or usual care. We performed a cross-sectional survey in 5 outpatient clinics during recruitment of RCT subjects from April to July 2016. Potential research subjects were Hong Kong citizens who received regular follow-up for hypertension. Most of the target patients attended once every 2 to 3 months for hypertension and other chronic conditions.

Inclusion and exclusion criteria

Uncontrolled hypertension is defined as a persistent office systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic BP (DBP) ≥ 90 mmHg according to the European Society of Cardiology (ESC) and the European Society of Hypertension (ESH) 2018 guideline [3]. We included all the patients who attended for doctors' follow-up with anti-hypertensive prescriptions more than six months, and their clinic systolic blood pressure (SBP) were more than 140 mmHg and / or diastolic blood pressure (DBP) more than 90 mmHg in their most recent 2 clinic visits. Patients who were mentally or physically unfit for the questionnaire survey, pregnancy or had atrial fibrillation were excluded from the study.

Subjects recruitment

Clinic nurses identified potential subjects after they had routine blood pressure measurement for patients using automated oscillometric blood pressure monitors. Research assistants helped explanation of the study and signing of written consent. Baseline blood pressure were measured 3 times after taking at least 5 minutes rest in a sitting position by Ormon HEM-907○R device (passed International Protocol of the European Society of Hypertension for elderly) [20]. We took the mean of the second 2 out of 3 office readings each time. All the patients were provided with the written informed consent, and the work was conducted in accordance with the Declaration of Helsinki [21]. Research assistants then interviewed eligible subjects with structured questionnaires.

Measuring outcomes and tools

Basic socioeconomic parameters were collected by structured questionnaires. Subjects' clinic BPs, body mass index and waist circumference were measured. All biochemical laboratory tests, anti-hypertensive drugs prescribed within 3 months, drug dosage, drug frequency, medical history such as presence of CVDs, DM and hyperlipidemia were collected from our computerized patient records. New laboratory tests were arranged if no appropriate lab results were available.

Clinical factors definition: Participants' body mass indexes were grouped into underweight, normal, overweight and obesity according to cutoff recommended by WHO (Western Pacific Regional Office) [22,23]. Waist circumference were categorized into normal when they were < 80 cm in women or < 90 cm in men according to the International

Diabetes Federation consensus worldwide definition of metabolic syndrome for South Asian [24]. Number of years since hypertension diagnosis were categorized into HT diagnosis < 5 years and ≥ 5 years. The cutoff was based on a study of elevated cardiovascular risk in patients with newly diagnosed hypertension when they had low drug adherence [11]. Hypertension was firstly classified into complicated hypertension if participants were diagnosed with disease of target organ damages, such as ischaemic heart disease, heart failure, stroke, renal impairment, significant proteinuria, hypertensive retinopathy and peripheral vascular disease. Otherwise, they had uncomplicated hypertension. Secondly, the level of hypertension was categorized into Grade I, II and III according to EHS/ ECS 2018 guideline's cutoff of office blood pressure levels [3].

Validated 8-item Morisky's Medication Adherence Scale (MMAS-8): The MMAS-8 consists of 8 self-reported items about patients' common medication-taking behaviours leading to the omission of drug [25]. There are seven yes/no questions, and the last one is a 5-point Likert-scale rating. It has been used widely in studies of different chronic illnesses including hypertension [19]. Subject with a score of 8 (full mark) indicates good drug adherence. Subject with a score of 6-7 indicates moderate drug adherence, while those with a score of 5 or below indicates low drug adherence.

Chinese Health Literacy Scale for Chronic Care (CHLSCC): The CHLSCC was validated in Hong Kong to assess health literacy in Chinese patients with chronic illnesses. It displayed a good internal reliability (Cronbach's α = 0.91) among Hong Kong subjects [26]. It assesses the subjects' abilities of remembering, understanding, applying and analyzing resulted in 4 corresponding subscales. The definitions of subscales can be divided into 4 component sessions: remembering- the ability of retaining knowledge; understanding, - the ability of acquiring the meaning of instructional messages; applying, the ability of executing procedures in a given situation and analyzing, the ability of breaking materials into parts and determining how these parts are related to one another and to the overall structure or purpose. The CHLSCC can be either self-administered or assisted-administered by the trained interviewer. In this study, all the participants were interviewed by investigators or clinic nurses. Participants scored 36 out of 48 or above indicated adequate health literacy. If not, for those who scored equal to or less than 35, they would be categorized as inadequate health literacy.

Sample size estimation

There were around 8,000 registered patients obtaining anti-hypertensive drugs regularly from the 5 study clinics. Sample size calculation was based on the expected good drug adherence rate as 65%, with reference to a similar study performed in similar clinical setting [19]. In order to achieve 90% confidence level and 5% false positive error to detect a difference in drug adherence using the MMAS-8, the minimum number of subjects required were 244 by sampling 5 general outpatient clinics.

Statistical analysis

Descriptive statistics were used to summarize participants' baseline demographic factors (such as age, sex, educational level, occupations, etc.) and clinical factors (such as waist circumference, body mass index, comorbidity, medication history). All continuous values are reported as means and standard deviations (SD), or frequencies and percentages as appropriate. Average of the 2 office blood pressure readings (discarded the first measurement reading) was calculated to get the mean SBP and DBP. Demographic variables were stratified by the total MMSA-

8 score into 3 drug adherence levels according: high, moderate and low. The non-adjusted odd ratio with significant values was calculated using Pearson Chi square Test. To evaluate the relationship of different sociodemographic and clinical characteristics between participants with low against those with moderate to good drug adherence, multivariate logistic regression was performed. In all the multivariable models, age, gender, race, years of education, employment status, and clinical characteristics were adjusted. $P < 0.05$ was considered statistically significant. All analyses were performed using SPSS 25 (Copyright© IBM, USA).

Results

Characteristics of sample

Table 1 showed the comparison of sociodemographic characteristics between different drug adherence of the 291 participants. 337 eligible subjects were initially approached. The response rate was 86.4%. Their mean age was 67.0 (S.D. 9.9). Vast majority of them (95%) were older than 50 years old. The male to female ratio was 0.65. The overall educational level was low. Almost two third (61.5%) of them attended primary school or below and only 4.1% of them attended University or above. In addition, most of them (78%) were not employed. In the perspective of their personal habits, majority of them did not smoke (never smoker = 73.9% Vs ex-smoker = 22.0%), nor drank (non-drinker = 89% Vs ex-drinker 2.7%). Most of them were either obese (62.7%) or overweight (19.5%) according to the World Health Organization (WHO) body mass index (BMI) cut off for Asian [22,27]. Almost two third of them (64.9%) had waist circumference higher than normal.

The mean SBP was 152.1 mmHg (S.D. 10.1 mmHg) and the mean DBP was 79.7 mmHg (S.D. 11.4 mmHg). Most subjects had predominately systolic hypertension. More than one third (36.1%) of them had complicated hypertension and the rest (63.9%) had uncomplicated hypertension. Most of the subjects (80.1%) were in grade 1 HT (SBP 140-159 mmHg and/or DBP 90-99 mmHg), 17.2% of them were in grade 2 HT (SBP 160-179 mmHg and/or DBP 100-109 mmHg) and less than 3% were in grade 3 HT (SBP ≥180 mmHg and/or DBP ≥110 mmHg). The average number of years since hypertension was diagnosed varied highly from 0.5 years to 49 years. The most commonly prescribed anti-hypertensive drugs (AHDs) was calcium channel blockers (73.5%), followed by beta-blocker (35.4%) and angiotensin converting enzyme inhibitor (23.7%). Most of the participants took one to two types of AHDs (mean number of types of AHDs = 1.73, S.D. 0.86) for their treatment in which 70% of them took AHDs once daily, while one fourth (26.5%) of them took drugs twice daily.

Validated 8-item Morisky's Medication Adherence Scale (MMAS-8)

All participants completed MMAS-8 either by themselves or with clinic nurses' assistance. The MMAS-8 overall mean score was 6.87/ 8 (S.D. 1.34, median 7). 41.2% of them scored full mark 8 over 8 and 45% of them scored 6 to 7 over 8. These indicated that 81.4% of the participants had good to moderate drug adherence. Whereas 17.1% of the participants scored 5 or less, indicating their low drug adherence.

The Chinese Health Literacy Scale for Chronic Care (CHLSCC)

The CHLSCC overall mean score was 31.7/ 48 (S.D. 13.65, median 35). Half of the subjects (49.8%) scored ≥ 36, which demonstrated an adequate health literacy. The remaining half (50.2%) scored < 36, which

Table 1. Comparison of sociodemographic characteristics between different drug adherence of the participants

Characteristics	Good DA Group (N=121)	Moderate DA Group (N= 116)	Low DA Group (N=54)	Total (N=291)	P-value*
Gender (%)					0.743
Male	48 (39.7%)	48 (41.4%)	19 (35.2%)	115 (39.5%)	
Female	73 (60.3%)	68 (58.6%)	35 (64.8%)	176 (60.5%)	
Age Group (%)					0.430
49 or below	3 (2.5%)	2 (1.7%)	4 (7.4%)	9 (3.1%)	
50 - 64	46 (38.0%)	44 (37.9%)	21 (38.9%)	111 (38.1%)	
65-79	55 (45.5%)	59 (50.9%)	24 (44.4%)	138 (47.4%)	
80 or above	17 (14.0%)	11 (9.5%)	5 (9.3%)	33 (11.3%)	
Education (%)					0.906
Primary or below	76 (62.8%)	72 (62.1%)	31 (57.4%)	179 (61.5%)	
Secondary	39 (32.2%)	40 (34.5%)	21 (38.9%)	100 (34.4%)	
Tertiary or above	6 (5.0%)	4 (3.4%)	2 (3.7%)	12 (4.1%)	
CHLSCC Chinese Health Literacy Scale for Chronic Care					0.779
Adequate Health Literacy (≥36) (%)	58 (47.9%)	58 (50.0%)	29 (53.7%)	145 (49.8%)	
Indequate Health Literacy (<36) (%)	63 (52.1%)	58 (50.0%)	25 (46.3%)	146 (50.2%)	
Occupation (%)					0.018
Retired / unemployed	60 (49.6%)	66 (56.9%)	23 (42.6%)	149 (51.2%)	
Housewife	35 (28.9%)	30 (25.9%)	13 (24.1%)	78 (26.8%)	
Manual	11 (9.1%)	4 (3.4%)	10 (18.5%)	25 (8.6%)	
Clerical	10 (8.3%)	4 (3.4%)	2 (3.7%)	16 (5.5%)	
Mixed	5 (4.1%)	12 (10.3%)	6 (11.1%)	23 (7.9%)	
Smoking History (%)					0.597
Smoker	4 (3.3%)	4 (3.4%)	4 (7.4%)	12 (4.1%)	
Non-smoker	92 (76.0%)	83 (71.6%)	40 (74.1%)	215 (73.9%)	
Ex-smoker	25 (20.7%)	29 (25.0%)	10 (18.5%)	64 (22.0%)	
Alcohol Intake (%)					0.678
Non-drinker	109 (90.1%)	104 (89.7%)	46 (85.2%)	259 (89.0%)	
≥ weekly Drinker	9 (7.4%)	8 (6.9%)	7 (13.0%)	24 (8.2%)	
Past Drinker	3 (2.5%)	4 (3.4%)	1 (1.9%)	8 (2.7%)	

CHLSCC: Chinese Health Literacy Scale for Chronic Care; DA: Drug adherence
* P-value by Pearson Chi-Square Tests

manifested an inadequate health literacy. Although some of the subjects scored the lowest in the applying section (mean score 6.04/ 12, S.D. 4.61), they performed the best in the remembering session (mean score 10.2/ 12, S.D. 3.70). Individual's socioeconomic and biochemical binary variables were put into the Pearson Chi-Square Test or Fisher Exact Test to form cross tabulation with low, moderate and good drug adherence. The association between participants taking angiotensin- converting enzyme antagonist or not and their occupation showed statistically significant difference among the subjects with different drug adherence (Table 2).

Table 3 showed the results of multivariate logistic regression model using low drug adherence as the dependent variable. In the logistic regression model, only diagnosis of HT less than 5 years was statistically significant to predict low drug adherence (adjusted OR = 2.32, 95%C.I. 1.12-4.80, p = 0.02). There was no statistically significant in terms of sex, older age, educational level, health literacy, occupation, number of types of antihypertensive drugs and daily frequency of drugs. The number or the types of AHD as well as the daily frequency of AHD had no association with the level of drug adherence.

Discussion

This study uncovered that in primary care patients with uncontrolled office BP, 81.4% of the participants had moderate to good drug adherence. The overall drug adherence level was higher than that previous literature. In a systematic review using MMAS-8, the result highlighted particularly low drug adherence among patients with uncontrolled hypertension [9]. In the comparison of other surveys for hypertensive patients in Hong Kong, there were 67.1% (indirect assessment method) and 65.1% (MMAS-8) of patients having high to intermediate drug adherence respectively [11,19]. The observed drug adherence rate was higher might be due to a higher proportion of study subjects with hypertension diagnosed for more than 5 years. Nevertheless, in our study, the low drug adherence group had diagnosis of hypertension less than 5 years, that is consistent with the better drug adherence in those having hypertension diagnosed for a longer period of time in a similar study [9]. Multifaceted approach is needed to improve medication adherence through patient education on hypertension, its treatment modalities and its long-term complication. Patient engagement should be encouraged through interactive education sessions, health coaching, motivation interviewing, stage of change behaviour counseling or pharmacist HT management [30].

As to the use of anti-hypertensive drugs, CCB was the most commonly prescribed medication, followed by ACEI or ARB and then beta-blocker. The prescription pattern was different from that practiced in 2001 to 2005. At that time, the most commonly prescribed AHD was beta-blocker, followed by CCB and ACEIs. The reason for such change in prescription could be that half of the subjects had diabetes mellitus and more than one third of them had complicated HT. The prescription recommendation of AHD followed the changes in various guidelines with patients' comorbidity [3,28].

In contrast to the systematic review by Smaje et al., this study did not demonstrate positive effect of patients with higher health literacy,

Table 2. Comparison of clinical characteristics between different drug adherence of the participants

Characteristics	Good DA (N=121)	Moderate DA (N= 116)	Low DA (N=54)	Total (N=291)	P-value*
BMI cutoff (kg/m²)					0.912
Underweight (<18.5)	3 (2.5%)	3 (2.6%)	1 (1.9%)	7 (2.4%)	
Normal (≥18.50 - <23)	22 (18.2%)	16 (13.8%)	8 (14.8%)	46 (15.8%)	
Overweight (≥23 - <25)	21 (17.4%)	27 (23.3%)	10 (18.5%)	58 (19.9%)	
Obese (≥25)	75 (62.0%)	70 (60.3%)	35 (64.8%)	180 (61.9%)	
Waist Circumference (cm)					0.995
Abnormal (%) (M ≥90cm or F≥ 80cm)	79 (65.3%)	75 (64.7%)	35 (64.8%)	189 (64.9%)	
Normal (%) (M <90cm or F< 80cm)	42 (34.7%)	41 (35.3%)	19 (35.2%)	102 (35.1%)	
No. of years since hypertension diagnosis					0.224
0-4 years	48 (39.7%)	38 (32.8%)	28 (51.9%)	114 (39.2%)	
5-9 years	16 (13.2%)	24 (20.7%)	6 (11.1%)	46 (15.8%)	
10-14 years	19 (15.7%)	17 (14.7%)	10 (18.5%)	46 (15.8%)	
15-19 years	18 (14.9%)	22 (19.0%)	5 (9.3%)	45 (15.5%)	
20 years or more	20 (16.5%)	15 (12.9%)	5 (9.3%)	40 (13.7%)	
No. of types of antihypertensive drugs					0.496
One type or less	61 (50.4%)	55 (47.4%)	22 (40.7%)	138 (47.4%)	
Two types or more	60 (49.6%)	61 (52.6%)	32 (59.3%)	153 (52.6%)	
Antihypertensive drug frequency					0.114
Once daily or less	94 (77.7%)	76 (65.5%)	38 (70.4%)	208 (71.5%)	
Twice daily or more	27 (22.3%)	40 (34.5%)	16 (29.6%)	83 (28.5%)	
Classification of office BP					
Grade 1 (140-159mmHg &/or 90-99mmHg)	100 (82.6%)	93 (80.2%)	40 (74.1%)	233 (80.1%)	0.618
Grade 2 (160-179mmHg &/or 100-109mmHg)	17 (14.0%)	21 (18.1%)	12 (22.2%)	50 (17.2%)	
Grade 3 (≥ 180mmHg &/or ≥110mmHg)	4 (3.3%)	2 (1.7%)	2 (3.7%)	8 (2.7%)	
Type of Anti-hypertensive Drug					
Diuretics	11 (9.1%)	3 (2.6%)	2 (3.7%)	16 (5.5%)	0.073
Beta Blocker	44 (36.4%)	40 (34.5%)	19 (35.2%)	103 (35.4%)	0.955
Calcium Channel Blocker	88 (72.7%)	82 (70.7%)	44 (81.5%)	214 (73.5%)	0.321
Angiotensin Receptor Blocker	22 (18.2%)	11 (9.5%)	12 (22.2%)	45 (15.5%)	0.057
Angiotensin Converting Enzyme Inhibitor	18 (14.9%)	37 (31.9%)	14 (25.9%)	69 (23.7%)	0.008
Hyperlipidemia (%)					0.645
Yes	101 (83.5%)	98 (84.5%)	48 (88.9%)	247 (84.9%)	
No	20 (16.5%)	18 (15.5%)	6 (11.1%)	44 (15.1%)	
Diabetes Mellitus (%)					0.864
Yes	49 (40.5%)	43 (37.1%)	21 (38.9%)	113 (38.8%)	
No	72 (59.5%)	73 (62.9%)	33 (61.1%)	178 (61.2%)	

* P-value by Pearson Chi-Square Tests

Table 3. Multivariate Logistic regression: predictors for having Low drug adherence

	Reference Group	Coefficient	P-Value	Adjusted Odd Ratio	95% C.I. of O.R.
Sociodemographic Factors					
Age	≥ 80	-0.71	0.09	0.99	(0.31,3.20)
Sex	Male	-0.01	0.99	0.49	(0.22,1.11)
Education	≤ Primary School	-0.14	0.71	0.87	(0.42,1.81)
Health Literacy	Inadequate = CHLSCC <36	-0.24	0.49	0.79	(0.40,1.56)
Occupation	Being employed	0.66	0.09	1.94	(0.91,4.14)
Smoking History	Being smoker	0.66	0.39	1.93	(0.44,8.49)
Drinking History	Being Drinker or ex-drinker	0.48	0.40	1.62	(0.53,4.96)
Clinical Factors					
Waist Circumference (cm)	Abnormal (M ≥90cm or F≥80cm)	-0.37	0.40	0.69	(0.29,1.65)
Body Mass Index (kg/m²)	Obesity (≥25)	0.24	0.58	1.28	(0.54,3.04)
Hypertension (Grade 1 Vs Grade 2&3)	Grade 1 Hypertension	-0.53	0.16	0.59	(0.28,1.24)
Complicated Hypertension	Yes	0.14	0.69	1.15	(0.57,2.34)
Year of Hypertension since diagnosis (Years)	**< 5 years**	**0.84**	**0.02**	**2.32**	**(1.12,4.80)**
Having DM	Yes	-0.11	0.76	0.90	(0.44,1.81)
Having Hyperlipidemia	Yes	0.58	0.27	1.79	(0.64,4.98)
No. of types of antihypertensive drugs	≥ 2	0.32	0.56	1.38	(0.47,3.99)

Daily Antihypertensive drugs frequency	≥ 2	0.23	0.57	1.26	(0.57,2.78)
On Diuretics	Yes	-0.44	0.61	0.64	(0.12,3.52)
On Beta-Blocker	Yes	0.08	0.85	1.09	(0.44,2.68)
On Calcium Channel Blocker	Yes	0.52	0.30	1.69	(0.63,4.55)
On Angiotensin Converting Enzyme Inhibitor	Yes	0.35	0.47	1.41	(0.56,3.59)
On Angiotensin Receptor Blocker	Yes	0.81	0.12	2.25	(0.81,6.23)

younger age and being male would have better drug adherence [29]. Factors which influenced the result were health related knowledge, cognitive impairment and polypharmacy as an impact on adherence. In this study, apart from duration of hypertension diagnosis, all other demographic and clinical factors were not statistically significant level. The reason why drug adherence were not associated with HL could be explained by one study, that there may be non-linear association between HL and drug adherence. The lowest adherence group were the patients with moderate health literacy. Further studies may need to be undertaken regarding their non-linear relationship.

The strength of this study involved both older-age group and lower educated participants, which can reflect a more realistic social phenomenon.

Limitations

We have excluded patients physically / mentally unfit for HBPM deliberately in this study because it is uncertain whether they would be the most vulnerable by the role of HL in their medication adherence. Factors associated with poor medication adherence in older patients include multimorbidity, cognitive impairment, complex regimens with multiple prescribing physicians [29].

Assessment by self-reporting drug adherence may only give snapshot of the patients' daily adherence. The actual drug adherence may be overestimated, due to the known phenomenon of white coat adherence: i.e. increased adherence during the few days preceding a medical contact.

Conclusion

In primary care setting, patients with uncontrolled hypertension reported satisfactory drug adherence. They would have lower drug adherence if their hypertension were diagnosed less than 5 years.

Declarations

Ethics approval and consent to participate

The study was approved by Research Ethics Committee, Kowloon West Cluster, Hospital Authority of Hong Kong S.A.R. approval number: KW/EX-15-115(88-14).

Consent for publication

Written consents for publication were sought from all participants

Availability of data and materials

All data generated or analysed during this study are included in this published article

Authors' contributions

SF, MD, CW and BC participated in the study design and analyses. SF and MD conducted the study, SF, MD and CW performed statistical Analysis. SF wrote the first draft of the manuscript. MD, CW and BC commented on this draft and performed critical revisions. All authors have read and approved the manuscript.

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