ORIGINAL ARTICLE

Thirty-minute Ambulatory Blood Pressure and Blood Biochemistry Measurements in Adults With Hypertension Using Herbs: A Cross-sectional Study

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ABSTRACT

Introduction: Introduction: Globally, there is a growing interest of herbs usage among hypertensive patients. The aim of study was to investigate thirty-minute ambulatory blood pressure (ABP), blood biochemistry measurements and associated factors among hypertensive adults using herbs. Methods: This cross-sectional study was performed among hypertensive adults complementing herbs and attending primary care clinics in Kinta Valley, Perak. Data was collected using standard International Complementary and Alternative Medicine Questionnaire (I-CAMQ) and measurements of thirty-minute ABP and blood biochemistry were conducted using ambulatory blood pressure monitor and point of care units respectively. Results: A total of 86 hypertensive adults using 55 herb combinations were recruited. 80.3% commonly used traditional Chinese medicine, ulam and fenugreek for more than one year. The median age of the participants was 63. The participants complementing herbs had means' for waist-hip ratio and BMI in the high (0.92 ± 0.07) and overweight (27.14 ± 5.63) range respectively. Mean ± SD reading of systolic blood pressure was 138 ± 14.27 mm/Hg and 81.4% had normal hemoglobin levels. The mean ± SD of total cholesterol and low-density lipoprotein were normal; 166.81 ± 39.40 mg/dl and 85.15 ± 34.34 mg/dl with higher triglyceride readings 181.02 ± 61.24 mg/dl. SBP (>140 mm/Hg) and age range 61-70, waist/hip ratio (high risk for CVDs) among females and Malay ethnicity were associated with higher TC (p=0.003), HDL (p=0.006), LDL (p=0.001) and Chol/HDL (p=0.036). Conclusion: Complementing drugs with herbs associated with patients aged above 60, females and the Malay ethnicity. The patients' attitude of complementing drugs with herbs showed no impact on the measured physiological and biochemical parameters. A randomized controlled trial with a fixed herb regime is warranted.
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Keywords: Herbs; Anti-hypertensive drugs; Ambulatory blood pressure measurements; Hypertension; Lipid profile

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INTRODUCTION

Hypertension is defined as persistent elevations of systolic blood pressure (SBP) of 140 mm/Hg or greater and/or diastolic blood pressure (DBP) of 90 mm/Hg or greater, taken at least twice on two separate occasions (1). It is a major risk factor for heart failure, stroke, renal failure and myocardial infarction (2). It was tabulated that 1.13 billion people globally were affected by hypertension and the death toll recorded was at an approximate value of 7.5 million (1). Globally including in Malaysia, there is a spike in the prevalence of hypertension from years 2015 to 2021 with a significant increase of 14.1% among individuals above the age of 30 years old (3).

Nevertheless, only one-quarter of Malaysians have been able to achieve blood pressure control despite the availability of many treatment options to curb hypertension (4). Among the factors attributed to poor control of blood pressure were delays in stepping

up treatment regimens such as lifestyle modification, and poor adherence to structured treatment (5).

On the other hand, there are evidence of hypertension patients using different herbs regime prescribed by herbs practitioners namely traditional Chinese Medicine (TCM) and self-prescribed herbs (6). TCM practitioners use various combinations of herbs in order to treat elevated blood pressure by focusing on patients' psychological and physical factors (7). An example of effective TCM use is Qian Yang He Ji which improved blood pressure readings significantly ($p<0.001$) (8). The self-prescribed herbs being used are usually raw plants that are either dried, minimally processed or even mildly boiled and infused (9). A study conducted by Asgary et al. (2016) reported that hypertensive patients with prescribed anti-hypertensive drugs found the use of self-prescribed herbs such as Vaccinium myrtillus was efficient in controlling hypertension (10).

Self-prescribed herbs are the act of complementing herbs or herbs supplements with conventional anti-hypertensive drugs in self-managing hypertension. A study by Ardalani et al. (2016), reported that participants who consumed Rhus coriaria capsules complemented with captopril reported significant improvements in SBP ($p=0.03$) and DBP ($p=0.04$) compared to the placebo group (11). Moreover, there have also been studies that elucidate the effectiveness of complementing herbs such as Salvia miltiorrhiza with diuretics and beta blockers in improving total cholesterol (TC) and low-density lipoprotein (LDL) levels ($p=0.01$) (12). Body mass index (BMI) values have also reported improvements ($p<0.01$) when Cynara scolymus was complemented with captopril (13).

Furthermore, blood pressure measurements using ambulatory blood pressure monitors (ABPM), are useful in detecting blood pressure variations and can be used as a treatment guidance for detecting treated but uncontrolled hypertension as it is able to measure the blood pressure readings over prolonged periods. Previous studies have explained that the usage of ABPM is preferred and is the gold standard as it provides consistency and is a better predictor for hypertension (14). Moreover, Point of Care Technology (PoCT) usage to measure parameters like lipid profile was found to be comparable to those done in laboratories and can be completed within five minutes (15). The use of PoCT can reduce cost, waiting time and the necessity for multiple visits. However, the use of PoCT and ABPM in actual clinical settings, particularly in Asian regions are rather limited (16).

A study reported some associated factors with the use of herbs among patients include females, higher education levels, high socioeconomic backgrounds and those with multiple ailments (17). There are plausible studies conducted worldwide on the prevalence of self-prescribed herbs use among adults with hypertension and performed assessments on blood pressure, anthropometry and blood biochemistry which reduced overall blood pressure readings alongside improving BMI, TC, LDL and HDL levels (11-13).

Some problem statements that are present however include, the prevalent usage of herbs with anti-hypertensive drugs in developing and developed countries as the number of people with hypertension still remains high despite using conventional treatments. Moreover, published articles on the concurrent herbs and drug usage in the management of hypertension, anthropometry measurements and biochemistry analysis are relatively low in Malaysia. Hence, the aim of the study was to identify the usage of herbs with anti-hypertensive drugs and to determine blood pressure levels, biochemistry analysis and anthropometry measurements using ABPM and PoCT among hypertensive patients complementing herbs and its' association with sociodemographic details in Malaysian primary health clinics.

MATERIALS AND METHODS

Study area and design

This research was conducted in Klinik Kesihatan Kampar (KK Kampar), a primary health clinic in the suburban district of Kampar which is located 160 km northwest of the capital of Malaysia, Kuala Lumpur, and Tabib Cina Teh Hun Phing which is situated in Jalan Pasir Pinji, Ipoh, Perak. The study was a cross-sectional based descriptive study that measured outcomes and exposures among the study participants.

Sample size calculation and determination

The sample size was determined based on the characteristics of randomized participants before and after complementing herbs. These values were taken from a paper published by Ardalani et al., (2019) due to the similarity it shares with this study. Using the online software G*power, it was calculated that 82 participants must be enrolled in this study with an effect size of 0.3 and an alpha error probability of 0.05. Upon the inclusion of a five percent dropout rate calculation, 86 participants were recruited.

Inclusion and Exclusion criteria

The inclusion criterion for the participants were that they had to be on anti-hypertensive drugs administered by doctors, actively complementing herbs and have completed booster vaccination for Covid-19. Participants who complemented herbs

were categorized as often (two to three times a week), sometimes (less than once a week) and rarely (less than twice a month). Adults with an age range of 18 years to 80 years, were included in the study.

Data Collection Tool

A semi-structured online questionnaire was used for data collection. This questionnaire was developed based on I-CAMQ which assesses the types of herbs and herbal supplements being taken by the participants (18) and other literature reviews. The questionnaire consists of six sections namely; sociodemographic characteristics, disease details and high blood pressure management, medical history, I-CAMQ and general information. A pre-test of the questionnaire was done with 10 subjects who were independent to the study. The questionnaire is available in English and Bahasa Melayu respectively. A patient complication form was given to the doctors in order for them to screen the participants on their herb usage and health complications.

Screening tools

Ambulatory and PoCT analysis were used to measure the thirty-minute blood pressure and blood levels of lipid profiles and hemoglobin (Hb) among hypertensive adults using herbs. The GMM H01 Body BMI Health Scale Ultrasonic Height, Weight & Fat Analyzer was used to measure height (cm), weight (kg) and BMI levels while waist and hip circumference was measured by a measuring tape. Blood pressure was measured using the ABPM machine, biochemical test for hemoglobin was assessed via hemocue and an Ultra Mission Cholesterol meter was used for lipid profile outcomes.

Ethical Consideration and Approval

Approval was obtained from the UTAR Scientific and Ethical Review Committee (SERC) with the code U/SERC/127/2021, National Medical Research Register (NMRR ID:22-00365-3NJ (IIR)) and other relevant approvals such as from Klinik Kesihatan Kampar as well as Tabib Cina Teh Hun Phing for site approval prior to the start of any study related activities. The informed consents were obtained during the official visit at the clinics by the investigator via face-to-face meetings. Written informed consent was obtained via patient information sheet and consent form which was given to participants as a hardcopy.

Data Collection Method

The target population included all eligible hypertensive adults attending the clinics in the time interval of the study period which was from March 2022 to October 2022. Purposive sampling technique was employed to recruit study participants. The participants were recommended by the doctors and the measurements were taken once the participants' current treatment regime for hypertension (conventional regime) and herbs regime were identified. The participants were first guided to fill in the semi-structured online questionnaire to determine sociodemographic factors and types of herbs complemented. Participants were not required to sign in to an account in order to fill in the questionnaire.

Anthropometric measurements for BMI and waist/hip ratio

Weight (kg) and height (m) were measured using the GMM H01 Body BMI Health Scale Ultrasonic Height, Weight & Fat Analyzer and the BMI values were generated automatically. The participants had to be barefooted with their heads upright and the analyzer was properly adjusted to obtain accurate readings as the measurements were only done once (19). Next, a stretch-resistant tape was used for measuring hip and waist circumference (WC) to calculate the waist/hip ratio. The narrowest point between the ribs and iliac crests was located and the placement of the measuring tape was snugly around it for waist measurement. The same was done at the roundest part of the rear for hip measurement and these were recorded in centimetres (20). Then, an online waist-to-hip calculator was used to calculate the results.

Thirty-minute ambulatory blood pressure measurements

Blood pressure was measured using an ambulatory blood pressure monitor (ABPM) with an appropriate cuff size which was not too loose or tight and was fixed onto the participant's arm by the researcher. The cuff was inflated at 5-minute intervals throughout a 30-minute period in order to obtain six blood pressure readings. The usage of the ABPM machine was explained thoroughly to the participants before fixing it to their arms to get the mean blood pressure, SBP and DBP. The digital monitor helped record the blood pressure readings during these intervals and was recorded into the researchers' device through the Vi-Health mobile application that was connected to the machine via Bluetooth (21).

Blood Biochemistry measurements of hemoglobin and lipid profile

The sample collection for the biochemical tests were done using the finger pricking technique and only a single deep prick was required to collect 10 µL of blood. The participant's finger was sterilised and punctured and the first drop of blood was wiped off while the second round drop of blood was collected. For lipid panel measurements, the Ultra Mission cholesterol monitor was used. Once the machine was turned on, the blood from the finger prick was added onto the strip and the lipid panel outcomes appeared on the meter together

with the unit of measurement that was set. The same steps were repeated for hemoglobin measurement whereby PoCT measurement was done with hemocue. Blood was filled into the microcuvette in one continuous process. The analyzer was turned on and the microcuvette was placed in the cuvette holder. Then, the cuvette holder was closed and the results were displayed within 15-60 seconds (22). Safety precautions were taken while handling and disposing of biohazard materials. The lancets, strips and microcuvettes were then disposed of into biohazard bags.

Data Analysis

The data was analyzed using Statistical Package for Social Science (SPSS) software, version 26. The z-test was applied for checking the normality of the data using kurtosis and skewness. The descriptive statistics of mean, median, standard deviation, frequency and percentages were calculated for the entire sample. A chi-square analysis was done for association analysis between sociodemographic characteristics with anthropometric, blood pressure and biochemical parameters. In this study, a p-value of less than 0.05 was considered statistically significant.

RESULTS

Participants' sociodemographic characteristics and medical histories

The initial number of participants recruited in this study was 88, however two of them decided to drop out resulting in a response rate of 97.7%. Table I displayed the sociodemographic and anthropometric characteristics of the study participants. Majority of the participants were from the age category of 61-70 (n=34; 39.5%) with a median age of 63. The ethnicity tabulation on the other hand showed that the participants were mostly Chinese (n=45; 52.3%), followed by Indians (24.4%) and Malays (23.3%). In addition to this, 52.3% of them had an income of less than three thousand while 61.6% had attained a secondary level of education. Moreover, the study participants were also mostly comprised of females. The commonly reported duration of using herbs was for more than one year and these herbs were mainly self-prescribed.

Table II on the other hand detailed the participants' medical histories. The majority of the participants had complaints of having high cholesterol (n= 63; 73.3%), followed by diabetes (46.5%), muscle pains (37.2%), migraine (20.9%) and asthma (18.6%). Furthermore, 58.1% of the participants had at least three co-morbidities.

Table I : Socio-demographic characteristics of the study participants

Variables	Total (n=86)		Chi-square
	n	%	(χ^2); p-value
Age groups			
<60	25	29.1	1.558; 0.459
61-70	34	39.5	
>70	27	31.4	
Gender			
Male	34	39.5	3.767; 0.052
Female	52	60.5	
Ethnicity			
Malay	20	23.3	13.977; 0.001*
Chinese	45	52.3	
Indian or Others	21	24.4	
Income levels			
No income	21	24.4	13.977; 0.001*
Below 3k	45	52.3	
Above 3k	20	23.3	
Education			
NA/Primary	19	22.1	31.419; 0.000*
Secondary	53	61.6	
Tertiary	14	16.3	
Herb Usage Frequency			
Sometimes	3	3.5	74.419; 0.000*
Often	83	96.5	
Herb Usage Duration			
<1 year	17	19.7	31.442; 0.000*
>1 year	69	80.3	
Complemented Herbs			
Self-Care	65	75.6	22.512; 0.000*
Prescribed (TCM and others)	21	24.4	

*indicates significance of p<0.05 for goodness of fit chi-square analysis

Table II : Medical History of participants complementing herbs and drugs

Medical History	Total (n=86)		Chi-square (χ^2); p-value
	n	%	
Asthma			
No	70	81.4	33.907; 0.000*
Yes	16	18.6	
Cancer			
No	84	97.7	78.186; 0.000*
Yes	2	2.3	
Heart Disease			
No	82	95.3	70.744; 0.000*
Yes	4	4.7	
Diabetes			
No	46	53.5	0.419; 0.518
Yes	40	46.5	
Cholesterol			
No	23	26.7	18.605; 0.000*
Yes	63	73.3	
Uric Acid			
No	86	100.0	-
Kidney Disease			
No	84	97.7	78.186; 0.000*
Yes	2	2.3	
Leukemia			
No	86	100.0	-
Liver Disease			
No	85	98.8	82.047; 0.000*
Yes	1	1.2	
Migraine			
No	68	79.1	29.070; 0.000*
Yes	18	20.9	
Muscle Pain			
No	54	62.8	5.628; 0.018*
Yes	32	37.2	
Parkinson			
No	86	100.0	-
Peptic Ulcer			
No	86	100.0	-
Stroke			
No	79	91.9	60.279; 0.000*
Yes	7	8.1	
Thyroid Disease			
No	84	97.7	78.186; 0.000*
Yes	2	2.3	
Urinary Tract Infection (UTI)			
No	84	97.7	78.186; 0.000*
Yes	2	2.3	
Falls			
No	78	90.7	56.977; 0.000*
Yes	8	9.3	
Osteoporosis			
No	85	98.8	82.047; 0.000*
Yes	1	1.2	
Number of Comorbidities			
<2	50	58.1	2.279; 0.131
3 or more	36	41.9	

*indicates significance of p<0.05 for goodness of fit chi-square analysis

'-' indicates that chi-square analysis was not done due to insufficient data

Prescribed anti-hypertensive drugs and herbs usage

Table III presented the prescribed anti-hypertensive drugs consumed by the participants. Amlodipine was the highly prescribed drug among the participants with 33 of them consuming it as a single drug to combat hypertension. Overall, 66.27% of the participants were prescribed with amlodipine as they were also taken in combination with other drugs such as bisoprolol, perindopril, hydrochlorothiazide, atenolol, valsartan and acetylsalicylic acid. On the other hand, 55 types of different combinations of herbs were reported by the participants. The usage of ulam was the highest among all the combination of herbs in this study with (n=13; 15.12%) and was specifically practiced by the Malay participants. Some examples of the common types of ulam consumed include Momordica charantia (bitter gourd), Centella asiatica (pennywort), Cucumis sativus (cucumber) and Carica papaya (papaya leaves). The next

Table III : Number of users for specific antihypertensive drug combinations

Antihypertensive Drug Combination	Number of Users (n), Percentage (%)
Amlodipine	33 (38.4)
Atenolol	1 (1.2)
Bisoprolol	1 (1.2)
Hydrochlorothiazide	2 (2.3)
Losartan	3 (3.5)
Micardis	1 (1.2)
Perindopril	4 (4.7)
Valsartan	1 (1.2)
Amlodipine + Acetylsalicylic acid or Atenolol or Bisoprolol or Hydrochlorothiazide or Perindopril or Valsartan (1 drug)	14 (16.3)
Amlodipine + Bisoprolol + Perindopril or Perindopril + Acetylsalicylic acid or Perindopril + Atenolol or Hydrochlorothiazide + Perindopril (2 drugs)	9 (10.5)
Amlodipine + Bisoprolol + Perindopril + Acetylsalicylic acid (3 drugs)	1 (1.2)
Acetylsalicylic + Perindopril + Aspirin	1 (1.2)
Bisoprolol + Acetylsalicylic acid or Hydrochlorothiazide or Perindopril or Losartan	8 (9.3)
Bisoprolol + Perindopril + Acetylsalicylic acid or Valsartan + Hydrochlorothiazide (2 drugs)	3 (3.5)
Losartan + Hydrochlorothiazide	1 (1.2)
Perindopril + Acetylsalicylic acid	1 (1.2)
Perindopril + Hydrochlorothiazide + Acetylsalicylic acid	1 (1.2)
Termisartan + Hydrochlorothiazide	1 (1.2)

frequent combination of herbs was tian ma gou teng yin (Gastrodia and Uncaria) which is classified as Traditional Chinese Medicine (TCM) with 14% (n=12) usage and commonly used by the Chinese participants. Trigonella foenum-graecum (fenugreek) was the third prevalent herb used among the participants in this study (n=8; 9.3%). Table IV elucidates the information on the diversity of complemented herbs with the frequency of intake and preparation methods respectively.

Measurements of anthropometry parameters (BMI and Waist/Hip Ratio)

Table V provided information on the participants anthropometry, thirty-minute blood pressure and biochemistry measurements. It is detailed that there was only a single person difference who distinguished participants in the normal and overweight BMI categories, with the majority falling under the normal BMI category (n=34; 39%). Subsequently, 22.1% of the individuals were obese. The mean ± SD for BMI was 27.14 ± 5.63 kg/m^2 which falls in the overweight group. Furthermore, the waist/hip ratio measurement showed that 47.7% of participants fell under the high risk of cardiovascular diseases as their mean ± SD values were 0.92 ± 0.07. Thus, complementing herbs with anti-hypertensive drugs was more common among the participants with a high risk for cardiovascular disease.

Measurements of thirty-minute of blood pressure

Blood pressure measurements via ABPM reported that the overall mean± SD of SBP among participants was 137.56 ± 14.27 mmHg whereby 51 (59.3%) of them had blood pressure readings of less than 140 mm/Hg. Similarly, DBP had a mean± SD of 77.57 ± 10.18 with a large majority of the participants reporting readings of less than 90 mm/Hg (n=78; 90.7%). Table 5 elucidates on the blood pressure measurements recorded.

Table IV : Information on diversity of complemented herbs with frequency of intake and preparation methods

Complement Herbs	Number of Users (n), Percentage (%)	Frequency of Intake	Preparation Methods
Almond and herbal concoction soup	1 (1.2)	1x/daily	Boiled
Aloe Vera	1 (1.2)	1x/daily	Blended
Apple Cider Vinegar with Butterfly pea and honey	1 (1.2)	2x/week	Boiled
Bamboo Orchid	1 (1.2)	1x/daily	Raw
Celery Juice	1 (1.2)	2x/week	Blended
Chamomile tea	1 (1.2)	1x/daily	Soaked
Chinese herbal tea (Pu-er/ Guan Yin)	6 (7)	1x/daily (4), 2x/week (2),	Soaked
Chinese Herbal tea (Herbal Sachets)	1 (1.2)	2x/day	Soaked
Chinese Herbal tea with Grape seed extract	1 (1.2)	2x/week	Blended
Citrus + Cactus (Powdered beverage)	1 (1.2)	1x/daily	As prescribed
Cloves of garlic	1 (1.2)	3x/week	Boiled
Cumin + Cloves (Blended)	1 (1.2)	2x/week	Blended
Cumin seed with fenugreek seeds	1 (1.2)	3x/week	Blended
Cumin seeds	1 (1.2)	1x/daily	Soaked
Cumin with Ladies finger water	1 (1.2)	2-3x/week	Soaked and blended
Fenugreek seeds + Carom seeds+ Black cumin	1 (1.2)	1x/daily	Boiled
Fenugreek seeds + Cumin seeds + Curry leaf + Coriander + Cinnamon	1 (1.2)	1x/daily	Boiled
Fenugreek (powder); Cardomon+ Cloves	1 (1.2)	2-3x/week (Alternate)	Boiled/ Blended
Fenugreek and Murungai leaf	1 (1.2)	2-3x/week	Soaked
Fenugreek powder	1 (1.2)	1x/daily	Boiled
Fenugreek seeds	2 (2.3)	3x/week	Raw
Ginger tea	1 (1.2)	1x/daily	Boiled
Ginseng	1 (1.2)	4-5x/month	Boiled
Ginseng extract with Goldflex (Organic soy +Egg +Collagen peptide)	1 (1.2)	1x/daily	As prescribed
Ginseng + Garlic + Lime	1 (1.2)	1x/daily	Soaked
Goji berries + wolfberries	1 (1.2)	1x/daily	Soaked
Goji berries + Dates	1 (1.2)	2-3x/week	Soaked
Goji berry with ginger and papaya leaf extract	1 (1.2)	3x/week	Boiled
Grape seed extract and Cats claw (pill)	1 (1.2)	3-4x/week	As prescribed
Green tea with lemon leaves and agarwood leaves (self-planted)	1 (1.2)	1x/daily	Boiled

Guan Yin tea with Jujube and Wolfberry	1 (1.2)	1x/daily	Soaked
Hawthorn slice with water and lemon	1 (1.2)	4x/week	Boiled
Wolfberry and Ginseng extract	1 (1.2)	1x/daily	Boiled
Jujubee + Wolfberry	1 (1.2)	1x/daily	Boiled
Ladys finger water	1 (1.2)	3x/week	Soaked
Lime + Salvia + Wolfberry + Jujube + Mongolian Milkvetch	1 (1.2)	1x/daily	Boiled
Moringa seeds	1 (1.2)	1x/daily	Raw
Murungai Leaf	1 (1.2)	3x/week	Boiled
Murungai Leaf + Curry leaf; Pennywort + Ginger + Fennel seeds	1 (1.2)	2-3x/week (Alternate)	Boiled
Nuvafemme (Soy Extract)	1 (1.2)	1x/daily	As prescribed
Oolong tea	1 (1.2)	2x/week	Soaked
Papaya leaf extract	1 (1.2)	3x/week	Soaked
Papaya leaf and bamboo orchid	1 (1.2)	4-5x/week	Raw
Peria	1 (1.2)	3x/week	Blended
Primrose	1 (1.2)	1x/daily	As prescribed
Red sage root + Grape seed extract (pill),	1 (1.2)	1x/daily	Prescribed
Sacha Inchi Seeds	3 (3.5)	Daily (1), 4x/week (2)	As prescribed (Boiled)
Tian Ma Gou Teng Yin (Granules water)	12 (14)	3x/day; 3g per time	As prescribed
Tiger milk mushroom + Pine root (sliced)	1 (1.2)	1-2x/week	Raw
Tok Adi Juice	1 (1.2)	2x/day	Soaked
Turmeric water with pepper, minyak zaitun and coconut oil	1 (1.2)	3x/week	Blended
Turmeric with milk	2 (2.3)	1x/daily	Boiled
Ulam	12 (14)	1x/week (2), 2x/week (2), 3-4x/week (6), 4-5x/month (2)	Raw
Uncaria tomentosa (Cat's Claw tea)	1 (1.2)	2-3x/week	Boiled
Wolfberry and Ginseng extract	1 (1.2)	1x/daily	Boiled

Measurements of Blood biochemistry parameters (hemoglobin and lipid profiles)

Table V tabulated the information on hemoglobin and lipid profile measurements. Normal hemoglobin readings were observed among 81.4% (n=70) of the participants with a mean ± SD of 13.17±1.16. Only 16 of the participants had low hemoglobin readings. Moving on to lipid profiles, it was found that total cholesterol (TC) outcome had a mean ± SD of 166.81± 39.40 and 80.2% (n=69) of participants had normal readings of less than 200mg/dl. Next, for triglycerides (TG), most of the participants (n=36) had elevated readings followed by 32 with normal readings although the mean of this parameter was 181.02 mg/dl which is classified as borderline high. The goodness of fit chi-square was significant with p=0.044 for TG hence indicating that participants commonly complementing herbs in this study had readings that were high. Furthermore, 55.8% (n=48) of the participants also had normal HDL readings with a mean of 46.21. This showed that most of the male participants had HDL levels within the

Table V : Measured outcomes of anthropometry, blood pressure and biochemical parameters among participants

Variables	Measured Outcomes		Reference Values
	n (%)	Chi-square (χ^2); p-value	
BMI			
Mean ± SD	27.14 ± 5.63		
<24.9	34 (39.5)	4.907; 0.086	Normal weight = 18.5–24.9kg/m^2 Overweight = 25–29.9 kg/m^2 Obese = >30 kg/m^2
Overweight	33 (38.4)		
Obese	19 (22.1)		
Waist/Hip Ratio			
Mean ± SD	0.92 ± 0.07		
Low Risk	25 (29.1)	8.395; 0.015*	M: ≤0.95; F: ≤0.80 M: 0.96 to 0.99; F: 0.81 to 0.84 M: ≥ 1.0; F: ≥ 0.85
Moderate Risk	20 (23.3)		
High Risk	41 (47.7)		
Systolic Blood Pressure			
Mean ± SD	137.56 ± 14.27		Not Applicable
<140 mm/Hg	51 (59.3)	2.977; 0.084	
>140 mm/hg	35 (40.7)		
Diastolic Blood Pressure			
Mean ± SD	77.57 ± 10.18		Not Applicable
<90 mm/Hg	78 (90.7)	56.977; 0.000*	
>90 mm/Hg	8 (9.3)		
Haemoglobin			M: <13.0 g/dl; F: <12.0 g/dl
Mean ± SD	13.17 ± 1.16		M: 13.0 g/dl- 17.5 g/dl; F: 12.0 g/dl- 15.3 g/dl
Low	16 (18.6)	44.698; 0.000*	(WHO, 2020)
Normal	70 (81.4)		
Total Cholesterol			125–200 mg/dl
Mean ± SD	166.81 ± 39.40		>200 mg/dl
Normal	69 (80.2)	31.442; 0.000*	(NIH, 2021)
High	17 (19.8)		
Triglycerides			<150mg/dl
Mean ± SD	181.02 ± 61.24		150-199mg/dl
Normal	32 (37.2)	6.233; 0.044*	≥ 200 mg/dl
Borderline	18 (20.9)		
High	36 (41.9)		(NIH, 2021)

High-Density Lipoprotein				
Mean ± SD	46.21 ± 13.97		M: ≤40mg/dl; F: ≤50mg/dl	
Low	38 (44.2)	1.163; 0.281	M: >40 mg/dl; F: >50mg/d	
Normal	48 (55.8)			(NIH, 2021)
Low-Density Lipoprotein				
Mean ± SD	85.15 ± 34.34		<100 mg/dl	
Normal	68 (79.1)	29.070; 0.000	≥ 100mg/dl	
High	18 (20.9)			(NIH, 2021)
Chol/HDL				
Mean ± SD	3.77 ± 1.37		≤3.5 mg/dl	
Normal	51 (59.3)	2.977; 0.084	>3.5mg/dl	
High	35 (40.7)			(NIH, 2021)

*indicates significance of p<0.05 for goodness of fit chi-square analysis

normal range while the female participants did not. LDL readings reported that 79.1% (n=68) of the participants had normal levels with a mean ± SD of 85.15 ± 34.34 while only 18 participants had high LDL. Lastly, 59.3% of participants had normal Chol/HDL readings despite the mean value of Chol/HDL being 3.77.

Associated factors analysis

The association between sociodemographic characteristics of the participants with measurements of anthropometry, thirty-minutes blood pressure and biochemistry measurements inclusive of hemoglobin and lipid profile outcomes were studied. The participants at the age range between 61-70 were significantly associated with SBP measurements of more than 140 mm/Hg (χ^2 = 24.500, p=0.001). The female participants were significantly associated with higher waist/hip ratios which meant having higher risks for CVDs (χ^2 = 8.676, p=0.013). Furthermore, the Malay participants were reported to have significantly high total cholesterol (χ^2 = 11.393, p=0.003), low HDL (χ^2 =10.246, p=0.006), high LDL (χ^2 = 13.394, p=0.001) and low Chol/HDL (χ^2 = 6.667, p=0.036). However, the analysis done between the complementation of drugs and herbs as well as its duration and frequency of usage did not show any positive associations with the measured parameters such as blood pressure, anthropometry and biochemical outcomes. Tables VI and VII respectively depict the association analysis detail.

DISCUSSION

This cross-sectional study is groundbreaking as it explores the unique practice of hypertensive patients that practice complementation of drugs with a diverse range of herbs as a part of their healthcare regimen. Information on the types of herbs and their various preparation methods as well as the socio-demographic group of patients that commonly complement drugs with herbs were uncovered. Although the act of complementing herbs by these patients did not exhibit an impact on the blood pressure levels, anthropometry measurements and biochemical analysis, this study unveiled other intriguing associations. This includes older patients above the age of 60 that had higher systolic readings, females who were more predisposed to higher risks of CVDs and also Malays with elevated cholesterol.

A survey carried out by the Ministry of Health Malaysia reported that biological-based therapies which include herbal products and pure herbs outlined to have the highest use among Malaysians (23). This could be attributed to the fact that the bioactive compounds found in herbs are able to exert anti-hypertensive effects such as relaxing smooth muscles in the walls of blood vessels (24). Studies have found that complementing herbs with anti-hypertensive drugs could lead to the amelioration of not only blood pressure but also improves parameters such as glucose, cholesterol and also BMI levels (9,10). Since studies on complementation are scarce in Malaysia compared to countries like Iran and China, this study sheds light on the complementation of herbs with anti-hypertensive drugs on anthropometric measurements, blood pressure and biochemistry analysis among hypertensive adults.

Moreover, it was discovered that characteristics such as being aged between 61-70, female Chinese with incomes of less than RM3000 and attaining

Table VI : Association analysis of socio-demographic characteristics with anthropometry, physiological and measured biochemical outcome data

Variables	Anthropometry and Physiological Parameters Outcome											
	BMI (kg/m²)			Waist/Hip			Systolic (mm/Hg)			Diastolic (mm/Hg)		
	<24.9	>24.9	(χ^2); p-value	Low/ Mod	High	(χ^2); p-value	<140	>140	(χ^2); p-value	<90	>90	(χ^2); p-value
	n (%)	n (%)		n (%)	n (%)		n (%)	n (%)		n (%)	n (%)	
Age												
<60	7 (28.0)	18 (72.0)	4.546; 0.103	13 (52.0)	12 (48.0)	0.009; 0.996	16 (64.0)	9 (36.0)	**8.676; 0.013***	22 (88.0)	3 (12.0)	4.162; 0.125[a]
61-70	12 (35.3)	22 (64.7)		18 (52.9)	16 (47.1)		14 (41.2)	20 (58.8)		29 (85.3)	5 (14.7)	
>70	15 (55.6)	12 (44.4)		14 (51.9)	13 (48.1)		21 (77.8)	6 (22.2)		27 (100.0)	0 (0.0)	
Gender												
Male	16 (47.1)	18 (52.9)	1.332; 0.249	29 (85.3)	5 (14.7)	**24.500; 0.001***a	18 (52.9)	16 (47.1)	0.943; 0.332	28 (82.4)	6 (17.6)	4.641; 0.053[a]
Female	18 (34.6)	34 (65.4)		16 (30.8)	36 (69.2)		33 (63.5)	19 (36.5)		50 (96.2)	2 (3.8)	
Ethnicity												
Malay	5 (25.0)	15 (75.0)	2.318; 0.314	7 (35.0)	13 (65.0)	7.821; 0.882	10 (50.0)	10 (50.0)	1.251; 0.535	16 (80.0)	4 (20.0)	3.596; 0.166
Chinese	20 (44.4)	25 (55.6)		30 (66.7)	15 (33.3)		29 (64.4)	16 (35.6)		42 (93.3)	3 (6.7)	
Indian/ Others	9 (42.9)	12 (57.1)		8 (38.1)	13 (61.9)		12 (57.1)	9 (42.9)		20 (95.2)	1 (4.8)	
Income levels												
No income	8 (38.1)	13 (61.9)	1.233; 0.540	8 (38.1)	13 (61.9)	4.236; 0.120	14 (66.7)	7 (33.3)	0.669; 0.716	21 (100.0)	0 (0.0)	3.098; 0.212
Less than 3k	16 (35.6)	29 (64.4)		23 (51.1)	22 (48.9)		26 (57.8)	19 (42.2)		40 (88.9)	5 (11.1)	
More than 3k	10 (50.0)	10 (50.0)		14 (70.0)	6 (30.0)		11 (55.0)	9 (45.0)		17 (85.0)	3 (15.0)	
Education												
NA/ Primary	11 (57.9)	8 (42.1)	5.257; 0.072	10 (52.6)	9 (47.4)	1.031; 0.597	10 (52.6)	9 (47.4)	0.520; 0.771	18 (94.7)	1 (5.3)	0.701; 0.704[a]
Secondary	16 (30.2)	37 (69.8)		26 (49.1)	27 (50.9)		32 (60.4)	21 (39.6)		47 (88.7)	6 (11.3)	
Tertiary	7 (50.0)	7 (50.0)		9 (64.3)	5 (35.7)		9 (64.3)	5 (35.7)		13 (92.9)	1 (7.1)	

Variables	Biochemical Parameters Outcome																	
	Hemoglobin (g/dl)			TC (mg/dl)			TG (mg/dl)			HDL (mg/dl)			LDL (mg/dl)			Chol/HDL (mg/dl)		
	Low	Normal	(χ^2); p-value	Normal	High	(χ^2); p-value	Normal/ Border	High	(χ^2); p-value	Low	Normal	(χ^2); p-value	Normal	High	(χ^2) ; p-value	Normal	High	(χ^2); p-value
	n (%)	n (%)		n (%)	n (%)		n (%)	n (%)		n (%)	n (%)		n (%)	n (%)		n (%)	n (%)	
Age																		
<60	4 (16.0)	21 (84.0)	0.285; 0.867	19 (76.0)	6 (24.0)	0.934; 0.627	14 (56.0)	11 (44.0)	1.231; 0.540	12 (48.0)	13 (52.0)	0.821; 0.663	17 (68.0)	8 (32.0)	2.742; 0.254	15 (60.0)	10 (40.0)	1.182;
61-70	5 (14.7)	29 (85.3)		29 (85.3)	5 (14.7)		18 (52.9)	16 (47.1)		16 (47.1)	18 (52.9)		29 (85.3)	5 (14.7)		18 (52.9)	16 (47.1)	0.554
>70	3 (11.1)	24 (88.9)		21 (77.8)	6 (22.2)		18 (66.7)	9 (33.3)		10 (37.0)	17 (63.0)		22 (81.5)	5 (18.5)		18 (66.7)	9 (33.3)	
Gender																		
Male	5 (14.7)	29 (85.3)	0.027; 1.000[a]	28 (82.4)	6 (17.6)	0.159; 0.690	22 (64.7)	12 (35.3)	0.996; 0.318	15 (44.1)	19 (55.9)	0.000; 0.992	28 (82.4)	6 (17.6)	0.366; 0.545	19 (55.9)	14 (44.1)	0.273; 0.602
Female	7 (13.5)	45 (86.5)		41 (78.8)	11 (21.2)		28 (53.8)	24 (46.2)		23 (44.2)	29 (55.8)		40 (76.9)	12 (23.1)		31 (61.5)	20 (38.5)	
Ethnicity																		
Malay	2 (10.0)	18 (90.0)	0.358; 0.836[a]	11 (55.0)	9 (45.0)	**11.393; 0.003*[a]**	11 (55.0)	9 (45.0)	0.154; 0.926	14 (70.0)	6 (30.0)	**10.246; 0.006***	10 (50.0)	10 (50.0)	**13.394; 0.001*[a]**	7 (35.0)	13 (65.0)	**6.667; 0.036***
Chinese	7 (15.6)	38 (84.4)		41 (91.1)	4 (8.9)		27 (60.0)	18 (40.0)		13 (28.9)	32 (71.1)		40 (88.9)	5 (11.1)		31 (68.9)	14 (31.1)	
Indian/ Others	3 (14.3)	18 (85.7)		17 (81.0)	4 (19.0)		12 (57.1)	9 (42.9)		11 (52.4)	10 (47.6)		18 (85.7)	3 (14.3)		13 (61.9)	8 (38.1)	

Income levels																		
No income	3 (14.3)	18 (85.7)	0.035; 0.983[a]	16 (76.2)	5 (23.8)	0.504; 0.777[a]	15 (71.4)	6 (28.6)	3.493; 0.174	11 (52.4)	10 (47.6)	0.897; 0.639	15 (71.4)	6 (28.6)	1.189; 0.552[a]	10 (47.6)	11 (52.4)	1.685;
Less than 3k	6 (13.3)	39 (86.7)		36 (80.0)	9 (20.0)		22 (48.9)	23 (51.1)		18 (40.0)	27 (60.0)		36 (80.0)	9 (20.0)		29 (64.4)	16 (35.6)	0.431
More than 3k	3 (15.0)	17 (85.0)		17 (85.0)	3 (15.0)		13 (65.0)	7 (35.0)		9 (45.0)	11 (55.0)		17 (85.0)	3 (15.0)		12 (60.0)	8 (40.0)	
Education																		
NA/ Primary	1 (5.3)	18 (94.7)	1.904; 0.386[a]	16 (84.2)	3 (15.8)	0.731; 0.694[a]	13 (68.4)	6 (31.6)	1.656; 0.437	7 (36.8)	12 (63.2)	0.617; 0.735	15 (78.9)	4 (21.1)	0.467; 0.792[a]	13 (68.4)	6 (31.6)	1.171; 0.557
Secondary	8 (15.1)	45 (84.9)		41 (77.4)	12 (22.6)		28 (52.8)	25 (47.2)		25 (47.2)	28 (52.8)		41 (77.4)	12 (22.6)		31 (58.5)	22 (41.5)	
Tertiary	3 (21.4)	11 (78.6)		12 (85.7)	2 (14.3)		9 (64.3)	5 (35.7)		6 (42.9)	8 (57.1)		12 (85.7)	2 (14.3)		7 (50.0)	7 (50.0)	

*indicates significant association; a-Fishers exact test was used.

secondary education levels were indicative of likely being herb users as these were common traits among the patients. Similar characteristics were reported in studies conducted in Indonesia and Iran for age and gender (25,26). In studies conducted in Malaysia however, it was reported that Malays and Chinese were the ones that usually complement herbs (4, 27). Furthermore, income levels among these hypertensive herb users varied between no income at all and low income in countries like Malaysia and the Philippines while attaining secondary level of education was 54.5% in Turkey and 51.4% in Malaysia which aligns with this study participants education (28,29).

This present study also found that mainly using self-prescribed herbs for more than one year and suffering from co-morbidities like high cholesterol levels were common among the participants. However, through this cross-sectional study, it was found that there was a negative correlation between the usage of herbs and having good cholesterol outcomes. A study in Thailand elucidated that frequent intake of herbs across a longer period of time was more likely to bring about either positive or negative outcomes on blood pressure (30). Moreover, a study carried out in Korea supported the findings in this study whereby dyslipidemia and having less than three co-morbidities were common among hypertensive participants (31). On the contrary, a Malaysian study discovered that diabetes was the co-morbid most observed among hypertensive participants that complement herbs followed by dyslipidemia and stroke (28). Despite the variation of ailments in different study settings, it can be inferred that participants tend to complement herbs in order to cope with managing more than one co-morbidity in addition to their hypertensive condition (32).

Among the hypertensive patients in this study, consumption of amlodipine was prevalent. Reportedly, a study carried out in Selangor, Malaysia by Ng et al. (2020), found that calcium channel blockers were the drugs most commonly prescribed in Malaysia for hypertension which also includes amlodipine (33). On the contrary, randomized clinical trials done in China, Iran and neighbouring countries like Indonesia, revealed that captopril was the most commonly taken drug among the hypertensive participants that complemented herbs (8,11,26). However, it is vital that factors such as age, ethnicity, previous history with anti-hypertensive drugs, medical conditions as well affordability and the possibility of drug interactions with complemented herbs be taken into account prior to administering any drugs to patients for their hypertensive treatment (34).

In previous cohort studies carried out in the US, Thailand and Palestine, 4-12 types of herb combinations were found to be complemented among the hypertensive participants (30,35). However, in this study as opposed to the others, 55 different combinations were identified which could possibly improve the measured parameters. Some of the most common herbs complemented with drugs across other studies include garlic, ginseng, whortleberries and Traditional Chinese medicine which was the only type of herb similar to this study. It was reported that these combinations of herbs when complemented with anti-hypertensive drugs were able to bring about positive changes on blood pressure and also lipid profile outcomes (26,36,37).

Several clinical trials done in Iran and Canada reported that among individuals that practiced complementation, the BMI of participants were 28.50 kg/m2 and 28.62 kg/m2 respectively thus categorized in the overweight group in both studies (11, 36). On the other hand, a study conducted in Malaysia, found that people with hypertension usually had BMI and waist/hip ratios that fell in the overweight and high risk for cardiovascular disease categories respectively which leads to higher chances of suffering from cardiovascular diseases (3). Hence, data from previous studies show that most participants had BMI levels that fall in the overweight group

which was not in accordance with the findings from this study.

In the instance of blood pressure measurements using ABPM in Western countries, it was observed that the readings were less than 140/90 mm/Hg which was similar to this study as it was measured repeatedly for more than 30 minutes (12,38). Repeated measurements provide greater reproducibility of an average blood pressure taken from multiple readings hence resulting in increased precision (39). In contrast, hypertensive participants complementing herbs from Thailand had readings above 140/90 mm/Hg when an office blood pressure machine was used as the measuring tool (30). Thus, the results obtained differ from previous study results in neighbouring countries and are more similar to those done in the West. Lower blood pressure readings as observed in the West and this current study could be attributed to the fact that participants were more relaxed when using ABPM as compared to office blood pressure machines and white-coat hypertension was avoided during the measurements (40).

Moving on to biochemical parameters, studies done on the complementation of herbs and anti-hypertensive drugs in relation to hemoglobin measurements are scarce worldwide. However, a study by Ghosh (2021) in India reported that individuals with hypertension that complement herbs usually have Hb readings of less than 11.5 g/dL which would fall in the low-level group (41). Thus, this current study sheds light on measurements of hemoglobin among participants that are actively complementing herbs with drugs which shows mostly normal levels of hemoglobin.

Based on a randomized control trial done in Japan among hypertensive adults complementing herbs, it was found that only total cholesterol and triglyceride categories differed from the hypertensive participants in this present study (42). Similarly, a trial done in India with consumption of gooseberries among hypertensive adults differed in HDL and triglyceride aspects (43). Thus, it can be said that the lipid parameters tend to vary among participants across studies carried out in different countries, but mostly had borderline high triglyceride levels which was the same as the overall mean for this present study. This could be due to the synergistic effect of the herbs which exert anti-hypertensive potential and anti-hypertensive drugs when used concurrently (24,25).

Furthermore, through this study's analysis, it was observed that only sociodemographic characteristics such as age, gender and ethnicity had positive correlations with systolic blood pressure, waist/hip ratio and high cholesterol outcomes respectively while herbs did not show any positive correlations with the measured parameters. It cannot be denied that age is indeed a contributor that affects systolic readings. This aligns with another study conducted in Malaysia which reported that those with advanced ages were more likely to have higher systolic readings (44). In a different study done in Poland that focused on the complementation of bermagot, improvements in systolic readings were mainly observed among individuals below the age of 65 years old due to the higher dosage of herbs that could be consumed by these individuals (45). Hence, it can be said that among older adults that complement herbs, controlling blood pressure readings could be a challenge due to the body's ability to recuperate (30).

Subsequently, as opposed to the current study which reported high waist/hip ratio which in turn leads to increased risk for cardiovascular disease (CVDs) among hypertensive women complementing herbs, a study in Taiwan elucidated that hypertensive males were prone to having high risk for CVDs. The reasons as to why males were more prone to CVDS were mainly due to obesity, smoking and physical inactivity (46). Since effects of complementation on waist/hip ratio is scarce in Malaysia, this study provides information on the associated risk of high/waist ratio and CVDs among hypertensive females complementing herbs.

Moreover, in Malaysia, the ethnic group that commonly suffers from elevated cholesterol levels is the Malay population (47). Subsequently in another study conducted in Selangor among hypertensive adults, it was reported that there were no associations with elevated lipid parameters among the Chinese and Indians due to better dietary intake and physical activity levels among these ethnicities as compared to the Malay population (47, 48). Thus, the findings from previous studies further supports the data from this current study as all cholesterol parameters except for triglycerides were found to be elevated and significantly associated with the Malay population that complemented herbs. However, it is vital to remember that lifestyle habits, enhanced stress levels, diets or even patient behaviour plays a part in the outcome of elevated blood pressure, anthropometry and lipid profile outcomes as well as the reason that herbs complementation did not show significant correlations with these measured parameters (49).

CONCLUSION

In conclusion, this study was able to shed light on the sociodemographic group of participants who commonly complement herbs with drugs which may give healthcare providers an idea of the group of people that tend to seek alternative therapies for

their health-related issues. This includes older Chinese females that attained secondary education and incomes of less than three thousand ringgit. Hence, advice could be provided by doctors in future to ensure safe consumption is done by patients and that they are aware of possible adverse effects of complementation. The usage of herbs did not bring about positive correlations with the measured parameters but the significant association of these parameters with sociodemographic characteristics were discovered such as age (61-70), gender (female) and ethnicity (Malays) with elevated systolic blood pressure readings, high risk for cardiovascular diseases and high cholesterol levels respectively. This information will enable medical personnel and doctors in future to assess and gain knowledge on the types of herbs consumed among these group of people as well as to provide the patients with knowledge on the outcomes of complementing herbs. Since various herbs were complemented in this study, conclusions cannot be drawn on which herb and drugs complemented could bring about changes on anthropometry, blood pressure and other biochemical parameters. Thus, a clinical trial should be done for a longer duration to identify the types and frequency of herbs complemented with drugs that are effective in improving blood pressure, anthropometry outcomes and other biochemical parameters in Malaysia. However, a fixed regime should be put in place to ensure proper patient compliance and an unbiased investigation.

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