Original article:

Relationship between Coping Mechanisms to Psychosocial Stress with Blood Pressure in Young Adults: A Pilot Study

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Abstract

Background: Hypertension is a major risk factor for cardiovascular diseases, one of the leading causes of death worldwide. Prehypertension is a precursor of hypertension, with high prevalence in young adults. Psychosocial stress can be one of the modifiable risk factors for hypertension. The objective of the study is to assess the relationship between coping mechanism to psychosocial stress and the blood pressure of young adults. ***Methods:*** A comparative cross-sectional pilot study was conducted in 36 young adults aged less than 45 years. The pulse rate, blood pressure and body mass index of the respondents were recorded. Psychosocial stress was measured by plasma cortisol following an acute mental stress test; and the level of stress and the coping strategies to stress were assessed using validated Malay Version questionnaires: DASS-21 and Brief R-COPE questionnaires. ***Results:*** Forty four percent of subjects had normotension and fifty six percent had above-normal blood pressure (prehypertension and mild hypertension). Subjects with above-normal blood pressure were associated with high plasma cortisol levels ($p = 0.032$), and high body mass indexes (BMI) ($p = 0.004$). Maladaptive coping strategy was found to be associated with high stress scores ($p = 0.019$). The relationship between stress and cortisol was not significant, though a higher cortisol level was noted in the high blood pressure group. ***Conclusion:*** In conclusion, higher cortisol levels and greater BMIs were associated with above-normal blood pressure in young adults. These findings are useful for future research in this area, and the continuation of this study will hopefully yield a more significant relationship.

Keywords: Psychosocial stress; hypertension; plasma cortisol

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Introduction

Cardiovascular disease is the leading causes of death worldwide. Hypertension is a major risk factor for cardiovascular diseases such as cerebrovascular accident, coronary artery disease, heart failure and renal failure[1]. Modifiable risk factors include smoking, diabetes mellitus, stress and diet, whereas non-modifiable risk factors include age, male sex and a positive family history. The prevalence of hypertensive-related cardiovascular diseases has increased in younger adults aged 20 years and older in recent years[2]. Hypertension is defined as systolic blood pressure (SBP) of 140 mmHg or more and/or diastolic blood pressure (DBP) of 90 mmHg or more for adults[3].The management of hypertension remains a challenge, as the exact pathogenesis is unclear and it is manifesting earlier in young adults[4,5].

Prehypertension, defined as a systolic blood pressure of 120 to 139 mmHg and/or a diastolic blood pressure of 80 to 89 mm Hg (The seventh joint national committee on prevention, detection, evaluation, and treatment of high blood pressure; JNC7), is a

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precursor of hypertension and is also a risk factor for cardiovascular diseases. More stressful workload, high-calorie and salty food intake, reduced physical activity, overweight and obesity are associated risk factors related to prehypertension[6]. Prevalence of prehypertension in different countries is shown in Table 1. To date, there are only a few studies that reported the rate of progression from prehypertension to hypertension.

The risk of developing hypertension is increased with higher baseline blood pressure of young adults aged between 20 and 45 years[7]. Hypertension becomes a self-accelerating disease and the blood pressure level will increase exponentially if prehypertension is left ignored[8]. Stressful conditions can cause activation of the Hypothalamo-Pituitary-Adrenal axis (HPA) in human body[9]. Within this axis, two main stress hormones, catecholamines and cortisol, play an important role in the fight-or-flight response and may cause elevation of blood pressure. Cortisol also increases cardiovascular activity via the sympathetic nervous system and increased blood glucose level via gluconeogenesis, lipolysis and proteolysis[9]. Although the body's stress-response system is usually self-limiting, the body may perceive the need to activate a prolonged stress-response when stressors are present constantly[10].

Stress also contributes to alterations in cardiac regulation by changing sympathetic nervous system activity and homeostasis, affecting the blood pressure status[11]. A significantly higher level of plasma adrenaline was found in prehypertensive and mildly hypertensive young adults as compared to the normotensives[12]. Moreover, two animal studies have also shown that prolonged adrenaline release plays an important role in the pathogenesis of essential hypertension and permanent reduction in blood pressure was seen by suppressing adrenaline synthesis at an early stage of prehypertension[12]. Many previous animal studies have also shown the link between cortisol and induced short-term stressors[13].

Furthermore, emotional states such as psychosocial stress in adults are also associated with elevated risks of cardiovascular morbidity, mortality and hypertension[14]. Neuroendocrine stress responses can also induce hypertension by increasing cortisol, especially among the younger, working-age population[14]. Conversely, coping behaviours adopted by individuals can influence the mental state[15]. Since individuals vary in ways of coping (problem-oriented coping, emotion-oriented coping and avoidance-oriented coping) and dealing with everyday life situations, targeting their coping strategies is therefore essential in optimizing one's management and blood pressure control.

However, coping mechanisms to stress, its direct or indirect link to cardiovascular risk factors such as hypertension, especially among the young adults, is still not well studied. There is a lack of research on young adults and in understanding the pathophysiology and factors associated with hypertension in this group, although there are plenty of such studies in older patients worldwide. Research into identifying the factors and pathogenesis of cardiovascular diseases in young adults is essential to reduce mortality and morbidity of cardiovascular diseases.

It is hoped that our study will provide evidence for amendment of current management protocols of young adults with hypertension. Consequently, we hope to prevent multiple, long-term complications associated with it by early screening and institution of treatment. The objective of the study isto assesses the relationship between coping mechanism to psychosocial stress and the blood pressure in young adults

Methodology

This is a comparative cross-sectional study which compares three groups: a young normotensive control group, young prehypertensive group and, young mildly hypertensive group and their relationship to stress and coping methods[12]. The research methodology was approved by the Institutional Research Ethics Committee (IREC 544).91 subjects sourced from a cohort study is to be recruited. However, for the pilot study purposes 36 were called back within the 3 month study period.

Malaysian citizens aged within the range of 18 to 45 years were included. Subjects satisfying the prehypertension (High Normal) definition were recruited into the 'Prehypertensive group'. Newly diagnosed patients with mild hypertension and who were not on any antihypertensives were recruited into the 'Mild Essential Hypertensive group'.

Subjects with evidence of end-organ damage such as left ventricular hypertrophy or retinal fundus hypertensive changes grade III or IV of the Keith-Wagener classification, proteinuria, history related to hypertensive complications such as congestive heart failure or cerebrovascular accident, had secondary causes of hypertension, had underlying diseases resulting in abnormal cortisol levels (i.e. Cushing's syndrome), were on corticosteroid medication (i.e. steroid inhaler), heavy drinkers or were unable to provide written, informed consent, subjects who were pregnant or on regular oral contraceptive medications were all excluded from the study.

Study Protocol

The subjects were fasted overnight (minimum of 8 hours) prior to the appointment for fasting blood samples, and advised to avoid strenuous exercise and alcohol consumption 24 hours prior to the appointment at the Clinical Trial Unit. Demographic data was recorded. Self-administered, validated Malay Version questionnaires: DASS-21 Questionnaire to assess chronic stress level (16), and Brief R-COPE Questionnaire to assess coping mechanism (17), were given to the subjects. A 2.5-minute, established and standardized mental stress test (Stroop test) was performed to induce acute stress.

Blood samples were then drawn for biochemical profile (fasting lipid profile: total cholesterol, LDL-cholesterol, HDL-cholesterol, triglyceride; fasting blood glucose; renal profile) and plasma cortisol. Blood samples were sent to an independent, certified laboratory for immediate analysis. Subjects' social-demographical data, and past medical history of cardiovascular diseases and risk factors were recorded and a complete physical examination (measurements of weight, height, body mass index, and waist circumference) of the patients was performed. Three blood pressure (BP) measurements were performed by using recently validated automatic digital blood pressure monitor (Omron HEM-7130), with one-minute rest in between and the averages of the three values were calculated. Mean arterial pressure was then calculated. The blood pressure subtypes were defined according to the Seventh Report of the National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-VII) criteria[3].

Assessment of Stress and Coping

The DASS-21 Questionnaire, was used to detect the level of stress. Subjects were asked to use a 4-point severity scale to rate the extent to which they had experienced each stateover the past week. The DASS questionnaire also measured anxiety and depression levels. The validated Malay version Brief R-COPE Stress Questionnaire was used to identify subjects' coping strategies. There were 14 domains assessed, 6 for maladaptive strategies and 8 for adaptive strategies. The scores ranged from "I haven't been doing this at all" (Score of one) to "I have been doing this a lot" (Score of four) and the higher score represents greater coping strategies adopted by the respondents. For instance, higher scores in adaptive coping subscale indicate greater use of adaptive coping and higher scores in maladaptive coping subscale indicate greater use of maladaptive coping.

Results

The normotensive group (with average blood pressure of less than 120/80 mmHg) had 16 subjects, and the prehypertensive and mildly hypertensive group had 20 subjects. No statistical significance was seen between the age and the different blood pressure groups (p = 0.547), between the genders in these two groups (p = 0.502), between smoking habit and the blood pressure level (p = 0.369) as shown in Table 2. There was a strong association between the body mass index of the subjects and their blood pressure status (p = 0.004).

A statistically significant relationship (p = 0.032) was seen between the serum cortisol level and the blood pressure status (Table 2). The mean (SD) of the serum cortisol level in normotensive group was 210 (73); and it was 290 (123) in prehypertensive and mildly hypertensive group. The 95% confidence interval of the serum cortisol level showed a wide range (153.12, -7.18). This is because of the small sample size recruited for this pilot study (Table 2).

The mean (SD) of the coping mechanism scorings are stated in Table 2, and there was no statistical significance between the adaptive coping and the blood pressure status of the subjects (p = 0.304), as well as between the maladaptive coping and the blood pressure status (p = 0.681). There was a strong association between stress and maladaptive coping (p = 0.019). However, no significant correlation was noted between the coping mechanisms and the pulse rate of the subjects.

As shown in Table 3, there was no statistical significance between the blood pressure status and stress (p = 0.392) or anxiety (p = 0.147) level of respondents. A strong association was seen between levels of depression and anxiety, depression and stress, anxiety and stress; and there was no association between cortisol and these psychological parameters.

Discussion

In this study, 11.11% of the subjects had high blood pressure. This proportion is lower than the findings of previous studies in Malaysia[1,4]. The prevalence of prehypertension seen in this study however is higher than mild hypertension in young adults less than 45 years. The prevalence of prehypertension is also higher compared to previous studies conducted in Malaysia at 44%[4].

It is well known that increased Body Mass Index (BMI) was positively related to high blood pressure. A study conducted by Akter et al, found that subjects who had increased weight were at higher risk to be hypertensive[18]. This is consistent with the present study where there was a strong relationship between increased BMI and high blood pressure groups including prehypertensive and mildly hypertensive groups.

Cortisol is the principle stress hormone and it can be assessed to measure the level of stress[19]. There have been several animal studies which showed the positive relationship between increased cortisol level and increased blood pressure[10]. The findings of Ginty et al, found that psychosocial stress can significantly affect the cardiovascular activity and rhythmicity of cortisol secretion in the body. Others have also illustrated that one of the aetiologies of increased blood pressure was stress related cortisol secretion[13]. In the present study, the finding of positive relationship between cortisol and increased blood pressure support the results of the aforementioned studies. The average value of cortisol in the normotensive group was lower than that in prehypetensive group and mildly hypertensive group. Although cortisol is a neuroendocrine stress marker[20], correlation between stress and cortisol was not seen in the present study, contradicting previous studies which proved that there was a relationship between stress and high blood pressure[21].

There were more subjects with moderate to extremely severe stressful conditions in the prehypertensive and mildly hypertensive group compared to the normotensive group. However, there was no statistically significant relationship between stress and blood pressure status. This finding seems to support the paradoxical observation of other studies which showed that there was no relationship between stress and hypertension[22]. This study has also found a significant statistical relationship between depression and stress scores as noted by other studies[23].

The results of the present study indicated that there was no relationship between blood pressure status and coping strategies. To our knowledge, there were not many specific studies which were done to assess the coping strategies (adaptive and maladaptive coping strategies) in young adults with different blood pressure status worldwide. However, two studies proved a significant relationship between hypertension and coping styles and lifestyle factors by using different questionnaires[24,25].

Limitations of the study

There are a few limitations in the present study. Firstly, the sample size of this study is small since it is aimed as a pilot study for a larger and more robust study. Although a preliminary study, it is an important first step in exploring the relationship between stress and different blood pressure levels before a more definitive prospective study can be conducted.

The second limitation is interpretation of the questionnaire scoring system of the validated Bahasa Malaysia Version of Brief R-COPE Stress Questionnaire used in assessing coping mechanisms. The Brief R-COPE Stress Questionnaire scoring system uses a continuous range (0 – 48 for maladaptive coping system and 0 – 64 for adaptive coping system), and does not have cut-off points for either a positive or negative finding. Furthermore, the Questionnaire has 14 domains and two items in each domain but the number of domains are not equal under each strategy (6 domains for maladaptive, and 8 domains for adaptive), further complicating interpretation of the results.

The presence of depression and anxiety should still be assessed among hypertensive and non-hypertensive subjects in addition to stress in future studies. This is because stress is the immediate psychological reaction and it is a potent inducer for depression and anxiety. Moreover, stress is associated with first lifetime episodes of depression, and the role of major life stress changes from an initial episode over subsequent recurrences. Depression on the other hand, is a more stable psychological parameter compared to stress. Depression is frequently characterized by recurrent episodes over the life course. Although the presence or absence of depression and anxiety may confound results of any future study, the findings of this pilot study are useful to guide future research in this area despite the aforementioned limitations.

Conclusion

As predicted, a strong association was found between the plasma cortisol level and blood pressure status. Although no significant relationship was seen between levels of stress and the blood pressure status, positive relationships were found between depression or anxiety and stress. There was no statistically significant relationship observed between the different coping strategies used and the blood pressure status. However, maladaptive coping mechanism and stress were found to be related. Moreover, a strong association was noted between the body mass index and the blood pressure status. The continuation of this pilot study is thus important in the hope to yield a more significant picture.

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Table 1. Prevalence of Prehypertension in Different Countries

Country	Target Age (years)	Years	Numbers of Participants	Prevalence of prehypertension (%)
China	35-44	1991	8359	33.8
		2002	18922	61.5
		2007	20162	48.9
Israel	21-50	1991-1999	36424	48.9
US	18-39	1999-2000	4805	32
Jamaica	15-74	2000-2001	1972	30
Korea	≥ 20	2001	6074	31.6
Malaysia	≥ 30	2007-2010	11288	34
	19-29	2008	237	42.9
India	18-23	2015	84	50

Table 2. Distribution of Age, Gender, Smoking History, Alcohol Drinking History, Race, Body Mass Index, Serum Cortisol Level, Stress Scoring (DASS-21), Coping Mechanisms and Religious Activities by Blood Pressure Status

		Blood Pressure Classification								95% CI	P value
		Normotensive				Prehypertensive and Mildly hypertensive					
		Count	Mean	SD	Row N%	Count	Mean	SD	Row N%		
Age		16	37	5		20	38	6		-4.887, 2.637	0.547
Gender	M	7			38.9%	11			61.1%		0.502[a]
	F	9			50.0%	9			50.0%		
BMI		16	26	3		20	32	8		-10.79, -2.27	0.004
Serum Cortisol		15c	210	73		20	290	123		-153.12,-7.18	0.032
Stress scoring (DASS-21)	0–9 [d]	15			46.9%	17			53.1%		0.392[b]
	10–21[e]	1			25.0%	3			75.0%		
Adaptivecoping		16	45	5		20	47	7		-6.118, 1.968	0.304
Maladaptive coping		16	22	4		20	22	5		-3.615, 2.390	0.681

Note. ORA = Organisational Religious Activity; NORA = Non-organisational Religious Activity; IR = Intrinsic Religiosity; a = Pearson Chisquare; b = Fisher's Exact test; c = Number of normotensive subjects after removing an outlier; d = Normal to mild stress; e = Moderate to extremely severe stress.

Table 3. DASS-21 scoring and the blood pressure status

DASS – 21		Blood pressure classification				
		Normotensive group		Prehypertensive and mildly hypertensive group		
		n	%	n	%	P value
Depression	Normal	16	100	20	100	-
	Mild-Extremely severe	-	-	-	-	
Anxiety	Normal	15	93.75	14	70	0.147[a]
	Mild-Extremely severe	1	6.25	6	30	
Stress	Normal-Mild	15	93.75	17	85	0.392[a]
	Moderate-Extremely severe	1	6.25	3	15	

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