PREDICTORS OF PREHYPERTENSION AMONG THE ISLAND RESIDENTS, MALDIVES

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ABSTRACT:

Background: Prehypertension was defined as a systolic blood pressure 120-139 mmHg and/or a diastolic blood pressure of 80-89 mmHg. It has been shown as a precursor of hypertension and a significant risk factor for cardiovascular disease. This study aimed to estimate the prevalence of prehypertension and examine the risk factors.

Methods: A cross-sectional study was conducted in adults aged 18 to 65 years at Baa Atoll, the Republic of the Maldives. A total of 407 participants from five islands were randomly recruited. Standard anthropometric measurements and face-to-face interviews were employed to collect the data from December 2013 to January 2014.

Results: The prevalence of prehypertension was about 38.1%. Bivariate analysis revealed that there was a statistically significant association between prehypertension and age, education, Body Mass Index (BMI), waist circumference, sources of obtaining health information, and levels of knowledge. Multiple logistic regression showed that the predictors of prehypertension were lower educational levels (AOR: 2.27; 95% CI: 1.62 to 4.58), and high waist circumference (AOR: 2.44; 95% CI: 1.43 to 4.14).

Conclusion: Screening for prehypertension should be focused on adults with low education, especially who have high waist circumference, and health system should promote a healthy lifestyle.

Keywords: Prehypertension, Risk factors, Body Mass Index, Waist circumference, Maldives

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INTRODUCTION

Prehypertension is defined as "a systolic blood pressure of 120-139 mm Hg and/or diastolic blood pressure of 80-89 mm Hg in adults over 18 years of age" [1]. It has been shown as a precursor of hypertension and a significant predictor of cardiovascular risk. Literature has proven that treating prehypertension reduces incidence of hypertension, and is of public health importance because hypertension is a silent killer and attributes to approximately 7.5 million complications annually, or 12.8% of all deaths worldwide [2]. This includes more than 50% of cases that are due to cardiovascular disease and stroke [3]. Additionally, prehypertension has become a major risk factor worldwide for non-communicable diseases (NCDs). It is a deadly epidemic which has caused 36 million (63%) of 57 million associated (2008) deaths all over the world [2, 4].

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According to the World Health Organization's (WHO) 'Country Cooperation Strategy', Republic of Maldives, between 2012 -2017, NCDs accounted for up to 70% of all deaths in the Maldives, with the majority (38.9%) due to CVD. These can be categorized in to groups, 11.4% are other forms of heart disease, 9.9% arise from ischemic heart disease, 9.5% are cerebrovascular diseases, and 6.9% of deaths being due to hypertensive diseases [5]. In 2010, surveillance for non-communicable disease risk factors in the Maldives revealed that the overall prevalence of high blood pressure was measured at 31.5% [6], and a higher proportion of prehypertension as opposed to hypertension was reported [7-9].

In Maldives, besides consecutive changes in health status, life expectancy at birth has increased from 1977 to 2011 [5]. Urbanized lifestyles, insufficient physical activity, unhealthy diet and tobacco use, have all contributed to the increase burdens of NCDs. In 2013, according to Health Ministry statistics 30 % males and 33% females

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suffered from high blood pressure in Maldives which are projected to be higher in the future [2].

Several studies have shown that the factors associated with prehypertension includes socio-demographics [4-7], medical history [8-10], lifestyle [10-12], and awareness [13, 14]. However, to reduce the burden of disease, it's important to understand risk factors within a local context is needed. This study aims to examine the prevalence of prehypertension and determine factors related to prehypertension among adult island residents in Maldives. This would be an important source of information for policy makers to initiate preventive strategies and implement specific interventions.

METHODS

A cross-sectional household survey was carried out among adults in the Baa Atoll regions of the Republic of the Maldives. Researcher estimated a minimum sample size of 369 by a confidence interval of 95% and acceptance error of 5%. To ensure the highest number of sample size, a proportion of 0.5 was used. Simple random sampling was applied to select five of thirteen islands in the study area. Eight midwives who work in study area were recruited as research assistants and trained to ensure the standard quality of data collection. Household survey was employed to recruit the potential subjects. Researcher enrolled a participant/household who was between 18-65 years in sample target area. Those who had already been diagnosed with hypertension or had taken anti-hypertensive drugs or were pregnant were excluded. A face-to-face interview was used to gather information from the subjects. In addition, the research assistants performed anthropometric measurements using the WHO standard guideline. It took approximately 20-30 minutes to complete the process. Data collection was conducted from December 2013 to January 2014.

A structured questionnaire was developed from previous studies [6,15-17] which consisted of five parts, namely: I) general information about age, gender, educational level, household income and family history of hypertension (demographic data), II) physical factors like history of comorbid disease, such as hypercholesterolemia, diabetes and other diseases, III) evaluating physical activity, diet and stress levels. The WHO recommends physical activity criteria divided into two categories. Metabolic equivalent task (MET) was calculated according to the guideline [15]. Low intensity activity represented achieving a minimum of at least <600 MET (min/week), and high intensity activity represents achieving $\geq$600 MET min/week. Recreational activities were not included in the questionnaire, unless evaluated by combining work related to high and low intensity physical activities. The diet factor was regarding the consumption of fruit and/or vegetable averages per day, type of oil used for preparation of meals, and the frequency of intake of different food items.

Stress factor was evaluated by measuring the degree of stress levels using the 'global measure of perceived stress scale' as a tool [16]. This measures the experience level of stressful life events concerning coping skills and personality factors. Ten questions were asked, and the scaling categories of answers were measured in the Likert scale, with; 0 = never, 1 = almost never, 2 = sometimes, 3 = fairly often and 4 = very often for positive statements. For negatively stated items, the scores were obtained by reversing. The total scores of the respondents were divided into two categories, offering low and high based on the median [16].

Part IV was used to gather sources of health information and about health check-up in the last 12 months. The respondent's knowledge about predicted factors, consequences and prevention of hypertension were measured. A correct answer was given a score of '1' and incorrect answer was given score of '0'. The level of knowledge of hypertension was classified into good (< median, 0-5 of the total score), and poor ($\geq$ median, 6-9 score). There were eight statements relating to the perception of complications, prevention and the risk factors of hypertension. The scores of 0 to 4 were given according to the proposed statement. The total possible scores were divided into two categories, based upon the median score. Good perception referred to a score equal to or above the median (25), and poor perception was less than the median. The Cronbach's alpha coefficient was 0.62 for the perception and the KR-20 coefficient was 0.67 for the knowledge.

The last part was anthropometric and blood pressure measurements. Blood pressure (BP), weight, height, waist and hip circumferences were measured by nurses according to WHO standard guidelines [15, 18]. BP categories were classified as normal when syslotic BP (SBP) < 120 mmHg and diastolic BP (DBP) < 80 mmHg, and classified as prehypertension when SBP 120-139 mmHg and/or DBP 80-89 mmHg [1]. The BMI of 23 kg/m^2 or higher, has been identified as representing an increased risk for the Asian population [19], and waist circumference (WC) cut off for Asian population WC > 90 cm (men) and > 80 cm (women) were applied as cut off [20-21]. In addition, cutoff values for WHR were 0.89 for men

Table 1 Description of blood pressure

Blood pressure	Statistic	Normotension (n=252, 61.9%)	Prehypertension (n=155, 38.1%)	Total
Systolic blood pressure	Median	114.3	132.0	118.0
	QD	4.5	5.5	6.0
	Minimum	81.5	120.5	81.5
	Maximum	120.0	139.0	139.0
Diastolic blood pressure	Median	73.5	84.0	78.0
	QD	5.3	2.5	5.5
	Minimum	48.5	80.5	48.5
	Maximum	80.0	89.0	89.0

*QD=quartile deviation

Table 2 Distributions of respondents by socio-demographic characteristics, supportive factors, and lifestyle factors

Characteristics	Number	%
Gender		
Male	63	15.5
Female	344	84.5
Age (years)		
18-29	95	23.3
30-39	110	27.0
40-49	125	30.7
50-59	65	16.0
60-65	12	2.9
Median = 39 QD = 8.5 Min =18 Max = 65		
Income (Approx. 15.42 MVR=1 US$)		
Low income (< median)	186	47.7
High income (≥ median)	206	53.3
*Missing 17		
Median = 8000.00 QD = 9498.00 Min = 750.00 Max = 2,000,000.00		
Educational level		
Primary school completed	294	72.2
Secondary school completed	87	21.4
Diploma	7	3.5
College / University completed	19	6.4
Family history of hypertension		
No one in the family	168	41.8
First degree relatives	225	56.0
Second degree relatives	9	2.2
*Missing 5		
Body Mass Index (kg/m²)		
Underweight (<18.50)	17	4.2
Normal (18.50-22.99)	86	21.1
Overweight (23-24.99)	77	18.9
Obesity (≥ 25)	227	55.8
Median = 25.70 QD = 2.66 Min = 12.31 Max = 42.97		
Diseases		
Hypercholesterolemia	50	12.3
Diabetes	10	2.5
Other diseases (thyroid disease, migraine, anemia)	25	6.2
WC (cm)		
Lower than cut off values	104	25.6
Higher than cut off values	303	74.5
Median = 88 QD = 6.75 Min = 55 Max = 134		
Male (n = 63)		
< 90 (Low risk)	35	55.6
≥ 90 (High risk)	28	44.4
Median = 89 QD = 6 Min = 27.7 Max = 117		

Table 2 Distributions of respondents' by socio-demographic characteristics, supportive factors, and lifestyle factors (Cont.)

Characteristics	Number	%
Female (n = 344)		
< 80 (Low risk)	69	20.1
≥ 80 (High risk)	275	79.9
Median = 88 QD = 6.75 Min = 55 Max = 134		
Waist - Hip Ratio (cm)		
Lower than cut off values	41	10.1
Higher than cut off values	366	89.9
Median = 0.91 QD = 0.04 Min = 0.17 Max = 1.99		
Male (n = 63)		
< 0.89 (Low risk)	20	31.7
≥ 0.89 (High risk)	43	68.3
Median = 0.92 QD = 0.05 Min = 0.78 Max = 1.03		
Female (n = 344)		
< 0.81 (Low risk)	21	6.1
≥ 0.81 (High risk)	323	93.9
Median = 0.91 QD = 0.04 Min = 0.17 Max = 1.99		
Physical activity (MET-minutes per week)		
Low	255	62.7
High	152	37.3
Median = 1440 QD = 3560 Min = 180 Max = 22400		
Fruits and vegetables consumption on average per day		
< 5 servings of fruits and/or vegetables	378	92.9
≥ 5 servings of fruits and/or vegetables	29	7.1
Median = 2.0 QD = 0.0 Min = 0.0 Max = 7.0		
Type of oil or fat used most frequently		
Vegetable	328	80.6
Sunflower	48	11.8
Other types	31	7.6
Perceived Stress Scale (PSS)		
Low (< median: score 0 -15)	199	48.9
High (≥ median: score 16 -58)	208	51.1
Sources of health information		
TV	243	59.7
Radio	124	30.5
Other sources	258	63.4
Health check-up in last 12 months		
No	240	59.0
Yes	167	41.0

*QD=quartile deviation

and 0.81 for women [20].

Prior to data collection, this study was approved by the Mahidol University Ethical Committee (COA. NO. 2014/012.1401) and the National Health Research Committee, Ministry of Health, Republic of Maldives. All participants were explained the purpose, content, and procedures of the study. The participants were informed that no personally identifiable information would be disclosed, and that they could withdraw or terminate their participation at any time.

Univariate analysis was used to describe the mean, standard deviation, median, quartile deviation, minimum and maximum numbers and percentage. Chi-square tests were used to identify any association between each independent variable and prehypertension. Finally, multiple logistic regression was used to determine the association between independent variables and prehypertension, where $p < 0.05$ was considered significant.

RESULTS

A total of 528 participants were approached in their households and 407 (76%) agreed to participate. Only 38% were classified as pre-hypertensive and 61.9% were normotensive (Table 1).

The majority of respondents were females (84.5%) with a median age at 39 years (QD= 8.5), and the majority (72.2%) of adults had completed primary school education. Over half (56.0%) had

Table 3 Association between prehypertension and independent variables

Independent variables	n	Prehypertension			*p-value*
		Yes %	No %	Crude OR (95% CI)	
Age (years)					
≥ 44	144	44.4	55.6	1.51 (1.00-2.29)	0.051
< 44	263	34.6	65.4	1	
Gender					
Male	63	39.7	60.3	1.08 (0.63-1.88)	0.776
Female	344	37.8	62.2	1	
Household income					
High income (≥ median)	204	38.7	61.3	1.12 (0.74-1.69)	0.582
Low income (< median)	186	36.0	64.0	1	
Educational level					
Lower than primary school completed (≤ grade 7)	294	44.6	55.4	2.98 (1.80-4.94)	<0.001
Higher than secondary school completed (>grade 7)	113	21.2	78.8	1	
Family history of hypertension					
Yes	225	40.9	59.1	1.31 (0.87-1.96)	0.195
No	182	34.6	65.4	1	
BMI (kg/m²)					
≥ 23	304	41.1	58.9	1.70 (1.05-2.75)	0.030
< 23	103	29.1	70.9	1	
Hypercholesterolemia					
Yes	50	30.0	70.0	0.66 (0.35-1.26)	0.209
No	357	39.2	60.8	1	
Diabetes					
Yes	10	30.0	70.0	0.69 (0.18-2.71)	0.594
No	397	38.3	61.7	1	
Waist circumference					
Higher than cut off values	303	43.6	56.4	2.72 (1.72-4.55)	<0.001
Lower than cut off values	104	22.1	77.9	1	
Waist–hip ratio					
Higher than cut off values	366	38.8	61.2	1.37 (0.68-2.72)	0.375
Lower than cut off values	41	31.7	68.3	1	
Physical activity					
Low	255	63.1	36.9	0.87 (0.58-1.32)	0.511
High	152	59.9	40.1	1	
Fruit and vegetable consumption					
< 5 servings of fruit and/or vegetable	378	37.8	62.2	0.86 (0.40-1.86)	0.704
≥ 5 servings of fruit and/or vegetable	29	41.4	58.6	1	
Oil or fat used for meal preparation					
Vegetable oil	328	37.2	62.8	0.83 (0.50-1.36)	0.452
Other types	79	41.8	58.2	1	
PSS					
High	208	38.5	61.5	1.03 (0.69-1.54)	0.872
Low	199	37.7	62.3	1	
Smoking status					
Yes	38	34.2	65.8	0.83 (0.41-1.68)	0.606
No	369	38.5	61.5	1	
Obtained hypertensive information through internet					
No	350	41.4	58.9	2.92 (1.46-5.84)	0.002
Yes	57	19.3	80.7	1	
Health check-up					
No	240	36.2	63.8	0.83 (0.55-1.24)	0.361
Yes	167	40.7	59.3	1	
Knowledge related to hypertension					
Poor	150	32.0	68.0	0.66 (0.43-1.02)	0.053
Good	257	41.6	58.4	1	
Perception of hypertension					
Poor	192	33.3	66.7	0.68 (0.46-1.02)	0.062
Good	215	42.3	57.7	1	

Abbreviation; OR, odds ratio; CI, Confidence interval; MVR, Maldivian rufiyaa.

Table 4 Final model of multiple logistic regressions analysis for predictors of prehypertension among adults resident of Maldives

Independent variables	Adj. OR	95% CI		*p-value*
		Lower	Upper	
Educational level				
Lower than primary school completed (≤ grade 7)	2.72	1.62	4.58	<0.001
Higher than secondary school completed (> grade 7)	1			
Waist circumference				
Higher than cut off values	2.44	1.43	4.14	<0.001
Lower than cut off values	1			
Family history of hypertension				
High risk	1.38	0.90	2.10	0.142
Low risk	1			
Perception of hypertension				
Poor	0.72	0.47	1.10	0.132
Good	1			

Hosmer and Lameshow Test= 5.360, p=0.498
Abbreviation; OR, odds ratio; CI, Confidence interval

a family history of hypertension, and the majority (55.8%) were classified as being obese (≥ 25 kg/m²). Hypercholesterolemia accounted for 12.3% of the respondents. In addition, a higher percentage of females were found to have a higher waist circumference than males (79.9% versus 44.4%).

For waist-hip ratio (WHR), 89.9% of the adults were categorized as higher than cut off values category. Similar to waist circumference, a higher percentage of females was found to have a higher WHR than males (93.9% versus 68.3%). According to General Physical Activity Questionnaire (GPAQ) guidelines, the majority (62.7%) of adults were classified as entertaining low intensity physical activity. In terms of fruit and vegetable consumption, almost all of the respondents (92.9%) consumed less than 5 servings of fruit and/or vegetables on average per day. For oil or fat often used for meal preparation, the majority used vegetable oil (80.6%). Finally, half (51.1%) had high perceived stress levels (Table 2).

The Chi-square test revealed that respondents with older age, lower education, high BMI, larger waist circumference, less likely to obtain health information from the internet, and having poor knowledge about hypertension are more likely to have prehypertension (Table 3).

Multiple logistic regressions indicated that adults who had low education level and larger waist circumferences were nearly 3 times more likely to have prehypertension after adjusting for other variables (Table 4).

DISCUSSIONS

This study revealed that the prevalence of prehypertension among the respondents was 38.1%, similar to studies conducted in India, China and Vietnam [22-24]. However, the prevalence was higher compared to Thailand (32.8%) [25]. Our study found that the proportion of prehypertension increased with age, family history of hypertension, BMI, and this was consistent with a study of the Chinese 'She' population [26]. A population based study on prehypertension and diabetic and cardiovascular diseases indicated that higher prevalence of prehypertension is a critical issue because of the morbidity and mortality related to hypertension [27]. More attention may be needed to decrease the prevalence of prehypertension in the Maldives.

In this study, all subjects with prehypertension had intermediate levels of BMI, waist circumferences, lower education levels, poor knowledge about hypertension, and were less likely to obtain health information from the Internet. Adults with low education were two times more likely to present with prehypertension. This was also consistent with previous studies [9, 28]. A study understanding the differences in health behavior through education revealed that better education can offer greater affects at about 20%, with general cognitive ability improving behavior [28]. Previous studies have indicated that low educational achievement at the township level is independently associated with diastolic BP [29]. Similarly, a WHO multinational project aged 35-64 years from 39 worldwide Monitoring of Trends and Determinants in Cardiovascular Disease (MONIC) revealed that systolic BP is independently associated with lower educational achievement [30]. This could explain that if subjects who have adequate knowledge may be more likely to have greater awareness about

control the risks associated with hypertension and cardiovascular diseases.

A family history of hypertension is positively associated with prehypertension [31, 32]. It is therefore obvious that genetic factors involve the inheritance of hypertension within a family, although this factor evaluated in pathophysiology of cardiovascular disease has its origins in childhood, compared to other predicted factors of cardiovascular diseases. Epidemiological studies indicate that genetic factor involve variations of BP at circa 30% between different societies [33]. The findings of this present study supported the outcome of previous studies which showed that those who have a family history of hypertension are 1.38 times more likely to suffer from prehypertension. Our findings also indicated that a higher waist circumference was significantly associated with prehypertension. Multiple logistic regression revealed that adults with a higher waist circumference are more likely to suffer from prehypertension. Waist circumference measures the anatomical distribution of fat in the body. A high percentage of obesity (55.8%) could relate to such an association. Similar findings have been found in a study conducted in province of the Attica region [34]. Therefore, waist circumference could be recommended to screen for assessing the risk of hypertension in people of Maldives.

A study conducted on 'management of blood pressure' indicated that the prevalence of hypertension can be reduced by 62% when taking 4-5 portions of fruit and vegetable servings per day (rich potassium and calcium), and a reduction in total saturated fats and limiting the amount of meat and sweets [35, 36]. This present study shows that almost all respondents (92.9%) consumed less vegetables and fruit. A low intake of vegetables and fruit in the diet reflects peoples' eating styles, due to the geography of the country and disenables people to access such items. It is important to encourage home gardening of fruit and vegetables to meet the dietary needs of all for their own good. Previous studies have identified interactive health communication in preventive medicine with new application technologies which persuade the delivery of health education [36, 37]. This study found that adults who do not obtain information via the Internet are 2.92 times more likely to suffer from prehypertension than those who have obtained hypertension information using other sources. In the 21st century, the Maldives might consider initiated mobile application for those who can access health information to promote a healthy lifestyle in young people.

Based on the findings of this study, it is necessary that health care professionals should promote health education programs and recommended lifestyle changes to those suffering from prehypertension or other illness; this could be conducted through various available pubic media. Public health managers can establish a screening clinic for NCDs on any particular day, and encourage whole communities over the age of 18 years old, especially women who are in risk groups, to join such a program. Measuring waist circumference could be used as an indicator to screen those who are at risk of prehypertension. Appropriate exercise programs should be initiated to those with high waist circumferences and have family history of hypertension.

This study has certain limitations- the alcohol consumption factor was excluded because it is a sensitive issue in a Muslim country. Second, the majority of the respondents were female. Finally, study subjects included those who lived in Baa Atoll area which may limit the generalizability.

CONCLUSIONS

This cross-sectional study demonstrates that low education levels and high waist circumferences are significant predictors of prehypertension among adults in Baa Atoll, the Republic of the Maldives. Measuring waist circumference could be recommended as a tool to identify high risk patients with prehypertension. Strategic planning among policy makers and public health managers should be targeted to promote healthy lifestyle. Inventing applications to increase modes of delivering health promotions could be strategies for those who can access technology, especially the younger generation. In addition, health education should emphasize adults to increase knowledge about the risk perceptions concerning cardiovascular health and enforce the maintenance of a healthy lifestyle to prevent hypertension, as well as cardiovascular disease.

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