Research Article

Predictors Of Hypertension Control In A Suburban Hypertensive Population

Dr. N. Sri Sakthi Priya[1]*, Farhana Rahman[2], Arul Amutha Elizebeth [3], Agila Balakrishnan[4], Pradeep Paul George[5], Nagasundaram Muthiah[6], Govindasamy Kumaramanikavel[7]

[1]Postgraduate Pharmacology Sree Balaji Medical College and Hospital Email: nsrisakthipriya@gmail.com
Orcid id: 0009-0003-5772-769X
[2]Professor, Sree Balaji Medical College and Hospital Specialisation: Pharmacology Pharmacology Bharath Institute of Higher Education and Research, Chromepet City: Chennai Pin code: 600044 Country: India
Email Id: contactfarah@gmail.com Orcid Id: 0000-0003-4045-1167
[3]Prof and HOD Pharmacology, Sree Balaji Medical College and Hospital Email: amuthasathish@gmail.com
Orcid id: 0000-0002-9235-1603
[4]Assistant Professor, Department of Optometry, School of Allied Health Sciences Dhanalakshmi srinivasan university, Mamandur, Chengalpattu, https://orcid.org/0009-0003-8682-6179
[5]Freelance Epidemiologist Email: pradeep_paul_g_gunapal@nhg.com.sg
[6]Retired (Professor) Pharmacology Email: nsm.healingtouch@gmail.com
[7]Director of Research and Development Narayan Nethralaya, Narayana Health City, Karnataka
Email: gkumarmvel@gmail.com

Abstract

Background and purpose: Hypertension is a preventable disease, provided certain cardiovascular behavioral factors are altered. Hence, there is dearth of physical activity and hypertension management of recent times. We enumerated various factors of hypertension control in patients from one hospital located in a suburban area of a south Indian metropolitan city. Methods: A cross-sectional hospital-based survey of 448 hypertensive patients (≥ 140/90 mm of Hg) on antihypertensive medications were recruited. To determine the behavioural factors associated with blood pressure control, multivariate logistic regression analysis (MLRA) were applied. Results: MLRA revealed that aerobic physical activity once per week (OR = 3.21, 95% Cl: 1.07 – 9.64, p = 0.04), more than twice a week (OR = 4.07, 95% Cl: 1.32 – 12.51, p = 0.01) when compared with daily exercise and maintenance of weight reduction through aerobic physical activity (OR = 3.65, 95% Cl: 1.10 – 12.15, p = 0.04) when compared to diet control are behavioural factors that independently associated with the control of hypertension. Conclusion: Our study concluded that, aerobic physical activity maintains optimal blood pressure among the study population. Henceforth, hypertensive patients could be encouraged by the physicians, to include some sort of physical activity in their daily routine along with antihypertensive drugs to maintain optimal blood pressure and to prevent complications.

Keywords: Hypertension, physical activity, control, logistic regression.

1. Introduction

In the current decade, hypertension and its complications were becoming a significant health economic burden nationally and internationally. Morbidity and mortality were rising both nationally and internationally, because of the high prevalence of cardiovascular disease and hypertension. Globally, about 1.38 billion people had hypertension, where, systolic blood pressure (SBP) accounts for ≥ 140 mm of Hg and diastolic blood pressure, (DBP) ≥ 90 mm of Hg in 2010.(1) Despite effective antihypertensive management with proven cardiovascular morbidity and mortality benefits, compliance and control of hypertension amongst patients remains poor. Variable risk factors of hypertension are aging population, gender difference, genetic polymorphisms, processed food, decrease in physical activity, overweight, diabetes, not limiting alcohol consumption, smoking, psychological stress, sleep disorders, and environmental pollution. It is well known from various observational studies that hypertension prevalence increases with age. Blood pressure of men increases at a younger age than women, but as the age increases (> 60 years), mean blood pressure and prevalence of hypertension increases in women.(2) In many cross-sectional studies, it has been reported that, hypertension have a direct association with higher intake of sodium in diet. (3) Excessive intake of processed foods, sweetened beverages, unhealthy fats, and sodium have been confirmed by studies as risk factors associated with hypertension. (4) Various studies between 2001-2016 investigated the trends of association with physical activity and control of hypertension and further reported that due to the lack of physical activity, women (31.7%) have a higher prevalence of hypertension than men (23.4%). (5) Fifty four randomized control trials(meta-analysis) (6) reemphasized the benefits of aerobic exercise in controlling BP amongst hypertensives and maintaining normal BP in normotensive individuals. Henceforward, management and control of high blood pressure would require

a better understanding of diverse factors that affect high BP regulation and control, particularly lifestyle modification practices.

In India, National Family Health Survey 4 (NFHS 4) covered twenty-nine states and seven union territories and conducted a survey between 2015-2016 that reports 1,31391 (17.8%) hypertensive patients aged between 15-49 years. The same study estimated that the poor control of BP in rural India as 7.7% (95% Cl 7.3% - 8.0%) and in urban India 8.3% (95% Cl 7.6% - 9.0%) amongst the treated hypertensive population, clearly reflecting negligence and appalling control of hypertension in the country in general. (7) In one of our recent studies, we also observed that only 11.8% of the hypertensive population could have better control of hypertension when analysed with various sociodemographic factors. (8) A case – control hospital – based study done in Kerala, a southern state in India emphasises that physical inactivity along with other modifiable risk factors are the driving forces behind the rising epidemics of hypertension. (9) Similarly, cross-sectional studies (10) from Jabalpur, a small town in the central part of India (community-based), and from Tigray, Ethiopia (hospital-based) (11) analysed that physical inactivity and non-adherence to physical activity was one of the key factors for prevalence of hypertension and uncontrolled hypertension. However, not much hospital-based or community-based data are available on the details of physical activity and BP control in India. Besides in the last couple of decades, the per capita income and socio-demographics in India have undergone swift changes due to the rapid increase in the economic activities, which lead to various health-related changes and influenced the prevalence of hypertension. Hence, the goals of the current study were to find the various correlates of BP control among patients with hypertension visiting the hospital in the suburban area of Chennai, India.

2. Methods

Study area and period
A hospital-based study, conducted in the suburban area of Chennai, a metropolitan city in the southern part of India. Study period was from the year 2018 to 2019.

Study design and population
Cross-sectional study design, among adult hypertensive patients who were attending the outpatient department of medicine at this hospital.

Inclusion and exclusion criteria
Hypertensive patients with >20 years of age, both gender, who were on anti-hypertensive medication, and came to hospital for follow-up regularly for at least 6 months. Pregnant mothers and critically ill hypertensive patients were excluded from the study.

Definition of hypertension
According to the International Society of Hypertension (ISH) guidelines committee, hypertension is defined as, when SBP is 140 mm of Hg or greater and/or DBP is 90 mm of Hg or greater is diagnosed as hypertension.(12)

Sampling method
For this study, consecutive sampling method was applied. The participants were enrolled, based on their eligibility and accessibility during data collections.

Study variables
Independent variables
Age, gender, marital status, employment, education status, clinical characteristics of the patient (body weight, family history of hypertension, duration of hypertension, SBP and DBP, presence of co-morbidities, number and types of antihypertensive drugs) and behavioural practices (physical activity, dietary management, weight management, smoking and alcohol status) were the independent variables.

Dependent variable
Hypertension control (< 140/90 mm of Hg) among the study participants was the dependent variable

Data collection tools and quality assurance

A pre-tested questionnaire was used to collect the data. Experts from different study field designed and reviewed the questionnaire. Different parts of the questionnaire were – Part I contains sociodemographic characteristics and clinical profile of the patients. Part II was on knowledge of hypertension, risk factors and complications. Part III was on questions to access the behavioural changes of the hypertensive patients. At first, the questionnaire was prepared in the English language and then it was translated to the local language (Tamil) and then again back translated to English to check for consistency and content of the item questions. A Tamil version of the questionnaire was also used to collect the data, for better understanding of the patient. Prior commencing the study, a pilot study was performed to validate the questionnaire in terms of understandability and was accordingly modified. Trained data collecting personnel collected the data and reviewed for completeness and consistency.

Data processing and analysis

Data were analysed with the help of SPSS version 22. T-test was analysed for continuous variables such as mean, and standard. Chi-square (χ^2) test were used to analyse categorical variables like percentage. Univariate analysis was conducted to ascertain the association between all demographic and lifestyle modification variables. All significant variables in the univariate analysis were entered into a multivariate logistic regression model to ascertain the factors associated with hypertension control. A 'p' < 0.05 was considered significant.

Ethical consideration

Ethical clearance was received from the IEC (institutional ethics committee). Informed consents were obtained from the participants after they agreed to participate for this study. (13)

3. Results

Mean age group of the study population was 53.32 years of age with a standard deviation of 11.2. More than half of the study population were in the 40 - 60 years age group (55.80%). Among the participants, there was a higher proportion of women (54.5%) than men (45.5%). SBP were 144.8 mm of Hg with a standard deviation 14.9 and DBP of 90.81 mm of Hg with 7.6 as standard deviation. Sociodemographic characteristics are summarized in Table 1A and 1B. Almost all the participants were married, and the secondary level (46.6%) of school education was higher in the study population. There were a very small number of illiterates whom we excluded from the study. About 34.8% females were homemakers and 53.3% of the study population did not have any known co-morbid disease, but among the participants who had co-morbid diseases, diabetics mellitus (28.6 %) was the most common. The most common antihypertensive medication class taken by the patients was angiotensin receptor blocker either as monotherapy (42.18%) or in combination with anti-diabetic drugs (10.71 %). Most of the patients were on monotherapy, and the most frequent fixed combination therapy was calcium channel blocker and angiotensin receptor blocker (3.57%). Around 45.3% of the hypertensive study population had a family history of hypertension.

Out of 448 participants we observed that 52% (n = 233) of the study subjects was not involved with any physical activity and among 233 study participants who was physically inactive, 87.9% had high blood pressure (>140/90 mm of Hg). Factors independently associated with BP control are presented in Table 2. When compared to participants who reported practicing daily aerobic physical exercise, the subjects who reported practicing exercises once a week (OR = 3.21, 95% Cl: 1.07 – 9.64, p = 0.04) and more than twice a week (OR = 4.07, 95% Cl: 1.32 – 12.51, p = 0.01) had greater odds of having hypertension under control. Similarly, compared to participants who only reported diet control for weight reduction, participants who reported performing the physical exercise for weight reduction had higher odds of bringing hypertension under control. (OR = 3.65, 95% Cl: 1.10 – 12.15, p = 0.04).

4. Discussion

In most patients, the cause of hypertension is unknown, and if they are left untreated or have poorly controlled BP, they develop complications that could lead to coronary artery disease, stroke, heart, and kidney failures. Therefore, poor control of BP is a major global public healthcare concern, hence modifiable and non-modifiable health determinants are the key predisposing risk factors, even in those who are under medical treatment. We also observed poor control of hypertension among the study participants in our recent study in urban population of southern India. (8) We could not find other hospital-based cross-sectional study from India which correlates physical activity and high blood pressure, but a community-based physical activity intervention study for 10 weeks from rural part of southern

India demonstrated the effectiveness of physical activity on regulation of BP. (14) Even international studies such as meta-analysis of 93 trials mentions that hypertensive individuals who were involved in aerobic physical training (walking or jogging) for 30 – 45 minutes thrice a week, showed a reduction of both SBP and DBP.(15) The meta-analysis (54 clinical trials) of randomized clinical trials (RCT) that examined aerobic exercise's effect on BP showed that aerobic exercise had a blood pressure-lowering effect for both SBP and DBP. But marked BP reduction was seen in these 54 clinical trials with shorter follow-up and not with longer follow-ups of physical exercises, and the reason could be due to the participants' adherence to the intervention program might have decreased over time.(6) The present study also reported that aerobic physical activity such as walking, jogging, and cycling for 30 minutes once or more than twice a week decreases both SBP and DBP. In the multivariate regression model, we saw that hypertensive participants who were involved in physical exercises once per week (OR: 3.21, 95% CI: 1.07 - 9.64) and more than twice a week (OR: 4.07, 95% CI: 1.32 - 12.51) were able to control their BP when compared to participants who were exercising daily. We had also recorded the mean SBP and DBP among hypertensive patients who exercised every day (SBP: 148.9 $\pm$ 1.6, 95% Cl 145.6 – 152.1; DBP: 93.1$\pm$ 0.6, 95% Cl 91.9 – 94.3), once a week (SBP: 141.6 $\pm$ 1.4, 95% Cl 138.8 – 144.5; DBP: 91 $\pm$ 1.0, 95% Cl 88.8 – 93.1), and more than two times a week (SBP: 138.8 $\pm$ 1.3, 95% Cl 136.1 – 141.5; DBP: 87.5 $\pm$ 1.0, 95% Cl 85.5 – 89.5). The average mean SBP and DBP were higher among those who exercised every day. This finding could most likely be because the people with higher SBP/DBP report exercising daily due to poor hypertension control. Since it is a cross-sectional study, we recorded the outcome (BP) and the exposure (physical activity) simultaneously. Another variable that we found in our study associated with controlled hypertension was the weight reduction adoption by physical exercise (OR: 3.65, 95% CI 1.10 - 12.15) compared with those who adopted diet control alone. Collectively, these findings show that physical activity increases the chances of an individual's efforts to control the BP.

International studies reported that, an adult (18 – 65 years of age) should perform endurance physical activity (brisk walking, gardening, housework, and domestic chores) for five days a week (thirty minutes/day) or high intensity aerobic activity (jogging, running, cycling, swimming) three days a week (twenty minutes/day).(16) Evidence shows that there is a negative co-relation between physical activity and cardiovascular disease.(17) and experiments showed that the post-exercise hypotension effect could be seen for about twenty two hours after exercise.(18) Inhibition of sympathetic activity mainly noradrenaline, alteration in the expression of adenosine, endothelin, prostaglandin and nitric oxide, improvement in insulin sensitivity, and reduction of peripheral vascular resistance are some of the salutary physiological effects associated with the decrease of BP after exercise in both normotensive and hypertensive individuals. Moreover, it was also observed that long term physical exercises lead to a decrease in the predictive biological factors (inflammatory cytokines, C-reactive protein) of morbidity and mortality. (19) In preventing and managing grade 1 hypertension, substantial evidence shows that endurance physical activity and high-intensity aerobic activity have a significant role. Nevertheless, managing grade 2 ($\geq$ 160/100 mm of Hg) hypertension with physical activity needs monitoring, and individual preferences as adherence to physical activity are required for long-term well-being.

There are certain limitations to our study. We acknowledge that the participants in this study were limited to patients seen in a tertiary hospital, and thus, could not be graphed and hypothesize to the entire Indian society. Again, sub-groups, such as endurance physical activity, vigorous-intensity aerobic activity, isometric activity to compare which group had better control of hypertension have not been created. Lastly, we accept that our study being a cross-sectional study had inherent limitations in explaining the uncertainty about the exact order or sequence of events on whether patients exercised daily as their BP was high or vice-versa. To assess the causal relationship between variables associated with the hypertension and its management, longitudinal studies are required.

5. Conclusion

The current study shows that the patients who were involved in physical exercises such as brisk walking, jogging, and/or cycling were able to control their hypertension and obtain an optimal BP ($<$ 140/90 mm of Hg) significantly to demonstrate the positive effect association in an urban southern Indian metropolitan city. Moreover, it was observed that participants who preferred physical exercise over diet to maintain their weight also had significant controlled blood pressure. To understand the better impact of various types of physical exercise in managing hypertension and prevent complications, further research and better methods are required to adhere to the physical activity for a successful outcome and reduce the health economic burden of a society.

Acknowledgment
None

Funding support: No

Conflict of interest: None.

Table 1A: Base-line sociodemographic characteristics

SN	Continuous predictors	Mean	Std. deviation
1	Age	53.32	11.213
2	SBP	144.81	14.905
3	DBP	90.81	7.680
4	Body weight	66.49	10.792
5	Duration of hypertension	5.21	4.914

Table 1B: Base-line sociodemographic characteristics

SN	Categorial predictors		Frequency (n)	Percentage (%)
1	Gender	male	204	45.5
		female	244	54.5
2	Marital status	married	441	98.4
		unmarried	5	1.1
		widow	2	0.4
3	Education level	not educated	15	3.3
		primary	102	22.8
		secondary	208	46.4
		graduate	123	27.5
4	Employment status	labourer	88	19.6
		executive	77	17.2
		senior executive	73	16.3
		top management	2	0.4
		own business	21	4.7
		homemaker	156	34.8
		retired	26	5.8
		others	5	1.1
5	Antihypertensive drugs	CCB	97	21.65
		ARB	189	42.18
		ACE	2	0.44
		Ds	8	1.78
		BB	5	1.11
		CCB + ARB	16	3.57
		CCB + BB	12	2.67
		CCB + Anti-diabetic drugs	26	5.80
		ARB + Anti-diabetic drug	48	10.71
		ACE + Anti-diabetic drug	3	0.66

		CCB + hypolipidemic drug	7	1.56
6	Co-morbid diseases	diabetics mellitus	128	28.6
		dyslipidaemia	35	7.8
		ischemic heart disease	11	2.5
		obesity	4	0.9
		others	22	4.9
7	Family history of hypertension	yes	173	38.6
		no	245	54.7
		no idea	29	6.5

Table 2: Multivariate analysis of factors associated with hypertension control

SN	Variables	Odds ratio	'P' value	95% Confidence interval	
				Lower	Upper
1	**Age**	1.02	0.45	0.98	1.06
2	**Employment status**				
a	Executive	1.17	0.81	0.32	4.32
b	Senior executive	1.76	0.40	0.48	6.48
c	Top management	1.38	0.89	0.01	127.49
d	Own business	4.56	0.09	0.78	26.57
e	Housewife	1.93	0.33	0.52	7.11
f	Retired	1.15	0.88	0.20	6.69
3	**Knowledge**				
a	Complete give up of smoking helps in lowering high blood pressure	0.65	0.46	0.20	2.06
b	Thirty to forty-five minutes of physical exercise is necessary for lowering high blood pressure	2.12	0.37	0.41	11.03
c	Alcohol limitation to one unit (10 ml) per day reduces high blood pressure	0.68	0.41	0.27	1.72
4	**Lifestyle modification practice**				

a	**Intake of fruits (1 medium size fruit 2-3 times a day)**				
(i)	More than twice per week	1.16	0.76	0.45	2.98
(ii)	Daily	0.43	0.30	0.08	2.16
b	**Intake of lean meat/skinless poultry/fish**				
(i)	Once per week	2.40	0.44	0.26	22.52
(ii)	Occasionally	1.99	0.57	0.18	21.74
c	**Physical exercises for 30-45 minutes**				
(i)	Once per week	3.21	**0.04***	1.07	9.64
(ii)	More than 2 times a week	4.07	**0.01***	1.32	12.51
d	**Maintenance of weight reduction during the treatment**				
(i)	Physical exercise	3.65	**0.04***	1.10	12.15
(ii)	Both (Physical Ex and Diet)	1.13	0.82	0.40	3.15
e	**Smoking**	0.46	0.32	0.10	2.14
f	**Barriers to the adaptation of therapeutic lifestyle changes**	0.58	0.24	0.24	1.44
g	**Drugs**				
(i)	CCB +Anti-DM	1.91	0.42	0.40	9.26
(ii)	ARB	1.23	0.76	0.32	4.77
(iii)	ARB +Anti-DM	1.02	0.98	0.24	4.35
(iv)	CCB	3.35	0.08	0.86	13.13
(v)	CCB+ARB	1.13	0.91	0.13	9.77

*p value considered significant ($p < 0.05$). CCB: Calcium channel blockers, Anti-DM: anti-diabetic drugs, ARB: Angiotensin receptor blockers. Reference category: Employment status: Labourers, Intake of fruits: rarely, intake of lean meat: daily, Physical exercise: everyday, maintenance of weight reduction: diet control, Drugs: CCB+BB

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