Original Article

Efficacy of a home blood pressure monitoring program on blood pressure control in hypertensive patients

Seyed Reza Hosseini (MD) [1*], Mohammad Ghanbari (MSc) [2], Hoda Qarouei (MD) [3], Ali Bijani (MD) [4]

1. Social Determinants of Health Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran. 2. Babol University of Medical Sciences, Babol, Iran. 3. Mazandaran University of Medical Sciences, Sari, Iran. 4. Social Determinants of Health Research Centre, Health Research Institute, Babol University of Medical Sciences, Babol, Iran

Abstract

Background: Hypertension may cause serious consequences such as cerebrovascular accident, coronary heart disease, ocular damage and renal diseases if left untreated. The aim of this study was to determine the efficacy of a home blood pressure monitoring (HBPM) on control of blood pressure in hypertensive patients.

Methods: This historical cohort study was carried out on hypertensive patients whose data was kept in health houses. The exposed group was included 110 hypertensive patients that were using HBPM and the non-exposed group was included 220 patients that did not use it. Both groups were receiving the usual health house visits. Data was analyzed by chi-square, t-test and logistic regression.

Results: The mean systolic (p=0.041) and diastolic (p=0.002) blood pressure was lower for the exposed group as written in their last records. In logistic regression model, HBPM had significant effect on lowering systolic blood pressure (OR=1.64, 1.01-2.66, p=0.04) but not on diastolic blood pressure (OR=1.12, 0.68-1.84, p=0.65). Frequency of having a regular exercise program (p<0.001) and avoiding the use of salt (p<0.001) was more in the exposed group and the mean BMI was lower in this group (27.09±5.02) than the non-exposed group (29.57±4.91) (p<0.001).

Conclusion: Use of HBPM was associated with better control of blood pressure and life style adjustments such as regular exercise program and avoiding salt.

Keywords: Home blood pressure monitoring, Hypertension, Efficacy, Cardiovascular disease.

*** Correspondence:**
Seyed Reza Hosseini (MD),
Department of Social Medicine, Babol University of Medical Sciences, Babol, Iran.

E-mail: hosseinim46@yahoo.com
Tel: + 98 11 32199936
Fax: +98 11 32199936

Received: Nov 15 2014
Revised: Dec 21 2014
Accepted: Jan 25 2015

Citation:
Hosseini SR, Ghanbari M, Qarouei H, Bijani A. Efficacy of a home blood pressure monitoring program on blood pressure control in hypertensive patients. Caspian J Soc Med 2015; 1(1): 5-10.

Caspian J Soc Med 2015; 1(1): 5-10

Today, more than one-third of adults in the world are suffering from hypertension, and more than half of the deaths resulting from stroke and cardiovascular diseases are due to the hypertension (1, 2). High blood pressure often has no symptoms, but can lead to serious consequences such as stroke, heart failure, coronary heart disease, kidney disease and eye damage (3). Hypertension is one of the most preventable risk factor for stroke and other cardiovascular complications, which is easily recognizable and in most cases no underlying cause can be found for it (4).

The number of patients with hypertension increases with aging, so that almost half of people over 65 years are suffering from systolic and diastolic blood pressure or isolated hypertension (5). Studies in Iran represent a 22% prevalence of hypertension in the population of 15-64 years old (6). In the report of Non communicable Disease Risk Factor, 11.6% of men and 17.8% of women had high blood pressure in Mazandaran, Iran; and it seems this figure among the 55-64 years old population of this province covers 54% of total men and 37% of total women in this area (7). Given the high prevalence of this disease and morbidity associated with it, control of the disease is less than desirable (8-10). Newer approaches in blood pressure control have been shown that the ways in which patients are directed towards self-monitoring and education or the increase in the number of health workers, are the best ways to decrease the blood pressure in hypertensive patients. Home blood pressure monitoring (HBPM) is a major component of blood pressure control (11, 12).

Home blood pressure monitoring benefits include early diagnosis of high blood pressure in pre-hypertensive patients or patients with diabetes and kidney disease which are at greater risk; a method for identifying the impact of anti-hypertensive drugs which helps physicians and healthcare team about the proper dosage of drugs or replacing medications; better control of blood pressure and increased responsibility with respect to their health; more motivation to have a diet; increase in physical activity and regular use of drugs, reduction in the required physician or clinic visits and generally, lower healthcare and travel costs to see a doctor (12). Home monitoring allows the doctor to ensure whether the blood pressure increases due to increased anxiety in the clinic or out-of-clinic blood pressure is still high (12).

Many studies were conducted or are underway in different parts of the world on the efficacy of HBPM, but still its role in the optimal control of blood pressure is not well known (13-15). Reviewing the studies conducted so far, no studies have been conducted in this regard in Iran; so, the aim of this study was to compare the blood pressure control in hypertensive patients who had HBPM with a group of patients with hypertension who do not use this method.

Methods

This historical cohort study was conducted on hypertensive patients between 2012 and 2013 whose information was available at health houses under the coverage of Vice Chancellery for Health of Babol University of Medical Sciences, Babol, Iran. The exposed group (N=110) included all patients who were using HBPM, in addition to usual care by family physicians, their blood pressure was controlled at least once a week at home, and the results of these measurements were reported at each visit to the doctor. Blood pressure controls were done by their own or other family members. Unexposed group (N=220) included all patients who received only usual care provided by family physicians and were randomly selected among all patients with hypertension. Due to lack of regular monthly BP registration of patient or lack of regular visits over a period of 12 months, the five registered blood pressures in both groups of patients taken by health workers were used to compare. Comparison criterion was the mean reduction in blood pressure in both groups during the one year period.

It is noteworthy that, according to the comprehensive health program in the rural areas, all the 30 year and older individuals are screening every three years in terms of blood pressure and those with systolic BP of 140 mm Hg or higher or diastolic blood pressure of 90 mm Hg or higher are considered as patients with hypertension. Then these patients were examined by family physicians in health centers every 3 months, or once a month by health workers at the health houses.

Data were collected using a questionnaire that included demographic data such as age, sex, marital status, education level, as well as data on the patient's blood pressure which were recorded at different intervals by health workers or physicians.

Information was collected about exercise, avoiding salt consumption, smoking and taking regular medication in a patient's self-report and by asking "Do you smoke or exercise or avoid salt or taking medications regularly or not ". Then, data were analyzed using SPSS15 statistical software and chi-square test, t-test, and logistic regression. $P \leq 0.05$ was considered significant.

Results

In this study, 330 patients with hypertension were studied: 110 cases were exposed to the HBPM, and 220 patients as unexposed group who received usual care. Frequency and percent of using HBPM are shown in Table 1 in two groups according to age, sex, level of education, the

use of regular exercise, avoid salt intake, regular drug use, smoking and body mass index (BMI). As can be seen in Table 1, in this study, the group of HBPM had significantly more regular exercise program (p<0.001) and more avoid salt intake (p<0.001). Frequency of regular drug use (p=0.40) and smoking (p=0.26) in the exposed group was higher compared to the control group, although this difference was not statistically significant. Also in this study, a group of HBPM had lower BMI compared to the control group (p<0.001) (Table 1).

Five blood pressure by at least one month intervals in both groups of patients were recorded. In Table 2, the mean blood pressure recorded from the patients using HBPM is presented. As can be seen in the table, the mean systolic blood pressure (p=0.041) and diastolic blood pressure (p=0.002) recorded at the last visit was lower in the group using HBPM. Also, differences in systolic (p=0.001) and diastolic (0.002) blood pressure between the last and first visits were higher in the exposed group.

The logistic regression model was used to control variables affecting the reduction in blood pressure. Tables 3 and 4 indicate the odds ratios for different variables in reducing systolic and diastolic blood pressure (any significant reduction) in the raw and adjusted model. As you can see, the use of HBPM and reducing salt intake can cause a significant decrease in systolic blood pressure (Table 3); but none of the variables could significantly reduce the diastolic blood pressure (Table 4).

Table 1. Distribution and use of home blood pressure monitoring program (HBPM) in the two groups based on the study variables

Variables	The Use of HBPM		P Value
	Yes N (%)	No N (%)	
Age (year) (Mean±SD)	59.06±7.08	63.35±12.77	0.001
Gender			
Female	58 (52 .7)	160 (72.7)	
Male	52 (47.3)	60 (27.3)	0.001
Education level			
Less than high school diploma	99 (90)	218 (99.9)	
High school diploma and college	11 (10)	2 (0.1)	0.001
The use of regular exercise			
Yes- completely	4 (3.6)	3 (1.4)	
Yes- not completely	42 (38.2)	24 (10.9)	
No	64 (58.2)	193 (87.7)	0.001
Avoid using salt			
Yes- completely	82 (74.5)	97 (44.1)	
Yes- not completely	27 (24.5)	116 (52.7)	
No	1 (0.1)	7 (3.2)	0.001
Regular use of drugs			
Yes- completely	93 (86.1)	176 (81.1)	
Yes- not completely	14 (13)	35 (16.1)	
No	1 (0.9)	6 (2.8)	0.40
Smoking			
Yes	15 (13.6)	21 (9.5)	
No	95 (86.4)	199 (90.5)	0.26
BMI (mean±SD)	27.09±5.02	29.57±4.91	0.001

Table 2. The mean and SD of blood pressure of patients in the two groups in terms of home blood pressure monitoring program (HBPM)

Using HBPM Blood Pressure Status	Yes Mean±SD	No Mean±SD	P Value
The mean systolic blood pressure recorded at the first visit	129.82±13.92	132.69±16.54	0.118
The mean diastolic pressure recorded at the first visit	82±7.23	82.34±8.69	0.722
The mean systolic blood pressure recorded at the fifth visit	124.55±11.86	128.75±14.34	0.041
The mean diastolic pressure recorded at the fifth visit	80.14±6.44	81.43±8.21	0.002
Systolic pressure difference between the first and the last visits	5.26±9.32	3.9±15.59	0.001
Diastolic pressure difference between the first and the last visits	1.86±6.52	0.9±9.57	0.002
Mean Arterial Pressure	96.38±7.63	97.64±8.08	0.323
The mean systolic blood pressure recorded during five visits	127.07±11.8	130.17±12.77	0.034
The mean diastolic blood pressure recorded during five visits	81.03±5.83	81.37±6.44	0.637

Table 3. Odds ratios and CI of variables in reducing systolic blood pressure in patients

Variables	OR (CI95%-Raw)	P Value	OR (CI95%)*-Adjusted	P Value
Male	1.06 (0.67-1.68)	0.78	1.24 (0.71-2.20)	0.45
HBPM	1.48 (0.93-2.35)	0.09	1.92 (1.11-3.31)	0.02
Education (literate)	0.75 (0.46-1.21)	0.23	0.64 (0.36-1.13)	0.13
Age≥60	0.94 (0.61-1.45)	0.78	0.93 (0.55-1.57)	0.77
BMI≥30	1.41 (0.90-2.20)	0.13	1.52 (0.94-2.47)	0.09
Regular use of drugs	0.59 (0.33-1.06)	0.08	0.72 (0.38-1.35)	0.31
Avoid using salt	0.63 (0.41-0.98)	0.04	0.59 (0.36-0.98)	0.04
Smoking	0.78 (0.39-1.57)	0.49	0.83 (0.36-1.89)	0.65
Regular exercise	1.29 (0.76-2.17)	0.34	1.18 (0.64-2.16)	0.59

* Odds ratio with Confidence Interval 95%

Table 4. Odds ratios and CI of variables in reducing diastolic blood pressure in patients

Variables	OR (CI95%- Raw)	P Value	OR (CI95%*- Adjusted)	P Value
Male	1.07 (0.67-1.73)	0.77	1.14 (0.63-2.04)	0.67
HBPM	1.12 (0.69-1.81)	0.64	1.30 (0.74-2.26)	0.36
Education (literate)	0.96 (0.58-1.59)	0.88	0.94 (0.52-1.68)	0.83
Age≥60	0.89 (0.56-1.40)	0.62	0.88 (0.51-1.50)	0.63
BMI≥30	1.05 (0.66-1.68)	0.81	1.01 (0.61-1.65)	0.98
Regular use of drugs	0.52 (0.29-0.93)	0.03	0.62 (0.33-1.15)	0.13
Avoid using salt	0.61 (0.39-0.97)	0.04	0.61 (0.37-1.03)	0.07
Smoking	0.93 (0.45-1.95)	0.86	0.97 (0.41-2.25)	0.94
Regular exercise	1.14 (0.66-1.95)	0.63	1.09 (0.58-2.03)	0.78

Discussion

The mean systolic blood pressure (p=0.041) and diastolic blood pressure (p=0.002) recorded at the last visit was lower in the group using HBPM. Also, the differences in systolic (p=0.001) and diastolic (0.002) blood pressure between the

last and first visits were higher in the exposed group, which represents a further reduction in blood pressure in the exposed group, although in the logistic regression model, the HBPM showed the only significant effect on systolic blood pressure. In some studies, the efficacy of HBPM in hypertensive patients was rejected (16); However, in many studies, a significant decrease in blood pressure was observed (17, 18). For example, in one study conducted in 2010 by McManus et al., the mean blood pressure in patients using the home HBPM has been less than the control group ($p=0.013$) (19).

In the study of Cuspidi et al., systolic blood pressure was lower in the intervention group ($p<0.005$), but no significant change in blood pressure was observed between the two groups (20). In the study of Halme et al. in Finland, there was a reduction in blood pressure of the intervention group after 6 months ($p<0.001$), but diastolic blood pressure was almost equal in both groups (21). De Silva et al. have studied the effect of the HBPM during the 6-month follow-up in hemodialysis patients; at the end of the study, the systolic blood pressure in the intervention group was significantly lower, but no significant change was observed in the diastolic blood pressure (22). Márquez-Contreras et al. have studied the response to the medications based on home the HBPM, which was greater in the intervention group (23). However, according to the study of Madsen et al. and Verberk et al., the effect of anti-hypertensive treatment was the same (24, 25).

In this study, the use of regular exercise and avoiding salt intake was significantly higher in the exposed group. No similar studies were found in this domain. Regular drug use was higher in the study group, but the difference between two groups was not significant. In the study of Cuspidi et al., no significant relationship between the acceptance of drug use and the use of the HBPM was seen, too (20). Measurement of blood pressure by patients may increase their responsibility towards their health and also make them more motivated to modify their diet, increase physical activity, and regular use of the drug (26, 27). In the present study, smoking has been used more in the group of HBPM, although the difference was not statistically significant. The study of Cuspidi et al. also showed no significant relationship between smoking and the use of HBPM (20). It seems that smokers tend to change their lifestyles in most aspects, but not quit smoking. In this study, the mean BMI in the group of HBPM was lower than the control group ($p<0.001$). The result of Cuspidi et al. and Tan et al. studies have shown similar results (20, 28). This is because of paying more attention to healthy nutrition and health factors in the intervention group.

One limitation of this study was the lack of recording blood pressure or the absence of hypertensive patients monthly in the health houses to check their blood pressure. Another limitation of this study was to measure weight, BMI, physical activity and salt intake for one time which made time comparison so difficult.

In this study, the control of blood pressure was better in those who used HBPM. Although the reduction in blood pressure was not clinically significant, but it was statistically significant and important for reducing cardiovascular complications. Based on the results of this study, the use of HBPM with adjustments in lifestyle, including regular exercise, regular use of medications and avoiding the use of salt, plays an important role in reducing cardiovascular complications.

Acknowledgements

We would like to thank our colleagues at Vice-Chancellery for Health for their cooperation in collecting data.

Funding: This study was financially supported by Vice-Chancellery for Research and Technology of Babol University of Medical Sciences, Babol, Iran (Grant number: 612)

Conflict of interest: No conflict of interest declared.

References

1. World Health Organization. Q & As on hypertension. Available at: http://www.who.int/ features/qa/82/en/. Accessed October 20th 2013.
2. Ahmadvand A, Jamshidi H, Setodeh M, Sayyari A, Shadpor K. World Health Report. Risk reduction, improvement of health life. 1st ed. Ministry of Health 2002. [in Persian]
3. High blood pressure. Available at: http:www. nlm.nih.gov/medlineplus/highbloodpressure.html. Accessed February 25, 2010.
4. Cappuccio FP, Kerry SM, Forbes L, Donald A. Blood pressure control by home monitoring: meta-analysis of randomized trials. BMJ 2004; 329(7458): 145.

5. Kaplan NM. Kaplan's clinical hypertension. 8th ed. Philadelphia: Lippincott Williams & Wilkins 2002; p: 4.
6. Haghdoost AA, Sadeghirad B, Rezazadehkermani M. Epidemiology and heterogeneity of hypertension in Iran: a systematic review. Arch Iran Med 2008; 11(4): 444-52.
7. Asgari F, Rafei A, Azimi SS, Rezanejad P, Heidarian H. Non-communicable diseases, risk factors surveillance of I.R. Iran, Provincial Report 2008; p: 8. [in Persian]
8. Oliveria SA, Lapuerta P, Mc Carthy BD, L'Italien GJ, Berlowitz DR, Asch SM. Physician-related barriers to the effective management of uncontrolled hypertension. Arch Intern Med 2002; 162(4): 413-20.
9. Chobanian AV, Bakris GL, Black HR, et al. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. JAMA 2003; 289(19): 2560-72.
10. Luepker RV, Arnett DK, Jacobs DR Jr, et al. Trends in blood pressure, hypertension control, and stroke mortality: the Minnesota heart survey. Am J Med 2006; 119(1): 42-9.
11. Green BB, Cook AJ, Ralston JD, et al. Effectiveness of home blood pressure monitoring, Web communication and Pharmacist care on hypertension control a randomized controlled trial. JAMA 2008; 299(24): 2857-67.
12. American Heart Association. Home blood pressure monitoring. Available at: http://www.heart.org/ HEARTORG/ Conditions/ HighBloodPressure/SymptomsDiagnosisMonitoringofHighBloodPressure/Home-Blood-Pressure-Monitoring_UCM_ 301874_Article.jsp. Accessed July 19th, 2013.
13. Stergiou GS, Nasothimiou EG, Kalogeropoulos PG, Pantazis N, Baibas NM. The optimal home blood pressure monitoring schedule based on the Didima outcome study. J Hum Hypertens 2010; 24(3): 158-64.
14. White JR, Pham PA-C, Schick J. Home blood pressure monitoring and diabetes. Clin Diabetes 2004; 22(1): 28-31.
15. Gohar F, Greenfield SM, Beevers DG, Lip GY, Jolly K. Self-care and adherence to medication: a survey in the hypertension outpatient clinic. BMC Complement Altern Med 2008; 8: 4.
16. Yarows SA, Julius S, Pickering TG. Home blood pressure monitoring. Arch Intern Med 2000; 160(9): 1251-7.
17. Imai Y, Obara T, Asamaya K, Ohkubo T. The reason why home blood pressure measurements are preferred over clinic or ambulatory blood pressure in Japan. Hypertens Res 2013; 36(8): 661-72.
18. Angell S, Guthartz S, Dalal M, et al. Integrating self blood pressure monitoring into the routine management of uncontrolled hypertension: translating evidence to practice. J Clin Hypertens (Greenwich) 2013; 15(3): 180-5.
19. McManus RJ, Mant J, Bray EP, et al. Telemonitoring and self-management in the control of hypertension (TASMINH2): a randomized controlled trial. Lancet 2010; 376(9736): 163-72.
20. Cuspidi C, Meani S, Fusi V, et al. Home blood pressure measurement and its relationship with blood pressure control in a large selected hypertensive population. J Hum Hyperten 2004; 18(10): 725-|31.
21. Halme L, Vesalainen R, Kaaja M, Kantola I. Home measurement of blood pressure study group. Self-monitoring of blood pressure promotes achievement of blood pressure target in primary health care. Am J Hypertens 2005; 18(11): 1415-20.
22. De Silva GV, de Barros S, Abensur H, Ortega KC, Mion D Jr; Cochrane Renal Group Prospective Trial Register. Home blood pressure monitoring in blood pressure control among hemodialysis patients: an open randomized clinical trial. Nephrol Dial Transplant 2009; 24(12): 3805-11.
23. Márquez-Contreras E, Martell-Claros N, Gil-Guillén V, et al. Efficacy of a home blood pressure monitoring program on therapeutic compliance in hypertension: the EAPACUM-HTA study. J Hypertens 2006; 24(1): 169-75.
24. Madsen LB, Kirkeqaard P, Pedersen EB. Blood pressure control during telemonitoring of home blood pressure. A randomized controlled trial during 6 months. Blood Press 2008; 17(2): 78-86.
25. Verberk WJ, Kroon AA, Lenders JW, et al. Self-measurement of blood pressure at home reduce the need for antihypertensive drugs. a randomized controlled trial. Hypertension 2007; 50(6): 1019-25.
26. Staessen JA, Wang J, Bianchi G, Birkenhager WH. Essential hypertension. Lancet 2003; 361(9369): 1629-41.
27. Staessen JA, Den Hond E, Celis H, et al. Antihypertensive treatment based on blood pressure measurement at home or in the physician's office: a randomized controlled trial. JAMA 2004; 291(8): 955-64.
28. Tan NC, Khin LW, Pagi R. Home blood pressure monitoring among hypertensive patients in an Asian population. J Hum Hypertens 2005; 19(7): 559-64.