



Impact of educational intervention on hypertension management by primary care physician: A randomized control trial

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ABSTRACT

Objective: The current study aimed to observe hypertension educational intervention's effect on general physicians (GPs) to improve blood pressure control and patient outcomes indirectly.

Methods: This randomized control trial includes 42 GPs divided into 2 groups. GPs in group 1 receive face-to-face education with structured educational material on hypertension management strategies by a senior cardiologist. GPs in group 2 receive the print version of education material. The data was collected from six major cities in Pakistan. GPs with at least three years of experience in the broad primary care disciplines, with ages above 18 years, were included in the study.

Results: A total of 42 physicians (21 from each group) completed questionnaires, while out of 420 hypertension patients, 105 newly diagnosed and already diagnosed patients enrolled under physicians of both groups. The educational material did just as well at informing clinicians as the face-to-face group intervention did and both the interventions had a significant effect on knowledge and BP control.

Conclusion: After the 3-month follow-up, both interventions, including face-to-face and educational approaches, demonstrated significant effectiveness in improving knowledge and blood pressure control.

Innovation: The study shows that hypertension educational intervention's effect on general physicians indirectly improves blood pressure control and patient outcomes. And emphasize for developing a hypertension educational program targeted at general physicians.

1. Introduction

Hypertension is considered one of the main risk factors for cardiovascular diseases and stroke. It is suggested that approximately 17 million deaths occur annually worldwide due to hypertension [1]. The prevalence of hypertension is higher among low to middle-income

developing countries. This high prevalence rate is suggested to be the primary cause of increased mortality, which accounts for a significant economic burden [2,3]. Pakistan estimated crude prevalence of hypertension is 35.1%, and age-standardized prevalence is 34.4%, causing severe challenges to the healthcare system. It is observed that despite many effective pharmacological approaches for controlling high blood

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pressure, complications associated with hypertension have increased globally [4,5].

In Pakistan, hypertension is one of the most common reasons to visit a physician, and it is characteristically diagnosed and treated in outpatient settings [6]. The burden of this disease is undeniably high in Pakistan since almost a quarter of the adult population aged 50 years and above generally have hypertension [6]. Therefore, getting control of this asymptomatic disease might be considered one of the essential preventive measures taken by physicians [7]. Several studies have documented the need to improve blood pressure control [8,9]. Various interventions have been suggested to improve hypertension. These interventions include patient-centered approaches, physician-centered strategies, and many others [10,11]. It is suggested that unsatisfactory blood pressure control in hypertensive patients is due to multiple causes. One of the leading causes that received particular attention is the physician's behavior and patient's compliance [12].

Numerous studies have underscored the imperative to enhance blood pressure control, identifying multiple factors contributing to suboptimal outcomes. Physician behavior and patient compliance emerge as significant determinants, prompting the exploration of various interventions aimed at improving hypertension management. Studies have shown that when given to the physician, educational interventions combined with adequate clinical management improve clinical decision-making and blood pressure control [13-19]. Educational interventions have garnered attention for their potential to augment clinical decision-making and blood pressure control when delivered to physicians. Studies suggest that educational interventions not only enhance physician knowledge but also improve patient understanding and adherence to treatment regimens. Notably, single teaching sessions have demonstrated increased patient knowledge and beliefs regarding hypertension and its management [13]. The study conducted by Inui TS and colleagues suggests that single teaching session tutorials given to physicians shows increased patient knowledge and strengthen the patient beliefs regarding hypertension and its treatment given by the allocated physician [20]. This also highlights that educational interventions play an important role in creating opportunities for patients to understand better the therapies given, their condition, and the progression and complications of the disease [20]. The study aims to compare face-to-face education with senior cardiologists and the distribution of printed educational materials to improve hypertension management among primary care physicians. Given hypertension's significance as a risk factor for cardiovascular diseases, enhancing its management is crucial to reduce associated health issues. Primary care physicians, often the initial contact for hypertensive patients, are pivotal in this process.

Given hypertension's significance as a risk factor for cardiovascular diseases, enhancing its management is crucial to reduce associated health issues. Primary care physicians, often the initial contact for hypertensive patients, are pivotal in this process [21]. Face-to-face education offers a personalized, interactive experience with immediate clarifications and tailored guidance. Conversely, distributing printed materials is a cost-effective means of reaching a broader audience. Through a randomized controlled trial, this study seeks to determine the effectiveness of these approaches in enhancing blood pressure control and patient outcomes. The findings will help inform healthcare professionals and policymakers in designing more effective and accessible hypertension management programs for primary care physicians. The study aims to compare face-to-face education with senior cardiologists and the distribution of printed educational materials to improve hypertension management among primary care physicians.

2. Methods

2.1. Trial design

The current Randomized Control trial was conducted as a multi-center study, with the participation of 42 General Physicians (GPs) from

different metropolitan cities in Pakistan. The study was conducted following the declaration of Helsinki. Ethical approval was obtained from the Pakistan medical association committee on ethics (Reference no. MN/1513/LSQ/18; Dated 5th September 2021). The trial was registered with [ClinicalTrials.gov](https://www.clinicaltrials.gov) NCT05038774.

2.2. Participants

GPs with at least three years of experience in the broad primary care disciplines and patients aged 18 years with uncontrolled blood pressure, according to Pakistan hypertension league guidelines [22], were included. While GPs who have attended a planned Hypertension educational program during the last 6 months and patients with a recognized psychiatric disorder as per the Diagnostic and Statistical Manual of Mental Disorders [23] were excluded from the study.

2.3. Interventions

GPs in group 1 receive face-to-face education with structured educational material on hypertension management strategies by a senior cardiologist; this training was mandatory for all enrolled GPs in the group. While physicians in group 2 receive the print version of education material (Structured educational material - Appendix 2) on strategies of structured hypertension management. Each session training was done for 3 h in room.

The structured educational material includes the key points of the current hypertension guidelines [24], along with a 10-step checklist on how to obtain standardized upper arm blood pressure readings according to guidelines, with the checklists to assist in the diagnosis of secondary hypertension, patients' information leaflet about hypertension, and a template of a blood pressure documentation sheet for serial documentation of blood pressure values by patients.

2.4. Allocation

After screening General Physicians as per inclusion criteria and recruitment of GPs by clinical research associates after obtaining informed consent, GPs were asked to fill a questionnaire including items about hypertension management at baseline. Both groups of GPs, with the help of a clinical research associate, recruited 10 patients from the study site after obtaining informed consent. Then the patients were asked to fill the study questionnaire including items about hypertension management at baseline or recruitment day and 12-h blood pressure measurement (from digital BP apparatus) at about the same times every day.

This choice to monitor blood pressure over a 12-h period aims to capture a comprehensive understanding of blood pressure variations throughout the day, considering potential fluctuations and patterns that might be missed with single-point measurements. The use of 12-h blood pressure monitoring aligns with established guidelines for standardized upper arm blood pressure readings and offers a robust assessment of blood pressure control, contributing to the overall evaluation of the trial's effectiveness in managing hypertension.

After the GPs educational intervention, patients were again invited for a regular checkup at the GPs clinic. They were again asked to fill the study questionnaire after 3 months and share pictures of 12-h blood pressure measurement (from digital BP apparatus) with a clinical research associate (1st, 2nd & 3rd month). The GPs were asked to fill out the study questionnaire again after 3 months (post-intervention).

Table 1
Responses of physicians denoting consulting behavior.

Variables		Total	Face-to-face (Group I)	Educational (Group II)	p- value
		Mean \pm SD			
The proportion of hypertension patients you have managed over the past 12 months based on grade	Grade 1 hypertension	28.53 \pm 17.96	29.68 \pm 13.047	27.37 \pm 22.134	0.697
	Grade 2 hypertension	42.13 \pm 18.50	38.42 \pm 17.325	45.84 \pm 19.343	0.221
	Grade 3 hypertension	25.39 \pm 15.44	23.95 \pm 15.686	26.84 \pm 15.475	0.570
The proportion of patients that you have managed in the past 12 months falls into the following categories	Primary hypertension with no co-morbidities	28.87 \pm 23.32	31.58 \pm 19.152	26.16 \pm 27.128	0.481
	Hypertension + diabetes (Type I or Type II)	31.58 \pm 12.14	35.00 \pm 12.910	28.16 \pm 10.569	0.082
	Hypertension + coronary heart disease (CHD)	15.13 \pm 10.36	19.21 \pm 13.045	11.05 \pm 3.937	0.013*
	Hypertension + CKD with microproteinuria	9.24 \pm 7.12	10.47 \pm 6.450	8.00 \pm 7.710	0.291
	Hypertension + CKD without microproteinuria	12.59 \pm 10.03	16.33 \pm 11.246	9.05 \pm 7.382	0.025*
	Hypertension + Stroke	11.92 \pm 9.40	6.68 \pm 5.548	17.16 \pm 9.639	0.000*
A proportion of your hypertension patients have 12 Hour blood pressure monitoring for each of the following prior to initiating treatment	To confirm diagnosis	27.68 \pm 19.50	22.07 \pm 23.116	32.11 \pm 15.304	0.138
	To assess white-coat hypertension	25.09 \pm 26.64	39.47 \pm 32.224	13.11 \pm 12.083	0.003*
	To assess masked hypertension	13.03 \pm 11.07	12.00 \pm 12.581	13.89 \pm 9.934	0.633
	To assess blood pressure over 12 h to measure night-time blood pressure and potential surges/lows during the day (e.g., morning surge)	17.26 \pm 12.70	13.00 \pm 13.202	21.25 \pm 11.180	0.070
The proportion of your hypertension patients informed about target blood pressure.		67.42 \pm 29.562	77.82 \pm 32.616	58.11 \pm 23.662	0.044*
The proportion of patients that reach their target blood pressure within your expected timeframe.		68.46 \pm 17.14	68.39 \pm 20.575	68.53 \pm 13.201	0.981
Initially prescribed therapeutic approach	Monotherapy (one treatment prescribed alone)	23.47 \pm 10.61	28.61 \pm 9.519	18.33 \pm 9.235	0.002*
	Combination therapy with two or more pills	33.58 \pm 21.42	33.61 \pm 22.804	33.56 \pm 20.606	0.994
	A single-pill combination	55.72 \pm 18.31	50.33 \pm 18.414	61.11 \pm 17.026	0.077
Initially prescribed treatment	Diuretics	17.91 \pm 12.15	22.00 \pm 15.268	13.82 \pm 6.002	0.048*
	ACE inhibitor	16.69 \pm 17.66	21.72 \pm 22.042	11.67 \pm 10.146	0.088
	Calcium channel blocker	23.89 \pm 17.08	32.78 \pm 20.380	15.00 \pm 4.201	0.001*
	Angiotensin II receptor blocker	37.06 \pm 16.24	34.06 \pm 18.817	39.72 \pm 13.555	0.318

ANOVA was used for continuous measures.

* $p < 0.05$ was considered statistically significant.

2.5. Outcomes

2.5.1. Primary outcomes

- Changes in the blood pressure control (pre and post) were assessed and represented as percentage of patients with average 12-h blood pressure being measure as $<130/80$ mmHg.
- Changes in average systolic and diastolic blood pressure before and after the intervention.

2.5.2. Secondary outcomes

- Pre & Post knowledge enhancement of GPs regarding hypertension management.
- Pre & Post knowledge enhancement of patients regarding hypertension.

These outcomes were measured by the percentage of correct responses.

2.6. Sample size

A total of 42 General Physicians (GPs) were recruited from 6 metropolitan cities in Pakistan via the probabilistic sampling technique. Each GP recruited 10 patients (5 newly diagnosed +5 already diagnosed patients) via the non-probabilistic convenience sampling technique (CONSORT flow Diagram). The data were collected from 42 sites in six major cities of Pakistan, including Karachi, Lahore, Peshawar, Islamabad, Quetta, and Multan.

To detect a change of 5 mmHg in blood pressure with a standard deviation (σ) of 10 mmHg [25], a significance level (α) of 0.05 (95% confidence), and a power ($1-\beta$) of 0.80 (80%), a sample size of 42 participants was calculated with the powering based on an independent t -test. This calculation was based on the effect size ($d = 0.5$), which was determined by dividing the desired change in blood pressure by the standard deviation.

2.7. Randomization

The GPs were randomized into 2 groups (Random sampling), using

Table 2
Baseline characteristics of the already and newly diagnosed hypertensive patients.

Baseline characteristics		Already diagnosed			Newly diagnosed		
		Face-to-face (Group I)	Educational (Group II)	p-value	Face-to-face (Group I)	Educational (Group II)	p-value
Socio demographics							
Highest Education Level	Less than high school	17(16.2)	15(14.3)		14(13.3)	29(28.2)	
	High school graduate	36(34.3)	28(26.7)		28(26.7)	18(17.5)	
	Technical/vocational institute	4(3.8)	24(22.9)		9(8.6)	17(16.5)	
	College/under-graduate	27(25.7)	22(21.0)	0.006*	25(23.8)	14(13.6)	0.042*
	Degree holder	13(12.4)	8(7.6)		11(10.5)	13(12.6)	
	Post-graduate or higher	4(3.8)	2(1.9)		4(3.8)	2(1.9)	
	Decline to answer	–	2(1.9)		6(5.7)	5(4.9)	
Employment Status	Other	4(3.8)	4(3.8)		8(7.6)	5(4.9)	
	Working full time (30 or more h/ week)	29(27.6)	27(25.7)		33(31.42)	27(25.71)	
	Working part-time (8–29 h/ week)	22(20.95)	11(10.47)		18(17.1)	6(5.7)	
	Working part-time (<8 h/week)	6(5.7)	14(13.3)	0.008*	6(5.7)	16(15.2)	0.023*
	Retired	26(24.8)	34(32.4)		23(21.9)	27(25.7)	
	Unemployed	8(7.6)	7(6.7)		4(3.8)	7(6.7)	
	Homemaker	4(3.8)	8(7.6)		9(8.6)	16(15.2)	
Consulting behavior & BP assessment	Other	10(9.5)	4(3.8)		12(11.4)	6(5.7)	
	How frequently do you see a doctor for your high blood pressure?						
	Every two weeks	–	2(1.9)		42(40)	30(28.57)	
	Once a month	45(42.9)	35(33.3)		35(33.3)	32(30.5)	
	Every 2–3 months	34(32.4)	33(31.4)	0.008*	13(12.4)	25(23.8)	0.250
	Every 4–6 months	20(19.04)	23(21.90)		8(7.6)	8(7.6)	
	Once a year	–	10(9.5)		1(1.0)	4(3.8)	
Less than once a year	6(5.7)	2(1.9)		6(5.7)	6(5.7)		
Which of the following statements best applies to the time you have available to discuss your high blood pressure with your doctor and get answers to any questions you may have?	Not enough time to discuss my condition	19(18.09)	32(30.47)		28(26.66)	22(20.95)	
	Can briefly discuss my condition but not in any depth	22(21.0)	21(20.0)		9(8.6)	15(14.3)	
	Usually have adequate time to get in-depth answers, but sometimes, they do not have enough time	25(23.80)	6(5.71)	0.008*	16(15.2)	23(21.9)	0.383
	My doctor always has time to discuss my condition and answer any questions I may have	39(37.1)	46(43.8)		52(49.5)	45(42.9)	
	More than once a week	42(40)	43(40.95)		50(47.61)	41(39.04)	
	Once a week	38(36.2)	28(26.7)		47(44.8)	20(19.0)	
	Once every 2–3 weeks	7(6.7)	14(13.3)		4(3.8)	12(11.4)	
How frequently is your blood pressure measured at home	Once every month	4(3.8)	8(7.6)	0.009*	–	10(9.5)	0.000*
	Once every 2–3 months	2(1.9)	10(9.5)		–	12(11.4)	
	Less than every 3 months	6(5.7)	2(1.9)		2(1.9)	6(5.7)	
	Never	6(5.7)	–		2(1.9)	4(3.8)	
	More than once a week	50(47.61)	29(27.61)		44(41.90)	33(31.42)	
	Once a week	4(3.80)	10(9.52)		12(11.4)	8(7.6)	
	Once every 2–3 weeks	7(6.7)	6(5.7)		–	12(11.4)	
How frequently is your blood pressure measured at the hospital	Once every month	4(3.8)	2(1.9)	0.000*	–	2(1.9)	0.006*
	Once every 2–3 months	3(2.9)	–		2(1.9)	2(1.9)	
	Less than every 3 months	–	6(5.7)		3(2.9)	4(3.8)	
	Never	37(35.2)	52(49.5)		44(41.9)	44(41.9)	
	Within the last month	46(43.81)	23(21.90)		29(27.61)	18(17.14)	
	2–3 months ago	27(25.71)	27(25.71)		31(29.5)	29(27.6)	
	4–6 months ago	20(19.0)	36(34.3)	0.010*	35(33.3)	37(35.2)	0.108
When did you last do blood pressure monitoring?	7–12 months ago	10(9.5)	16(15.2)		8(7.6)	11(10.5)	
	Over one year ago	2(1.9)	3(2.9)		2(1.9)	10(9.5)	
	Every day	38(36.19)	16(15.24)		35(33.33)	26(24.76)	
	4–6 times a week	18(17.14)	22(20.95)		17(16.2)	14(13.3)	
	2–3 times a week	26(24.76)	47(44.76)		22(21.0)	28(26.7)	
	Once a week	13(12.38)	10(9.52)	0.001*	15(14.3)	21(20.0)	0.468
	2–3 times a month	4(3.8)	4(3.8)		12(11.4)	8(7.6)	
How frequently do you measure your blood pressure at home using this device?	Once a month	6(5.7)	1(1.0)		–	2(1.9)	
	Less than once a month	–	5(4.8)		4(3.8)	6(5.7)	
	Yes	80(79.2)	72(71.3)	0.192	76(81.7)	61(62.2)	0.003*
Has your doctor informed you of your target blood pressure?	No	21(20.8)	29(28.7)		17(18.3)	37(37.8)	
	How much time do you spend treating your high blood pressure in a typical month, including time with doctors, waiting time in the hospital, filling prescriptions, and travel time?	3.06 ± 3.12	3.14 ± 4.80	0.934	4.29 ± 8.180	2.50 ± 1.136	0.227
And when you see your doctor, how long does a typical routine consultation spent with your doctor regarding your high blood pressure take?	18.20 ± 7.77	15.55 ± 10.28	0.066	18.13 ± 8.180	14.28 ± 9.44	0.007*	

(continued on next page)

Table 2 (continued)

Baseline characteristics		Already diagnosed			Newly diagnosed		
		Face-to-face (Group I)	Educational (Group II)	p-value	Face-to-face (Group I)	Educational (Group II)	p-value
What is your average blood pressure over the past 2 weeks?	SBP	151.04 ± 15.35	156.61 ± 15.33	0.035*	153.17 ± 15.432	152.67 ± 18.745	0.867
	DBP	90.62 ± 15.74	96.45 ± 10.09	0.013*	91.11 ± 12.458	92.58 ± 14.040	0.533
And what is your target blood pressure?	SBP	129.64 ± 16.22	126.94 ± 14.40	0.279	134.66 ± 20.213	124.03 ± 24.152	0.004*
	DBP	82.96 ± 10.17	82.22 ± 9.22	0.639	81.51 ± 10.629	83.33 ± 7.327	0.218
At what blood pressure level would you start to become concerned about your condition?	SBP	159.01 ± 16.22	156.55 ± 15.05	0.365	163.56 ± 12.733	155.52 ± 12.019	0.000*
	DBP	94.69 ± 7.84	93.79 ± 10.40	0.562	91.37 ± 17.346	92.41 ± 10.141	0.685
Hypertension Treatment Profile							
How long have you been taking your current blood pressure-lowering medication	Months	5.25 ± 2.50	3.57 ± 2.27	0.047*	5.11 ± 2.888	4.33 ± 3.130	0.415
	Years	5.12 ± 10.29	2.73 ± 1.93	0.051*	2.69 ± 3.812	3.06 ± 2.264	0.494
Would you adjust treatment by yourself (without consulting the doctor) should you not be happy with your current blood pressure medication?	Yes	48(47.5)	65(63.1)	0.025*	82(81.2)	67(66.3)	0.016*
	No	53(52.5)	38(36.9)		19(18.8)	34(33.7)	
When you were diagnosed with high blood pressure, did your doctor explain the potential risks of not taking your high blood pressure medication as instructed?	Yes	76(76.8)	87(84.5)	0.166	68(67.3)	74(76.3)	0.162
	No	23(23.2)	16(15.5)		33(32.7)	23(23.7)	

ANOVA was used for continuous measures and analogous contingency table tests for categorical measures.

* $p < 0.05$ is considered significant.

Parallel Assignment Intervention Model.

2.8. Statistical methods

Data were analyzed using SPSS version 22.0. For all categorical variables, we presented the results as frequencies and percentages. Continuous variables were described using means and standard deviations.

2.8.1. For categorical variables

To assess the pre and post-training differences between groups, we employed the Chi-square/Fisher Exact Test and McNemar tests for within-group comparisons.

2.8.2. For continuous variables

For group-wise comparisons of continuous variables, we employed the independent sample t-test. To evaluate the pre and post-training changes, we utilized the paired sample t-test.

2.9. Assessment of intervention fidelity

A checklist was used to assess the adherence to the intervention components as outlined in the intervention protocol. This checklist was completed after each session by research staff who observed the intervention sessions.

3. Results

3.1. Study procedure flow diagram

Patients were assessed for eligibility criteria and a total of 42 Physicians were recruited at baseline. Physician to patient ratio was 1:5 and were randomly allocate into 2 groups (Random sampling), using Parallel Assignment Intervention Model. (CONSORT Flow Diagram).

3.2. Physician's consulting behavior

A total of 42 physicians (21 from each group) completed questionnaires. The responses of general physicians concerning consulting behavior are summarized in Table 1. The responses were defined as the mean proportion out of 100%. At baseline, most physicians reported assessing the patient's blood pressure at consultation (83.33%). Moreover, 38.0% of GPs reported that a lack of patient adherence to the prescribed medication was the major reason behind the inability to reach target blood pressure in the expected time among hypertension patients.

3.3. Baseline characteristics of hypertensive patients

The baseline characteristics of the hypertensive patients are summarized in Table 2. A total of 420 hypertension patients, 105 newly diagnosed and 105 already diagnosed patients, enrolled under physicians of both groups.

3.4. Hypertension prevention knowledge among general physicians

Table 3 elaborates on the within and between-group comparison of the knowledge of the GPs. Regarding diagnosis, more GPs of both groups responded correctly after training ($p < 0.05$), where the educational group scored well compared to the face-to-face group. For the blood pressure control standards, the GPs of the educational group showed a significant improvisation after the training period, i.e., 42.9% vs. 81.0% correctly answered ($p = 0.057$). In contrast, no significant within-group difference was observed in the face-to-face group, even after attending the physical training session.

3.5. BP management

Both study groups showed improvement in blood pressure (BP) control, although the intervention did not have a statistically significant effect. After three months, BP was controlled in a total of 181 patients,

Table 3
Pre & Post-intervention changes in the knowledge of hypertension prevention and control based on correct responses in the two enrollment groups.

Questions	Enrollment Group	Pre-training n(%)	Post-training n(%)	p-value ¹
Which of the following is not correct about the diagnosis of hypertension?	Face-to-face (Group I)	4(19.0)	14(66.7)	0.001*
	Educational (Group II)	1(4.8)	19(90.5)	0.000*
When the BP is >180/120 mmHg, and there is chronic target organ damage, no ongoing acute organ injury is known as...	Face-to-face (Group I)	6(28.6)	16(76.2)	0.001*
	Educational (Group II)	3(14.3)	18(85.7)	0.001*
For a patient with hypertension whose blood pressure is 165/95 mmHg, the correct risk stratification should be () if he/she has three prognostic risk factors: smoking, obesity, and dyslipidemia.	Face-to-face (Group I)	9(42.9)	11(52.4)	0.366
	Educational (Group II)	10(47.6)	19(90.5)	0.021*
The main goal of hypertension treatment is to reduce blood pressure to certain standards. Which of the following blood pressure control standards is correct?	Face-to-face (Group I)	6(28.6)	9(42.9)	0.405
	Educational (Group II)	9(42.9)	17(81.0)	0.057*
Treatment follow-up plan for elevated BP 120–129/80–84 mmHg includes.....	Face-to-face (Group I)	9(42.9)	12(57.1)	0.593
	Educational (Group II)	12(57.1)	18(85.7)	0.065
Which is correct for the average daily consumption of sodium chloride	Face-to-face (Group I)	9(42.9)	12(57.1)	0.317
	Educational (Group II)	13(61.9)	20(95.2)	0.039*
What should be Drug choices as initial therapy for HTN with Diabetes Mellitus	Face-to-face (Group I)	4(19.0)	10(47.6)	0.071
	Educational (Group II)	6(28.6)	19(90.5)	0.000*
In Which of the following condition(s), the use of diuretics are contraindicated?	Face-to-face (Group I)	6(28.6)	13(61.9)	0.012*
	Educational (Group II)	8(38.1)	20(95.2)	0.035*
Which of the following is correct regarding β-blockers?	Face-to-face (Group I)	11(52.4)	13(61.9)	0.166
	Educational (Group II)	18(85.7)	21(100.0)	1.000
Which of the following combination regimens of antihypertensive drugs causes a substantially higher risk of developing type 2 diabetes?	Face-to-face (Group I)	6(28.6)	11(52.4)	0.206
	Educational (Group II)	9(42.9)	17(81.0)	0.022*
First-line drug(s) can be used for the treatment of HTN in pregnancy	Face-to-face (Group I)	8(38.1)	11(52.4)	0.317
	Educational (Group II)	5(23.8)	14(66.7)	0.012*
Which of the following can happen due to which use of sublingual drugs to lower BP has been contraindicated to manage both severe HTN (BP >180/120 mmHg) and no symptoms with or without chronic target organ damage acutely?	Face-to-face (Group I)	6(28.6)	15(71.4)	0.021*
	Educational (Group II)	9(42.9)	20(95.2)	0.000*
Considering the Basic Diagnostic work-up needed	Face-to-face (Group I)	8(38.1)	14(66.7)	0.034
	Educational (Group II)	5(23.8)	14(66.7)	0.012*

Table 3 (continued)

Questions	Enrollment Group	Pre-training n(%)	Post-training n(%)	p-value ¹
for HTN, which tests should be excluded?	Educational (Group II)	9(42.9)	19(90.5)	0.002*
	Face-to-face (Group I)	0.753	0.060*	0.096
The preferred device for the measurement of BP	Educational (Group II)	11(52.4)	17(81.0)	0.039*
	Face-to-face (Group I)	0.212	0.292	

¹ pre and post-training comparison using McNemar tests.

² group-wise comparison using chi-square tests.

without a difference between study groups (face to face: $n = 84$; control: $n = 97$, $P = 0.340$) as shown in Table 5. A mean decline of SBP 9.80 ± 11.81 mmHg and DBP 3.14 ± 6.61 mmHg was observed among already diagnosed patients enrolled under GPs of face to face group from baseline to 3rd follow-up. Similar were the outcomes for the same patient category enrolled under educational group GPs and newly diagnosed patients of both groups (Table 4).

3.6. Adherence, perception and knowledge of hypertensive patients towards hypertension management

Lastly, the patient knowledge, and adherence have assessed both pre and post-training the physician based on their correct responses to the survey questions. When asked about stopping the medication after experiencing adverse effects with the high blood pressure medication without consultation, 53.3% of patients enrolled under GPs of the educational group responded correctly (post-training). At the same time, no significant group-wise difference was observed (Table 6).

4. Discussion and conclusion

4.1. Discussion

The current study was conducted to observe the effect of hypertension educational intervention for general physicians to indirectly improve patient outcomes. It is believed that the results of this study provide a basis for developing a hypertension educational program targeted at general physicians, since hypertension is one of the main causative factors for developing cardiovascular diseases and stroke [26]. A systematic review conducted in 2005 suggested that an organized system of regular follow-up and a review of hypertensive patients needs to be established and practiced in general practices in community-based clinics [27]. Our results show that at baseline, the majority of included physicians reported typically assessing the patient's blood pressure at the time of consultation.

Talking about developed countries like Australia and the US, hypertension awareness rates are quite prominent. However, 24% and 35% control rates of this disease show discouraging results [28]. The scenario in Pakistan is similar, where the National Health Survey of Pakistan has estimated hypertension in 18% of adults and 33% above 45 years of age, out of which 50% get diagnosed. However, only half of those diagnosed patients are treated [29]. Results of our study summarized that GPs considered the lack of patient adherence to the prescribed medication as the major reason behind the inability to reach target blood pressure in the expected time among hypertension patients. This also summarized the importance of providing hypertension prevention knowledge among general physicians and patients.

Studies also suggest that a low adherence of high blood pressure patients to antihypertensive medications prescribed by a general physician is one of the main causes of uncontrol blood pressure [30]. This behavior of patients is suggested to be negatively influenced by

Table 4
Pre and post-intervention changes in average systolic and diastolic blood pressure in relation to practice-specific hypertension management.

Patient category	Enrollment Group	Baseline, mean ± SD		2nd month, mean ± SD		3rd month, mean ± SD		Mean Difference		p-value ¹	
		SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP
For morning											
Already Diagnosed	Face-to-face (Group I)	136.80 ± 11.19	85.99 ± 6.38	133.79 ± 7.14	84.60 ± 4.65	127.02 ± 4.05	82.71 ± 1.95	9.80 ± 11.81	3.14 ± 6.61	0.000*	0.001*
	Educational (Group II)	130.92 ± 6.95	86.87 ± 6.93	131.11 ± 9.62	88.20 ± 9.57	126.96 ± 4.60	82.81 ± 1.68	4.30 ± 8.23	4.07 ± 6.79	0.000*	0.000*
	p-value ²	0.001*	0.474	0.210	0.074	0.942	0.748				
Newly Diagnosed	Face-to-face (Group I)	139.42 ± 11.72	85.00 ± 6.267	135.29 ± 7.55	85.87 ± 5.44	126.13 ± 4.077	82.25 ± 1.808	13.34 ± 12.17	2.84 ± 6.49	0.000*	0.009*
	Educational (Group II)	135.16 ± 9.19	85.30 ± 5.30	133.38 ± 4.90	86.38 ± 7.66	125.78 ± 3.916	82.96 ± 1.675	9.28 ± 11.30	2.37 ± 6.36	0.000*	0.068
	p-value ²	0.124	0.843	0.387	0.809	0.729	0.108				
For Afternoon											
Already Diagnosed	Face-to-face (Group I)	133.95 ± 22.97	86.05 ± 8.57	132.39 ± 8.37	85.45 ± 5.52	125.95 ± 3.58	83.10 ± 2.08	8.06 ± 23.44	2.90 ± 9.27	0.015*	0.027*
	Educational (Group II)	131.71 ± 9.64	87.66 ± 9.35	130.34 ± 11.48	87.95 ± 12.15	126.45 ± 4.01	82.97 ± 1.91	5.67 ± 9.77	4.59 ± 9.62	0.000*	0.000*
	p-value ²	0.469	0.332	0.434	0.340	0.453	0.709				
Newly Diagnosed	Face-to-face (Group I)	138.81 ± 13.76	85.94 ± 6.86	133.02 ± 8.84	85.80 ± 6.78	125.08 ± 4.135	82.68 ± 1.886	13.76 ± 14.93	3.30 ± 6.81	0.000*	0.004*
	Educational (Group II)	131.72 ± 9.79	84.03 ± 7.186	130.88 ± 7.28	85.00 ± 8.91	126.93 ± 3.463	83.15 ± 2.381	4.91 ± 10.66	0.87 ± 7.61	0.027*	0.562
	p-value ²	0.027*	0.284	0.440	0.751	0.060	0.369				

¹ pre and post-training comparison using paired T-test.

² group-wise comparison using One-way ANOVA.

* $p < 0.05$ is considered significant.

Table 5
Pre & Post change in the blood pressure control.

BP control		Enrollment group		p-value
		Face to face (Group I)	Educational (Group II)	
Pre-Intervention	Controlled	16(16.3)	13(10.8)	0.235
	Uncontrolled	82(83.7)	107(89.2)	
Post-Intervention	Controlled	84(85.7)	97(80.8)	0.340
	Uncontrolled	14(14.3)	23(19.2)	

several factors, including the patient-doctor relationship and drug-induced side effects [30]. In order to improve the patient's compliance, various strategies are recommended, in which educational programs and awareness of self-measurement of blood pressure and monitoring of compliance is considered one of the best interventional strategies to educate patients [30,31]. Educational interventions are also considered more helpful in patients' cases to encourage them to take the prescribed medication regularly [31].

Moreover, a major factor suggested to encourage the patients to follow the treatment is the motivation they get from their doctors and physicians [31]. In the current study, the patient knowledge, and adherence have been assessed both pre and post-training of the physician. It was observed that 53.3% of patients enrolled under GPs of the educational group responded correctly (post-training). This shows that providers, be it any physician, can help patients identify barriers to medication adherence. They can also actively engage their patients in decision-making procedures regarding their treatment by educating them about their disease and circumstances [32].

Educational interventions significantly affect lifestyle modification and BP control among patients [33]. One factor in suboptimal hypertension control rates is clinical inertia among primary care physicians. Such Interventions can be incorporated as a health care intervention to overcome this inertia, aimed to improve the initiation and intensification of BP-lowering treatment by primary care physicians [19]. Similar are the results of our study, suggesting that the GPs of the educational

group showed a significant improvement after the training period, i.e., 42.9% vs. 81.0% correctly answered ($p = 0.057$). In contrast, no significant within-group difference was observed in the face-to-face group, even after attending the physical training session. This highlights that when hypertension education is provided culturally sensitive, benefits are observed with blood pressure reduction and adherence to medication and lifestyle recommendations [34].

Educational programs focused on hypertension management are proposed to enhance the effectiveness of conveying information regarding lifestyle changes for BP control [35]. There was a significant effect of the training on BP control or alterations, and the improvements were apparent in both newly and already diagnosed patients of both groups ($p < 0.05$). In line with our findings, a comparable study underscores that educational approaches directed at physicians may enhance the population's systolic/diastolic blood pressure (SBP/DBP) levels and improve hypertension control rates [36].

There is no general practice of regular follow-up and review of hypertensive patients in community-based clinics. Therefore, the 12-h blood pressure measurement monitoring of the patients, at baseline and 3 months follow-up was very difficult for the study associates.

Therefore, these recommendations should be followed for future studies:

- Educational interventions should become an integral part of managing patients with HTN.
- Public educational programs for promoting HTN awareness and lifestyle modification are urgently needed.
- Additional resources should be dedicated to creating and evaluating sustainable educational delivery models that provide results over time, including financial implications for the health system.
- With technology advancing at an exponential rate, supportive methods within the educational intervention to align with the rapid advancements in technology and modern-day realities, aiming to enhance clients' adherence behavior. These supportive methods could encompass various technological tools and approaches aimed at facilitating patient engagement, interaction, and adherence to treatment plans.

Table 6

Pre & Post-intervention alteration in patients' adherence, perception, and knowledge regarding hypertension management based on correct responses in the two enrollment groups.

Questions	Enrollment Group	Pre-training n(%)	Post-training n(%)	p-value ¹
Adherence				
If you experience adverse effects with your high blood pressure medication, do you sometimes stop taking it before consulting your doctor?	Face-to-face (Group I)	86 (41.0)	93(44.3)	0.34
	Educational (Group II)	82 (39.0)	112 (53.3)	0.001*
	p-value ²	0.500	0.099	
Do you sometimes stop taking your high blood pressure medicine when you feel better?	Face-to-face (Group I)	72 (34.3)	79(37.6)	0.767
	Educational (Group II)	110 (52.4)	111 (52.9)	1.000
	p-value ²	0.000*	0.004*	
Perceptions of Hypertension Management				
Considering all aspects of dealing with your high blood pressure (diet and exercise, taking your medication, etc.), how successful do you think you are at managing your condition?	Face-to-face (Group I)	38 (18.1)	26(12.4)	0.000*
	Educational (Group II)	20(9.5)	45(21.4)	0.493
	p-value ²	0.053*	0.001*	
Have you ever received a written action plan from your doctor that details the steps you need to take to manage your high blood pressure?	Face-to-face (Group I)	110 (52.4)	118 (56.2)	0.305
	Educational (Group II)	74 (35.2)	114 (54.3)	0.866
	p-value ²	0.001*	0.419	
Knowledge of Hypertension Symptomatology				
Can one have high blood pressure (hypertension) without signs and symptoms?	Face-to-face (Group I)	143 (68.1)	115 (54.8)	0.263
	Educational (Group II)	126 (60.0)	135 (64.3)	0.178
	p-value ²	0.129	0.129	

¹ pre and post-training comparison using McNemar tests.

² group-wise comparison using Chi-square test.

* p < 0.05 is considered significant.

In our study, we acknowledge that there were unadjusted differences in patient characteristics across various groups. These differences could potentially introduce bias into our results. The feasibility challenges in implementing multilevel models at this stage are primarily associated with factors such as the structure of our data and the intricate nature of the model within the context of our study. While we have taken measures to mitigate this bias to the best of our abilities, it's important to recognize that some residual confounding may persist due to these unadjusted differences.

4.2. Innovation

The present study introduces a novel and impactful approach to addressing the challenges posed by hypertension, a pervasive risk factor for cardiovascular diseases and stroke. By focusing on the critical role of general physicians in the management of hypertension, this study pioneers an innovative educational intervention that not only enhances physicians' knowledge and skills but also leads to substantial improvements in patient outcomes. Unlike traditional patient-focused interventions, this study recognizes the pivotal role of general physicians in guiding patients' healthcare journeys. This physician-centric approach marks a departure from the conventional patient-exclusive strategies, thereby opening new avenues for holistic healthcare improvements.

Recognizing the technological advancements of the modern era, the

study emphasizes the importance of incorporating supportive methods within educational interventions to enhance patient adherence, interaction, and data tracking. While the intervention itself may not directly involve digital health tools, mobile applications, or telemedicine, the overarching goal is to leverage technological innovation to align healthcare strategies with contemporary patient expectations and habits. By embracing these advancements, future iterations of the intervention could explore the integration of digital health tools to facilitate remote monitoring, personalized communication, and data-driven decision-making, thereby further enhancing the effectiveness and accessibility of hypertension management programs.

Moreover, the study does not limit its impact to immediate patient outcomes but envisions a systemic transformation of healthcare practices. By advocating for educational interventions to become an integral part of hypertension management and calling for public educational programs and enhanced resource allocation, the study seeks to reshape healthcare structures. This visionary approach lays the groundwork for sustained improvements in hypertension management across broader healthcare contexts. Therefore, this study introduces a multifaceted and forward-thinking approach to hypertension management, centered around the education of general physicians. By redefining the roles, strategies, and expectations in hypertension care, this innovative study offers a holistic solution that transcends conventional approaches and charts a new course towards enhanced patient outcomes and improved public health.

4.3. Conclusion

This study evinced that both the educational material and the face-to-face intervention effectively enhanced general physicians' knowledge and positively influenced blood pressure control. Suggesting that similar strategies may be adopted to reinforce the implementation of clinical practice guidelines for hypertension management. Moreover, the outcomes of this study also provide a basis for developing a hypertension educational program targeted at general physicians.

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Disclosures

None declare.

CRedit authorship contribution statement

Tariq Ashraf: Conceptualization, Resources. **Kanwal Fatima Aamir:** Methodology. **Asif Nadeem:** Software. **Mahmood Ul Hassan:** Visualization. **Haseeb Raza:** Data curation. **M. Abdur Rauf:** Writing – review & editing. **Jalal Ud Din:** Project administration. **Saeedullah Shah:** Supervision. **Fayza Khan:** Resources. **Zubair Akram:** Investigation. **Muhammad Ishaque:** Writing – original draft. **Bashir Hanif:** Formal analysis.

Declaration of competing interest

None declare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pecinn.2024.100285>.

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