Ir J Med Sci (2018) 187:675–682
https://doi.org/10.1007/s11845-017-1706-9

ORIGINAL ARTICLE

Outcomes from a community-based hypertension educational programme: the West of Ireland Hypertension study

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Received: 12 June 2017 / Accepted: 23 October 2017 / Published online: 6 November 2017

Abstract
Background Hypertension is a leading modifiable risk factor for premature cardiovascular disease. Research indicates a growing prevalence of hypertension among adults worldwide, with accompanying low levels of patient knowledge, and sub-optimal clinical management.
Aims This study aims to explore the impact of a structured hypertension educational intervention on patient knowledge, lifestyle behaviours and blood pressure control.
Design An observational, prospective cohort design was selected.
Methods Participants were recruited through a public blood pressure screening event in a community-based setting. They were asked to complete a self-report questionnaire followed by an assessment of their blood pressure. Participants with high blood pressure were randomly assigned to either a control group or an intervention group. Those in the intervention group received an educational intervention on hypertension 4 weeks later. Both groups were recalled 4 months later for a repeat of the same initial assessment.
Results Eighty-one participants with a mean age of 64 years were included in this study. There were no significant differences in the baseline measures between the two groups. Significant improvements were found in the intervention group compared with the control group in levels of hypertension knowledge and awareness ($p = <0.001$), exercise levels ($p = 0.002$) and weight ($p = 0.003$). Participants who underwent the intervention showed a greater reduction in both systolic (SBP) and diastolic (DBP) blood pressure (SBP 158.8 to 141.6 mmHg, $p < 0.0001$ and DBP 84.7 to 77.7 mmHg, $p < 0.001$).
Conclusion Providing a tailored educational intervention can positively impact on hypertension knowledge, self-care management and control within community-based settings.

Keywords Community-based setting · Educational intervention programme · Hypertension · Knowledge and awareness

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Introduction

Hypertension (HTN) is the most common, chronic, non-communicable disease in the world [1]. European studies indicate a prevalence rate of 60%, which exceeds prevalence figures for the United States of America (USA) and Canada. HTN is estimated to be responsible for at least 25% of myocardial infarctions in Europe and to be the leading cause in 42% of all deaths in the European Region per year [2]. In the Republic of Ireland, several studies have recorded the prevalence of HTN in the community. The Survey of Lifestyle, Attitudes and Nutrition in Ireland (SLÁN) 2007 found that around 60% of people, 45 years and older had high blood pressure (BP) [3]. 'Heart Smart', a West of Ireland community-based study with a sample of 1491 individuals, identified that more than 40% of 50-year-old adults were hypertensive [4]. Furthermore, the TILDA study (The Irish Longitudinal Study on Ageing) has estimated that 64% of individuals over 50 years of age in Ireland have high BP. This study has also revealed that almost half of those with

high BP are unaware of their condition, and almost half of those who are on medications do not achieve their target levels [5].

Despite the fact that HTN is considered a major global concern and blood pressure management is responsible for significant healthcare costs, fewer than 25% of patients with HTN are achieving target levels globally [6, 7]. Some observational studies suggest that this sub-optimal control could be due to low levels of patient knowledge and understanding of their condition, or due to lack of adherence to prescribed medications [8, 9]. Other studies report that many people with HTN remain undiagnosed, and of those who are diagnosed, many continue to engage in unhealthy lifestyle choices which do not contribute to improved blood pressure control [10, 11]. Thus, the level of knowledge and awareness towards HTN and benefits of a healthy lifestyle can have a significant impact on BP control and the patient's life [12].

Educational intervention programmes have been associated with an improvement of the patient's knowledge, awareness and adherence to antihypertensive agents, as well as the adoption of healthier lifestyle choices that lead to effective control of BP and an overall improvement in their quality of life [13, 14]. Within the Irish context, there are insufficient data on the introduction of educational interventions to improve patients' knowledge, awareness and control of HTN. Thus, this study aimed to develop a tailored educational intervention for individuals with high BP and to assess the impact of this novel community-based intervention. The objectives of the study were to identify individuals in the community with high BP and refer them to their physician for review, when appropriate, in line with clinical protocols. Additionally, we aimed to recruit these individuals to a pilot study, with a control and intervention arm, designed to assess the impact of a short-term hypertension educational programme on patient knowledge, lifestyle behaviours and BP control.

Methods

Setting

The subject recruitment was conducted in Croi House, a specialist heart and stroke centre, managed by Croi, a charity organisation in Galway, Ireland. The recruitment started with advertising the study through various local media. Specialist nurses from the centre with the researcher's assistance led and conducted the recruitment screening. The main purpose of screening was to identify and recruit individuals with high BP (including those with established HTN and also those whose BP was elevated on the recruitment day) to a pilot study, with a control and intervention arm.

The screening event took place over a number of days, where the researcher helped to explain the questionnaire, clarifying the consent form and the procedure of the study. The nurse's role was to measure BP and body mass index (BMI), provide individualised lifestyle advice and refer participants with high BP to General Practice in accordance with the 2012 European Guidelines for cardiovascular disease prevention [6].

Participants

The study screened 200 individuals, with an anticipation of a 60% response rate. The inclusion criteria for the screening were adults of 40 years and older. Participants were required to have a proficiency in the English language, so they could understand and answer the questionnaire (this was assessed subjectively during the first contact with the investigator). Adults < 40 years old or those whose BP could not be measured in either arm with an automated blood pressure monitor due to a medical contraindication, such as bilateral lymphoedema, were excluded from the study [15].

Measurement of knowledge of hypertension

A self-administered questionnaire of nine items was developed and modified from previous validated questionnaires for use in the study [16, 17].

Measurement of clinical parameters

BP

The BP was measured on both arms with the use of a validated automated BP monitor (Omron M6). If the reference reading was ≥ 140/90 mmHg, the BP measurement was repeated on the reference arm, after a rest period (5 min). If the second measurement was ≥ 140/90 mmHg, it was recorded as high BP, based on the 2013 European Guidelines for the management of arterial hypertension [7].

BMI

Height and weight were measured without shoes, hats and any heavy objects, using a Seca Leicester height measure and a validated digital weight scale (TANITA BWB-800S). Overweight was defined as a BMI ≥ 25–29.9 kg/m^2 and obesity as a BMI ≥ 30–35 kg/m^2 [18].

Educational intervention

After the baseline screening event, the total sample of participants with high BP (those with established HTN and also those with elevated BP on the day) was randomised with the aid of an on-line random number generator, into two groups (intervention and control) [19]. Over 60% of the participants

in both groups were aware about their high blood pressure and were taking medication to control their condition. The intervention group was invited after 4 weeks to attend a 3-hour education programme. This educational programme was delivered by a multidisciplinary team which included a cardiologist, nurse specialists, a dietician and a physiotherapist. Interactive educational sessions were provided on a range of topics relevant to BP management and included information on understanding and taking control of BP, the positive effects of healthy lifestyle modifications on BP, while a consultant cardiologist delivered updates on the role of antihypertensive medications and the importance of adherence. At the end of the sessions, the participants received a booklet on principal issues relating to HTN disease and management. Four months following the intervention, both the control and intervention groups were called back for a repeat assessment of their BP and BMI, and they were also asked to complete the same questionnaire again.

Statistical analysis

The sample size was estimated using Statistical Package for the Social Sciences software package version 22 (SPSS). Non-categorical variables were reported by mean and standard deviation. Categorical data were analysed using frequency and percentiles. The paired-samples *t* test was used to compare the means of the two groups. Chi-square tests (Pearson and likelihood ratio) were used to investigate any significant differences after the introduction of the programme. *P* values were reported for comparisons of specific interest (p value < 0.05 was considered as statistically significant).

Results

Baseline profile

One hundred eighteen adult participants met the study criteria allowing for 59 participants in each group. Sixteen participants of the control group and 21 of the intervention group dropped out before the study ended, resulting in a response rate of 69%. At baseline, the control and intervention groups had no significant difference in their demographics and clinical characteristics (Table 1). The mean age ± SD of the participants was 64 ± 5 years old, and the male participants dominated the intervention group, accounting for 57.9% (n = 22), while female participants accounted for 58.1% (n = 25) in the control group. At the start of the study, approximately 21% (n = 22) of the participants in the control group and 52% (n = 20) in the intervention group reported that they did not add salt in their meals, either while cooking or at the table. Additionally, about 95% of the participants in both groups were either overweight or obese resulting in a mean BMI of 28 kg/m^2 for participants in both groups. The majority of the participants were non-smokers; only 4% of the participants in the control group and 10% of the participants in the intervention group identified themselves as smokers.

Knowledge and awareness of the study population towards HTN

At baseline, the control and intervention groups had no significant difference regarding knowledge, awareness and attitude levels (p = 0.09). Fifty nine percent of the control group (n = 25) did not know the meaning of HTN, instead understanding it to be either high blood sugar or high stress level. Similarly, 53% (n = 20) of the intervention group did not know the meaning of HTN. In excess of 70% of participants in both groups were unaware of the recommended BP target levels and equally so they were unaware of the consequences of HTN, as fewer than 30% of the participants in both groups were able to identify the correct answers. The majority of the participants in both groups (90% of the control group versus 94% of the intervention group) agreed that lifestyle changes can help to lower BP. They had less specific knowledge on the effects of medications and exercise on BP, as less than 30% of the control group and 25% of the intervention group identified the correct answers. Taking the baseline profile into account, the overall knowledge and awareness levels showed a significant improvement particularly among the participants of the intervention group at the study endpoint. A very high percentage of the participants (more than 90%) were able to choose the right answers when compared with those in the control group (55%). All the knowledge and awareness questions yielded p values less than 0.005, showing a significant difference between both groups (Table 2).

Lifestyle behaviours and clinical profiles of the study population

Table 3 shows the significant changes in lifestyle and clinical outcomes in both groups. The lifestyle variables improved considerably after completion of the study, especially among the intervention group. While both groups reported a positive increase in their daily exercise levels, mean exercise levels revealed an increase of 15 min per day (p = 0.002) in the intervention group compared with an increase of 5 min per day in the control group (p = 0.75). Other self-reported lifestyle habits also demonstrated an improvement among the participants of both group.

Table 1 Demographics and characteristics of the study population

Variables	Control group		Intervention group		*p* value
	n (%)	mean ± SD	*n* (%)	mean ± SD	
Gender (male)	18 (41)		22 (57)		0.500
Age in years		63.7 ± 9		66.5 ± 10	0.340
BMI in kg/m^2		28.3 ± 4		28.0 ± 4	0.987
Days of exercise per week		4 ± 1		5 ± 1.3	0.986
Alcohol intake (yes)	28 (65)		24 (63)		0.902
Alcohol units per week		11 ± 4		12 ± 3	0.888
Smoker	2 (4)		4 (10)		0.056
No additional salt intake	22 (51)		20 (52)		0.064
On antihypertensive medication	26 (60)		21 (55)		0.054
SBP (mmHg)		149.4 ± 15		158.8 ± 45	0.110
DBP (mmHg)		84.6 ± 10		84.7 ± 13	0.045

Values are expressed as frequency, percentage and mean ± standard deviation. *n*, 43 for control group; *n*, 38 for intervention group. *$p < 0.05$ level

At baseline, systolic and diastolic BP readings did not differ significantly between the control and intervention groups. As the study ended, BP control was significantly improved in the intervention group with a marked reduction of 17 mmHg in their average SBP ($p = < 0.0001$), while the control group showed less optimal control (Table 3). Additionally, mean DBP levels improved significantly in the intervention participants with a reduction of nearly 7 mmHg ($p = < 0.001$). There was also an improvement in DBP score for the control group with a reduction of 4 mmHg by the end of the study. Approximately 57% ($n = 22$) of the participants in the intervention group achieved optimal BP levels (< 140/90 mmHg) at the end of the study, compared with 25% ($n = 11$) of the control group. The intervention group had a better weight reduction compared to that of the control group. There was a significant reduction of 7 kg in the average weight of the intervention group, whereas there was no significant reduction in the average weight of the control group. Table 4 presents

Table 2 Frequency of correct answers from control and intervention groups at baseline and at the end of the study

Knowledge questions With the correct answer	Control group *n* (%)		Intervention group *n* (%)		*p* value
Term of HTN means?	Start	End	Start	End	
• High blood pressure	18 (41)	28 (65)	18 (47)	32 (89)	< 0.001
Recommended BP target?					
• < 140/90 mmHg	13 (30)	13 (38)	9 (23)	29 (76)	< 0.001
Would lowering high BP improve a person's health?					
• Yes	29 (67)	29 (67)	25 (65)	36 (94)	< 0.0001
Which BP number is important?					
• Both numbers (top and bottom)	8 (18)	11 (25)	9 (20)	30 (78)	< 0.001
Can lifestyle changes help lower BP?					
• Yes	39 (90)	40 (93)	36 (94)	38 (100)	< 0.001
Most people can tell when their BP is high?					
• False	12 (27)	16 (37)	9 (23)	30 (78)	< 0.001
Uncontrolled BP can lead to which of the following?					
• Kidney failure	12 (27)	16 (37)	9 (23)	30 (78)	< 0.001
Individuals who are taking BP medications do not need to exercise regularly?	Start	End	Start	End	
• False	13 (30)	20 (46)	10 (26)	33 (86)	< 0.001
Most people with high BP need more than one medicine to control their BP?					
• True	9 (20)	22 (51)	11 (28)	32 (84)	< 0.001

Chi-square tests were used to calculate *p* value. *n*, 43 for control group; *n*, 38 for intervention group. *$p < 0.05$ level

Table 3 Comparison (mean ± SD) between the clinical profiles of the control and intervention groups at baseline and at the end of the study

Variables	Control group at baseline	Control group at end of study	*p* value	Intervention group at baseline	Intervention group at end of study	*p* value
SBP (mmHg)	149.4 ± 15	149.9 ± 16	0.803	158.8 ± 17	141.6 ± 15	0.0001
DPB (mmHg)	84.6 ± 11	80.4 ± 10	0.004	84.7 ± 13	77.7 ± 10	0.001
BMI (kg/m$^{2)}$	28.3 ± 4	28.1 ± 4	0.126	28.3 ± 4	27.6 ± 3	0.119
Weight (kg)	77.25 ± 16	77.0 ± 16	0.655	77.0 ± 10	70.6 ± 7	0.003
Exercise level (mins/day)	30 ± 4	35 ± 5	0.759	30 ± 9	45 ± 11	0.002

Paired-sample *t* test was used to calculate *p* value. *$p < 0.05$ level. *n*, 43 for control group; *n*, 38 for intervention group

SBP systolic blood pressure, *DBP* diastolic blood pressure, *BMI* body mass index

data related to achievement of target levels for clinical and lifestyle outcomes.

Discussion

This research study was carried out in order to evaluate the status of HTN knowledge, awareness and control in a sample of the Irish population and to determine the effects of a short-term educational programme on the parameters. The levels of knowledge and awareness towards HTN among the study population at baseline were consistent with several previous studies [20–22]. According to the study findings, the levels of HTN knowledge and awareness were low at baseline with only less than 50% of the population study having sufficient knowledge and awareness about the disease.

Limited numbers of participants were aware of the correct meaning of HTN, and the majority of participants (73%) were not familiar with the complications of high blood pressure. The results of our study showed that the majority of the participants (80%) were not aware of the importance of both the top and bottom numbers of their BP reading. These findings reveal a poor knowledge and awareness of blood pressure among individuals with HTN. This is consistent with findings from previous studies, which have also demonstrated inadequate knowledge and awareness among Irish adults [5]. However, this is incompatible with the international studies conducted in China and the USA, which have reported higher levels of knowledge and awareness [23, 24]. These differences could be due, in part, to better publicity, promotion and effort from health professionals and governmental agencies on HTN in those countries.

HTN control at the start of this study was even less than that reported in other Irish and European studies. In our cohort, about 67% of those screened had a BP above 140/90 mmHg compared to those included in TILDA study, SLÁN and EUROASPIRE IV surveys [5, 25, 26]. Mean systolic BP was 153 mmHg, which was higher than that observed in the Irish national survey of 135 mmHg, and mean diastolic BP was also higher than previously reported in an Irish cohort (84 versus 77 mmHg) [25]. Despite the limited sample size used in this study, these figures suggest that there is still an

Table 4 Participants achieving clinical and lifestyle targets

Variables	Control group at baseline *n* (%)	Control group at end of study *n* (%)	*p* value	Intervention group at baseline *n* (%)	Intervention group at end of study *n* (%)	*p* value
SBP (< 140 mmHg)	10 (23)	9 (20)	0.084	8 (21)	16 (42)	0.06
DPB (< 90 mmHg)	22 (51)	10 (23)	0.09	20 (52)	28 (73)	0.07
BMI (< 25kg/m^2)	9 (20)	10 (23)	0.12	10 (26)	12 (31)	0.11
Alcohol limits (17 units/men, 11 units/women)	20 (46)	26 (83)	0.65	20 (33)	35 (92)	0.003
Exercise target levels	17 (39)	19 (43)	0.75	12 (31)	18 (47)	0.42
Fruit and vegetables	8 (18)	7 (16)	0.98	4 (10)	19 (50)	0.04
No added salt	22 (51)	29 (67)	0.50	20 (52)	24 (63)	0.66
Smoker	2 (4)	1 (2)	0.89	4 (10)	2 (5)	0.69
CVD drugs adherence	26 (60)	28 (65)	0.95	21 (55)	22 (57)	0.85

Chi-square tests were used to calculate *p* value. Exercise target levels; 30 min/5times/ week. Fruit and vegetables consumption target; ≥5 times/day. *$p < 0.05$ level. *n*, 43 for control group; *n*, 38 for intervention group

SBP systolic blood pressure, *DBP* diastolic blood pressure, *BMI* body mass index, *CVD* cardiovascular medication

ongoing issue with sub-optimal hypertension control and prevention and considerably more attention is required to address this issue.

Lifestyle habits and behaviours at the baseline of the study were less favourable than those reported in the previous national surveys. The mean alcohol consumption was more than 10 units/week, which is higher than reported in the national SLAN survey undertaken in 2007 with an average of 7 units/week [25]. Though these levels still remain within the recommended guideline levels for alcohol intake, any reduction of that consumption level can have a positive impact on HTN control and prevention [6].

Smoking prevalence was very low among this study population with fewer than 10% of participants reporting they were current smokers compared with Irish and EUROASPIRE IV figures of 29 and 16%, respectively [25, 26]. This very low rate of smoking in our study could be due to the sample size and criteria that were chosen. The number of participants who were achieving the recommended exercise levels was much lower than that reported in the SLÁN and Heart Smart studies [4, 25].

Most of the baseline findings were significantly improved in the intervention group after introducing the educational programme. Knowledge and awareness levels increased markedly among the participants of the intervention group. Almost 90% of the intervention group participants demonstrated improved levels of knowledge and awareness of HTN following the educational programme. This demonstrates the beneficial effects of disease-specific education as shown by other studies. Improving a patient's education, self-monitoring and management of BP have been shown to be effective healthcare measures for HTN control and prevention [27, 28].

BP control was also significantly improved among the intervention group at the end of the study with an average reduction of 17 mmHg in SBP and 7 mmHg in DBP. This substantial reduction could be as a result of providing a structured HTN-specific educational programme which emphasised the importance of medication adherence and encouraged self-care management in the control of blood pressure. In addition, the regular visits of the participants to their healthcare practitioners, e.g., family doctor, could be a contributing factor, as almost all of those in the intervention group had visited their doctor at least once after the intervention. These findings are consistent with other studies which have found that the most important factors for optimal BP control are improvements in participants' knowledge and awareness, home BP monitoring, drug adherence and continuous follow-up [14, 29]. While some studies have demonstrated poor BP control among individuals with a relatively high knowledge of HTN, other studies suggest that providing this kind of educational intervention to individuals who have very low levels of knowledge and awareness, as in our population study, will impact positively on BP control [30, 31].

With the emphasis on the importance of lifestyle modifications during the educational sessions of the intervention, we also observed significant changes in weight and exercise levels in the intervention group. We believe that these improvements were as a result of the individualised brief counselling which occurred at the recruitment day being followed up with more in-depth information via the dedicated education session by a specialist dietitian and physiotherapist. These improvements were comparable to those reported by a very similar intervention study recently conducted in India, highlighting the effectiveness of short-term educational interventions on lifestyle behaviours in community-based settings [32]. Each intervention or combination of intervention components is unique, and it is difficult to state that either nurse-led programmes with a multidisciplinary input, as in the current study, or other interventionist programmes can provide definite BP prevention and control. Nevertheless, the current intervention programme has shown significant results which were similar to those in the Croí MyAction programme regarding BP control [33].

As recruitment for this study took place at community-based screening events, participants were therefore recruited on the basis of having a high BP on that day. This may have led to the recruitment of individuals with 'white coat hypertension' rather than solely including those with a previous diagnosis of HTN. This effect would overestimate the true prevalence of high BP as white coat hypertension is likely to be present in 15–30% of those with elevated office BP readings [34, 35]. Additionally, some individuals with true hypertension may have been categorised as participants with normal BP, termed 'masked hypertension' [36]. We used self-reported data to measure the participants' lifestyle behaviours, which can be affected by both recall bias and social desirability responses; hence, the result findings might have been different if we used objective measures. Effectiveness of the study programme was based on a small sample size and a short-term intervention and follow-up phase. This might have been too short a time to assess the increase in the proportion of participants achieving BP control. As most of the studies have implemented a variety of interventions, it is difficult to determine which part of the intervention has been essential for the reduction of the cardiovascular risk factors. In order to understand the interaction between different parts of the intervention and the success of elements inside the intervention, there should be more focus on process evaluation.

Our study points to opportunities to improve the use of community-based healthcare services for hypertension prevention and control across the entire population. In order to improve HTN knowledge, awareness and control, we

recommend a well-designed educational intervention programme operating on a regular basis through the existing community-based healthcare settings.

Conclusion

This study provides a short-term educational intervention that achieved a significant improvement in HTN knowledge and awareness and a measurable increase in blood pressure control. With upward national trends for hypertension and cardiovascular disease, it is imperative that new models of care are developed to improve hypertension management in the community.

Acknowledgements The authors wish to express their gratitude to all the participants, nurses and administrators at the Croí Heart and Stroke Centre, Galway, Ireland.

Funding This work was part funded by an unrestricted educational grant from the Medtronic Philanthropic Foundation, Galway, Ireland.

Compliance with ethical standards Full ethical approval was granted from Galway University Hospitals Clinical Research Ethics Committee (study number C.A.1376).

Conflict of interest The authors declare that they have no conflict of interest.

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