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Original Article

Knowledge change related to hypertension in the Southern province of Vietnam: a community based, before and after intervention evaluation

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ABSTRACT

Background: This study describes the changes in knowledge of hypertension among adults aged 40 and above in four districts of Ho Chi Minh City as a result of the Communities for Healthy Hearts program, which started in 2016 and ended in 2019.
Methods: We conducted a baseline and endline cross-sectional study of the Communities for Healthy Hearts program, the former in May 2016, and the latter in July 2019. A combination of multistage cluster random sampling techniques was used to recruit a total of 1296 adults within four districts of Ho Chi Minh City: including District 8, District 12, Go Vap, and Thu Duc. Information on the knowledge of hypertension, sociodemographic characteristics, and health behaviors were collected. Multivariable logistic regression analyses were employed to estimate the influence of socio-demographic factors on the knowledge of hypertension.
Results: In the endline survey, a majority of participants showed adequate knowledge on the identification of normal blood pressure range (64.4%), hypertension risk factors (91.7% for correctly identifying at least three modifiable risk factors) and its symptoms (85.5% for correctly identifying at least three symptoms), which demonstrated a significant increase from the baseline survey. Higher educational levels and those previously diagnosed with hypertension had a significant positive correlation with the knowledge of hypertension in both survey evaluations. Whereas, knowledge was poorer in those who were retired/unemployed compared to officers (adjusted odds ratio, 0.33; 95% confidence interval, 0.18–0.61). Besides television, health care professionals, and the project's channels (SMS message and collaborator) become the primary source of information for hypertension knowledge.
Conclusion: The Communities for Healthy Hearts Program improved the levels of hypertension knowledge among people in the program areas. However, a lack of knowledge was observed among the uneducated, suggesting a streamlining of educational campaigns in this specific subsection of the population.

Keywords: Hypertension; Knowledge; Primary prevention; Health information management; Vietnam

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INTRODUCTION

Hypertension is a key modifiable risk factor for cardiovascular disease. According to a 2019 World Health Organization report, an estimated 1.13 billion people worldwide have raised blood pressure (BP) representing 7.5 million deaths and 12.8% of the total mortality.[1,2] This prevalence doubled compared to the rate reported globally in 1975, which was nearly 600 million[2] The majority of cases are found in low- and middle-income countries that face the double burden of infectious and chronic diseases.[2] Vietnam, a middle-income country, faces a "double burden" of communicable and non-communicable diseases, including hypertension. The prevalence of hypertension increased by 8% from 2002 to 2008, posing a massive health problem in Vietnam.[3] In 2012, it was estimated that approximately 25.0% of Vietnamese adults aged 25 and above had been diagnosed with hypertension, and the prevalence among urban citizens was more than twice that of those living in rural areas.[4,5] These prevalences increase sharply for both sexes in those above 40 years of age.[5]

Modifiable risk factors of hypertension include tobacco use and the harmful use of alcohol, excess sodium intake, physical inactivity, and high body mass index. Knowledge of hypertension and its risk factors are stressed as an important aspect of improving healthy behaviors and guided behavior change in various models.[6] A previous finding also indicated that a strong association was found between hypertension knowledge and a higher frequency of BP measurement.[7] Participants may be more aware of their risk and may try to control it through daily habits such as reducing salt intake, regular physical activities, and stop/limit tobacco-use and alcohol consumption.[7] Thus, inadequate rates of hypertension knowledge throughout the world emphasize the need for community-based interventions to reach more people and improve their awareness and knowledge of hypertension.[8-11]

To reduce the hypertension burden in Vietnam, the National Strategy on Prevention and Control of NCDs (2015-2025) prioritizes lowering the rate of uncontrolled hypertension to less than 30% in 2025.[12] At the same time, to support this strategy, the Vietnam Ministry of Health established national standards and guidelines for hypertension management. The Communities for Healthy Hearts program, funded by the Novartis Foundation and implemented by PATH in Ho Chi Minh City (HCMC), Vietnam was a well-timed program. The Communities for Healthy Hearts program was established in 2016, it drew on international best practices, and was built upon local innovations in developing, testing, and incubating novel models of hypertension service delivery that could strengthen primary health care options, bring services closer to home for people at risk or affected by hypertension, and engage multiple sectors in an effort to both increase access and affordability without burdening the public health system. A variety of awareness campaigns were introduced to reach the public including street-side banners, mobile loudspeaker broadcasts (a traditional and culturally appropriate mode of communication), leaflets distributed by community collaborators and checkpoints, and a social media campaign in HCMC. Together with BP checks, face-to-face consultation was stated as the most effective communication channel. For those with hypertension, they received an SMS reminder weekly that focuses on the importance of taking hypertension medication every day as prescribed medication adherence, medical appointment retention, or modifiable behavior change; and the many benefits of physical activity, limiting salt intake, and eating fruits and vegetables (**Supplementary Data 1**). These campaigns reached approximately 1,287,520 people at risk of hypertension.

To know the changes after the Communities for Healthy Hearts program implemented, an independent monitoring and evaluation project was put in place. This paper reports on an endline evaluation of community surveys after a 3-year implementation (from 2016 to 2019). It aimed to describe the changes in knowledge of hypertension among adults aged 40 and above in HCMC at the completion of the Communities for Healthy Hearts program as compared to the baseline survey's data. The resulting analysis provides insights that illustrate the changes after the Communities for Healthy Hearts program developed to increase the community's knowledge of hypertension and hypertension services.

METHODS

Sample size and sampling method

We calculated the required sample size for a before-after study based on the McNemar's test[13] with p-before and p-after set at 50% and 75%, respectively. We took an average of 50% for the p-before in this calculation. Whereas, with the target of a 50% relative increase by the end of this project, p-after was estimated at 75%. Since we would detect the increase in hypertension knowledge, a one-sided test was necessary, whereby the minimum sample size needed to detect a 50% change before and after the intervention with a statistical power of 90% and confidence level of 95 is 30.

Additionally, since utilizing the clustered sampling method, it needed to be adjusted for the unequal probability of selection. We, therefore, multiplied the sample size with the design effect of 2 and tripled the sample to prevent the lack of sample size power. As a result, the sample size for each district was 180 persons aged 40 and above, making up the minimum total sample size of 720 people. However, an increase of the sample size was made for cases in which a participant refused to participate or was absent during the collection period. Our final sample size, thus, was rounded up to 1296 adults each round, making up 2,592 participants in total.

The study location was set up in HCMC, the largest urban population in Vietnam, which had a large number of low-income households.[14] The HCMC health system could become a model and reference for the country's southern provinces. The sample was allocated to the commune/ward using a multistage random sampling method.

At first, four districts were selected as the intervention sites of the Communities for Healthy Hearts program since they had a close consultation with the HCMC Provincial Health Department. Criteria for selection included 1) lower socioeconomic status of the population; 2) expressed commitment from district health leadership to address hypertension; and 3) presence of organized networks of community-based groups, volunteers, and workplace infrastructures (e.g., industrial zones) that could be mobilized. In each district, four wards were randomly selected. All information about the number of groups, number of residents, number of people aged 40 and above in each group by wards and by four districts (District 8, 12, Go Vap, Thu Duc) were obtained from the 2009 Vietnam Population and Housing census.[15] Based on the demographic characteristics of each ward provided by the district preventive center, we randomly selected 14 participants from each sex (men, women) and age groups (the 40s, 50s, and 60s+) in each ward. In the end, 54 adults from each sex and age group in each district were included in this study, representing a total of 1,296 participants in the baseline survey. We applied the same method for the participant selection in the endline evaluation, thus, a total of 2,592 adults were surveyed in both rounds.

Study design and setting

We employed a series cross-sectional study design, which included community surveys before and after the implementation of the intervention (we did not follow them by time). The baseline survey was conducted from April to May in 2016 and the endline survey was conducted from June to July in 2019. This study involved all four intervention districts of HCMC, including District 8, 12, Thu Duc, and Go Vap. This component of the Monitoring and Evaluation program of the Communities for Healthy Hearts program was referred as the community-based component. Ethical approval for this component was reviewed and approved by the Institutional Review Board of Hanoi University of Public Health (approval No. 300/2019/YTCC-HD3). Informed consent was submitted by all subjects when they were enrolled.

Inclusion criteria

Participants were recruited into the study if they met the following inclusion criteria: 1) aged 40 and above at the time of the survey; 2) residents of selected areas: District 8, District 12, Go Vap, Thu Duc; and 3) willingness to participate in the study. We excluded participants if they met one of the following criteria: 1) a tourist or a resident who did not intend to stay for a further three years; 2) history of mental illness (depression, anxiety disorder, schizophrenia, etc.); or 3) failure to obtain informed consent.

Survey instruments and measurement

After obtaining ethical approval, a team of medical students trained as data collectors interviewed all participants using a paper-based questionnaire and took their blood pressure either at their home or in the local health commune. Participants were asked to sit in a chair with their feet on the floor with the arms supported, and BP measurements were taken on the left arm. The blood pressure measurement was taken twice and the average of the two was reported. One was taken at the beginning of the interview after the participant took a rest of at least five minutes and another at the end of the survey (after 15–20 minutes). During the period of data collection, all participants were given the right to withdraw from the study at any stage. Our paper-based questionnaire included a variety of questions on several socioeconomic factors, general health status, and knowledge of hypertension (**Supplement material 2** – Questionnaire).

Variable definition

Our primary outcome of interest was the knowledge of hypertension. We defined people to have a satisfactory knowledge of hypertension if they could correctly identify the normal BP level and at least three modifiable risk factors of hypertension. Whereas, hypertension prevalence (suffering from hypertension) was defined as a systolic blood pressure ≥ 140 mmHg, or a diastolic blood pressure ≥ 90 mmHg, or ever diagnosed with hypertension and currently being on treatment (taking medication).

Statistical method

A descriptive analysis stratified by rounds (baseline versus endline) was applied. Categorical variables were described with proportions, and hypertension prevalence was estimated between the two surveys. Pearson's chi-square test was employed to compare hypertension knowledge between baseline and endline surveys. To estimate the influence of demographic factors on the knowledge of hypertension, univariate and multivariate logistic regression models were performed using the knowledge of the normal BP level and at least three risk factors of hypertension in the endline survey as dependent variables. A *P*-value of less than 0.05 was considered to indicate statistically significant. All analyses were performed using STATA software version 16 (StataCorp, College Station, TX, USA).

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RESULTS

Using the sampling method described above, we interviewed 2,592 participants, equally divided into baseline and endline surveys. Demographic characteristics are presented in **Table 1**.

Table 1 shows the participants' characteristics at baseline and endline surveys. A similar pattern was observed in baseline and endline surveys. Most of the participants had only secondary school or lower education level, were self-employed, retired, or currently unemployed, and almost all were married or living with a partner. Approximately half of the participants had a normal BMI with a mean of 22.5 ± 3.1 at baseline survey and 23.0 ± 3.0 at the endline. While there was a considerable variation in the household income in the endline survey, nearly two-thirds of the respondents reported less than five million VND per month in the baseline (equal to less than the US$ 215.3). Additionally, the age- and sex-standardized hypertension prevalence were 33.7% and 41.6% for the baseline and endline evaluation, respectively.

Table 2 presents the knowledge of hypertension among all respondents. The number of respondents who correctly identified a normal BP increased from one half to nearly two-

Table 1. Participants' characteristics at baseline and endline surveys

Characteristics	Baseline (n = 1,296)	Endline (n = 1,296)	*P*-value
Age, mean (SD)	57.0 (10.6)	55.5 (9.9)	< 0.001
Age group			< 0.001
40–49	335 (25.8)	448 (34.6)	
50–59	483 (37.3)	454 (35.0)	
≥ 60	478 (36.9)	394 (30.4)	
Sex			< 0.001
Male	547 (42.2)	646 (49.8)	
Female	749 (57.8)	650 (50.2)	
Education			< 0.001
Primary school and lower	479 (37.0)	562 (43.4)	
Secondary school	368 (28.4)	376 (29.0)	
High school and higher	449 (34.6)	358 (27.6)	
Occupation			< 0.001
Officer/staff	95 (7.3)	95 (7.3)	
Self-employed	499 (38.5)	469 (36.2)	
Homemaker	-	268 (20.7)	
Retired/unemployed	283 (21.8)	332 (25.6)	
Laborers/farmer	235 (18.1)	132 (10.2)	
Others	184 (14.2)	-	
Marital status			< 0.001
Living without a partner	163 (12.6)	249 (19.3)	
Living with a partner	1,130 (87.4)	1,040 (80.7)	
Household income (VND)			< 0.001
< 5 million	630 (60.8)	125 (11.0)	
≥ 5 and < 10 million	291 (28.1)	306 (26.8)	
≥ 10 and < 15 million	88 (8.5)	277 (24.3)	
≥ 15 and < 20 million	18 (1.7)	152 (13.3)	
≥ 20 million	9 (0.9)	281 (24.6)	
BMI, mean (SD)	22.5 (3.1)	23.0 (3.2)	< 0.001
Underweight	110 (8.5)	87 (6.8)	0.002
Normal	654 (50.5)	572 (45.0)	
Overweight	284 (21.9)	307 (24.1)	
Obesity	246 (19.0)	306 (24.1)	
Prevalence hypertension* (%)	33.7	41.6	< 0.001

Values are presented as number (%).
Sample size for individual characteristics may not equal total due to missing values.
SD = standard deviation, VND = Vietnam Dong, BMI = body mass index.
*The standardized prevalence were age- and sex-standardized using the direct standardization method.

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Table 2. Knowledge of threshold and risk factors of hypertension

Items	Baseline (n = 1,296)	Endline (n = 1,296)	*P*-value
Know normal range of BP	648 (50.0)	834 (64.4)	< 0.001
Risk factors of hypertension[a]			
Alcohol abuse	570 (44.0)	1,073 (92.7)	< 0.001
Excessive cigarette smoking	462 (35.6)	984 (86.8)	< 0.001
High-sodium diet	839 (64.7)	1,166 (95.3)	< 0.001
Having diabetes	341 (26.3)	885 (84.3)	< 0.001
Lipid disorder	150 (11.6)	727 (81.0)	< 0.001
Family history of hypertension	328 (25.3)	575 (51.5)	< 0.001
Higher age	665 (51.3)	1,121 (92.5)	< 0.001
Overweight or obesity	486 (37.5)	1,072 (93.8)	< 0.001
Physical inactivity	201 (15.5)	1,041 (90.0)	< 0.001
Having a stressful lifestyle	237 (18.3)	1,078 (91.4)	< 0.001
Identify correctly ≥ 3 modifiable risk factors[b]	582 (44.9)	1,188 (91.7)	< 0.001
Hypertension symptoms			
No symptom	31 (2.4)	421 (38.4)	< 0.001
Sudden confusion or trouble speaking	346 (26.7)	955 (84.4)	< 0.001
Sudden numbness/weakness of face, arm or leg, on one side	-	843 (79.1)	-
Sudden trouble seeing in one or both eyes	-	894 (82.2)	-
Nausea/vomit	-	611 (60.0)	-
Sudden chest pain or discomfort	301 (23.2)	705 (67.2)	< 0.001
Sudden trouble walking, dizziness, or loss of balance	944 (72.8)	1,159 (95.5)	< 0.001
Severe headaches with a known cause	913 (70.4)	1,057 (90.9)	< 0.001
Identify correctly ≥ 3 symptoms of hypertension	355 (27.4)	1,108 (85.5)	< 0.001

Values are presented as number (%).
BP = blood pressure.
[a]Multiple choice; [b]Modifiable risk factors include diabetes, smoking, physical activity, obesity, salt intake, alcohol abuse, stress.

thirds between baseline and endline surveys. Whereas, the number of those who correctly identified at least three risk factors of hypertension increased nearly double from 44.9% in baseline to 91.7% in the endline survey. A high sodium diet was cited by most of the participants in both surveys. While the knowledge of the influence of inactivity and a stressful lifestyle on hypertension was extremely low in the baseline survey, it sharply increased in the endline measurement. When it comes to identifying at least three hypertension symptoms, the endline results were three times higher compared to baseline (from 27.4% to 85.5%).

The outcomes of the multivariate analysis of the factors associated with the knowledge of hypertension among respondents in the baseline and endline evaluation are shown in **Table 3**. The pattern was quite similar between the two evaluations. Overall, we identified that having higher educational level (adjusted odds ration [aOR], 2.22 and aOR, 2.08 in baseline and endline survey, respectively, for those had secondary school attainment; and aOR, 3.91 and aOR, 3.36 in baseline and endline survey, respectively, for those had high school or above attainment) and suffering from hypertension (aOR, 2.21 and aOR, 1.85 in baseline and endline survey, respectively) were positively associated with a higher knowledge of hypertension in both round evaluations. Whereas, compared to those who worked in the formal office, those were retired or unemployed had a lower knowledge level of hypertension (aOR, 0.53; 95% confidence interval, 0.32–0.90) in the baseline survey.

Table 4 presents participants' accessibility and their information source preference related to hypertension messaging. Overall, 38.8% of participants had heard/seen/received information about hypertension in the baseline survey, and this number increased to 43.2% in the endline

Table 3. Multivariate logistic analysis for hypertension knowledge in the baseline and endline evaluation

Characteristics	Baseline (n = 1,291)		Endline (n = 1,265)	
	aOR	95% CI	aOR	95% CI
Sex, female (ref)	**0.74**	**0.54–0.99**	0.74	0.55–1.01
Age, 40–49 (ref)				
50–59	1.41	0.97–2.04	0.79	0.58–1.08
≥ 60	1.52	0.98–2.36	0.94	0.63–1.39
Marital, living without partner (ref)	1.36	0.83–2.24	0.97	0.67–1.41
Educational level, primary school or lower (ref)				
Secondary school	**2.22**	**1.50–3.28**	**2.08**	**1.54–2.82**
High school or above	**3.91**	**2.63–5.81**	**3.36**	**2.37–4.75**
Occupation, officer (ref)				
Self-employed	0.69	0.40–1.21	0.62	0.36–1.07
Homemaker	N/A	N/A	0.97	0.52–1.82
Retired/unemployed	**0.33**	**0.18–0.61**	0.87	0.48–1.58
Laborers/farmer	0.58	0.33–1.03	0.58	0.31–1.11
Household monthly income, < 5 million VND (ref)				
≥ 5 and < 10 million	0.95	0.67–1.33	0.93	0.59–1.48
≥ 10 and < 15 million	1.42	0.85–2.35	1.28	0.79–2.07
≥ 15 and < 20 million	0.81	0.28–2.38	1.18	0.69–2.02
≥ 20 million	1.45	0.34–6.28	1.21	0.74–1.96
BMI, normal (ref)				
Overweight	0.92	0.65–1.32	1.31	0.95–1.81
Obesity	1.34	0.93–1.93	1.24	0. 90–1.72
Suffer from hypertension, no (ref)	**2.21**	**1.61–3.03**	**1.85**	**1.39–2.46**

Bold-face value indicates a statistically significant correlation with a *P*-value less than 0.05.
aOR = adjusted odds ratio, CI = confidence interval, VND = Vietnam Dong, BMI = body mass index.

Table 4. Accessibility and preference for the source of information related to hypertension in the last six months

Items	Baseline (n = 1,296)	Endline (n = 1,296)	*P*-value
Received information about hypertension in the past six months	419 (38.8)	552 (43.2)	0.030
Three information sources to receive hypertension information[a]			
Television	1,192 (92.0)	576 (46.4)	< 0.001
SMS message	-	271 (21.8)	-
Internet (forum, newsfeed)	316 (24.4)	158 (12.7)	< 0.001
Radio	561 (43.3)	101 (8.1)	< 0.001
Social media (Facebook, Youtube, Zalo, etc.)	138 (10.6)	127 (10.2)	0.730
Newspaper	726 (56.0)	91 (7.3)	< 0.001
Email	22 (1.7)	15 (1.2)	0.300
Hospital/healthcare workers	-	503 (40.5)	-
Communities for Healthy Hearts collaborators	-	197 (15.9)	-
Other	13 (1.0)	187 (15.1)	< 0.001
Do not want to receive this information	-	85 (6.8)	-

round. Regarding information sources, TV still remained the key informative channel. However, in the endline survey, health care professionals and the program's related channels (SMS message and collaborators) were reported as having provided hypertension information to the public.

DISCUSSION

This study describes the changes in hypertension knowledge among adults aged 40 and above in four districts of HCMC after the implementation of the Communities for Healthy Hearts program. Overall, hypertension knowledge improved from baseline to endline evaluations including the normal BP range, hypertension risk factors, and its symptoms. Additionally, those who had higher educational levels, and experienced hypertension had higher levels of hypertension knowledge. Whereas, in the baseline round, the knowledge was

poorer in those who were retired or unemployed, especially compared to government and non-government officers/staffs (**Table 3**).

The in-depth knowledge of hypertension was low in the baseline survey but increased in the endline, which sheds a light on the changes after the Communities for Healthy Hearts program implemented. The knowledge about the BP threshold was found to increase by nearly 15% between the two evaluations, standing at around two-thirds of the those surveyed in the endline survey. This percentage was also higher than findings in a rural population in China,[16,17] Tibet,[18] and other Southeast Asian nations.[11,19] This difference may be explained by the difference in the data collection location and time. Respondents in HCMC, a metropolitan city in southern Vietnam, could have higher education levels and consequently a higher chance of getting more information on hypertension than those living in rural areas. The difference in knowledge of the normal range of BP level and study location was also shown in the previous study in Tibet where the sample was divided into resident areas.[18]

The likelihood of identifying a least three modifiable risk factors doubled from the baseline to the endline survey. Commonly cited risk factors included a high-sodium diet, excessive use of alcohol, and obesity; alcohol intake in both rounds was in line with previous findings in Vietnam[5] and other parts of the world.[16,18,20,21] The number of people able to identify three or more hypertension symptoms were three times higher in the endline survey than the baseline survey, emphasizing the favorable changes of the Communities for Healthy Hearts program. Of these identified symptoms, the headache was cited as one of the common symptoms and that was consistent with previous findings.[22,23]

Besides, factors associated with hypertension knowledge included maximum education level - the higher educational level someone attained, the better knowledge of hypertension they had. This finding is similar to other findings around the world.[9,11] Participants previously diagnosed with hypertension had a greater amount of knowledge of hypertension, which is in line with a study in India.[10] It could be explained by the fact that these people had greater health-seeking behaviors and implement preventive measures such as limiting tobacco and alcohol consumption, reducing salt intake, or doing regular exercise. They may previously have had medical appointments, frequently access health care services, and receive advice from health care professionals. On the other hand, hypertension knowledge was significantly lower among retirers/unemployed workers (applied even among those who had previously been diagnosed with hypertension). This had been attributed to the difference in education levels, lack of information access, and lesser likelihood to utilize health care services. Therefore, this study may serve as a guideline for promoting educational campaigns that are targeted to these subsections of the community.

In terms of receiving information about hypertension, more than two-fifths of participants had heard/received information during the last six months in the endline evaluation. In line with the national survey of hypertension in Vietnam and other nations, mass media, particularly television, was the main channel of obtaining hypertension information for participants in the surveys.[5,9] Almost all Vietnamese people had accessed to some type of mass media channels daily ay, which can provide information and improve their basic knowledge, such as the impact of high salt intake, tobacco smoking, and the harmful use of alcohol.[24] Mass media channels should be taken into account for increasing and further spreading hypertension knowledge to the wider public.

With specialized knowledge, healthcare professionals usually are reliable sources for both receiving information and hypertension services.[9] Improving and strengthening the knowledge of health care workers, at the primary care level and in community outposts, is needed for them to take further responsibility in hypertension prevention and management and reduce the health burden at higher levels of the healthcare system, will be critical for the long term management of chronic diseases like hypertension. In the endline measurement, the impact of the programs' channel was clearly seen since a number of respondents cited these channels as their informative sources (SMS message or collaborators). These findings are supportive evidence of the favorable changes after the implementation of the Communities for Healthy Hearts program.

This is one of the very first comprehensive, community-based hypertension interventions in Vietnam. With a relatively large sample size and employment of a clustered random sampling method, our findings have the potential to be generalized across urban Vietnam. Participants in the endline survey were more exposed to educational information throughout the Communities for Healthy Hearts program and therefore tended to have more knowledge about hypertension. On the other hand, there are some limitations to be acknowledged. We must note the possibility of other projects with interventions related to hypertension in HCMC (e.g. Abundant health program) that may have had an impact on the people's knowledge of NCDs. Further, this study only focuses on the change in hypertension knowledge and prevalence, not on the control rate and their behavior over time. Also, data was employed in a cross-sectional study, so it beyond the present scope to determine any causal relationship. This series cross-sectional studies were employed participants in the baseline and endline separately and had not followed them by time. Therefore, we could not make any further advanced analysis including difference-in-difference analysis.

For all the aforementioned reasons, our findings have several implications for forthcoming researches. The Communities for Healthy Hearts program improved the knowledge of normal range BP and was coupled with a relatively high level of knowledge on risk factors of hypertension and its symptoms for those surveyed in the endline of this evaluation. It has notable implications for future educational campaigns if it is to have further impact in similar studies. These campaigns should ensure even more targeted approaches for those who have lower educational levels and those who work as farmers or laborers. Besides Television, healthcare workers were the most frequently accessed source of information for the Vietnamese public.

In conclusion, the Communities for Healthy Hearts program improved the knowledge of hypertension among people in the areas of the intervention, particularly on its risk factors and symptoms. These findings shed light on the importance of comprehensive community-based hypertension management programs to improve prevention efforts through educational campaigns in Vietnam. Given the results, it highlights remaining gaps between different demographics and highlights the need for targeted approaches in several specific subgroups of the population in order to increase the knowledge levels of hypertension and its risk factors. These findings have the potential to inform research uptake, as well as provide guidance to similarly-designed interventions in Vietnam.

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SUPPLEMENTARY MATERIALS

Supplementary Data 1

CH2 project overview.

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Supplementary Data 2

Questionnaire.

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REFERENCES

1. World health organization. Global health observatory (GHO) data: raise blood pressure. https://www.who.int/gho/ncd/risk_factors/blood_pressure_prevalence_text/en/. Updated 2019. Accessed October 20, 2019.
2. World Health Organization. Hypertension. https://www.who.int/news-room/fact-sheets/detail/hypertension. Updated 2019. Accessed October 20, 2019.
3. Son PT. Hypertension in Vietnam: from community-based studies to a national targeted programme. Umeå: Umeå University; 2012.
4. Minh HV, Byass P, Chuc NT, Wall S. Gender differences in prevalence and socioeconomic determinants of hypertension: findings from the WHO STEPs survey in a rural community of Vietnam. *J Hum Hypertens* 2006;20(2):109-15.
PUBMED | CROSSREF
5. Son PT, Quang NN, Viet NL, Khai PG, Wall S, Weinehall L, et al. Prevalence, awareness, treatment and control of hypertension in Vietnam-results from a national survey. *J Hum Hypertens* 2012;26(4):268-80.
PUBMED | CROSSREF
6. World Health Organization. *Health Education: Theoretical Concepts, Effective Strategies and Core Competencies.* Geneva: World Health Organization; 2012.
7. Lao XQ, Xu YJ, Wong MC, Zhang YH, Ma WJ, Xu XJ, et al. Hypertension prevalence, awareness, treatment, control and associated factors in a developing southern Chinese population: analysis of serial cross-sectional health survey data 2002–2010. *Am J Hypertens* 2013;26(11):1335-45.
PUBMED | CROSSREF
8. Oladapo L. Knowledge of hypertension and other risk factors for heart disease among Yoruba rural southwestern Nigerian population. *Br J Med Med Res* 2013;3(4):993-1003.
CROSSREF
9. Agyei-Baffour P, Tetteh G, Quansah DY, Boateng D. Prevalence and knowledge of hypertension among people living in rural communities in Ghana: a mixed method study. *Afr Health Sci* 2018;18(4):931-41.
PUBMED | CROSSREF
10. Busingye D, Arabshahi S, Evans RG, Riddell MA, Srikanth VK, Kartik K, et al. Knowledge of risk factors for hypertension in a rural Indian population. *Heart Asia* 2019;11(1):e011136.
PUBMED | CROSSREF
11. Aung MN, Lorga T, Srikrajang J, Promtingkran N, Kreuangchai S, Tonpanya W, et al. Assessing awareness and knowledge of hypertension in an at-risk population in the Karen ethnic rural community, Thasongyang, Thailand. *Int J Gen Med* 2012;5:553-61.
PUBMED | CROSSREF
12. Vietnam Ministry of Health. *National Strategy on Prevention and Control of Noncommunicable Diseases, Period 2015–2025*. Hanoi: Vietnam Ministry of Health; 2015.
13. Connor RJ. Sample size for testing differences in proportions for the paired-sample design. *Biometrics* 1987;43(1):207-11.
PUBMED | CROSSREF
14. Central Population and Housing Census Steering Committee. *The 2009 Vietnam Population and Housing Census: Major Findings*. Hanoi: Central Population and Housing Census Steering Committee; 2010.

15. General Statistics Office of Vietnam. *The 2009 Vietnam Population and Housing Census.* Hanoi: General Statistics Office of Vietnam; 2009.
16. Zhang X, Zhu M, Dib HH, Hu J, Tang S, Zhong T, et al. Knowledge, awareness, behavior (KAB) and control of hypertension among urban elderly in western China. *Int J Cardiol* 2009;137(1):9-15.
PUBMED | CROSSREF
17. Li SS, Zhou F, Lu YC, Lyv P, Zhang HF, Yao WM, et al. Hypertension related knowledge and behaviour associated with awareness, treatment and control of hypertension in a rural hypertensive population: a community based, cross-sectional survey. *Blood Press* 2016;25(5):305-11.
PUBMED | CROSSREF
18. Yao DK, Su W, Zheng X, Wang LX. Knowledge and understanding of hypertension among Tibetan people in Lhasa, Tibet. *Heart Lung Circ* 2016;25(6):600-6.
PUBMED | CROSSREF
19. Buang NF, Rahman NA, Haque M. Knowledge, attitude and practice regarding hypertension among residents in a housing area in Selangor, Malaysia. *Med Pharm Rep* 2019;92(2):145-52.
PUBMED | CROSSREF
20. Lamptey P, Laar A, Adler AJ, Dirks R, Caldwell A, Prieto-Merino D, et al. Evaluation of a community-based hypertension improvement program (ComHIP) in Ghana: data from a baseline survey. *BMC Public Health* 2017;17(1):368.
PUBMED | CROSSREF
21. Jongen VW, Lalla-Edward ST, Vos AG, Godijk NG, Tempelman H, Grobbee DE, et al. Hypertension in a rural community in South Africa: what they know, what they think they know and what they recommend. *BMC Public Health* 2019;19(1):341.
PUBMED | CROSSREF
22. Familoni BO, Ogun SA, Aina AO. Knowledge and awareness of hypertension among patients with systemic hypertension. *J Natl Med Assoc* 2004;96(5):620-4.
PUBMED
23. Lugo-Mata ÁR, Urich-Landeta AS, Andrades-Pérez AL, León-Dugarte MJ, Marcano-Acevedo LA, Jofreed López Guillen MH. Factors associated with the level of knowledge about hypertension in primary care patients. *Med Univ* 2017;19(77):184-8.
24. Oto MA, Ergene O, Tokgözoğlu L, Ongen Z, Kozan O, Sahin M, et al. Impact of a mass media campaign to increase public awareness of hypertension. *Turk Kardiyol Dern Ars* 2011;39(5):355-64.
PUBMED | CROSSREF