ORIGINAL ARTICLES

Effectiveness of an Intervention on Knowledge of Hypertension among High School Students in a Mountainous and Rural Area of Vietnam

Nguyen Thi Phuong Lan[1*], Hoang Minh Nam[1], Hoang Thi Phuong[1], Nguyen Diep Trong Duc[1], Dao Thi Hong Phuong[1]

ABSTRACT

Introduction: While there are numerous studies on hypertension prevention, there is limited evidence regarding the effectiveness of school-based interventions. This study aimed to evaluate the outcomes of interventions designed to improve knowledge about hypertension among high school students in a mountainous area.

Methods: A quasi-experimental study was conducted with students at Dong Hy High School in Thai Nguyen Province, involving 368 students across 10th, 11th, and 12th grades. For each grade, three classes were randomly selected for the study, in which one class from each grade was randomly assigned to the intervention group and the remaining two classes were assigned to the control group. The main variables included knowledge on the definition, risk factors, and prevention of hypertension. Health education sessions were conducted in the intervention group by the Youth Union and class leaders. Difference-in-differences analysis was applied to estimate the effectiveness.

Results: The total score at the baseline survey was 15.07 out of 29 points. The intervention by the health education sections revealed that the effectiveness of the health education intervention improved the knowledge by 0.12 points. However, this change was not statistically significant, except for the improved knowledge about daily salt intake among 24% of the students ($p<0.001$).

Conclusion: The intervention had an impact on changing the knowledge about daily salt intake among 24% of the high school students. To be able to enhance knowledge of hypertension among high school students, future research should consider factors such as enhancing students' need, using better visual media, engaging intervention activities while designing interventions.

Keywords: *Hypertension, school students, knowledge, health education.*

INTRODUCTION

Hypertension causes more than 9.4 million deaths worldwide each year (1). A systematic review by Peige Song et al. on hypertension in children under 19 years old, showed that the prevalence of hypertension in children tended to increase from 1994 to 2018, with the estimated rates at 4.00% (95% CI: 3.29%-4.78%), 9.67% (95% CI: 7.26%-12.38%), 4.00% (95% CI: 2.10%-6.48%), and 0.95% (95% CI: 0.48%-1.57%) at the stage of hypertension, pre-hypertension, stage 1, and stage 2 hypertension, respectively. Similarly, between 2000 and 2015, the prevalence of hypertension increased among children aged 6 to 19 years, ranging from 75% to 79%. In 2015, hypertension was found in 4.32% of children under 6 years old and 3.28% of 19-year-olds, with the highest rate of 7.89% seen among 14-year-olds (2). This

Corresponding author: *Nguyen Thi Phuong Lan*
Email: nguyenthiphuonglan@tnmc.edu.vn
[1] Thai Nguyen University of Medicine and Pharmacy

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indicates that hypertension in the youth has become more common and poses a significant public health challenge worldwide.

Hypertension can be prevented by controlling risk factors, such as reducing alcohol and tobacco use, adopting a healthy diet by eating less salt and consuming more fruits and vegetables, increasing physical activity, and avoiding psychological stress. However, intervention studies among high school students indicated that knowledge about the risk factors for hypertension remained limited. Although a significant prevalence are aware that dietary adjustments can prevent hypertension, only 25% correctly know the recommended daily salt intake (3). Therefore, improving knowledge for this group is essential to reduce the risk factors for hypertension.

A systematic review in developing countries showed that school-based interventions were effective in improving the knowledge of adolescents (4). According to Teisovinuo Semou, an intervention involving 30-minute videos on hypertension knowledge, coordinated by a psychologist, significantly enhanced children's knowledge when comparing pre- and post-intervention results (5). A systematic review by Mohamed A. Hassan et al. indicates that the most effective intervention for impacting students' blood pressure is integrating nutrition, behavior change education, and physical activities (6).

A study conducted in India found that health education was an effective intervention measure for changing the knowledge, attitudes, and practices related to the prevention of hypertension among 220 students aged 13 to 16. The health education on diet, exercise, and lifestyle changes resulted in a difference in the average scores of knowledge and attitude. Furthermore, improvements were also observed in practice. Consequently, they were recommended to be scaled up in other schools to control adolescents' lifestyles (7). The findings, as mentioned earlier, suggest that school-based education can improve students' knowledge of hypertension in some developing nations. Nevertheless, most studies on high blood pressure in Vietnam primarily focus on adults. There is little evidence on interventions and their effectiveness in improving knowledge of hypertension among high school students. Therefore, *this study aimed to evaluate the effectiveness of interventions in improving knowledge about hypertension among students at Dong Hy High School in Thai Nguyen Province in 2023.*

METHODS

Study design and participants: A quasi-experimental design was applied in this study. The study participants included students in grades 10, 11, and 12 at Dong Hy High School. The eligible students were able to hear, speak, read, and write; were willing to participate in the research; gave informed consent from both students and their parents; and responded to both baseline and endline surveys.

Sample size and sampling: To calculate the required sample size, we applied a two-sided hypothesis test for comparing two population proportions. The baseline proportion (p_1) was 31.7%, representing participants who were aware of the intake recommendation by the Chinese Dietary Guidelines at the baseline. The expected endline proportion (p_2) was 57.6%. A significance level was set at $\alpha=0.01$, and the statistical power was set at 90% (8). Based on these parameters, a minimum of 108 participants should be recruited for both control and intervention groups.

$$n = \frac{\left\{ z_{1-\alpha/2}\sqrt{2\bar{P}(1-\bar{P})} + z_{1-\beta}\sqrt{P_1(1-P_1)+P_2(1-P_2)} \right\}^2}{\left(P_1 - P_2\right)^2}$$

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In this study, we selected the intervention and control groups in a 1:2 ratio to increase the precision of statistical tests. We stratified the subjects by grade level (10th, 11th, and 12th grades). Then, within each grade, three classes were randomly selected. A list of classes for each grade was compiled (14 classes per grade), and then the dice-rolling method was used to select a single class randomly. The first class from each grade was chosen for intervention, while the remaining two classes served as controls. In each selected class, all students were invited to the study. Finally, 381 students from these classes participated in the pre-intervention survey; however, 13 students (3 students in the intervention and 10 students in the control) did not do the final survey (dropout rate at 3.4%). Thus, the total number of students who fully participated in this study was 368, with 121 and 247 students in the intervention and control group, respectively.

Study setting and time: The study was conducted at Dong Hy High School, Thai Nguyen, situated in a mountainous and rural area in the Northeast region of Vietnam. Students at Dong Hy High School are diverse in terms of their characteristics, including ethnicity and household socioeconomic status. The baseline survey was implemented in January 2024. The health education intervention was carried out in March and April 2024. The endline survey was at the end of May 2024.

The intervention and procedure: The baseline survey identified a gap in knowledge of hypertension among Dong Hy High School students. Knowledge of hypertensive symptoms was quite good (93.5% known symptoms), but knowledge of risk factors of hypertension was poor. The baseline revealed a high percentage of knowledge on diet to prevent hypertension (84.3%), but a low percentage of knowledge on the amount of salt intake per day (25%) (3). Therefore, this intervention provided students with knowledge of hypertension, its risk factors, and methods for preventing hypertension. The contents of the health education followed recommendations from the Ministry of Health and the World Health Organization.

In the intervention group, the students who were in the Youth Union Executive Board and the class leaders of their classes were trained through direct instructions with practice by researchers from the Thai Nguyen University of Medicine and Pharmacy. Handouts and PowerPoint images were distributed to these students to use as health education materials. These students then gave short presentations directly to other students during class meetings. Additionally, the students participated in competitions and mini-games organized by the trained students. All of the intervention activities were implemented under the supervision of the school health staff.

Study variables: The general characteristics of the study participants were gender, grade level, academic performance, and information channels used to update knowledge of hypertension. Knowledge of high blood pressure included its definition, signs and symptoms, complications, risk factors, and prevention. Each right or wrong answer gets one point or zero points, respectively. There were 29 knowledge questions in total (corresponding to 29 points). Outcome variables were the differences in total scores of knowledge and changes in each item between the baseline and endline, as well as between the intervention and control groups.

Data collection and Statistical methods: The questionnaire was developed by researchers, then it was tested and revised before conducting data collection. Students filled in the questionnaire by themselves under the researcher's supervision. The procedure was as follows: The study information sheet and questionnaire were sent to parents two days

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before the baseline and endline survey, and to both intervention and control groups. After obtaining consent from the school, parents, and students, the researchers explained the content of the questionnaire to the students and instructed them on how to complete it. Students filled in the form in class with direct instructions. Any question related to the questionnaire was responded or explained by the researcher to ensure accurate information.

The results were described via absolute numbers, percentages, and mean values. Differences in proportions were tested using the Chi-square test. Knowledge differences between the intervention and control groups for continuous variables were tested by the Independent Samples T-test. Knowledge changes (continuous variable) before and after the intervention, as well as between the intervention and control group, were compared by the Difference-in-Differences test.

Ethics Approval: The study was approved by the Board of Ethics in Biomedical Research at Thai Nguyen University of Medicine and Pharmacy at the Official Dispatch No. 754 dated July 3, 2023.

RESULTS

General characteristics of the participants

In the baseline survey, 100% of selected students completed the survey. However, 3.4% dropped out of the study. Finally, the data from 368 students who completed both baseline and endline surveys were included in this analysis.

Table 1. Characteristics of students (n=368)

	Control group (n=247)		Intervention group (n=121)		Both groups (n=368)		p
	n	%	n	%	n	%	
Gender							0.003
Male	106	42.9	33	27.3	139	37.8	
Female	138	55.9	82	67.8	220	59.8	
Undescribed	3	1.2	6	5	9	2.4	
Academic results							0.058
High Distinction	91	36.8	49	40.5	140	38	
Distinction	145	58.7	72	59.5	217	59	
Credit	11	4.5	0	0	11	3	
Heard about HBP at the baseline							0.036
Never heard	196	79.4	84	69.4	280	76.1	
Have heard	51	20.6	37	30.6	88	23.9	
Grades							0.401
Grade 10	70	28.3	42	34.7	112	30.4	
Grade 11	87	35.2	36	29.8	123	33.4	
Grade 12	90	36.4	43	35.5	133	36.1	
Total	247	100	121	100	368	100	

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The characteristics of students are presented in Table 1. Female participants were predominant, 59.8%. There was a statistically significant difference in gender between the control and intervention groups. There was no statistically significant difference in academic results across the grade levels between the control and intervention groups.

Table 2. Channels accessed by the students to update knowledge of hypertension before the intervention (n=368)

Channels	Control group		Intervention group		Total		p
	n	%	n	%	n	%	
Radio, newspapers, and television	113	45.7	57	47.1	170	46.2	0.446
Social media (Zalo, Facebook)	148	59.9	51	42.1	199	54.1	0.001
Friends, family, acquaintances	125	50.6	47	38.8	172	46.7	0.022
School (teachers, school medical staff)	89	36.0	31	25.6	120	32.6	0.029
Medical staff at clinics, hospitals	74	30.0	25	20.7	99	26.9	0.037
Accessed to at least one communication channel	229	92.7	101	83.5	330	89.7	0.006

Before the intervention, the range of accessed media channels was quite diverse. The proportion accessing at least one media channel was significantly higher in the control group, compared to the intervention group. Similarly, it was significantly higher in the control group when considering other channels, except the channels of radio, newspapers, and television (details in Table 2).

Table 3. Knowledge score in control group and intervention group (n=368)

Knowledge score	Both groups (n=368)		Control group (n=247)		Intervention group (n=121)		p
	Mean	SD	Mean	SD	Mean	SD	
Pre-intervention	15.07	6.13	15.30	6.15	14.62	6.10	0.322
Post-intervention	18.01	6.62	18.20	6.43	17.64	7.03	0.449
Change in score after intervention	2.94 (p=0.000)		2.9 (p=0.000)		3.02 (p=0.000)		
Change in score, comparing before & after intervention, and control & intervention group	0.12 (p=0.9)						

Before the intervention, there was no significant difference in total knowledge score between the intervention and control groups. After the intervention, the total knowledge score was higher in the control group compared to the intervention group, but this difference was not statistically significant (details in Table 3). In a further analysis, which considered changes in individuals (both groups), the mean of the improvement was 2.94 points with p=0.000.

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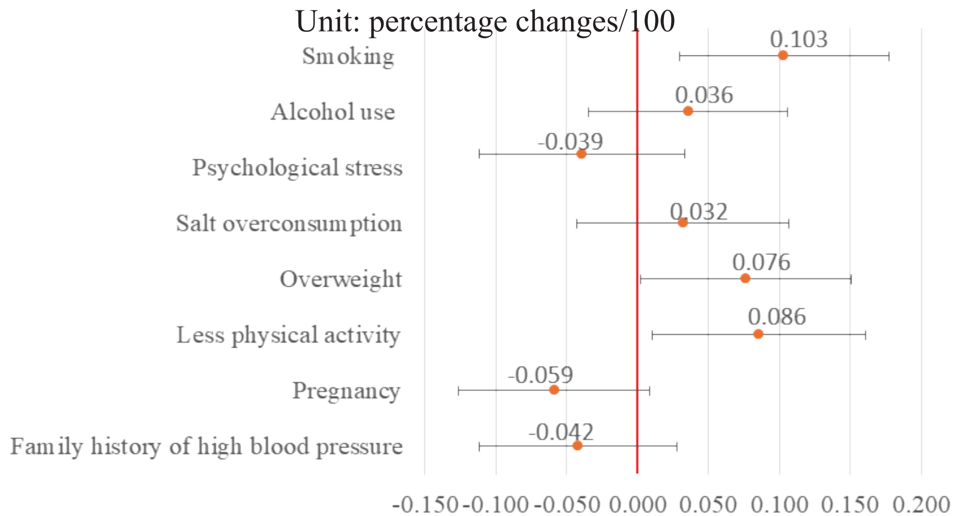
The different in different test to compare the effect of intervention between the control and intervention group before and after the intervention revealed an improved knowledge by 0.12 points. However, this change was not statistically significant (p = 0.9).



Note: Smoking, alcohol use, psychological stress, salt overconsumption, overweight, less physical activity, pregnancy, and family history of hypertension are binary variables. Effect sizes for all these binary variables are interpreted as percentage changes divided by 100 (unit: %, percentage point*). All p-values > 0.05. Control variables included grade and gender. Heard of hypertension before the baseline survey and academic results.*

Figure 1. Effectiveness of intervention on knowledge of hypertension risk factors, as measured by the difference-in-differences test (n=368)

The effectiveness of the intervention on knowledge of hypertension risk factors is presented in Figure 1. The double difference analysis showed that knowledge about the risk factors of hypertension, such as smoking, alcohol use, salt overconsumption, overweight, and less physical activity, increased due to the treatment relative to the control group (see Figure 1). More individuals in the treated group knew more about risk factors, but all of these factors were not statistically significant.

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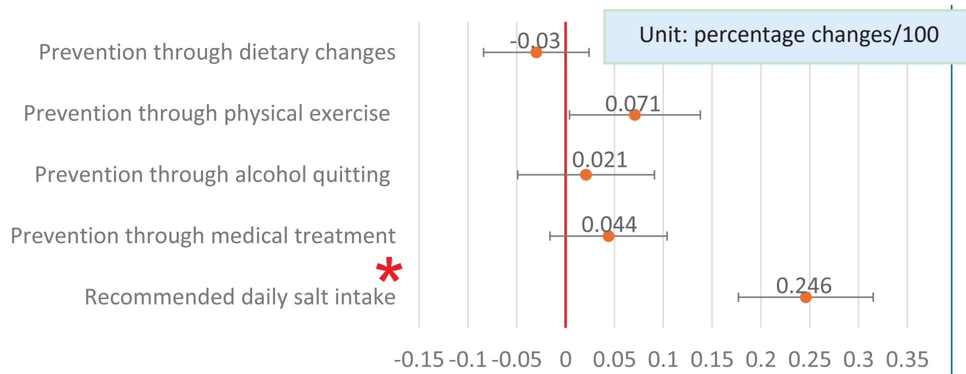

Note: Prevention through dietary changes and physical exercise. Alcohol quitting and medical treatment are binary variable. The recommended dialy salt intake is a continuous variable but converted into binary variable for different in different analyis. Effect sizes for all these binary variables are interpreted as percentage changes divided by 100 (unit:%, percentage points*). All p values > 0.05, except the variable of recommendation dialy salt intake (p= 0.000). Control variables included grade, gender, heard of hypertension before the baseline survey, and academic results.*

Figure 2. Effectiveness of intervention on knowledge of hypertension prevention, as measured by the difference-in-differences test (n=368)

The effectiveness of the intervention on knowledge of hypertension risk factors was presented in Figure 2. The result suggests that the impact of prevention through physical exercise is considerable, equal to approximately 7.1 percentage points, but it was not statistically significant. Notably, the intervention resulted in improved knowledge about daily salt intake among 24.6% of students, with p equal to 0.000.

DISCUSSION

This study provided the first evidence of a school-based intervention aimed at changing the knowledge of hypertension prevention among high school students in Vietnam. After the intervention, the overall knowledge level of the research participants was relatively low, with a mean score of 18.01 ± 6.62 out of a total of 29 points. This evidence reveals a significant gap compared to the goal set by the Ministry of Health, which aimed for 60% of the community to have accurate knowledge about hypertension by 2020.

Comparing the changes before and after the intervention among all 368 participants shows an average increase of 2.94 points. The findings are consistent with a school-based study in India, which also showed a statistically significant change in hypertension prevention knowledge using paired samples T-tests. However, it should be noted that the study in India only had a pre- and post-intervention design without a control group (7).

Interestingly, although the control group in our study did not receive health education from the students in the youth union and class leaders, their knowledge also increased by 2.90 points over a total of 29 points after the intervention period. This may be attributed to the fact that students in the control group have higher access to the information channel than students in the intervention group. In the current economic, cultural, and social context of Vietnam, access to media channels for updating knowledge is quite diverse. Our study indicates that students have accessed various sources to update

their knowledge of hypertension. Before the intervention, 89.7% of students had access to at least one information channel, and the access to media channels in the control group was higher than in the intervention group (92.7% and 83.5% in the control and intervention groups, respectively).

Regarding the effectiveness of the health education intervention on knowledge change, the intervention increased knowledge by 0.12 points, but this change was not statistically significant. In reality, these improvements reflect the persistence large gap in reaching the target set by the Ministry of Health (9). In contrast, the study by Moothedath et al. showed a significant improvement in knowledge by comparing pre- and post-intervention with a control group and recommended expanding school-based interventions in other locations (6). The dissimilarities between our study and this study could be attributed to the economic, cultural, and social contexts, access methods to information channels, or intervention variations between Vietnam and India.

The reason why the expected changes in knowledge were not recorded in the study may be explained by the implementation of the intervention and students' perceived needs to learn about hypertension. During the intervention, we gave a set of handouts, two short oral presentations, and mini-games. These activities were not as strict as other usual academic lessons, so students did not pay much attention to them. On the other hand, in the current Vietnamese context, the topic of hypertension has not yet been well understood by the student group, as the prevalence is high among the elderly. Therefore, the students' need to learn about this issue is not high.

Nevertheless, we highlight an improvement in knowledge about the recommended daily salt consumption (less than 5 grams/day), which occurred in 24.6 % of students. Its success may be attributed to the health education method and visuals that created a positive impression on the students and improved their memorization ability. The effectiveness of altering knowledge about daily salt consumption in this study is similar to the results of a community-based intervention in China, where the change was 25.9% (CI: 19.0 - 32.8). However, the study in China was conducted on adults with a comparison study design between pre-and post-intervention without a control group (8).

The study has several strengths and limitations. The strength lies in applying an intervention research design, with pre- and post-intervention comparisons and a control group, utilizing a difference-in-differences test. As a result, the study accurately determined the effectiveness of the intervention. Regarding limitations, the study's findings cannot be generalized to all high school students in Vietnam, as it was conducted at a single high school in a specific province. Additionally, future research should explore more effective methodologies for educational methods, as the one used in this intervention did not effectively engage students. The video-based educational approach, which has been successful in India, may serve as a reference for future studies.

CONCLUSION

The intervention resulted in a change in the knowledge of hypertension prevention among high school students. However, the overall improvement was not statistically significant, except for knowledge regarding daily salt consumption, which showed a statistically significant change in 24% of the participating students.

The school may apply this intervention to enhance understanding of salt consumption for other classes. To be able to enhance knowledge of hypertension among high school students,

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future research should consider factors such as enhancing students' need, using better visual media, engaging intervention activities while designing interventions.

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REFERENCES

1. World Health Organization. A global brief on hypertension : silent killer, global public health crisis: World Health Day 2013. Switzerland: World Health Organization; 1013. 9 p.
2. Song P, Zhang Y, Yu J, Zha M, Zhu Y, Rahimi K, et al. Global Prevalence of Hypertension in Children: A Systematic Review and Meta-analysis. JAMA pediatrics. 2019;173(12):1154-63.
3. Lan NTP, Phuong HT, Nam HM, Anh LD, Nhi VH. Knowledge of hypertension prevention among students at Dong Hy High School, Thai Nguyen. Journal of Preventive Medicine. 2024;34(1):104-10.
4. Xu T, Tomokawa S, Gregorio ER, Jr., Mannava P, Nagai M, Sobel H. School-based interventions to promote adolescent health: A systematic review in low- and middle-income countries of WHO Western Pacific Region. PloS one. 2020;15(3):e0230046.
5. Semou T, Monteiro SR. Hypertension Knowledge Intervention: A study on Awareness, Retention, and effect on Healthy Lifestyle Practices among Children. Indian Journal of Health Studies. 2022;4(2):107-21.
6. Hassan MA, Zhou W, Ye M, He H, Gao Z. The effectiveness of physical activity interventions on blood pressure in children and adolescents: A systematic review and network meta-analysis. Journal of sport and health science. 2024;13(5):699-708.
7. S M, V J. Effectiveness of an Educational Intervention Programme on Knowledge, Attitude and Practice of School Children Regarding Prevention of Hypertension. Indian Journal of Public Health Research & Development. 2019;10(8):515.
8. Xu A, Ma J, Guo X, Wang L, Wu J, Zhang J, et al. Association of a Province-Wide Intervention With Salt Intake and Hypertension in Shandong Province, China, 2011-2016. JAMA internal medicine. 2020;180(6):877-86.
9. Minister of Ministry of Health. Decision No. 346/QD-BYT dated January 30, 2015, issued by the Minister of Ministry of Health on the implementation of the non-communicable disease prevention plan for the period 2015-2020 Ha Noi: Minister of Ministry of Healt; 2015. Available from: https://thuvienphapluat.vn/van-ban/The-thao-Y-te/Quyet-dinh-346-QD-BYT-phong-chong-benh-khong-lay-nhiem-2015-2020-308064.aspx.

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Completing interests

The authors declare that there is no conflict of interest.

Author's Contributions

Nguyen Thi Phuong Lan contributed to the conception, performed data analysis and wrote the original draft preparation. Hoang Minh Nam created the idea of intervention and performed data analysis. Nguyen Diep Trong Duc contributed to the intervention at Dong Hy High School. All authors performed data analysis and interpretation, wrote sections of the manuscript, and contributed to manuscript revision, read, and approved the submitted versions.