Research Articles

Effects of a Transtheoretical Model-Based Intervention on Stroke Prevention Behaviors among People at Risk in a Community of Nakhon Phanom Province, Thailand

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Abstract

***Objective**: Transtheoretical model (TTM) is one of the most commonly used methods for behavioral change. This Quasi-experimental research with a one-group pretest-posttest design aimed to examine the effects of a Transtheoretical model-based Intervention on stroke prevention behaviors, systolic blood pressure (SBP), diastolic blood pressure (DBP) and body mass index (BMI) among people at risk in community of Nakhon Phanom province. **Methods**: Twenty participants were selected by a purposive sampling method. The eligible participants were those with aged 55 years or older, diagnosed with chronic illness, without history of stroke or transient ischemic attack (TIA), with Thai Cardio-Vascular (CV) risk of 10% or higher, classified in the stage of "not ready for change" and willing to participate in the research project. The participants received an intervention from June to November 2020 once a week. The intervention was divided into 4 activity sessions and one booster session on week 16. The intervention was made commensurate with the constructs of processes of change and appropriate content. The outcomes were evaluated at six months after the intervention. The data were collected by a demographic data form, a stroke prevention behavior questionnaire, blood pressure level and BMI record. The data were analyzed using descriptive statistics and t-test statistics. **Results**: After completion of the intervention, the results showed that the mean stroke prevention behavior scores of the participants were statistically significantly greater than before attending the intervention ($p < .001$). SBP level was also lower than that before intervention with statistical significance ($p < .01$). Mean DBP and BMI of the participants after the intervention decreased without statistical significance. **Conclusion**: The Transtheoretical model-based Intervention showed effectiveness in stroke prevention of people at risk. The findings of this study are of importance for further practice in that the proposed intervention may be applied for stroke preventive care.*

Keywords: people at risk; stroke prevention behaviors; transtheoretical model

Significance of the problem

Stroke or cerebrovascular disease is a major cause of disability and death in the global population with likelihood to increase yearly.[1] According to Thailand public health statistics, stroke rates were reported to increase from 366.81 cases per hundred thousand people in 2013 to 467.46 cases per hundred thousand people in 2017, while the mortality rate increased from 35.9 deaths per hundred thousand people in 2013 to 47.8 deaths per hundred thousand people in 2017.[2] The incidence of stroke increases with age, with the incidence doubling for each decade after age 55.[3]

Stroke is a condition whereby blood cannot reach the brain due to abnormalities of the brain's capillaries caused by occluded or broken capillaries. Thus, the brain suffers from blood and oxygen deficiency,[4] eventually leading to long-term disability. These impairments affect both physical and psychological quality of life of stroke survivors, place burdens on families and society[5] and cause significant economic loss due to the costs of treatment and extended rehabilitation.[6]

The primary prevention of stroke aims to reduce the risk of the first stroke event by providing stroke knowledge and raising awareness of the individuals so that they can manage themselves to reduce or modify their risk factors. One of the effective ways to reduce those risks is to modify lifestyles, such as, physical activity, diet, weight control, smoking cessation, stress management, adherent to treatment to control blood pressure, blood glucose and blood lipid to meet normal criteria.[3] Such modification could prevent 80-90% of stroke incidents.[7,8]

In previous studies, the Transtheoretical Model (TTM) or the Stages of Change Model[9] was found effective in promoting health behavior among groups with inappropriate health behaviors or with chronic diseases, such as, hypertension, and diabetes. This model could lead people at risk to modify their behaviors, including physical exercise,[10] blood pressure control,[11,12] blood glucose control,[13,14] and weight control.[15] Moreover, the TTM is found to be associated with significant reductions in the incidence of stroke (5.11% vs. 9.90%).[16] Based on the TTM, individuals' behavioral change gradually begins from having no intention to change to undergoing behavioral change through the process of change along with making the decision whether to change behaviors by weighing pros and cons. Furthermore, perceiving higher self-efficacy promotes an increased level of behaviors and enables individuals to maintain healthy behaviors so consistently that such behaviors become daily activities.[17]

Nakhon Phanom, a northeastern border province in the Mekong River Basin of Thailand, where multiple ethnic groups reside, has specific lifestyles, beliefs and cultures. Most residents consume spicy food and salty flavor; for instance, Khao Poon Nam Nua (noodles cooked with shrimp paste sauce and fermented fish), sticky rice, papaya salads and so forth. Customarily, they consume fermented fish as a main ingredient and consider routine chores (i.e., doing house chore) and work-related activities as a form of exercise.[18] Such behaviors and belief may result in non-communicable diseases (NCDs). It is the case that recently Nakhon Phanom province has been reported an increasing number of patients with NCDs. According to stroke risk screening among people aged over 55 years residing in Nakhon Phanom province, 43.58% had Thai CV risk score at the moderate level and 24.81% at high to very

high levels.[19] Indeed, community health promotion hospitals have attempted to provide them with the stroke knowledge and promote them to have healthy behavioral changes against the diseases; nevertheless, the incidence and prevalence remain high, indicating that the sole application of stroke education seems ineffective in encouraging the risk groups to reduce their behavioral risk factors.

A newly developed Transtheoretical Model-Based Intervention was designed for stroke prevention tailored to suit specific lifestyles and local context of people at risk in Nakhon Phanom province. The intervention was implemented through education specifically on stroke severity, risk factors, warning signs and prevention in combination with process of change. The aim of the process of change was to allow the risk groups to gradually develop intention or readiness to modify their behavior step-by step from the precontemplation to maintenance stage so that the participants collaborate to implement stroke prevention behaviors and control blood pressure and BMI, thereby reducing incidence of stroke.

Research Question

The research question is whether the Transtheoretical model-based Intervention improves stroke prevention behaviors and control blood pressure and BMI of people at risk.

Objectives

1. To compare the effects of a Transtheoretical model-based Intervention on stroke preventive behavior score among people at risk in community of Nakhon Phanom Province before and after the stroke preventive intervention.

2. To compare mean SBP, DBP and BMI among people at risk in communities of Nakhon Phanom Province before and after the Transtheoretical Model-based intervention.

Research Design

This study employed a quasi-experimental research with a one-group pretest-posttest design.

Research Hypotheses

1. After the experiment, the participants have greater stroke prevention behavior mean scores than before the experiment.

2. After the experiment, the participants have lower SBP, DBP and BMI value than before the experiment.

Conceptual Framework

This study applied the TTM[20] as a conceptual framework in designing the Transtheoretical Model-based intervention for stroke prevention behaviors among people at risk in communities of Nakhon Phanom. The model proposes that a person's behavioral changes are a contiguous process. Individuals engaging in a new behavior move through a series of stages of change from "not ready for change" to "ready for change". The intervention used the process of change[9] to modify behaviors using cognitive/experiential processes. Practically, individuals not ready to change were provided with the essential information concerning risks and warning signs (raising consciousness) of stroke severity. To illustrate, the participants were presented case studies (dramatic relief). Regarding potential effects on surrounding people, if having stroke (environmental reevaluation), individuals were required to conduct self-assessment of stroke risks; search for causes (e.g., lack of exercise and inappropriate diet) (self-reevaluation); and weight pros and cons, thereby leading them to decide to change behaviors and enter the stage of "already changing". At this stage, individual intended and planed appropriate exercise and food consumption. Support was provided using behavioral processes including recommendations about choices or demonstrations of additional exercise models,

replacement of foods and seasonings by taking their individuals' contexts, lifestyles and culture into account (counter-conditioning). Indeed, the model was intended to make participants promise to change from familiar behaviors to new behaviors to prevent stroke (self-liberation). This process allowed the patients to engage in searching for the relevant information and coping with potential barriers, which could facilitate behavioral changes (stimulus control). In addition, they were assisted through a variety of actions, including organizing groups to exchange experience concerning performance of stroke prevention behaviors, adjusting exercise regimen and food consumption plans (helping relationship), encouraging and praising to provide positive reinforcement in order to maintain desirable behaviors (reinforcement management), increasing self-efficacy in individuals, promoting an increased levels of behavior and enabling them to improve participant's behavior-related stroke risk factors (i.e., healthy diet, physical activities and stress management). Furthermore, they also received outcome assessments including stroke prevention behavior levels, SBP, DBP and BMI (see Figure. 1).

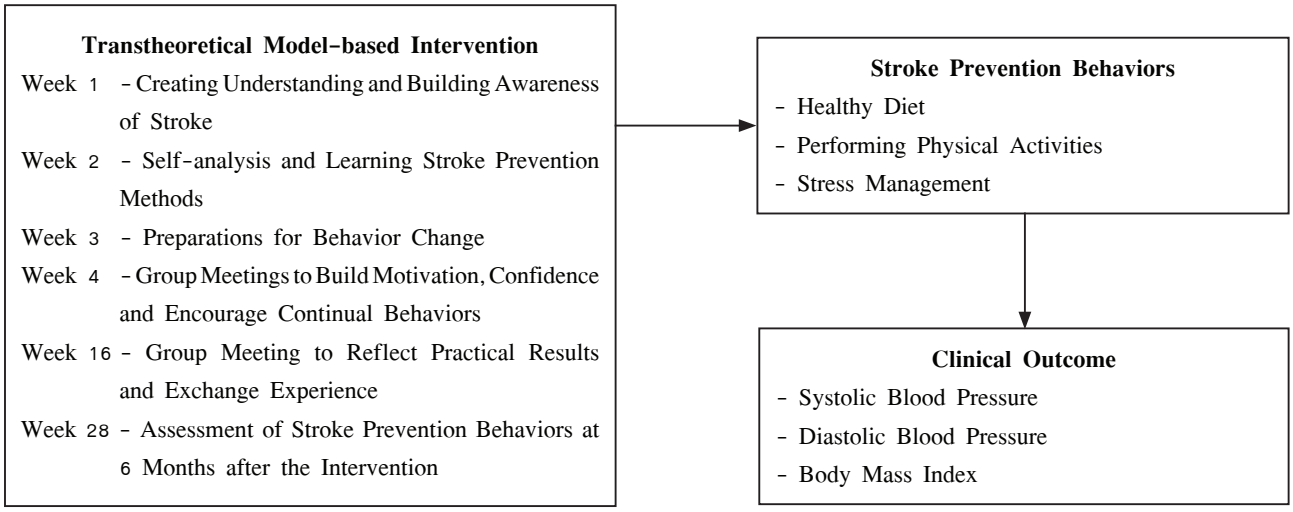

Figure 1 Conceptual Framework

Methods

Participants

The participants were ≥ 55 years old, with non-communicable diseases, and receiving a continual treatment at one community health promotion hospital in Nakhon Phanom Province. The sample size was calculated using the G*power program (3.1.9.2), with an α of .05, power of .80.[21] According to Gong et al. study,[16] they calculated effect size (ES) from a physical activity level of hypertension patients six months before and after the experiment ($\overline{\chi}_{pretest}$ = 3.54, SD = 1.62, $\overline{\chi}_{posttest}$ = 4.35, SD = 1.16) and obtained .56. Twenty two participants were purposively selected based the criteria: 1) diagnosed by a doctor with at least one of the following non-communicable disease (e.g., hypertension, diabetes mellitus, or hyperlipidemia); 2) adherent to medication consistent with treatment plans; 3) having Thai CV Risk Score[22] ≥ 10%; 4) classified in stage "Not Ready for Change" of readiness for behavior change[23]; and 5) literate in Thai. The exclusion criteria were as follows: (1) documented history of stroke or TIA; (2) blood pressure level ≥ 180/110 mmHg; and (3) blood sugar level higher than 300 mg%. The withdrawal criteria included: (1) developing an acute disease,

causing them to be hospitalized; and (2) refusing to participate in the study or not completing the project. During the study, a total of two participants withdrew from the study, leaving a sample size of 20 participants.

Ethical Consideration

This study was approved for research ethics by the Human Research Ethics Committee, Nakhon Phanom Provincial Public Health Office, No. HE630002 dated 9 March 2020. After the approval, we approached the population when they attended their appointment at Tambon health promotion hospital. The participants who met the inclusion criteria were informed the research objectives and procedure and that it was voluntary for them to decide to participate or refuse participation, and that their refusal did not affect their given treatment or services. Once agreeing to participate in the study, the participants signed the consent form.

Research instruments

1. The Transtheoretical Model-based intervention for stroke prevention behaviors was developed by the researchers based on the TTM[20] and on the relevant literature review.[3,14,16,24] The intervention components comprising:

1) The Transtheoretical Model-based intervention activity handbook. The intervention comprised three lectures, one group meeting on a weekly basis, along with one booster session engineered in a progressive manner at three months post-intervention in a group activity session. Each session lasted approximately 60-90 minutes.

2) A portable stroke information board is a model simulating ischemic stroke and hemorrhagic stroke, equipped with audio presentation pertaining to stroke knowledge, risk factors, warning signs, prevention, as well as a song, rendered into the local dialect, whose lyric emphasized perception, earlier perception and prevention of stroke.

3) The stroke risk avoidance booklet. It was intended to be used by the participants as a manual for stroke prevention practices. Booklet contents included stroke knowledge, risk factors, warning signs, treatment, stroke risk assessments and stroke prevention by modifying behaviors in daily life.

2. Assessment tools

1) The readiness for lifestyle changes inventory[23] was used to assess participant's willingness or readiness to change eight behavior patterns: physical activity performing, low-fat consumption, low salt diet, low sugar intake, fruit and vegetable consumption, stress management, smoking cessation and alcohol abstinence. The response scale had five options: (1) "No, and I do not plan (Pre-contemplation Stage)"; (2) "No, but I may start in the next 6 months (Contemplation Stage)"; (3) "No, but I intend to start next month" or "Not active on a regular basis but occasionally (Preparation Stage)"; (4) "Yes, and I have been for less than 6 months (Action Stage)"; and (5) "Yes, and I have been for more than 6 months (Maintenance Stage)." Each behavior was interpreted at two levels. "Not Ready for Change" meant behavioral change in the Pre-contemplation Stage, the Contemplation Stage or the Preparation Stage. "Ready for Change" meant behavioral change in either the Action Stage or the Maintenance Stage.

All of the participants in this study had behavior modification in relation to physical activity, low-fat consumption, eating low salt diet, low sugar intake, fruit and vegetable consumption and stress management in the "Not Ready to Change" stage. They also abstained from drinking alcohol and smoking.

2) Thai CV Risk Score[22] was used to assess stroke risks in the following ten years.

3. Data collection instruments

1) The demographic information form[25] comprised 12 items: 1) gender; 2) age; 3) marital

status; 4) level of education; 5) religion; 6) occupation; 7) history of chronic illnesses; 8) smoking history; 9) weight, height and BMI; 10) blood pressure; 11) blood glucose level; and 12) Thai CV Risk Score. The responses were designed in multiple-choice question and fill-in-the-blank format.

2) The stroke prevention behavior questionnaire[25] contained 25 questions with responses on a 4-level rating scale ranging from zero to three points: 'Never', 'Occasionally', 'Frequently' and 'Regularly'. Scores were interpreted at three levels including "low" total scores < 60% (0-44.99 points), "medium" (45-60 points) and "high" (60.01-75 points).

3) A desktop Omron automatic blood pressure measuring device, HEM-7130 model, was used to measure the participants' blood pressure before all of interventions to assess readiness and monitor participants for potential abnormal symptoms during sessions. In addition, measurements were performed after the experiment to assess effects of stroke risk reduction practices.

4) A Camry needle scale, DT602 Model, was used to weigh the participants to calculate body mass index before and after the study.

Instrument Quality Testing

1. The Transtheoretical Model-based intervention was tested for content validity by three qualified experts: one professional nurse, one registered nurse specialized in nursing care for stroke patients and one nursing teacher specialized in nursing care for stroke patients and research. The researcher made modifications and corrections as per their recommendations on content coverage and language appropriateness. The intervention was then trialed with five persons with characteristics similar to the study participants once a week for four times. The trial showed that all activities had appropriate amount of time, simplicity of contents and relevance to daily lifestyle of the participants.

2. The stroke prevention behavior questionnaire had been tested for content validity and used in other studies,[25] so the form for content validity was not subjected to additional test. Nevertheless, the questionnaire was trialed with 30 persons with characteristics similar to the participants and Cronbach's Alpha Coefficient reliability was at 0.83.

3. The blood pressure measuring device and the needle weighing scale were tested and calibrated according to the standards by medical equipment staff, Nakhon Phanom Hospital. The researcher measured blood pressures, weighed the participants and used the same devices throughout the study. The devices were tried out in 30 persons with characteristics similar to the participants. Test-retest reliability of the blood pressure measuring device was assessed 10 minutes apart using Pearson Correlation Coefficient (r) and the needle weighing scale, obtaining 0.89 and 1.0 respectively.

Data Collection Methods

The researchers conducted data collection at a community health promotion hospital in Nakhon Phanom Province, from June to November 2020. Before attending the first activity session, the participants were assessed for stroke preventive behavior levels, blood pressure and body mass index and reassessed on week 28 (6 months post intervention), which took approximately 30-40 minutes. The Trans-theoretical Model-based intervention was administered to the participants in 4 activity sessions over 4 weeks, with one booster session on week 16 (3 months post-intervention). Before each of the sessions, which lasted approximately 60-90 minutes, all participants were seated in a backrest position and measured for blood pressure twice with a five-minute interval. The followings were detailed activities:

Activity Sessions in the Intervention

Session 1 - At week one, the session focused on creating understanding and raising awareness of stroke, stroke risk factors and assessing stroke risks in the following ten years. The researchers provided a participatory teaching on stroke using the portable stroke information board and the stroke risk avoidance booklet as teaching media and presented them case studies as dramatic relief to illustrate harmful effects and severity of the disease, knowledge of risk factors, warning signs and appropriate responses.

Session 2 - At week two, the participants learned how to control stroke risk factors by changing their behaviors. The activity session aimed to create understanding, raise awareness, discover real situations and undergo self-reevaluation. This session deployed the following activities: (1) recording the risk factor profile of individuals on the stroke avoidance booklet; (2) having the participants analyze personal stroke risk factors in the following ten years; and 3) delivering lecture on sodium and sugar in food, demonstrating correct principle of exercise by instructing them how to perform warm-up and cool down before and after exercise (e.g., arm swing exercise, Nine-squares exercise) and allowing the participants to share techniques of stress reduction.

Session 3 - At week three, the participants were prepared to perform stroke prevention behaviors. This session comprised the following activities: (1) providing the participants with additional information on benefits of behavioral changes by emphasizing potential risks or harmful consequences unless they changed previous behaviors in addition to allowing participants opportunities to weigh pros and cons before making decisions (decisional balance); (2) encouraging the participants to review their personal stroke prevention performance (self-reevaluation) concerning eating, exercising, and stress management; (3) motivating the participants to plan their personal behavioral changes by selecting and specifying activities, dates, times, places and equipment (self-scheduling); and (4) assisting the participants to make self-promise (self-liberation) and set goals on performing their stroke prevention behaviors.

Session 4 - At week four, group meetings were held to raise motivation and confidence for adherence in healthy eating and exercise behaviors through experience sharing in the groups of 10 participants. The activities included: (1) reflecting on their personal performance; 2) sharing lesson learned from performing behaviors; 3) encouraging to perform healthy behaviors; and 4) modifying plans and mutually set goals to assist each other in overcoming immediate challenges and promoting friendships among the group members (helping relationship).

Session 5 - At week 16, a group meeting was held to allow each participant to share experiences. The activities were as follows: (1) reflecting on their personal performance; (2) sharing successful experiences and barriers; (3) encouraging to change behaviors; and (4) modifying plans and set mutual practical goals.

Data Analysis

The demographic data were analyzed using descriptive statistics. After obtaining preventive behavior score, we measured SBP levels, DBP levels and BMI testing for normal distribution, statistical data comparison of before and after intervention using paired t-test.

Results

1. Demographic data

Most of the participants (55%) were female, married (75%) and practiced agriculture as the main occupation (40%). Most of the participants attained the primary education, were non-smokers, and had hypertension and diabetes. Almost half of them (45%) had Thai CV Risk Scores falling in the very high and dangerously high levels (Table 1).

Table 1 Frequency and percentage of the participants classified by demographic and clinical characteristics (N = 20)

Participant Characteristics	Number	Percentage
Gender		
Female	11	55
Male	9	45
Age-Years ($\bar{\chi}$ = 63.1, SD = 5.54, range 52-73)		
Under 60	8	40
Over 60	12	60
Marital Status		
Married	15	75
Single	2	10
Divorced/Widowed	3	15
Religion		
Buddhism	20	100
Level of Education		
Primary Education	18	90
Secondary Education	2	10
Occupation		
Farmer	8	40
Vendor	6	30
Unemployed	3	15
Hired Worker	2	10
Civil Servant	1	5
Duration of having chronic illnesses-Years		
Hypertension (median = 8.5, IQR = 16)		
< 10	9	56.25
10-20	5	31.25
> 20	2	12.50
Diabetes (median = 8.0, IQR = 4.75)		
< 10	10	62.50
10-20	5	31.25
> 20	1	6.25
Hyperlipidemia (median = 6.0, IQR = 6.50)		
< 10	10	76.92
≥ 10	3	23.08
Heart Disease	1	5
Smoking		
Non-smoker	17	85
Smoked in the Past	3	15
Thai CV Risk Score		
Medium (10-19.99%)	4	20
High (20-29.99%)	7	35
Very High-Dangerously High (30% and up)	9	45

2. Effects of the Transtheoretical Model-based Intervention on Stroke Prevention Behaviors of Participants.

Prior to the intervention, 45% of the participants were found to have stroke prevention behaviors at a medium level, followed by a high level (30%) and a low level (25%). After the intervention, 60% were found to have stroke prevention behaviors at a medium level, followed by a high level (40%) (Figure 2).

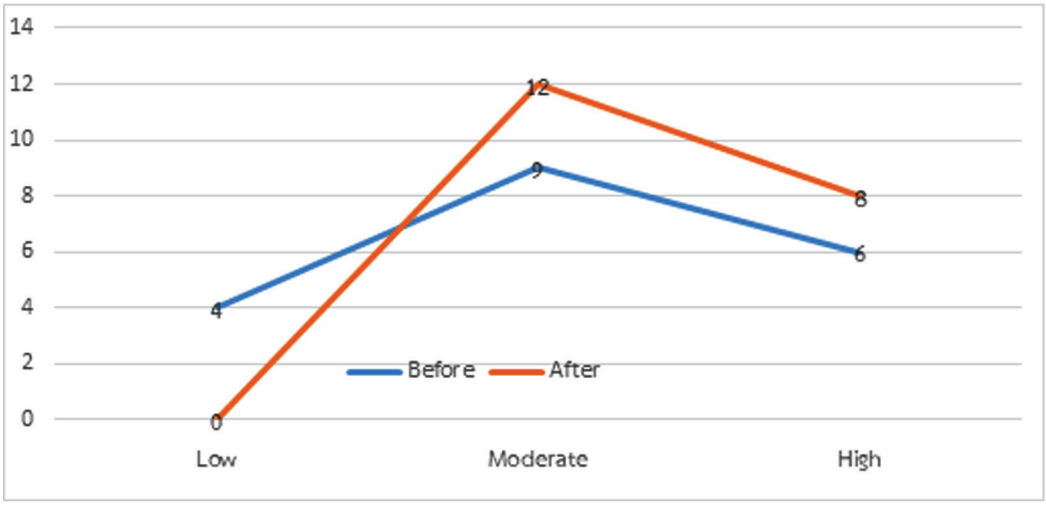

Figure 2 Stroke Prevention Behaviors of the Participants Before and After the Study

The mean stroke prevention behavior scores of the participants after the intervention were higher than before the intervention with statistical significance ($\bar{\chi}_{before}$ = 34.00, SD = 6.16, $\bar{\chi}_{after}$ = 44.25, SD = 5.06, p < .001) (Table 2).

Table 2 Comparisons of mean scores of stroke prevention behaviors, systolic blood pressure, diastolic blood pressure and body mass index of the participants before and after the study using Paired t-Test (N = 20)

Studied variables	Pre-test		Post-test		t	p
	M	SD	M	SD		
Stroke Prevention Behaviors	34.00	6.16	44.25	5.06	-7.11	.000**
Healthy Diet	12.75	4.08	17.55	3.90	-4.41	.000**
Physical Activities	7.50	3.66	11.15	0.99	-4.20	.000**
Stress Management	13.75	1.65	15.55	0.89	-4.35	.000**
Blood Pressure (BP)						
Systolic BP	147.70	19.99	135.85	13.41	3.42	.001*
Diastolic BP	77.85	9.18	77.75	7.02	0.07	.473
Body Mass Index (BMI)	26.55	3.75	26.47	3.52	0.20	.421

**p < .001, *p < .01

3. Comparison of Mean SBP, DBP and BMI of Participants before and after the experiment.

Mean SBP of the participants after the experiment was lower than before the intervention with statistical significance ($\overline{\chi}_{before}$ = 147.70, SD = 19.99, $\overline{\chi}_{after}$ = 135.85, SD = 13.41), while no differences were found for mean DBP and BMI of the participants before and after the intervention (Table 2).

Discussion

The findings showed that the participants improved stroke prevention behaviors at the medium level and the high level after the Transtheoretical Model-based intervention. In addition, mean stroke prevention behavior scores of the samples after the intervention were greater than before the intervention with statistical significance. The results indicated that the intervention could increase awareness of the participants' personal stroke risk factors through cognitive and behavioral processes,[9,15] including delivering education; learning from case studies; undergoing self-reevaluation; demonstrating aerobic exercise with simple and recreational actions but without additional exercise facilities; instructing a simple analysis method of determining appropriate levels of sodium and sugar consumption in regular food; adopting plans for own behavioral change (i.e., diet management, exercise, and stress management); using group process to reflect upon behavioral change outcomes; declaring goals and commitment; raising self-esteem and monitoring the participants' implementation, thereby leading them to adopt behavioral changes for stroke prevention.

The procedure used to prepare the participants for stroke prevention began with providing the participants with education on stroke, warning signs, and risk factors and on disease prevention so as to raise the participants' knowledge and understanding of stroke (consciousness raising). This is one of the cognitive processes assisting the participants to modify their behaviors from precontemplation to contemplation.[9,14] Moreover, in this study, the participants could perform self-reevaluations of risk factors and self-assessment of stroke risks, making the participant likely to acquire knowledge and understanding of stroke risk behaviors by themselves. To illustrate, unhealthy behaviors included consumption of sticky rice with local diets, which are usually added by fermented fish, sodium glutamate, and sugar; in addition, they did not have exercise regimen since they may perceive working in the field and doing house chores as performing exercise. We used case studies with high risk of stroke who resided in the same community as the study participants, inappropriate health behaviors and subsequent strokes with negative effects on life, family and surrounding people as a dramatic strategy so as to enhance the participants' perception of harmful effects and severity of stroke, assess threats and personal risks, and inspire fear of stroke. This intervention may lead the participants to foster awareness and intention of behavior change. The findings reflected on the importance of the cognitive process in motivating the participants to think, weigh advantages and disadvantages of previous behaviors and decide whether to change (decisional balance). In addition, conducting the intervention in their local dialect allowed the participants to acquire the accurate information, enjoy rapport with other members, and have confidence in making conversation, reflecting viewpoint or asking questions, thus leading to better understanding of the stroke risk factors and its severity. This session probably helps the participants commit themselves to changing personal risk behaviors, which allows them to enter the "Prepare" step where they can self-schedule appropriate practices; select and establish dates, time, places and frequency; and

set goals and promises to change behaviors (self-liberation). For example, the participants promised to adhere to exercise and consume healthy foods, have discretionary salt intake and reduce intense flavor intake (e.g., avoiding consumption of high sugar, monosodium glutamate, fish sauce and mixed instant coffee). As for stress management, once feeling felt discontent, the participants consulted with their reliable persons in addition to meditating and praying. It is noted that such stress management methods are typical of northeastern people.[26] During the activity sessions, all group members actively engaged in reflecting on their understanding and sharing experience through group discussion for adopting solutions or alternative choices (helping relationships). Recommendation and demonstration on how to perform exercise, read nutrition labels and select dietary supplements provided the participants with adequate choices or conditions specific to their contexts and goals (counter-conditioning). This finding supports by Pattanaporkrattana,[27] who found that after the participation in the stroke prevention program, the stroke patients had greater scores of stroke knowledge, intention of stroke prevention and the mean scores of stroke preventive behaviors after in comparison with before the intervention.

Similarly, the study findings were congruent with Alzeidan et al.,[14] who investigated the effects of lifestyle modification (e.g., healthy eating, physical activity practices) among impaired glucose tolerance patients. The participants were sent message about healthy diet and physical activity for six months. The message contents were constructed in accordance with all of the process of change and TTM of behavior change. In the early stages of change, to raise their awareness, the participants were sent message to their smartphone three times/ week. Afterward, they were sent separate message based on their stage of change, which was assessed every month. It was found that 36 months after the intervention, the participants had appropriate eating and exercise habits, resulting in decreased body weight by 5-10% per year and had normal limit of blood pressure.

Furthermore, encouragement and support of stroke prevention behaviors should emphasize perceived self-efficacy so as to strengthen confidence in their inherent ability, which is another component of the TTM.[20] This study reflected experience from successful behavioral changes. Positive reinforcement to maintain desirable behaviors (reinforcement management) helps to increase individuals' self-efficacy and promote an increased level of behavior. This accords with the study findings conducted by Dishman et al.,[28] who studied perceived self-efficacy and steps of readiness in changing exercise behaviors and found that individuals unlikely to begin exercising had a low level of perceived self-efficacy on the contrary to those with regular an exercise regimen. This indicates that individuals who perceived a higher level of ability to exercise have a higher level of improvement in term of readiness to change own behaviors.

According to comparison of mean SBP and DBP among the participants before and after the Transtheoretical Model-based intervention, participants had significantly lower mean SBP than before the experiment; meanwhile, the mean DBP of the participants were lower without statistical significance. A likely explanation is that process of change and decisional balance according to lifestyle and culture of the participants allow them to gradually intensify effort and readiness of behavioral change. In addition, when informed of stroke disease and its risk factors and perceiving relative risk of stroke, the participants may instill fear and desire to change their behaviors and then begin to make plans and perform regular exercise. Furthermore, nutritional practices, mindfulness and relaxation contribute to a decreased level of blood pressure, particularly

SBP,[3] and DBP remained at the baseline level (90 mmHg.).[29] Similarly, a study conducted by Gong, et al.[16] suggested that adults with hypertension had a greater level of exercise behaviors at six months after attending a Community-Based physical activity program for stroke prevention with statistical significance (d = 0.45, 95% CI 0.04, 0.85), while systolic and diastolic blood pressure showed no difference from before the program (SBP -3.72 mmHg, DBP -2.92 mmHg), and it also showed that the experiment group had a lower incidence rate of stroke than the control group (5.11% vs. 9.90%, p<0.05) at 6-month post-intervention.

However, given body mass index of the participants, no difference before and after the intervention was found. This may be because the monitoring period was not sufficient to detect changes in clinical outcomes and outcomes may need monitoring in the long term probably for more than one year.[14] In a study conducted by Salas-Salvado,[30] after participation in the Mediterranean diet and exercise intervention, body mass index was found no change after six months but declined with statistical significance at 12 months after participation in the intervention.

Limitation

1. The major limitation of this study was the small size of samples and there was no control group, which may limit generalization to other population at risk of stroke.

2. A six months follow-up period made it difficult to conclude long-term effectiveness of the intervention.

3. Factors affecting physical, emotional and mental states as well as economic status, for instance livelihood or other life burdens, may mitigate against behavioral change.

4. The current study did not investigate stage of behavioral modification of the participant in person but as group activity; thus, it may not be practical to study patients with different duration of process of change or different stages of process of change.

Conclusions

The findings suggest that the Transtheoretical Model-based intervention is compatible with lifestyle including way of life, language, and culture, of the group at risk demonstrated effectiveness in promoting stroke prevention behaviors among people at risk, helping individuals to foster interest, concentration and confidence in changing behaviors step-by-step and eventually to implement the preventive behaviors. The early stages of change (Not ready for change) is designed to raise individuals' awareness, dramatic relief, environmental reevaluation, and self-reevaluation to decide to change. The following stages of change (Ready for change) assist participants in a smooth transition through the process of change by five behavioral processes. The people at risk could increase or maintain stroke prevention behaviors so regularly that behaviors became an activity in daily life and that susceptibility to stroke significantly declined.

Recommendations and Implications

Health care providers in primary health care settings should provide the Transtheoretical Model-based intervention with broader expansion in order to continuously change behaviors of individual at risk of stroke. Future work is required to design a study with two-group comparison design and assess the stage of behavioral process after intervention every six months so as to determine whether participants have a higher level of behavioral process.

Participation in article writing

The first authors have contributed all the process of the study and this manuscript. The 2nd and 3rd authors have engaged in methodology, validation, and supervision. The 4th to 6th has conducted in data collection.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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