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ORIGINAL ARTICLE

The Effects of Long-term Yoga Program on Blood Pressure and Physical Fitness of Older Adults with Stage 1 Hypertension

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ABSTRACT

Background. The effects of yoga on older adults' blood pressure and physical fitness have been rarely considered in Vietnam. **Objectives.** This study aims to evaluate the impact of yoga programs on Blood Pressure and Physical Performance of Older Adults with Stage 1 Hypertension. **Methods.** Thirty female participants aged 60 to 74 (66.48±4.48) were recruited from Vinh City, Vietnam. A six-month Yoga program included pre-training, post-training, and follow-up. Participants attended a 60-minute yoga practice in three weekly sessions for 6 months. The outcome measurements are blood pressure and physical fitness. An adjustable cuff-sided sphygmomanometer is used for measuring blood pressure. A senior fitness test is used to measure physical fitness. **Results.** BMI, waist, and blood pressure of older adults with stage 1 hypertension are significantly improved. The difference in BMI between the two phases is 0.47, p<0.001; Sequentially, waist is 3.25, p<0.001; pulse is 1.59, p<0.001; systolic blood pressure is 2.63, p<0.001; diastolic blood pressure is 2.25, p<0.001; Physical tests have also significantly improved. The difference of the chair stand test is -2.11, p<0.001; Sequentially, arm curl is -2.07, p<0.001; 2-minute step is -2.55, p<0.001; chair sit reach is -2.40, p<0.001; back scratch is -1.07, p<0.001; 8-foot up and go is 0.33, p=0.017. **Conclusion.** Yoga can improve older adults' BMI, waist, blood pressure, and physical fitness.

KEYWORDS: ***Older Adult, Blood Pressure, Hypertension, Senior Fitness Tests, Yoga.***

INTRODUCTION

Hypertension is one of the most common diseases in the world; an estimated 1.28 billion adults aged 30–79 years worldwide have hypertension, most (two-thirds) living in low- and middle-income countries (1). Hypertension, also known as high blood pressure, is a long-term medical condition in which the blood pressure in the arteries is persistently elevated (2). It is a highly prevalent condition that dramatically increases incidence with age (3). Long-term high blood pressure, however, is a significant risk factor for coronary artery disease, stroke, heart failure, peripheral vascular disease, vision loss, and chronic kidney disease (4, 5). Lifestyle changes and medications can lower blood pressure and decrease the risk of health complications. Lifestyle changes include weight loss, decreased salt intake, physical exercise, and a healthy diet (6). Modern medicines can treat hypertension, but in the long run, they have side – effects (7).

Physical function declines with aging. At the biological level, aging results from the impact of

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the accumulation of a wide variety of molecular and cellular damage over time. This leads to a gradual decrease in physical and mental capacity, a growing risk of disease, and, ultimately, death (8); a reduction in functional fitness found in both men and women is due to the aging process (9).

Yoga, an ancient and profound psych-spiritual tradition from India, has developed over the past 5,000 years and includes a wide range of moral and ethical principles, mental disciplines, and physical exercise practices (10). Yoga was also developed to promote a vibrant lifestyle and support meditation practices (11). Yoga is widely practiced to enhance health and alleviate or treat various diseases. In addition, Yoga practice emphasizes controlled breathing, meditation, and physical posture, respectively (12), and it is a popular branch that includes three fundamental components: asanas (postures), pranayama (breathing exercises), and dhyana (meditation) (13). Previous studies proved that practicing yoga alleviated depression and anxiety in women (14), enhanced strength of upper extremities (15), muscular endurance (16), flexibility and balance (17), and respiratory system (18).

To date, little data has been available on the benefits of yoga for long-term yoga practice in Vietnam. Accordingly, the current study was planned to assess the effect of long-term yoga exercises on blood pressure and physical fitness in older adults.

MATERIALS AND METHODS

Participants. Thirty female participants aged 60 to 74 (66.48±4.48) were recruited via flyers, interviews, emails, and telephone from Vinh City, Vietnam. Three participants dropped out at the beginning because of private reasons. Inclusion criteria: participants can perform the senior fitness test fully, finish the Mini-mental state examination (19) with a score greater than 24, have no experience in yoga, have a primary high blood pressure level of 1 according to systolic blood pressure 140-159 mmHg or/and diastolic blood pressure 90-99 mmHg, follow yoga program and advice on diet and lifestyle changes. Exclusion criteria: participants with serious diseases such as angina, arrhythmia, dementia problems, or complications of the heart, brain, kidneys, eyes, or peripheral blood vessels.

Intervention. A six-month Yoga program included pre-training, post-training, and follow-up. Prior to intervention, participants were asked to complete an informed consent. Participants were assigned a yoga program under the instruction of qualified and experienced yoga instructors from HD Yoga Center, Vinh City, and yoga experts from the Vietnam Yoga Federation. Participants attended a 60-minute yoga practice in three weekly sessions for 6 months. Each session consisted of the warm-up, central part, and cool-down period. Physicians and physical education experts checked the blood pressure and fitness tests of participants at three different times: first time (baseline)-prior to participating in the yoga program, second time (midtest)-after three months of yoga training, and third time (post-test)-after the next three months of yoga training. The intervention was divided into two phases: primary (first three months) and intensive (the next three months). At the basis phase, participants engaged in yoga techniques such as: Tadasana (Mountain Pose), Virabhadrasana (Warrior Pose), Utthita Trikonasana (Extended Triangle Pose), Padahastasana (Hand Under Foot Pose), Surya Namaskar (Sun Salutation), Diirghaprasana (Long Stretch Pose), Balasana (Child's Pose), Adho Mukha Svanasana (Downward-Facing Dog), Kumbhakasana (Plank Pose), Vajrasana (Thunderbolt Pose), Marjaryasana (Cat Pose), Dandasana (Staff Pose), Yoga Mudra (Symbol of Yoga Pose), Vakrasana (Twisted Pose), Janu Sirsasana (Head to Knee Pose), Bhadrasana (Gracious Pose), Gomukhasana (Cow Face Pose), Makarasana (Crocodile Pose), Bhujangasana (Cobra Pose), Uttana Padasana (Raised Legs Pose), Setu Bandha Sarvangasana (Bridge Pose), Bhastrikasana (Bellows Breath). In the intensive phase, some more yoga techniques were added, as the follows: Sheetkari Pranayama (hissing breath), Sadanta Pranayama (cooling breath), Nadi Shodana Pranayama (Alternate Nostril Breathing), Bhramari Pranayama (Bee Breath), Kapalabhatti Pranayama (Skull Shining Breath), Uttanasana (Standing Forward Bend), Vrksasana (Tree Pose), Garudasana (Eagle Pose), Ardha Chakrasana (Half Wheel Pose), Karmasana (Karma Pose), Kaoshiiki (Kaoshiiki Dance), Ardha Ustrasana (Half Camel Pose), Parighasana (Gate Pose), Utkatasana (Chair Pose), Shashaungasana (Rabbit Pose), Parivrtta Parsvakonasana (Revolved Side Angle Pose), Ardha Matsyendrasana (Half Lord of the Fishes Pose), Paschimottanasana (Seated Forward Bend), Ardha Shalabhasana (Half Locust Pose),

Dhanurasana (Bow Pose), Ardha Halasana (Half Plow Pose), Chakrasana (Wheel Pose), Anantasana (Side-Reclining Leg Lift), Utkata Paschimottanasana (Intense Stretch Pose), Utksepa Mudra.

Outcomes measures and test protocol. Blood pressure and physical fitness tests were the two primary outcomes of this study.

Blood pressure measurement. Blood pressure was measured while the participants were seated comfortably. The arm should be relaxed, uncovered, and supported at the level of the heart. An adjustable cuff-sided sphygmomanometer (Boso Clinicuss II, Germany) was used for arm circumferences 27 to 34 cm. Participants were measured at least two times within a one-test period before exercise and at least one hour after. Having measured the participants before exercise, they were given 10 minutes to adjust to the temperature of the testing room. Explain to the participants what they are going to do. Explain the sensation of the cuff tightening on the participant's arm and reassure that this is safe.

Ask the participant to loosen any tight clothing or remove long-sleeved garments so that it is possible to access the upper arm. Place the cuff around the upper arm and secure it. Connect the cuff tubing to the sphygmomanometer tubing and secure it. Rest the participant's arm on a surface that is level with her/his arm. Place the stethoscope over the brachial artery (in the bend of the elbow) and listen to the pulse. Pump up the cuff slowly and listen for when the pulse disappears. This is an indication to stop inflating the cuff. Start deflating the cuff very slowly while watching the sphygmomanometer's mercury level. Note the sphygmomanometer reading (the number the mercury has reached) when the pulse reappears: record this as the systolic pressure. Deflate the cuff further until the pulse disappears: record this reading as the diastolic pressure. Record these two measurements, the systolic and then the diastolic (e.g., 120/80), in the participant's notes or chart. Tell the participant the blood pressure reading (20).

Senior Fitness Test. The Senior Fitness Test includes seven tests consisting of six domains of physical function: lower body strength, upper body strength, aerobic endurance, lower body flexibility, upper body flexibility, agility, and dynamic balance. According to Rikli and Jones, it is essential to determine whether the 6-minute test or the 2-minute step is used as the aerobic endurance measure. It depends on the space or the weather of the day testing. In this study, we used the 2-minute step test. The test items should be scheduled in the following order to minimize fatigue: Chair stand test, arm curl test, 2-minute step test, chair sit-and-reach test, back scratch test, and 8-foot up-and-go test (21). The descriptions of tests are the following:

- 30 second-chair stand test: For lower body strength assessment. Participant sit in the middle of the chair with their back straight, feet flat on the floor, arms crossed at the wrists, and held against the chest. On the signal "go," the participant rises to a complete stand and returns to a fully seated position in 30 seconds (21). Equipment: straight back chair - LAT6101, Ho Chi Minh City, Vietnam (width: 39cm x 39, height: 75cm, seat height: 43cm), stopwatch (PC 530 30LAP, China), scorecard.

- Arm curl test: For upper body strength assessment. Participant sit in the middle of the chair with their back straight, feet flat on the floor, and the weight is held down at the side, perpendicular to the floor, in the dominant hand with a handshake grip. Weight is curled up and returned to the fully extended down position in 30 seconds from the signal "go" (21). Equipment: straight back chair - LAT6101, Ho Chi Minh City, Vietnam (width: 39cm x 39, height: 75cm, seat height: 43cm), stopwatch (PC 530 30LAP, China), adjustable dumbbell 2.27 kg for women and 3.63 kg for men (adjustable dumbbells - Plastic Filling Dumbbell Sand Dumbbell Water Dumbbell, Sport-Tec, Germany), scorecard.

- Back-scratch test: For upper body flexibility assessment. The participant stands and places his or her preferred hand over the same shoulder, palm down and fingers extended, reaching down the middle of the back as far as possible. Elbow pointed up. The other arm around the waist with the palm up, reaching up the middle of the back as far as possible to touch or overlap the extended middle fingers of both hands. Give a minus (-) score if the middle fingers do not touch, a zero score if the middle fingers touch, and a plus (+) score if the middle fingers overlap (21). Equipment: Ruler (50cm, C-mart, Vietnam), scorecard.

- Chair sit-and-reach test: For lower body flexibility assessment. The participant sits on the edge of the chair. One leg is bent with the foot flat on the floor. The other leg is extended

straight in front of the hip. The heel is placed on the floor with the food flexed at approximately 90 degrees. Arms outstretched, hands overlapping, and middle fingers even, the participant slowly bends forward at the hip joint, reaching as far as possible or past the toe. Maximum reach must be held for two seconds (21). Equipment: Straight back chair - LAT6101, Ho Chi Minh City, Vietnam (width: 39cm x 39, height: 75cm, seat height: 43cm), Ruler (50cm, C-mart, Vietnam), scorecard.

- 2-minute step test: For aerobic endurance assessment. On the signal "go," the participant begins stepping in place as often as possible during the 2 minutes. The knee must be raised to the correct height (21). Equipment included: Stopwatch (PC 530 30LAP, China), masking tape (Astar, Vietnam), tally counter (Kiprun, China), and scorecard.

- 8-foot-up-and-go test: For agility and dynamic balance assessment. Participant sit in the middle of the chair with their back straight, feet flat on the floor, and their thighs. The torso slightly leans forward. On the signal "go," the participant gets up from the chair, walks around either side of the cone as quickly as possible, and sits back in the chair. The distance is 8 feet (244cm) (21). Equipment: straight back chair - LAT6101, Ho Chi Minh City, Vietnam (width: 39cm x 39, height: 75cm, seat height: 43cm), stopwatch (PC 530 30LAP, China), tape measure (Taky, Vietnam), cone (Dainam Sport, Vietnam), scorecard.

Environment condition. According to the Senior Fitness Test guide, the tests should not be administered if the temperature or humidity conditions are uncomfortable or appear unsafe for the participants (21). Each individual should be tested for comfort level depending on temperature and humidity tolerance. Observing the sight and symptoms of participants, if one tends to be in bad health condition during the tests, stop immediately.

Warm-up and cool-down exercises and participants' instructions. Before testing begins, participants should engage in five to eight minutes of warm-up and stretching activities such as brisk walking, jogging in place, arm circles, leg swings, and gentle joint rotations. After completing the central part, participants take five to eight minutes of cool-down, such as static stretches (focus on major muscle groups such as calves, hamstrings, quadriceps, chest, shoulders, and back) and deep breathing.

Ethical Considerations. The data is collected with the informed consent of participants, who know how their data will be used and have the right to withdraw at any time. Participants' privacy is protected; they do not share identifiable information without explicit permission. The data is accurately recorded and reported. Data or results are not manipulated to achieve a desired outcome. Document all analysis steps, including data cleaning, transformations, and statistical tests. Data analysis and confirmation are free from biases. Statistical methods are appropriately used for the type of data and research questions. All findings are precisely reported. Potential conflicts of interest are disclosed. The authors are responsible for the integrity of the work and use licensed software.

Statistical analyses. The paired samples t-test was used to analyze the difference within groups of each phase (baseline, midtest, post-test). A value of $P<0.05$ was considered to be statistically significant. The normal distribution of the data was tested. The skewness value of all variables is between −1 and +1). It suggests that the data distribution is relatively symmetric, meaning the data are normally distributed.

RESULTS

The participants are 60 to 74 years old (66.48±4.48). The mean score of the Mini-mental state examination is 25.15±1.51; greater than 24 meets the inclusion criteria. Thirty participants are female were recruited. Three participants withdrew for personal reasons, so 27 female participants participated in this study.

BMI, waist, and blood pressure within the research group between baseline and midtest

All variables show significant differences between baseline and midtest determined by paired samples t-test (Table 1). It can be observed in Table 1 the differences between the two phases: the difference in BMI between the two phases is 0.55 with $t(26df) =4.004$, $p<0.001$; the difference of waist between two phases is 3.65 with $t(26df) =9.776$, $p<0.001$; the difference of pulse between two phases is with $t(26df) =4.665$, $p<0.001$; the difference of systolic blood pressure between two phases is 4.14 with $t(26df) =6.353$, $p<0.001$; the difference of diastolic blood pressure between two phases is 2.22 with $t(26df) =6.253$, $p<0.001$; respectively. After three months of intervention, results show significant differences between baseline and midtest variables.

Table 1. Comparison of BMI, waist, and blood pressure between baseline and midtest

Variables	Baseline		Midtest		Difference	p*
	M	SD	M	SD		
BMI (kg/m^2)	23.55	1.84	22.99	1.60	0.55	<0.001
Waist (cm)	89.06	6.07	82.40	5.90	3.65	<0.001
Pulse (bpm)	79.37	3.35	78.52	2.83	.949	<0.001
Systolic blood pressure (mmHg)	151.52	9.50	147.37	9.91	4.14	<0.001
Diastolic blood pressure (mmHg)	90.22	5.93	88.00	5.18	2.22	<0.001

*: determined by paired samples t-test; BMI: body mass index; M: Mean; SD: Standard Deviation.

All variables show significant differences between the midtest and post-test, as determined by the paired samples t-test (Table 2). It can be observed from Table 2 shows the differences between the two phases; the difference in BMI between the two phases is 0.47 with t(26df) =5.283, p<0.001; the difference in waist between the two phases is 3.25 with t(26df) =5.625, p<0.001; the difference of pulse between two phases is 1.59 with t(26df) =6.324, p<0.001; the difference of systolic blood pressure between two phases is 2.63 with t(26df) =6.555, p<0.001; the difference of diastolic blood pressure between two phases is 2.25 with t(26df) =7.359, p<0.001; respectively. After six months of intensive intervention, results show significant differences between midtest and post-test variables.

Table 2. Comparison of BMI, waist, and blood pressure between midtest and post-test

Variables	Midtest		Post-test		Difference	p*
	M	SD	M	SD		
BMI (kg/m^2)	22.99	1.60	22.52	1.49	0.47	<0.001
Waist (cm)	82.40	5.90	79.17	4.87	3.23	<0.001
Pulse (bpm)	78.52	2.83	76.93	2.05	1.59	<0.001
Systolic blood pressure (mmHg)	147.37	9.91	141.74	8.65	2.63	<0.001
Diastolic blood pressure (mmHg)	88.00	5.18	85.44	5.06	2.55	<0.001

*: determined by paired samples t-test; BMI: body mass index.

A significant difference exists between the baseline and mid-test of intervention for fitness tests (Table 3). Statistical results of paired samples t-test showed differences of chair stand test is -0.59 with t(26df) =-6.150, p<0.001; arm curl test is -1.00 with t(26df) =-6.624, p<0.001; 2-minute step test is -8.52 with t(26df) =-5.410, p<0.001; chair sit reach test is -1.14 with t(26df) =-11.177, p<0.001; back scratch test is -2.25 with t(26df) =-13.768, p<0.001; and 8-foot up and test is 0.33 with t(26df) =2.550, p=0.017; respectively.

Table 3. Comparison of fitness tests between baseline and midtest

Variables	Baseline		Midtest		Difference	p*
	M	SD	M	SD		
Chair stand (stands)	12.22	1.69	12.81	1.64	-0.59	<0.001
Arm curl (times)	13.07	2.14	14.07	1.88	-1.00	<0.001
2-minute step (steps)	73.48	4.34	74.33	3.96	-8.52	<0.001
Chair sit reach (cm)	-4.07	1.35	-2.93	1.17	-1.14	<0.001
Back scratch (cm)	-2.33	2.43	1.93	2.30	-2.25	<0.001
8-foot up and go (second)	8.25	1.31	7.92	0.95	0.33	0.017

*: determined by paired samples t-test.

There is a significant difference between the midtest and post-test of intervention for fitness tests (Table 4). Statistical results of paired samples t-test showed differences of chair stand test is -2.11 with t(26df) =-10.832, p<0.001; arm curl test is -2.07 t(26df) =-11.756, p<0.001; 2-minute step test is -2.55 with t(26df) =-12.646, p<0.001; chair sit reach test is -2.40 with t(26df)

=-15.694, p<0.001; back scratch test is -1.07 with t(26df) =-4753, p<0.001; and 8-foot up and test is 0.33 with t(26df) =5.550, p=0.017; respectively.

Table 4. Comparison of fitness tests between midtest and post-test

Variables	Midtest		Post-test		Difference	p*
	M	SD	M	SD		
Chair stand (stands)	12.81	1.64	14.93	1.56	-2.11	0.000
Arm curl (times)	14.07	1.88	16.15	1.46	-2.07	0.000
2-minute step (steps)	74.33	3.96	76.89	3.63	-2.55	0.000
Chair sit reach (cm)	-2.93	1.17	-0.52	0.97	-2.40	0.000
Back scratch (cm)	1.93	2.30	3.00	1.90	-1.07	0.000
8-foot up and go (second)	7.92	0.95	7.59	0.69	0.33	0.017

*: determined by paired-sample t-test.

DISCUSSION

This study shows that six months of regular yoga practice can improve older people's blood pressure and physical fitness by using blood pressure and senior fitness tests. There was a significant improvement in all blood pressure variables and senior fitness test variables.

In the primary phase, participants were instructed in breathing and relaxation techniques, various postures and poses, and methods to coordinate mental focus with each body movement, enhancing their concentration. The significant changes in BMI, waist circumference, and blood pressure among participants in the primary phase demonstrate the yoga program's effectiveness on these indicators. The physical capacity of the participants showed a statistically significant improvement. This outcome is attributed to the characteristic focus of yoga on enhancing flexibility and fostering muscle strength. After training, the hamstring and back ligament systems increased in elasticity due to bent postures, while the vertebrae became more flexible from twisting postures. Additionally, muscle groups improved their flexibility and elasticity through coordination exercises. These factors collectively contributed to the participants' enhanced performance in physical fitness.

After the next three months of the intensive phase, the incidence of high blood pressure among participants decreased significantly compared to the end of the primary phase, and participants' physical capacity showed substantial improvement. These results are attributed to the synchronized coordination of the training program's components, which positively influenced participants' physical capacity. In the intensive phase, participants continued with a series of yoga routines aimed at regulating blood pressure and enhancing physical capacity, in addition to maintaining the exercises from the primary phase. This routine included sequential yoga exercises and practices using bricks and ropes, partner yoga, and laughter yoga. These activities required more energy and were more effective at improving flexibility, endurance, and strength than individual postures or small sequences of asanas practiced in the primary phase.

This study's results follow previous findings, which showed that yoga may control and lower blood pressure in patients with mild hypertension (22-24). Some other findings suggested that yoga therapy holds promise as a non-pharmacological approach for alleviating insomnia symptoms and reducing systolic blood pressure in older women experiencing insomnia (25), reducing blood pressure in hypertension (26), decreasing systolic blood pressure (27), controlling blood pressure and pulse rate (28). Moreover, yoga proves to be an effective, safe, and less expensive adjunct therapy for hypertension management. Yoga was also found to be effective in reducing the level of stress, having solid effects on depression symptoms and blood pressure (29), improving quality of life, anxiety reduction, and blood pressure control (30), reduce blood pressure (31-33). Some other results suggest that yoga may reduce oxidative stress and improve antioxidant defense in elderly hypertensive individuals (34), improving cardiovascular risk factors, including central obesity and blood pressure in middle-aged and older adults with metabolic syndrome (35).

The results of this study also follow previous studies which suggest that yoga may have positive effects on the physical fitness of older adults, including improving strength in the upper and lower extremity, static and dynamic balances, and agility (36-39), engender improvements in some components of fitness in older adults (40), have a significant favorable influence on physical abilities such as balance control and body composition rather than on mental health

aspects in older adults aged sixty-five and over (41). The results of this study also agree with previous findings, which indicate that yoga exercises are beneficial for improving body and right shoulder joint flexibility, promoting health-related physical fitness, and enhancing various aspects of physical fitness. Specifically, yoga can elicit improvements in muscle strength and endurance, overall physical fitness, and health-related fitness status (42), and enhance various aspects of physical fitness (43), Specifically, yoga can elicit improvements in muscle strength and endurance (44), overall physical fitness (45), and health-related fitness status (46).

The current study shows its strengths, demonstrating significant improvements in BMI, waist, blood pressure, and physical fitness among older adults with Stage 1 hypertension following a six-month yoga program. However, it also has a limitation: the small sample size and the absence of a control group for comparison. The study included only thirty female participants from a specific region in Vietnam. This small sample size limits the generalizability of the findings to broader populations of older adults with hypertension. Without a control group (e.g., a group not participating in yoga), it is challenging to attribute the observed improvements solely to the yoga intervention. Factors like natural progression or other concurrent lifestyle changes could also have influenced the results. Future studies may be conducted in randomized controlled trials (RCTs) with larger sample sizes. RCTs randomly assign participants to an intervention group (yoga) or a control group. This design helps to isolate the effects of the intervention more effectively.

CONCLUSION

The results of this study show that after six months of yoga training, the BMI, waist, blood pressure, upper and lower body strength, upper and lower body flexibility, aerobic endurance, agility, and dynamic balance of older adults with stage 1 hypertension were remarkably improved.

APPLICABLE REMARKS

- It may be suggested that yoga training (60-minute yoga practice session, three times per week for 6 months), low and moderate intensity, should be implemented in larger populations who contract hypertension type 1 to reduce blood pressure and improve physical fitness.
- Yoga should be considered part of a holistic approach to hypertension management, alongside other lifestyle modifications such as dietary changes, medication adherence, and regular medical check-ups.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Tho Thi Nhu Ngo. Acquisition of data: Tho Thi Nhu Ngo. Analysis and interpretation of data: Hung Manh Nguyen. Drafting the manuscript: Hung Manh Nguyen. Critical revision of the manuscript for important intellectual content: Tho Thi Nhu Ngo. Statistical analysis: Thuy Thi Nguyen. Administrative, technical, and material support: Dan Van Pham. Study supervision: Hung Manh Nguyen.

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the publication of this article.

ETHICAL CONSIDERATION

informed consent was obtained from each participant included in the study, and the study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the institution's human research committee.

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ROLE OF THE SPONSOR

The funding organizations are public institutions and have no role in the design and conduct of the study, collection, management, and analysis of the data, or preparation, review, and approval of the manuscript.

FINANCIAL DISCLOSURE

All authors declare that they have no financial interests related to the material in the manuscript.

ARTIFICIAL INTELLIGENCE (AI) USE

AI was not used to prepare or write any part of our manuscript.

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