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Effectiveness of the therapeutic lifestyle changes diet complemented with Thai traditional herbal sauna to improve cardiovascular disease parameters

Alongkote Singhato[a,*], Natthapaninee Thanomsridetchai[b], Somjet Khongkhon[c,d] & Rawiwan Charoensup[e,f]

[a]Department of Nutrition and Dietetics, [b]Department of Medical Technology, [d]Doctor of Philosophy Program in Biomedical Sciences, Faculty of Allied Health Sciences, Burapha University, Chonburi 20131, Thailand

[c]Department of Thai Traditional Medicine, Faculty of Thai Traditional and Alternative Medicine, Ubon Ratchathani Rajabhat University, Ubon Ratchathani 34000, Thailand

[e]Medicinal Plants Innovation Center, [f]School of Integrative Medicine, Mae Fah Luang University, Chiang Rai 57100, Thailand

[*]E-mail: alongkote@go.buu.ac.th

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Cardiovascular disease (CVD) is a significant health concern with detrimental effects on patients' quality of life. The Therapeutic Lifestyle Changes (TLC) diet has been proven to improve blood lipid profiles, a critical CVD parameter. Additionally, steam sauna therapy may stimulate metabolism and enhance blood circulation. This study investigated the effectiveness of the TLC diet complemented with Thai traditional herbal sauna in improving CVD parameters among individuals with dyslipidemia. A total of 60 participants were recruited and divided into 30-person control and intervention groups. The intervention group received individualized dietary planning based on the TLC diet guideline from a registered dietitian (biweekly appointments) and participated in herbal steam sauna sessions twice weekly for 12 weeks. The control group received only TLC diet-based dietary planning. Blood lipid profiles, Ankle Brachial Index (ABI), and body composition were assessed at baseline and study endpoint. Results demonstrated that participants in the intervention group exhibited significantly lower triglyceride, total cholesterol, and low-density lipoprotein cholesterol (LDL-c) levels compared to the control group ($p<0.05$). Furthermore, the intervention group showed significantly reduced arterial stiffness index values at right brachial and left ankle regions ($p<0.05$). In conclusion, TLC diet intervention appears to be more effective when complemented with herbal sauna steam therapy in improving CVD parameters.

Keywords: Ankle brachial index, Blood lipid profiles, Cardiovascular disease, Herbal steam sauna, Therapeutic lifestyle changes diet

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It is well-known that cardiovascular disease (CVD) is one of the major health problems globally that affects people's quality of life and increases mortality rate[1]. The estimated global prevalence of CVD in 2019 is 0.07%, which increased from 2010 when it was 0.06%. As of 2023, CVD affects 523 million people globally. In India, it accounts for nearly 28% of total deaths annually[2]. In Thailand, the probability of dying from CVD for males was 0.15% and for females was 0.04%[3]. People with cardiovascular diseases have reduced quality of life due to its complications such as chest pain, shortness of breath, stroke, fatigue, and other symptoms[4]. The main factor that elevates the risk of CVD is long-term unhealthy dietary intake. A previous study pointed out that a high amount of dietary fatty acid intake, especially saturated fatty acids, is a cause of lipid accumulation in blood vessels[5,6]. Long-term high concentrations of fatty acids in blood vessels are a cause of plaque formation along arterial walls, which lead to arterial stiffness and blockage[7]. This condition represents a silent danger that requires screening and diagnosis through testing blood lipid levels, including total cholesterol (TC), low-density lipoprotein cholesterol (LDL-c), high-density lipoprotein cholesterol (HDL-c), and triglycerides (TG)[8]. In addition, arterial stiffness can be screened by performing the ankle-brachial index (ABI), a non-invasive technique used to evaluate blood vessel quality that has been proven by previous studies for its reliability and accuracy as a predictor of cardiovascular disease development[9-11]. To minimize the risk of CVD development, the Therapeutic Lifestyle Changes (TLC) diet is a dietary and lifestyle modification pattern guideline suggested to improve blood lipid profiles. Examples of dietary recommendations according to the

[*]Corresponding author

TLC diet guideline include: fiber intake of 20-30 g/day, saturated fatty acid intake less than 10% of total caloric intake, polyunsaturated fatty acid (PUFA) intake of 6-10% of total caloric intake, and cholesterol intake less than 300 mg/day[12]. The prior studies established the effectiveness of TLC diet intervention on CVD biomarkers improvement such as lowering TG, TC, and LDL[13,14].

Thai traditional herbal sauna (TTHS) is a healthcare method handed down through local wisdom of ancient Thai people to improve respiratory and blood circulation systems. The TTHS employs a variety of herbal regimens, including Borneo camphor, lemongrass, and cinnamon, for their volatile oils in the steamed sauna bath[15]. This TTHS is comparable to other well-known steam sauna methods, such as Finnish and Japanese saunas, which are commonly used to promote circulation[16,17]. Previous studies revealed that steamed sauna intervention is effective in promoting blood circulation by increasing core body temperature, which induces vasodilation of blood vessels[18]. In addition, findings from previous studies indicated that steamed sauna has potential for lowering blood lipid profiles by improving circulation and stimulating fatty acid metabolism[19,20]. Steamed sauna intervention is thus a healthcare process that promotes circulation and blood vessel quality. While previous studies have demonstrated the effectiveness of the TLC diet in lowering CVD risk and the potential of steamed sauna in improving circulation, there remains a significant gap in understanding the combined effects of TLC diet intervention and TTHS. Therefore, this study aimed to investigate the effectiveness of TLC diet complemented with TTHS in improving cardiovascular disease parameters.

Materials and Methods

Study tools

Herbal regime used in this study

The selected herbal regime, when used in steam form, may promote lipid-lowering effects through enhanced circulation, vasodilation, and thermogenic stimulation, for the steamed sauna bath intervention was based on the Thailand National List of Essential Medicine (TNLEM). A traditional Thai herbal regime, Ya-Hom-Tip-O-Soj, was chosen due to its listing for blood circulation promotion according to the TNLEM's indications[21-23]. Examples of herbs in this regime include cinnamon bark, jasmine, ylang-ylang, and others. The herbal steam included scientifically identified herbs-*Cinnamomum verum* (cinnamon), *Jasminum sambac* (jasmine), and *Cananga odorata* (ylang-ylang)-used traditionally for circulatory enhancement. Proportion was 1:1:1, temp 45-50°C, 15 min/session, twice/week.

ABI assessment device

Peripheral arterial function assessment was conducted utilizing the HBP-8000 ABI measurement device (OMRON Inc., Kyoto, Japan). The device underwent systematic calibration and maintenance protocols to ensure measurement precision and reliability. The HBP-8000 enables comprehensive bilateral assessment of peripheral arterial hemodynamics by measuring ABI values across upper and lower extremities, with integrated reporting capabilities. Interpretation of ABI values follows established clinical parameters: a normative range of 0.9 to 1.4 indicates typical peripheral vascular function, while values below 0.9 are considered diagnostic indicators of potential arterial pathology. Furthermore, the device incorporates Arterial Stiffness Index (ASI) measurement, which provides quantitative assessment of arterial elasticity. The ASI stratification reveals progressive risk levels: values below 70 represent optimal arterial compliance, the range of 70-180 suggests moderate arterial stiffness risk, and measurements exceeding 180 indicate significant arterial stiffness and potential cardiovascular complications[24].

Body composition analyzer

Body composition analysis, analyzed separately for males and females to address gender-based fat distribution differences, was performed using the InBody270 bioelectrical impedance analyzer (InBody Co., Seoul, South Korea) and BODPOD (COSMED Inc., Rome, Italy), which underwent consistent calibration to ensure measurement accuracy. The devices quantified multiple physiological parameters, including percentage body fat, muscle mass, body fluid percentage, thoracic gas volume, and basal metabolic rate (BMR). Comprehensive assessments were conducted at both baseline and post-intervention stages to evaluate longitudinal changes in participants' body composition metrics.

Three-days food record

A structured, closed-ended dietary assessment questionnaire was implemented to document participants' nutritional intake during the study's final week. The methodology incorporated a comprehensive three-day dietary recall, strategically designed to capture both weekday and weekend nutritional consumption patterns. Specifically, participants recorded their food intake across two weekdays and one weekend day following nutritional education and portion size calculation training. The recorded dietary data underwent comprehensive nutritional analysis to quantify energy intake and macronutrient distribution. Nutritional computations were performed utilizing the INMUCAL-Nutrient version 4.0 software, developed by the Institute of Nutrition at Mahidol University, Thailand, and supplemented by the United States Department of Agriculture (USDA) nutritional database for precise nutrient intake calculations.

All study instruments, comprising comprehensive questionnaires and detailed study protocols, underwent rigorous expert validation to ensure methodological integrity. Three independent specialists in nutrition and dietetics critically reviewed the instruments, providing comprehensive feedback to enhance their scientific validity and precision. Following meticulous revision based on expert recommendations, the study documentation was submitted for ethical review in strict adherence to the ethical principles outlined in the Declaration of Helsinki. The study received formal ethical clearance from the Human Research Ethics Committee of Burapha University, Thailand, which granted approval under reference number IRB1-045/2567, thereby ensuring compliance with established study governance standards.

Participants

A total of 60 participants were recruited from the Saensuk Sub-district Municipality, Mueang District, Chonburi Province, through a systematic sampling methodology. The participant selection process was governed by comprehensive inclusion and exclusion criteria designed to ensure study validity and participant safety. Inclusion criteria include: Thai nationals with abnormal blood lipid profiles, adults aged between 18 and 60 years (age group stratification: 18-30, 31-45, and 46-60 years), individuals demonstrating functional literacy in the Thai language. Participants were excluded based on the following conditions: documented histories of food or dietary supplement allergies, existing muscle or bone injuries precluding exercise participation, diagnosed serious communicable diseases, gastrointestinal disorders affecting oral intake, mastication, or nutrient absorption, concurrent consumption of dietary supplements or herbal interventions, pregnant or lactating status, intellectual disabilities compromising effective communication, presence of fever or hypertension, incomplete study participation or questionnaire documentation. All participants provided written informed consent prior to study enrollment, in accordance with established ethical study protocols.

Study procedures

Upon signing the informed consent, participants were randomly assigned to either the intervention or control group through a quota sampling method, with 30 participants in each group during the first week. For the intervention group, the initial meeting at the Faculty of Allied Health Sciences, Burapha University involved providing information about Thai food exchange lists and food category proportions, which was subsequently used to record participants' dietary intake. Participants underwent comprehensive measurements, including: blood lipid levels (TC, TG, LDL-c, HDL-c), health indicators such as blood pressure, body mass index (BMI), and body composition using the InBody270 and BODPOD device. Additionally, peripheral arterial circulation performance was evaluated through the ABI and ASI using the ArterioVision MS-3000 arterial performance measurement device. Subsequently, participants were individually consulted by a registered dietitian in a designated room to receive medical nutrition therapy according to the TLC diet guidelines. The consultation focused on modifying dietary behaviors across food categories to improve blood lipid levels and incorporate exercise modifications. The dietitian developed individualized meal plans tailored to each participant's physiological requirements. To monitor dietary adherence, a Line application group was established where participants were required to photograph and share their meals. This approach ensured compliance with the individually prescribed food portion and category guidelines. Participants met with the dietitian every two weeks throughout the 12-week study period (specifically during weeks 1, 2, 4, 6, 8, and 12), totaling six consultations.

Concurrently, participants in the intervention group were scheduled for herbal steaming sessions at the Thai Traditional and Alternative Medicine Clinic, Faculty of Allied Health Sciences, Burapha University. During weeks 1-12, they attended herbal steaming sessions twice weekly in the evening, at their convenience. Prior to each herbal steaming session, temperature and blood pressure were measured, with immediate discontinuation of the session in the event of any physiological abnormalities. The herbal formula, selected from a previous study phase (data unpublished), was administered with participants changing into provided attire. Each session consisted of three 10-15 min rounds, with rest periods between rounds at room temperature. Participants were provided drinking water, and their blood pressure was monitored during these intervals to ensure safety. The herbal steaming temperature was maintained between 45-50 degrees Celsius. During attended this herbal steaming period, participants in the intervention group also met with a registered dietitian to receive an individualized nutritional plan based on the TLC diet pattern. The individualized dietary planning focused on limiting saturated fat to less than 7% of daily calories and dietary cholesterol to under 200 mg per day, while increasing soluble fiber intake to 5-10 g daily. The planned diet emphasized fruits, vegetables, whole grains, lean proteins like fish and skinless poultry, and low-fat dairy products. Participants were also recommended to add 2 g of plant stanols/sterols daily through fortified foods or supplements. They were instructed to restrict high-fat meats, full-fat dairy, fried foods, and tropical oils like coconut and palm oil. Furthermore, participants were advised to perform aerobic exercise for 30-45 min, 3-4 days per week, or engage in strengthening activities for 15-30 min, 1-2 days per week. The dietary habits of participants were monitored via the Line application between the participants and the registered dietitian throughout the 12-week period. At the conclusion of the 12-week period, participants underwent a final assessment including a 3-day dietary record, body composition measurements, blood lipid level tests, ABI, and ASI evaluations using the ArterioVision MS-3000 device for subsequent statistical analysis.

For the control group, participants underwent identical initial assessments, similar to the intervention group, including a 3-day dietary record, body composition measurements, blood lipid and blood pressure tests, and peripheral arterial circulation evaluations. However, these participants only received medical nutrition therapy following the TLC diet guidelines with the same dietary pattern and were monitored similarly to the intervention group, but did not participate in herbal steaming sessions. Following the 12-week period, they underwent a final data collection for subsequent statistical analysis.

Statistical analyses

Data on participants' sex and educational level were reported as percentages using the Pearson's chi-squared test to determine the differences in proportions. Other data on age, BMI, blood lipid profiles, ABI and ASI values, and body composition were reported as mean ± standard deviation (SD) using the independent t-test to determine differences between groups. Additionally, the dependent t-test was used to determine mean differences within each group. Statistical analyses were performed using Predictive Analytics Software Statistics (SPSS) version 26.0 (SPSS Inc., Chicago, IL, USA). Statistical significance was established at $p<0.05$.

Result

Participants' background and characteristics

Most participants in both groups were female (67% in the control group and 60% in the intervention group) and held bachelor's degrees (93% in the control group and 83% in the intervention group), with no statistically significant differences between the two groups. Additionally, there were no significant differences in age or weekly exercise duration between the two groups (Table 1).

Regarding the effectiveness of medical nutrition therapy intervention according to the TLC diet guideline complemented with herbal steam sauna on blood lipid profiles, the results revealed no significant differences in participants' blood lipid profiles at baseline between the two groups. At the endpoint, the findings established that participants in the intervention group presented significantly lower TG, TC, and LDL-c levels (213.40 mg/dL, 203.73 mg/dL, and 167.70 mg/dL, respectively) compared to those in the control group (227.83 mg/dL, 209.76 mg/dL, and 172.20 mg/dL, respectively; p< .(0.05Moreover, participants in the intervention group demonstrated significantly decreased TG, TC, and LDL-c levels when compared with baseline (p< .(0.05In contrast, participants in the control group exhibited significant decreases in their TG and LDL-c levels and significant increases in their HDL-c levels when compared with baseline (p< 0.05 (Table 2).

Regarding the effectiveness of medical nutrition therapy intervention according to the TLC diet guideline complemented with herbal steam sauna on ABI values and body composition, the results indicated that participants in the intervention group obtained significantly lower right brachial ASI (63.56) and left ankle ASI (78.56) values compared to those in the control group (67.03 for right brachial ASI and 88.10 for left ankle ASI) at endpoint ($p<0.05$). Moreover, results showed that participants in the intervention group significantly increased both right (0.95 at baseline and 1.14 at endpoint) and left ABI (0.91 at baseline and 1.12 at endpoint) values at the endpoint when compared with baseline ($p<0.05$). Additionally, they demonstrated significant decreases in right ankle ASI and left ankle ASI at endpoint (80.26 for right and 78.56 for left) compared with baseline (90.23 for right and 96.40 for left; $p<0.05$). For body composition, there were no significant differences between the two groups at endpoint. However, both groups showed significant increases in body weight by mineral (control group: 2.61 kg at baseline and 2.82 kg at endpoint; intervention group: 2.57 kg at baseline and 2.91 kg at endpoint) and thoracic gas volume (control group: 2.29 L at baseline and 2.61 L at endpoint; intervention group: 2.40 L at baseline and 2.75 L at endpoint) when compared with baseline ($p<0.05$). Additionally, participants in the intervention group demonstrated a significant decrease in their estimated daily total kcal requirement at endpoint (2,309.10 kcal) compared with baseline (2,343.20 kcal; $p<0.05$) (Table 3).

The dietary habits of all participants were collected using a 3-day food record (2 weekdays and 1 weekend day). The results revealed no significant differences between the two groups in any aspects of calories and nutrients consumed (Table 4). Common Thai dishes reported during the assessment included rice with stir-fried basil and pork (Pad Kra Pao), green curry with chicken, fried egg, papaya salad (Som Tum), and grilled chicken (Gai Yang), reflecting typical dietary patterns of the study population.

Discussion

Poor blood lipid profiles and ABI values are accurate indicators used to predict the risk of CVD development, as established by previous studies[25,26]. Participants in both groups who received medical nutrition therapy according to the TLC diet guideline demonstrated significant improvements in their blood lipid profiles, including reduced TG, TC, and LDL-c levels after intervention compared with baseline. These findings support previous studies demonstrating the effectiveness of medical nutrition therapy based on the TLC diet in improving CVD biomarkers[27,28]. Low fat intake and high dietary fiber intake according to the TLC diet may be key factors in lowering blood lipid levels among participants in both groups according to dietary habit results[29-31]. Participants closely achieved the recommended

Table 1 — Baseline data on the characteristics of the participants

Characteristics	Control group (n=30)	Intervention group (n=30)	p value
Sex			
- Male, n (%)	10 (33)	12 (40)	0.78#
- Female, n (%)	20 (67)	18 (60)	
Age (year), mean (SD)	28.30 (5.40)	27.16 (5.38)	0.41^
Education			
- Bachelor degree, n (%)	28 (93)	25 (83)	0.42#
- Graduate degree, n (%)	2 (7)	5 (17)	
Length of weekly exercise (minute), mean (SD)	60.66 (56.19)	68.50 (79.71)	0.66^

^Independent t-test
#Pearson's chi-squared test

Table 2 — Clinical data and blood lipid profiles baseline and endpoint for both two groups

Clinical data and blood lipid profiles	Baseline		p value	End point		p value
	Control n =82	Intervention n =82		Control n =82	Intervention n =82	
TG (mg/dL), mean (SD)	241.40 (15.10)	237.53 (14.49)	0.31	227.83† (13.59)	213.40† (10.17)	<0.05*
TC (mg/dL), mean (SD)	210.86 (7.14)	212.53 (10.46)	0.47	209.76 (6.40)	203.73† (7.69)	<0.05*
LDL-c (mg/dL), mean (SD)	175.83 (7.10)	176.60 (9.48)	0.72	172.20† (5.09)	167.70† (6.80)	<0.05*
HDL-c (mg/dL), mean (SD)	35.03 (2.52)	35.93 (3.51)	0.25	37.56† (3.18)	36.03 (3.52)	0.08

*Significant difference between groups determined by independent t-test at p<0.05
†Significant difference within group compared with baseline determined by dependent t-test at p<0.05

Table 3 — ABI values and body composition at baseline and endpoint for both two groups

Parameters	Baseline		p value	Endpoint		p value
	Control (n=30)	Intervention (n=30)		Control (n=30)	Intervention (n=30)	
Right ABI, mean (SD)	0.93 (0.18)	0.95 (0.19)	0.58	1.05 (0.24)	1.14 (0.28)^	0.21
Left ABI, mean (SD)	0.89 (0.17)	0.91 (0.17)	0.71	1.03 (0.21)^	1.12 (0.27)^	0.16
Right brachial ASI, mean (SD)	69.03 (6.59)	67.46 (6.33)	0.35	67.03 (7.12)	63.56 (5.54)^	<0.05*
Left brachial ASI, mean (SD)	68.53 (10.02)	67.10 (9.20)	0. 56	67.73 (11.08)	63.93 (11.93)	0.20
Right ankle ASI, mean (SD)	92.06 (24.88)	90.23 (20.49)	0.75	87.53 (21.41)	80.26 (13.21)^	0.19
Left ankle ASI, mean (SD)	98.86 (16.33)	96.40 (21.77)	0.62	88.10 (17.01) ^	78.56 (12.06)^	<0.05*
BMI, mean (SD)	27.70 (2.50)	26.86 (2.95)	0.24	27.30 (2.29)	26.36 (1.71)	0.07
Body fluid (L), mean (SD)	28.88 (2.88)	29.52 (2.51)	0.35	28.60 (2.93)	29.49 (2.27)	0.19
Muscle mass (kg), mean (SD)	19.79 (2.28)	20.03 (1.88)	0.65	19.83 (1.74)	20.26 (1.83)	0.36
Body fat mass (kg), mean (SD)	24.85 (4.15)	24.38 (3.89)	0.65	22.94 (2.96)	23.55 (2.82)	0.41
Body weight by mineral (kg), mean (SD)	2.61 (0.19)	2.57 (0.25)	0.55	2.82 (0.23)^	2.91 (0.14)^	0.07
Thoracic gas volume (L), mean (SD)	2.29 (0.54)	2.40 (0.43)	0.40	2.61 (0.51)^	2.75 (0.26)^	0.21
Estimated daily total kcal requirement (kcal), mean (SD)	2,343.20 (143.81)	2,378.86 (122.60)	0.30	2,294.43 (159.23)	2,309.10^ (146.73)	0.71

*Significant difference using independent t-test when compared between groups at p<0.05
^Significant difference using simple t-test when compared within-group from baseline to endpoint at p<0.05

Table 4 — Dietary habits of participants

Nutrients	Control group (n=30)	Intervention group (n=30)	p value
Total kcal consumed (kcal), mean (SD)	2,176.96 (338.37)	2,127.86 (231.03)	0.51
%kcal from carbohydrate, mean (SD)	56.13 (5.94)	58.03 (7.43)	0.27
%kcal from protein, mean (SD)	14.63 (5.35)	13.66 (6.40)	0.52
%kcal from fat, mean (SD)	29.43 (3.23)	28.63 (3.31)	0.34
Dietary fiber intake (g/day), mean (SD)	21.83 (8.82)	23.96 (5.18)	0.25
Sodium intake (mg/day), mean (SD)	2,520.73 (417.05)	2720.56 (543.36)	0.11

dietary fiber intake of 18-38 g/day[32]. The protective efficacy of dietary interventions can be attributed to multifaceted physiological mechanisms. Specifically, high-fiber dietary regimens demonstrate significant potential in mitigating lipid metabolism disorders through two primary pathways: reducing lipid absorption and augmenting satiety signals. Furthermore, contemporary studies have elucidated additional complex mechanisms involving alterations in intestinal microbiota composition and modulation of short-chain fatty acid production, which collectively contribute to the therapeutic potential of high-fiber nutritional strategies in addressing dyslipidemia and managing obesity-related metabolic dysregulation[33,34]. While polyphenols from grains, fruits, and vegetables-the same sources of dietary fiber-regulate dietary fat metabolism and absorption in the small intestine[35]. Regarding ABI assessment and body composition, results suggested that adhering to the TLC diet guideline may help improve participants' blood vessel quality. This could be attributed to the reduction in TG, TC, and LDL-c levels, which minimizes the risk of arterial stiffness[36]. However, no changes in body fat percentage were observed in either group. Participants may be required further monitoring and promotion of physical activity and exercise to improve muscle mass and fat mass.

Regarding the intervention group, extended effectiveness on blood lipid profiles and ABI values was found when compared with the control group. The observed physiological benefits may be ascribed to the systematic implementation of herbal steam sauna therapy. Emerging evidence suggests that this interventional approach exerts multifaceted salutary effects on cardiovascular health and mortality risk through several interconnected mechanisms. These include: comprehensive modulation of hemodynamic parameters via blood pressure reduction; enhancement of endothelial function; attenuation of oxidative stress and inflammatory processes; adaptive recalibration of autonomic nervous system dynamics; optimization of lipid metabolic profiles; augmentation of arterial elasticity and compliance; and substantive improvements in cardiopulmonary system functioning. The integrated physiological responses elicited by this therapeutic modality demonstrate potential significant implications for CVD prevention and overall systemic health optimization[37]. These effects could improve blood circulation, induce sweating, and stimulate basal metabolism[38]. The findings support previous studies suggesting that steam sauna therapy may help lower blood lipid profiles and improve CVD parameters by stimulating fat metabolism[39,40]. Moreover, steam sauna bathing may improve blood circulation by enhancing blood vessel flexibility and promoting relaxation which help improve blood pressure reported by previous study[41]. Other studies have also elucidated the potential therapeutic benefits of steam sauna bathing in alleviating symptoms associated with allergic rhinitis conditions and rheumatoid arthritis[42,43]. However, the results indicated that herbal steam sauna had no significant effect on BMI, body composition, or thoracic gas volume. Therefore, encouraging participants to increase their physical activity could help improve these parameters[44]. Interestingly, despite participants following dietary habits according to the TLC diet guideline, their daily sodium intake remained above the recommended amount of less than 2,300 mg/day[45]. The study's limitations include the lack of monitoring participants' weekly exercise duration and its short-term interventional design. Moreover, future study should investigate which natural compounds or volatile oils from the herbal regime used in the herbal steam sauna intervention may have contributed to the observed results.

Conclusion

This study confirms that TLC diet intervention, when combined with Thai traditional herbal steam sauna, is more effective in improving CVD parameters than diet alone. Participants receiving both interventions showed significantly better outcomes in TG, TC, LDL-c, ABI, and ASI. The TLC diet's emphasis on reduced saturated fat and increased fiber likely contributed to improved lipid metabolism, while the herbal sauna, containing circulation-promoting herbs and administered at controlled temperature and frequency, may enhance peripheral blood flow and fat mobilization. Although lipid changes were modest, the combined approach presents a promising integrative strategy for CVD risk reduction. Given the cultural familiarity and historical use of steam-based therapies in India, particularly in Ayurvedic practices, the Thai herbal steam sauna approach may be feasibly adapted and integrated into Indian traditional healthcare settings. These findings support the integration of traditional therapies into evidence-based care models.

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Conflict of Interest

Authors declare they do not have any conflict of interest.

Author Contributions

Conceptualization; AS. Formal analysis; SK. Funding acquisition; AS Resources; SK Software; AS and SK. Supervision; NT and RC. Roles/Writing - original draft; AS and SK. Writing - review & editing; AS and RC.

Informed Consent

All participants were informed about the study procedures and provided written informed consent prior to participation.

Ethics Statement

The study received formal ethical clearance from the Human Research Ethics Committee of Burapha University (approval number IRB1-045/2567).

Data Availability

All relevant data supporting the findings of this study are contained within the article.

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