Original Article

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Influence of Comprehensive Lifestyle Intervention (LSI) Program on Health, Fatigue, and Quality of Life in Middle-Aged Women

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Background: Middle age is one of the most important times in a woman's life, and it is a time when multiple changes occur that affect the body and health. The study aimed to investigate the efficacy of a comprehensive lifestyle intervention (LSI) program, including stress management, on middle-aged women's physical, physiological, and mental health.
Methods: A total of 40 middle-aged women participated in a short-term LSI program, nutrition, exercise, and mental and physical management with various experiential activities. Physical measurements, biochemical indicators, stress hormones, chronic fatigue, and quality of life indicators were evaluated to interpret the clinical efficacy of the program.
Results: LSI program significantly improved satisfaction and quality of life in participants. Total chronic fatigue scores reduced significantly compared to scores before the start of the program. Moreover, fat mass and body fat were reduced without loss of muscle mass. Further, blood pressure and triglyceride levels significantly decreased after completing the LSI program. However, changes in stress hormone levels remained insignificant.
Conclusion: Adoption of LSI in middle-aged women demonstrated positive implications of the program. LSI efficiently regulates body fat, fat mass, fatigue, hypertension, and triglyceride levels which play a critical role in determining the quality of life. Thus, the LSI program could spread healthy lifestyles among middle-aged women.

Key Words: Healthy lifestyle, LSI, Nordic walking, Fatigue, Lifestyle modifications, Stress management, Chalder fatigue scale, Health promotion, Quality of life

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INTRODUCTION

Generally, middle-aged women face multiple challenges, including perimenopause, hormonal variations, irregular periods, sleep disorders, increased risk of cardiovascular diseases (CVD), stress, and depression. All these factors contribute to physiological, physical, and psychological changes affecting the quality of life. Additionally, middle-aged women have an increased risk and prevalence of non-communicable disease (NCD) due to irregular eating habits and lack of exercise due to menopause [1,2]. Previous reports indicate that social support and stress are the major factors

affecting the quality of life in middle-aged women, and these factors greatly influence the onset of NCD [3-5]. A recent report by Health Insurance Review and Assessment (HIRA) service, Korea, suggests that the incidence of chronic fatigue syndrome was 47.5% higher in women than in men. Among these, middle-aged women in their 40s or older have a 53.3% higher risk of developing chronic fatigue syndrome than men of similar age. Specifically, chronic stress experienced by middle-aged women triggers lethargy, mental and physical illness. Subsequently, the onset of other illnesses like nervousness, memory loss, tension, insomnia, and depression are greatly reduced [4]. Hence, managing physical and mental health in middle-aged women is essential for individual satisfaction. Also, social support is as important as clinical interventions to improve the lifestyle. These physical, mental, and social strategies are key to improving the quality of life in middle-aged women [6,7]. It is well-known that lifestyle habits directly influence health, thereby contributing to the quality of life in middle-aged women. Lifestyle intervention (LSI) programs promote health and reduce psychological discomfort and mental stress. Due to these positive implications, LSI is a well-adopted and efficient program to investigate the relationship between lifestyle, fatigue, stress, and physical activity in middle-aged women to improve their quality of life. However, most of these LSI investigations are cross-sectional investigations [8-19]. Thus, a comprehensive LSI program includes a nature walk for a better breathing experience, and various other activities to support LSI goals are essential for a better outcome. In this study, a comprehensive LSI program was investigated to verify its effectiveness on middle-aged women's physical, physiological, and mental health, contributing significantly to their quality of life.

MATERIALS AND METHODS

1. Study subjects

The current study is a before-and-after comparative investigation to evaluate the influence of a comprehensive LSI program on physical, physiological, and mental health in middle-aged women having chronic stress affecting the quality of life. The investigation is approved by the Institutional Review Board (IRB) of Jeonbuk National University (JBNU-IRB- 2019-006-001). The study followed all the guidelines set by International Conference on Harmonization Good Clinical Practice (ICH GCP). The study participants in this clinical trial were recruited Clinical Trial Center for Functional Foods (CTCF2). CTCF2 recruited 40 middle-aged women aged 40 to 60 years from Jeonbuk, Republic of Korea, who felt stress in their life. All the participants were recruited between February 11 to February 15, 2019. The subjects who met the selection criteria and signed the informed consent were selected for the study. Inclusion criteria were 1) Middle-aged women aged 40 to 60 who felt stress in life living. 2) those who heard and fully understood a detailed description of this study and agreed in writing to participate and comply with the precautions.

Exclusion criteria were 1) Male. 2) Individuals with 3 or more chronic wasting inflammatory diseases at the same time. 3) Individuals with type 1 diabetes and type 2 diabetes. 4) Patients requiring treatment or with cardiovascular, cerebrovascular, immune, respiratory, hepatobiliary, renal and urinary systems, neuropsychiatric, musculoskeletal, inflammatory and hematological and neoplastic diseases. 5) Patients with gastrointestinal diseases that may affect the absorption of nutrients (e.g., Crohn's disease, etc.) or gastrointestinal surgery (except for simple appendectomy or hernia surgery). 6) Individuals taking antipsychotic drugs or narcotic analgesics. 7) Individuals who are judged as unsuitable to participate in the human application test by the physician.

2. Collection of lifestyles associated data

Demographic data and lifestyle-associated aspects of the volunteers were investigated through a questionnaire survey. The questionnaire collected information on age, gender, and habits (smoking, drinking). Additionally, medical history and information on medication for the past 3 years were examined. If any disease developed for the first time or worsened during the trial period, it was regarded as an adverse reaction and recorded. The ingredient names, doses, usage, and administration period of all concomitant drugs in this study were recorded in detail.

3. Study Design

1) Comprehensive lifestyle intervention program (LSI)

In this study, a short-term (3 nights, 4 days) compre-

hensive LSI program with some experimental activities was applied. As suggested in the previous LSI research, the LSI program was developed and divided into education and experiential activities [20]. In this study, participants were educated on the significance of diet, exercise, and stress management on quality of life. Further, various experiential activities were organized for subjects to practice the educated content. Subjects participated in the program for a total of 26 hours (18 hours of education, 8 hours of experience) at the Jinangowonsoop healing Center (Jinan, Jeonbuk, Republic of Korea) for 3 nights and 4 days. This comprehensive LSI program was conducted by 20 professional

Table 1. Content of comprehensive lifestyle intervention program

Category	Contents	Time
Lifestyle management education	• Let us discuss the 7 most fundamental lifestyle habits for a healthy life. - Breathing: Why breathing fresh air is better than taking tonic pills any day! - Exercise: Why exercise is now a must, not a choice! - Drinking Water: Simply drinking water can help prevent strokes! - Good food: The secrets for clean and healthy blood; the importance of good food! - Sunlight: Why is the absolute mortality rate is higher in places with less access to sunlight? - Rest & Sleep: A broken car cannot be repaired while it is running. - Love: Of all, love is the greatest! → Habits for a healthy life! Now, we will see how each one of these habits contribute to good circulation of blood and how they provide body cells with enough nutrients. • Aging management.	3.5 h
Diet education	✓ Used the healthy eating plate as a guide for creating healthy, balanced meals. • Eat 50% of every meal with vegetables and fruits of various types and colors! However, avoid potatoes as they do not help control blood sugar. • Consume 25% of each meal with whole grains, unrefined. → Recommendation of whole grains, which include brown rice, glutinous rice, whole oats and whole wheat. • Eat 25% of each meal with protein and eat healthy vegetable oils in moderation. • Drink water, coffee, or tea. • The key message of a one-meal healthy meal is to focus on the 'quality' of the meal.	3.5 h
Exercise education	• The importance and benefits of exercise. • Nordic working exercise and correct posture for walking. • Exercises to correct bad posture and habits walking properly. • Healing of musculoskeletal disorders.	4.5 h
Diet prescription	• Building a Healthy and balanced diet of Harvard (A vegetarian diet with minimal carbohydrates). • How many carbohydrates you get from a food is more important than how many carbs you get from it (Eating carbohydrates from vegetables, fruits, whole grains, and beans other than potatoes is good for your health). • It is important to avoid consuming sugary drinks that are high in calories and have no nutritional value. • Eat healthy oils. If you consume fat through healthy oil, you do not need to put any restrictions on the proportion of fat in total calories consumed.	10 meals (10 h)
Exercise prescription	• Nordic walking exercise map and strength training.	2 h
Stress management (meditation)	• Meditation: find your pure inner consciousness. • Learn to breathe deeply/ body scan, yoga. 21 method for reduced stress.	3 h
Experiential activities	• Massage using health equipment: scalp massage, dry half body bath.	4 h
	• Foot bath.	1 h
	• Pottery making.	1 h
	• Eco bag making.	1 h
	• Making natural detergent.	1 h
	• Hanji craft.	1 h
	• Dyeing experience.	1 h
	• Laughter therapy.	2 h
	• Flower arranging experience.	1 h

medical and healthcare professionals (5 doctors, 1 nutritionist, 2 nurses, 1 psychiatric health expert, 1 laughter therapist, 1 exercise prescriber, and 9 experience activity experts). Participants were randomly divided into two groups (20 per group), and the team created an environment where participants were actively involved by providing frequent feedback on the ongoing study. The lifestyle and educational contents of the comprehensive LSI program are listed in Table 1.

2) Comprehensive LSI part Ⅰ: Diet for a healthy life

The dietary experience of this study was constructed as per Harvard diets recommendations (The Healthy Eating Pyramid; Harvard Health Graduate School) [20]. During the LSI program, participants were educated and given an opportunity to practice eating habits in their daily life through the consumption of healthy food. The participants' diet corresponded to the average daily caloric intake (1800 Kcal) of middle-aged Korean women (50-64 years old; dietary reference in take for Koreans). The ratios of carbohydrates, proteins, and lipids were 55%, 15% and 30%, respectively, in the food presented to the participants. Diet includes whole grains and fermented foods of a vegetarian diet, legumes, seeds, mushrooms, seaweeds, vegetables, and fruits. Generally, a meal consists of fruits, vegetables, whole grains, chicken, and bread. However, red meat and processed meat products were restricted as much as possible.

3) Comprehensive LSI part Ⅱ: Exercise for a better life

According to previous reports, education on exercise and guidelines on Nordic walking were set and applied for physical activities [21,22]. Nordic walking is an exercise that requires different skills and instruments than general walking. Nordic walking involves the whole body, where the pole is used to push the ground forward. Participants were instructed about Nordic walking for two hours indoors, followed by outdoor exercise. During the exercise, participants were taught about body posture while walking and muscle strength training. Later, participants were taken outdoors for Nordic walking for two hours in a nearby forest environment with a professional instructor from LEKI, Germany.

4) Comprehensive LSI part Ⅲ: Stress management

For efficient stress management, various activities were organized. All the activities are listed in Table 1 under the stress management and experimental activity category. Meditation, yoga, and aging management were the major activities.

4. Study Evaluation

1) Anthropometrics

Participants' anthropometric data were obtained for weight, height, and body mass index (BMI) in kg/m^2 with the BSM 520 system (Inbody, Seoul, Republic of Korea). Additionally, muscle mass, fat mass, and fat percentage were evaluated.

2) Dietary intake

A professional nutritionist collected the participant's dietary habits and relevant data before and during the study period (3 nights and 4 days). Dietary analysis was made assuming that all subjects consumed food provided during the study period. Dietary intake was analyzed using CAN-Pro 5.0 professional program (Computer Aided Nutrition Analysis Program, The Korean Nutrition Society, Republic of Korea). The key factors like average daily energy intake and nutrient composition were determined.

3) Biochemical and blood parameters

The participant's blood pressure and biochemical indicators were evaluated twice before and after participating in the LSI program. Blood pressure was measured using a multifunctional electronic sphygmomanometer BPB 10330 (Inbody, Seoul, Republic of Korea) after a minimum of 10 minutes of rest. All the biochemical tests were analyzed by collecting blood and urine after fasting for more than 12 hours. Lipid metabolism indices like total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) were analyzed using a hematology analyzer (Accutrend Plus, Roche) by collecting peripheral blood from the subject. Blood inflammatory indicators such as high-sensitivity C-reactive protein (hs-CRP) and erythrocyte sedimentation rate (ESR) were measured. Additionally, stress hormone cortisol (blood, urine) was measured.

4) Quality of Life Survey (WHOQOL-BREF; World Health Organization Quality of Life)

It is a survey comprising 26 items that assess individuals' views of their position in life with respect to goals, expectations, standards, and concerns. In this study, the Korean version of the WHOs Simple Scale of Quality of Life (WHOQOL-BREF; L-BREF [23] questionnaire was used to evaluate the quality of life. The survey was conducted twice. The first survey was conducted before the LSI study and later was conducted after the LSI study. The survey consists of multiple questions in 4 different areas. General health (QLS-G: 2), physical health domain (QLS-D1: 7), psychological domain (QLS-D2: 6), social relationships domain (QLS-D3: 3), environmental domain (QLS-D4: 8). The WHOQOL-BREF was evaluated on a Likert 5-point scale. 'Not at all' was rated as 1 point, 'somewhat agree' with 2 points, 'agree' with 3 points, 'much so' with 4 points, and 'very much so' with 5 points. The scores ranged from 26 to 130. These scores were then linearly translated to a 0-100 scale. Higher values indicate a better quality of life.

5) Chalder Fatigue Scale (CFS)

The evaluation of CFS was constructed by referring to the study of Cella and Chalder [24]. CFS was used to measure the severity of mental and physical fatigue in chronic fatigue syndrome. CFS was conducted once before the start of the LSI program and once after completion of the program. CFS has 11 items and was evaluated on a Likert 3-point scale. 'Less than usual' rated as 0, 'as usual' rated as 1, 'more than usual' rated as 2 points, and 'much more than usual' rated as 3. The total scores ranged from 0-33. A higher score suggests higher chronic fatigue.

5. Statistics

All the statistical analyses were performed using SPSS 24.0 (IBM SPSS statistics Grad pack Base V24.0). Continuous variables were expressed as mean±standard deviation (SD), and categorical variables were expressed as frequency (%). For comparative analysis, paired t-test was applied. If normality was not satisfied by performing the normality test, then non-parametric tests such as Kruskal-Wallis test, Wilcoxon rank sum test, and Wilcoxon signed rank test were performed. The analysis of categorical data was performed by the Chi-square test or Fisher's Exact test. The statistical significance was set at $p < 0.05$.

Table 2. General characteristics of subjects (N = 34)

Variables	Mean ± SD
Sex	Female
Age (years)	55.15 ± 5.07
Height (cm)	159.20 ± 4.97
Weight (cm)	61.65 ± 10.77
Body Mass Index (kg/m^2)	24.61 ± 3.92
SBP (mmHg)	131.56 ± 19.86
DBP (mmHg)	84.5 ± 10.44

SBP: Systolic blood pressure, DBP: Diastolic blood pressure.

RESULTS

1. General characteristics of subjects

The general characteristics of the subjects are presented in Table 2. The average age of participants was 55.2 years. BMI, an indicator of obesity, averaged 24.6±3.9 kg/m^2, which is equivalent to overweight. The subjects' blood pressure was 131.6±19.9 mmHg and 84.5±10.4 mmHg for SBP and DBP, respectively, which corresponds to stage 1 of prehypertension.

2. Changes in body composition

The body composition of the subject is shown in Table 3. Body weight and BMI remained similar during the study period. However, body fat percentage significantly decreased from 33.6% before participation to 32.3% after participation ($p < 0.002$). In addition, the amount of body fat significantly decreased from 21.2 kg before participating in LSI to 20.6 kg after participating ($p < 0.001$). Muscle mass showed a tendency to increase from 40.9 kg before participation to 41.1 kg after participation in LSI, but there was no significant difference between before and after participation.

3. Change in blood pressure and biochemical parameters

The subject's SBP and DBP were significantly decreased after participation in LSI than before participation ($p < 0.05$). The blood TG levels significantly decreased from 120.2 mg/dL before LSI participation to 92.75 mg/dL after

Table 3. Change of anthropometric, metabolic, and stress index before and after the LSI program

Variables	Before (Mean ± SD)	After (Mean ± SD)	t-value (p)
Weight (kg)	61.64 ± 10.77	61.78 ± 10.54	−1.327 (0.194)
Body Mass Index (kg/m^2)	24.61 ± 3.92	24.28 ± 3.48	0.869 (0.391)
Body fat (%)	33.56 ± 6.49	32.27 ± 6.68	3.285 (0.002)†
Fat mass (kg)	21.22 ± 7.43	20.64 ± 7.09	4.155 (0.000)‡
Muscle mass (kg)	40.93 ± 4.37	41.06 ± 4.36	−0.243 (0.809)
SBP (mmHg)	131.06 ± 19.86	126.0 ± 19.90	2.205 (0.035)*
DBP (mmHg)	84.50 ± 10.44	80.0 ± 10.72	3.392 (0.002)†
Total cholesterol (mg/dL)	202.50 ± 41.29	200.32 ± 42.25	0.843 (0.405)
Total glyceride (mg/dL)	120.15 ± 50.82	92.68 ± 37.08	3.974 (0.000)‡
HDL-C (mg/dL)	57.47 ± 9.40	57.56 ± 9.70	−0.122 (0.904)
LDL-C (mg/dL)	129.06 ± 40.24	133.79 ± 42.39	−1.751 (0.089)
hs-CRP (~5 mg/L)	0.082 ± 0.069	0.079 ± 0.070	0.432 (0.669)
ESR (~20 mm/h)	12.62 ± 8.72	15.82 ± 11.197	−2.533 (0.016)*
Cortisol (urine)	8.28 ± 9.611	7.58 ± 7.14	0.414 (0.682)
Cortisol (blood)	7.80 ± 2.79	8.58 ± 2.86	−1.478 (0.149)

SBP: Systolic blood pressure, DBP: Diastolic blood pres sure, HDL-C: high density lipoprotein cholesterol, LDL-C: low density lipoprotein cholesterol, hs-CRP: High sensitivity C-reactive protein, ESR: erythrocyte sedimentation rate.
*$p<0.05$, †$p<0.01$, ‡$p<0.001$, respectively by paired t-test.

Table 4. Change of chalder fatigue scale (CFS) in subjects

Variables	Before (Mean ± SD)	After (Mean ± SD)	t-value (p)
Do you have problems with tiredness?	1.29 ± 0.72	0.76 ± 0.69	3.919 (0.000)‡
Do you need to rest more?	1.35 ± 0.92	0.97 ± 0.72	2.024 (0.051)
Do you feel sleepy or drowsy?	1.15 ± 0.82	0.97 ± 0.87	0.863 (0.394)
Do you have problems starting things?	1.15 ± 0.74	0.85 ± 0.61	2.147 (0.039)*
Do you have energy?	1.03 ± 0.72	0.79 ± 0.59	1.676 (0.103)
Do you have less strength in your muscles?	1.12 ± 0.69	0.88 ± 0.59	1.757 (0.088)
Do you feel weak?	1.19 ± 0.67	0.82 ± 0.63	2.978 (0.005)†
Do you have difficulties concentrating?	1.15 ± 0.78	0.85 ± 0.82	1.664 (0.106)
Do you make slips of the tongue when speaking?	1.32 ± 0.68	0.88 ± 0.73	3.124 (0.004)†
Do you find it more difficult to find the right word?	1.24 ± 0.70	1.03 ± 0.63	1.748 (0.090)
How is your memory?	1.65 ± 0.64	1.27 ± 0.71	3.199 (0.003)†
Total score	24.62 ± 5.47	21.0 ± 5.69	3.863 (0.000)‡

*$p<0.05$, †$p<0.01$, ‡$p<0.001$, respectively by paired t-test.

participation. Blood TC, LDL-C, and HDL-C levels were not significantly different before and after LSI participation. The inflammatory marker hs-CRP decreased from 0.082±0.069 before LSI participation to 0.079±0.07 after participation. ESR increased from 12.62±8.72 before participation to 15.82±11.19 after participation, but this number was considered meaningless as it was within the standard range. There was no significant change in cortisol levels (urine and blood). All the biochemical and blood pressure data are presented in Table 3.

4. Changes in Chalder Fatigue Scale

The subject's total CFS score significantly decreased from 24.6±5.5 before LSI participation to 21.0±5.7 after participating ($p < 0.001$). Moreover, a comprehensive LSI program significantly improved scores associated with tiredness, a slip of the tongue, and memory ($p < 0.05$). CFS survey scores are presented in Table 4.

Table 5. Average scores on the WHOQOL-BREF questionnaire in middle-aged women suffering from chronic stress

Variables	Before (Mean ± SD)	After (Mean ± SD)	t-value (p)
Quality of life (QOL)	3.12 ± 0.69	3.41 ± 0.70	−2.385 (0.023)*
Overall health situation	2.15 ± 0.78	2.79 ± 0.91	−5.842 (0.000)†
Physical health	20.65 ± 3.21	21.38 ± 3.92	−1.331 (0.192)
Psychological health	20.29 ± 2.71	20.74 ± 3.80	−0.978 (0.335)
Social relationship	9.91 ± 2.09	10.03 ± 1.82	−0.494 (0.624)
Environment	25.26 ± 4.10	25.59 ± 4.02	−0.663 (0.512)
Total score of QOL	81.38 ± 9.29	83.94 ± 12.40	−1.736 (0.092)

*$p<0.05$, †$p<0.001$, respectively by paired t-test.

5. Change in quality of life

All the scores relevant to different areas representing the quality of life are listed in Table 5. Scores associated with quality of life and health condition significantly improved after the LSI program ($p < 0.05$). Specifically, health condition scores improved to 2.79±0.91 from 2.15±0.78 before participating in LSI ($p < 0.001$). However, scores pertaining to physical health, psychological health, social relationship, environmental health, and the total score of QOL remained insignificant. Average scores on the WHOQOL-BREF questionnaire are presented in Table 5.

6. Dietary intake

The food groups and nutrient intake of subjects during the study are presented in Table 6. The average daily intake of whole grains was 194.5±21.46 g, vegetables was 589.6±28.1 g, and fruits was 160±10.5 g per day. The intake of milk and dairy products was 160.0±20 g, and the intake of eggs and meat was 50.4±2 g and 67.45±5.4 g, respectively. The average daily calorie intake during LSI program was 1,823±10.6 kcal. The diet has 55.7% carbohydrates, 16.3% protein, and 29.0% fat. The intake ratio of macronutrients is in accordance with levels set by the dietary reference intakes for Koreans (2020). The dietary fiber intake was 35±1.0 g (17.5 g/1,000 kcal). Moreover, micronutrients and vitamins like calcium, iron, vitamins, and folic acid are at par dietary reference intakes for Koreans. Detailed food groups and nutrients provided during the LSI program are listed in Table 6.

7. Safety and adverse events

A comparison of laboratory tests, ECG, and safety indicators showed no significant clinical changes before and after the LSI program. The RBC count appears to decrease, but levels lie within the reference range even though there was a statistically significant difference between before and after the LSI program. Similarly, creatine levels increase to 0.75±0.07 after the LSI program from 0.72±0.07. However, a slight increase in creatine levels does not have clinical significance. Additionally, WBC, Hemoglobin, Platelet, AST, and ALT levels revealed a decreasing trend, but the change is insignificant. Biochemical and blood parameter observations are listed in Table 7.

DISCUSSION

The current short-term comprehensive LSI program for middle-aged women who feel much stress in life demonstrated indicators that represent the improved quality of life. Changes that occurred in this short period revealed that the LSI program potentially takes participants in the desired direction towards a better quality of life through reduced CVD risk factors, improving aspects associated with quality of life, and improving chronic fatigue. Further, body composition changes showed a positive effect by significantly reducing body fat percentage and body fat mass without muscle loss. Also, significant reductions in blood pressure, blood TG levels, and chronic fatigue indicate that the LSI program helps in managing mental health and metabolic disease risk factors. The previous investigation suggests that NCDs risk factors like blood pressure, TC, and TG were significantly lowered after the short-term LSI program with exercise and a plant-based diet [25]. These clinical observations strongly support the study outcomes. In this study, participants muscle mass remained the same, obesity de-

Table 6. Food group and nutrients intake of the subjects during the LSI program

Food groups	Intake amount (g/day)	Nutrients	Intake amount (day)
Whole grains	194.1 ± 12.5	Energy (kcal)	1,823.7 ± 10.6
Sweet potatoes	43.3 ± 20.5	Carbohydrate (g)	258.4 ± 10.7
Sugars	15.0 ± 2.2	Lipid (g)	58.3 ± 3.7
Bean	33.8 ± 20.4	Plant lipid (g)	39.3 ± 3.3
Seed and nuts	21.7 ± 2.3	Animal lipid (g)	19.0 ± 7.0
Vegetables	589.9 ± 15.4	Protein (g)	74.2 ± 1.1
Mushrooms	26.7 ± 3.2	Plant protein (g)	48.2 ± 3.7
Fruits	160.0 ± 10.5	Animal protein (g)	25.0 ± 4.9
Meats (poultry)	67.5 ± 5.4	Total carbohydrate (%)	56.7
Eggs	50.4 ± 2.0	Total protein intake (%)	15.3
Fish & shellfish	38.7 ± 4.2	Total lipid (%)	28.3
Seaweed	21.8 ± 20.2	Cholesterol (mg)	230.2 ± 29.3
Dairy products (low fat)	160.0 ± 10.8	Total fatty acid (g)	51.8 ± 0.5
Lipids and oils	28.7 ± 10.5	SFA (g)	13.4 ± 2.9
		MUFA (g)	18.9 ± 1.8
		PUFA (g)	19.4 ± 4.8
		Omega-3 (g)	0.73 ± 0.75
		Omega-6 (g)	5.10 ± 4.9
		Vitamin A (μg RE)	1,245.7 ± 308.6
		Beta-carotene (μg)	12,046.1 ± 2,246.9
		Vitamin D (μg)	2.8 ± 1.5
		Vitamin E (μg)	24.2 ± 1.3
		Vitamin K (μg)	577.9 ± 13.1
		Vitamin C (μg)	179.7 ± 89.3
		Vitamin B_6 (mg)	2.2 ± 0.2
		Folate (μg)	811.2 ± 56.1
		Vitamin B_{12} (μg)	5.7 ± 2.3
		Vitamin B_1 (mg)	2.1 ± 0.3
		Vitamin B_2 (mg)	1.9 ± 0.2
		Niacin (mg)	16.8 ± 0.5
		Sodium (mg)	5,197.3 ± 189.1
		Potassium (mg)	3,735.2 ± 313.5
		Calcium (mg)	915.2 ± 67.6
		Phosphorus (mg)	1,427.7 ± 22.8
		Magnesium (mg)	136.2 ± 12.8
		Iron (mg)	20.1 ± 1.4
		Zinc (mg)	10.4 ± 1.3

Values are presented as mean ± SD.

creased, and metabolic syndrome risk factors were significantly improved even though the study period was less than a week. Diet is one of the primary reasons for these remarkable improvements, as participants had a healthy eating experience (Harvard Healthy Diet) during the LSI program. Secondly, physical activities played a crucial role in these health benefits. Hence, it can be assumed that the synergistic effect of diet and physical activity acted to a great extent for health benefits in middle-aged women. Multiple reports suggest that a plant-based diet with whole grains, fruits, vegetables, legumes, and seeds positively influences NCDs such as metabolic diseases and plays an essential role in reducing total mortality [26-28]. Here, similar indications were observed as a majority of the program diet had plant-based ingredients. Further, subjects were at the pre-hypertensive stage at the beginning of the study, and later, it was observed that the program appeared to reverse the hypertensive stage. This specific observation can be attributed to a plant-based diet that followed recommendations of the Harvard diet during the LSI program [29-31].

Table 7. Change in blood and biochemical parameters in subjects

Variables	Before	After	t-value (p)
WBC ($\times 10^3$ cells/μL)	5.41 ± 1.25	5.10 ± 1.05	1.990 (0.055)
RBC ($\times 10^3$ cells/μL)	4.35 ± 0.28	4.30 ± 0.31	2.038 (0.050)*
Hemoglobin (g/dL)	13.24 ± 0.88	13.09 ± 0.97	2.009 (0.053)
Hematocrit (%)	39.30 ± 2.31	39.06 ± 2.31	1.153 (0.257)
Platelet ($\times 10^3$ cells/μL)	251.94 ± 47.47	249.56 ± 45.61	0.855 (0.399)
Creatinine (mg/dL)	0.72 ± 0.07	0.75 ± 0.07	−4.226 (0.000)†
GGT (IU/L)	24.29 ± 18.54	24.58 ± 19.74	−0.652 (0.057)
AST (IU/L)	30.71 ± 12.57	28.59 ± 10.42	0.357 (0.724)
ALT (IU/L)	25.65 ± 17.273	25.35 ± 18.22	−1.751 (0.089)

GGT: γ-glutamyl transferase, AST: aspartate aminotransferase, ALT: alanine aminotransferase.
*$p<0.05$, †$p<0.001$, respectively by paired t-test.

Generally, exercise is well recognized and accepted for its benefits on mental wellness and stress relief. Previous reports reveal that walking can improve the mental health of employees who are under stress [32]. Similarly, an investigation demonstrated that practicing yoga for 8 weeks helps to reduce physical stress and cognitive impairment in middle-aged women [33]. However, vigorous high-intensity physical activity increases psychological stress. Thus appropriate exercise according to individuals' age is the most effective way to relieve negative stress [34]. Specifically, walking is a well-accepted method of reducing depression and anxiety [35]. Nordic walking style reduces leg load and improves ankle safety than the conventional walking style. Thus, it can be practiced for a longer duration and improve upper extremity muscle strength [21]. Additionally, Nordic walking burns more calories and involves more muscle than conventional walking. Moreover, walking through a forest landscape reduces stress and anxiety, which regulate acute emotions and improve mental health [36]. Hence, the comprehensive LSI program adopts Nordic walking through a forest landscape. Based on the observations and previous reports, it can be concluded that Nordic walking through a forest landscape for 2 hours benefits body composition, relieving stress and quality of life. In addition to physical activity, a healthy diet given to subjects played a crucial role in the health benefits of the LSI program. In general, chronic fatigue syndrome has been shown to have various non-specific symptoms and persistent and muscle wasting. Further, mild to moderate anxiety or depression are common symptoms of chronic fatigue syndrome along with psychosomatic diseases such as headache, poor concentration, muscle pain, and joint pain. In this study, total CFS significantly decreased from 24.62±5.47 before participation to 21.0±5.69 after participation in the LSI program. Among the items, among CFS items, variables associated with tiredness, problems in starting things, weakness, speaking, and memory were significantly reduced after the LSI program. These observations confirm the effectiveness of the comprehensive LSI program on chronic fatigue syndrome. Previously, rest was recommended for those who complained of fatigue. However, recent developments suggest that aerobic exercise is of great help in improving symptoms of fatigue, and exercise is being modified in various ways to relieve fatigue. In the case of severe fatigue, if no exercise is practiced, then muscle condition and fatigue symptoms worsen [37]. However, regular exercise showed improvement in fatigue symptoms in most individuals irrespective of gender [38,39]. Study outcomes strongly exhibit the significance of the LSI program. Although the program is short-term, its significance on the quality of life is indisputable. A comprehensive LSI program with physical activity potentially forms an effective alternative intervention method to relieve stress and mental health. It also assists individuals in learning desirable lifestyles that influence healthy longevity.

Several investigations have adopted LSI programs to resolve the mental health issues in middle-aged women through meditation or exercise [40]. However, current investigations adopted multiple intervention methods where diet, mental health, and modified physical activity were fo-

cused on achieving the desired outcome. Additionally, activities like laughter therapy, pottery making, and eco bag making reduced societal pressure observed at that specific age. Naturally, targeting nutritional aspects along with mental, social, and physical aspects is the strength of the current LSI program. However, short-term and comparative analysis of the investigation without a control group could be the limitations of the study. Despite this, the contents of the program created interest and motivated participants to continue with the education and habits learned during the program to improve their quality of life. Based on the success and interest of participants in the program, it is suggested that the current LSI program can be modified to suit different age groups with a large population for an extended period may expand its applicability to improve the quality of life in individuals under stress.

CONCLUSION

This study strongly demonstrated that a comprehensive LSI program that combines learning, nutrition, mental health, social activities, and physical activity in the forest landscape is beneficial in multiple ways as it helps to manage CVD risk factors, reduce chronic fatigue, and improves the quality of life in middle-aged women experiencing chronic stress. Therefore, a comprehensive LSI including various activities in middle-aged women can be an effective alternative strategy to promote physical and psychological health.

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CONFLICTS OF INTERESTS

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