Original Article

Lifestyle Interventions vs. Multi Interventional Therapy on Physiological Parameters of Metabolic Syndrome among Women: A Comparative Study

A. J. Elizabeth[1], Aruna J[2], P. J. Mercy[3]

[1]Vice Principal, Department of Medical Surgical Nursing, Sree Sudheendra College of Nursing, Ambalamedu, Ernakulam, Kerala, India, [2]Assistant Professor, Department of Nursing, Jazan University, Saudi Arabia, [3]Assistant Professor, Academic Staff College, Kerala University of Health Sciences, Thrissur, Kerala, India

Abstract

Background: Metabolic syndrome is one of the emerging health issues in developing countries. It includes diabetes, high Blood Pressure (BP), obesity, and elevated blood cholesterol. **Materials and Methods:** This comparative study was conducted from March 2019 to February 2020 in selected areas of Ernakulam district, Kerala. The study used a quasi-experimental design with a nonequivalent control group. One-way analysis of variance and paired *t*-tests were used for statistical analysis. Women (aged between 35 and 55 years) with metabolic syndrome were recruited by multistage sampling ($N = 220$) and randomly assigned into three groups: (a) control, (b) Lifestyle Interventions (LI), and (c) Multi Interventional Therapy (MIT). LI was given to the LI group, and reflexology foot massage along with LI was given to the MIT group for 12 weeks. The control group received routine care. Physiological variables were assessed before and after the intervention. **Results:** Women who received MIT and LI had significantly lower values of weight, Body Mass Index (BMI), and waist circumference after the treatment from baseline and compared with control ($F = 12.09, 15.58, 22.37$, $p < 0.001$). A remarkable change in systolic and diastolic BP was found in the MIT group (pretest mean of systolic BP and diastolic BP in control: 142.3 and 90.1, LI: 141.7 and 89.7, MIT: 141.8 and 89.8, $p = 0.945$, posttest means control: 142.6 and 90.4, LI: 131.5 and 85.5, MIT: 118.5 and 78.3, ($F = 54.83, 57.87$, $p < 0.001$). **Conclusions:** Both LI and MIT should be considered as interventions for reducing the physiological parameters of metabolic syndrome, such as body weight, BMI, and obesity. MIT was found to be more effective in reducing blood pressure.

Keywords: *Body mass index, hypertension, obesity*

Introduction

Metabolic syndrome is a combination of diabetes, high Blood Pressure (BP), and obesity. It is a group of disorders consisting of Insulin resistance, abdominal obesity, dyslipidemia, endothelial dysfunction, genetic susceptibility, increased blood pressure, hypercoagulable state, and continuous stress.[1] Obesity is a killer lifestyle disease, and it is interrelated with other components of metabolic syndrome.[2] The obesity rates have leveled off during the past 10 years in several developed countries.[3] In 2016, more than 1.9 billion adults, 18 years and older, were overweight all over the world.[4] A correlation was found between overweight and obesity with metabolic syndrome.[5] Hypertension (HTN) increases the risk of cardiac arrest, cerebrovascular accident, renal failure, and blindness.[6] In the North Indian state of Punjab, 40.1% of people were found to be hypertensive.[7] Metabolic syndrome adversely affects several body systems.[8] The prevalence of metabolic syndrome among the adult population is 20–25%, whereas in women, it varies between 7 and 56.7%. The prevalence also increases with age.[9] In India, around 1/3rd of the adult population has metabolic syndrome, and in females, it is very high (48.2%) as compared to males (16.3%).[10] In Kerala, it is more prevalent among women.[5] Hence, prime importance should be given to early diagnosis and lifestyle changes.[9] Numerous systematic reviews confirmed the positive effect of reflexology.[10] Studies reported that reflexology foot massage has a significant effect on BP, lipoproteins, and blood sugar levels. However, little is known about the combined effects of LI and reflexology foot massage on body weight, Body Mass

Address for correspondence:
Dr. A. J. Elizabeth, Sree Sudheendra College of Nursing, Ambalamedu, Ernakulam, Kerala – 682 303, India. E-mail: elizabethbiju1979@gmail.com

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Index (BMI), waist circumference, and BP among women with metabolic syndrome. Therefore, the study aimed to compare the effectiveness of LI and MIT on body weight, BMI, waist circumference, and BP among women with metabolic syndrome between 35 and 55 years.

Materials and Methods

The current study was conducted from March 2019 to February 2020 among self-help group women in selected areas of Ernakulam district in Kerala. A quasi-experimental nonequivalent control group design was used in this study. Multistage sampling was used to select the samples. The selection of samples and sampling technique are depicted in Figure 1. The sample size was estimated with a 12% expected difference in mean independent variables, a 20% Standard Deviation (SD), and 90% power. Women belonging to the age group of 35–55 years who meet any three of the five criteria of metabolic syndrome were included in the study, like waist circumference >88 cm, systolic BP (SBP) >130 mmHg, or diastolic BP (DPB) >85 mmHg or on treatment for hypertension, high fasting blood sugar >100 mg/dL or on treatment for Diabetes Mellitus (DM), High-Density Iipoprotein (HDL) <50 mg/dL and triglycerides >150 mg/dL. Women who reported a history of heart or kidney disease, cancer, ligament injury, surgery in the leg, neurovascular problems, pregnancy, mental illness, or severe cognitive impairment were excluded from the study. A socio-demographic and clinical information sheet was used to collect the basic information. Body weight was recorded using a calibrated weighing machine (ASIN: B00JB81EWA) kept on a firm surface. A flexible, non-stretchable, narrow plastic inch tape was used to measure height and waist circumference. BMI was calculated by the formula, weight/height $(m)^2$. Waist circumference was measured with non-stretching tape. BP was measured by using a calibrated sphygmomanometer (Model No: CEO483) and a stethoscope. After the assessment interventions are given, LI are given to the LI group. Dietary modification: BMI was assessed. The dietary modification was given as per the BMI. One woman (BMI <18.5) received 1800 kcal/day, 26 women (BMI: 18.5–24.99) received 1500 kcal/day, and 47 (BMI ≥25) women received 1200 kcal/day. A food exchange list was prepared as per the directions of the dietician and provided to the participants. Participants were instructed to maintain a daily diary, and it was monitored weekly to ensure their intake.

Moderate intensity exercises: The women were instructed to walk 30 min per day (between 5 pm and 7 pm) for 5 days a week. Before beginning the exercises, the women were instructed to do warm-up exercises for 10 min, followed by brisk walking for 30 min, and cool down after the walking. A record of walking exercises, including distance walked, duration, and walking speed, was maintained by the participants. It was observed and monitored weekly.

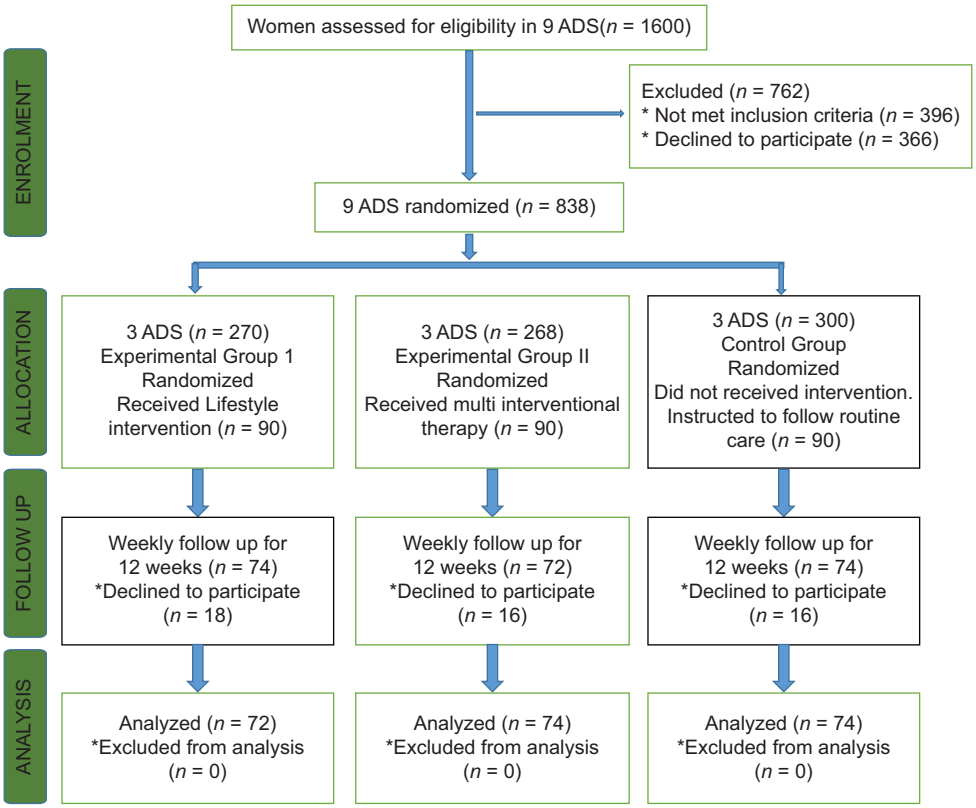

Figure 1: Consort diagram of the study

Structured health education: Individualized health education was given regarding metabolic syndrome components, causes, and its control measures, including diet, exercises, and regular follow-up. The importance of dietary modification was emphasized, and a daily dietary intake of calories, salt, and fiber was recommended. Further emphasized were the benefits of moderate intensity exercises like walking and steps to be followed while walking and warm-up exercises. An information booklet related to metabolic syndrome was given to the participants after the education.

Reflexology foot massage has 10 stages:1. Preparation 2. Lungs 3. Thyroid 4. Liver 5. Gall bladder 6. Stomach from right foot 7. Small intestine, and 8. Large intestine from the left foot, 9. spinal cord, 10. solar plexus, and 11. hypophysis from both feet. Begin every foot reflexology session on the right foot; do the whole foot, followed by the left. The duration of the procedure was 30 min in the specific points related to metabolic syndrome. It was provided once a week for 12 weeks in the home setting. The control group received routine care. The posttest was performed after 12 weeks of intervention among two groups [Figure 1].

One-way Analysis of Variance (ANOVA), paired *t*-test with Student–Newman–Keul's multiple comparisons, was used for comparison between pre and posttest scores of physiological variables. The analysis was carried out using Sigma Plot 13.0 (Systat Software Inc., USA).

Ethical Considerations

The study was approved by the institutional ethical committee. (Approval no: 003/02/2019/IEC/SMCH). Permission was obtained from the State Kudumbashree Mission and Community Development Society. Informed consent was obtained from the participants. Confidentiality was maintained.

Results

Demographic and clinical characteristics of the participants, such as age, marital status, education, occupation, monthly income, type of family, preferred food groups, lifestyle habits, menstruation, history of gestational diabetes, pregnancy-induced hypertension, history of diabetes mellitus, history of hypertension were assessed. Homogeneity was observed in all characteristics of women ($p < 0.05$) [Tables 1 and 2].

The mean weight in the pretest of the control group, Lifestyle Intervention (LI) group, and Multi Interventional Therapy (MIT) group were 62.30, 61.1, and 61.30 kg, respectively. It was not found to be statistically significant ($p = 0.825$). The mean weight in the posttest of the control group, LI group, and MIT group were 62.30, 54.20, and 54.60 kg, respectively. It was found to be statistically significant ($p < 0.001$). The pretest and posttest of the respective control group, LI group, and MIT group were tested by paired *t*-test. In the case of control, it was not significant ($p = 1.0$). Whereas, in the case of the LI group and MIT group, it was statistically significant ($t = 22.74, 14.58$, $p < 0.001$). Compared to the control, both MIT and the interventional package were found to be statistically significant ($F = 12.09$ $p < 0.001$). Compared to LI, MIT was not significant ($p = 0.849$). The mean BMI in the pretest of the control group, LI group, and MIT group are 26.50, 23.60, and 23.70, respectively. It was not found to be statistically significant ($p = 0.927$). The mean BMI in the posttest of the control group, LI group, and MIT group are 26.5, 23.6, and 23.7, respectively. It is found to be statistically significant ($F = 15.58$, $p < 0.001$). A significant difference was observed in the paired *t*-test between the pre and posttest of the respective LI group and MIT ($t = 19.39, 12.98$, $p < 0.001$). However, it was not significant in the control group ($p = 0.188$). Compared to LI, MIT was not significant ($p = 0.849$). The mean waist circumference in the pretest of the control group, LI group, and MIT group are 95.0, 95.1, and 95.0 cm, respectively. It was not found to be statistically significant ($p = 0.996$). The mean waist circumference in the posttest of the control group, LI group, and MIT group are 95.20, 88.30, and 87.9 cm, respectively. It was found to be statistically significant ($F = 22.37$, $p < 0.001$). The pretest and posttest of the respective control group, LI group, and MIT group were tested by paired *t*-test. In the case of control, it was not significant ($p = 0.021$). Whereas, in the case of the MIT group and LI group, it was statistically significant ($t = 17.08, 22.48$, $p < 0.001$). Compared to control, both MIT and LI were found to be statistically significant ($F = 22.37$, $p < 0.001$). Compared to MIT, LI was not significant ($p = 0.758$). The mean SBP in the pretest of the control group, LI group, and MIT group were 142.3, 141.7, and 141.9 mmHg, respectively. It was not found to be statistically significant ($p = 0.971$). The mean systolic BP in the posttest of the control group, LI group, and MIT group were 142.7, 131.51, and 118.2 mmHg, respectively. It was found to be statistically significant ($F = 54.83$, $p < 0.001$)*. The pretest and posttest of the respective control group, LI group, and MIT group were tested by paired *t*-test. In the case of control, it was not significant ($p = 0.156$). Whereas, in the case of the MIT group and LI group, it was statistically significant ($t = 27.36, 27.36$, $p < 0.001$). Compared to control, both MIT and LI were found to be statistically significant ($F = 54.83$, $p < 0.001$). Compared to LI, MIT was significant.

The mean DBP in the pretest of the control group, LI group, and MIT group were 90.1, 89.7, and 89.8 mmHg, respectively. It was not found to be statistically significant ($p = 0.945$). The mean systolic BP in the posttest of the control group, LI group, and MIT group were 90.4, 85.5, and 78.3 mmHg, respectively. It was found to be statistically significant ($F = 57.87$, $p < 0.001$). The pretest and posttest of the respective control group, LI

Table 1: Homogeneity verification of demographic characteristics (*n*=220)

Characteristics	Classification	CO* (*n*=74) *n* (%)	MIT** (*n*=72) *n* (%)	LI*** (*n*=74) *n* (%)	χ^2	*p*
Age (Years)	35–40	13 (17.60)	11 (15.31)	11 (14.90)	0.54	0.997
	41–45	11 (14.99)	12 (16.70)	12 (16.20)		
	46–50	17 (23.00)	16 (22.20)	19 (25.70)		
	51–55	33 (44.60)	33 (44.80)	32 (43.30)		
Marital status	Married	63 (85.10)	61 (84.70)	63 (85.10)	0.05	0.997
	Widow	10 (13.50)	10 (13.90)	10 (13.50)		
	Divorced	1 (1.50)	1 (1.40)	1 (1.40)		
Education	Graduation and above	6 (8.10)	6 (8.30)	6 (8.10)	0.86	0.990
	Higher Secondary	21 (28.40)	20 (27.8)	19 (25.70)		
	Secondary	21 (28.40)	22 (30.60)	26 (35.10)		
	Primary	26 (35.10)	24 (33.30)	23 (31.10)		
Occupation	Professional	2 (2.70)	2 (2.80)	2 (2.70)	0.20	1.0
	Skilled worker	8 (10.80)	8 (11.10)	8 (10.80)		
	Unskilled worker	15 (20.30)	14 (19.40)	13 (17.60)		
	Unemployed	49 (66.30)	48 (66.70)	51 (69.00)		
Monthly income (Rupees/Month)	<6000/-	17 (23.00)	18 (25.00)	18 (24.30)	1.43	0.964
	6000–10000	29 (39.20)	29 (40.30)	34 (45.90)		
	10000–20000	23 (31.10)	20 (27.80)	17 (23.00)		
	20000–50000	5 (6.80)	5 (6.90)	5 (6.80)		
Type of family	Joint family	23 (31.10)	22 (30.60)	25 (33.80)	0.20	0.903
	Nuclear family	51 (68.90)	50 (69.40)	49 (66.20)		
Food habits	Vegetarian	16 (29.60)	15 (20.80)	14 (18.90)	0.18	0.916
	Mixed food	58 (78.40)	57 (79.20)	60 (81.10)		
Menstruation	Regular	31 (41.90)	28 (38.90)	24 (32.40)	2.58	0.631
	Irregular	12 (16.20)	12 (16.70)	18 (24.30)		
	Menopause	31 (41.90)	32 (44.40)	32 (43.20)		

*CO=Control, **LI=Lifestyle interventions, ***MIT=Multi interventional therapy

group, and MIT group were tested by paired *t*-test. In the case of control, it was not significant ($p = 0.244$). Whereas, in the case of the MIT group and LI group, it was found to be statistically significant ($t = 15.84, 21.08$, $p < 0.001$). Compared to control, both MIT and LI were found to be statistically significant ($F = 54.83$, $p < 0.001$). Compared to LI, MIT was significant [Table 3].

Discussion

The findings of the study highlight that the application of MIT and LI has a remarkable role in improving the physiological parameters of metabolic syndrome. In the present study, the MIT group and LI group showed a significant decrease in the means of body weight, BMI, and waist circumference after 12 weeks of intervention. A review says that exercise programs reverse metabolic syndrome, and weight loss is best achieved by decreasing energy consumption and increasing energy expenditure.[11,12] A three-armed RCT on the effect of diet with or without exercise on abdominal fat in postmenopausal women for 15 weeks found a reduction of weight among both groups.[13] Moderate or vigorous aerobic exercises have a greater effect on visceral adipose tissue, and exercise training significantly reduces body weight.[14,15] Well-planned lifestyle modification programs are necessary for treating obesity.[16] Reviews support the use of exercise to reverse metabolic syndrome.[11] Similarly, the combined use of acupuncture and massage also significantly reduced the BMI among obese women.[17]

Here, a marked reduction in SBP and DBP among the MIT group was observed as compared to the LI group. A significant correlation was found between SBP and DBP with weight, waist circumference, salt intake, and physical activity.[17] Another study using multi-lifestyle residential medical interventions for reversing hypertension also found that SBP decreased significantly within 14 days.[18] A systematic review observed that Community-based health workers' interventions are effective in promoting Cardiovascular Disease (CVD) risk reduction.[19] Studies found increased adherence to the therapeutic regimen in people with hypertension who received teaching by nurses.[20] Similarly, in another study, LI by a female healthcare provider was found to be effective in lowering SBP.[21] The review says that foot massage on both feet for 20 min twice a day for 3 days significantly reduced the BP.[22] Both reflexology massage and trans-dental meditation were found effective.[23] A systematic review also supports the role of reflexology in reducing BP.[24] In another study, foot massage and back massage

Table 2: Homogeneity verification of clinical variables (*n*=220)

Variables	Classification	CO* (*n*=74) *n* (%)	MIT*** (*n*=72) *n* (%)	LI** (*n*=74) *n* (%)	χ^2	*p*
H/o PIH	Present	4 (5.40)	3 (5.60)	4 (5.40)	0.01	0.999
	Absent	70 (94.60)	69 (94.40)	70 (94.60)		
H/o gestational diabetes	Present	6 (9.50)	7 (9.70)	8 (9.50)	0.004	0.998
	Absent	68 (90.50)	65 (90.30)	66 (90.50)		
H/o diabetes mellitus	Present	19 (25.70)	18 (25.00)	16 (21.60)	0.38	0.827
	Absent	55 (74.30)	54 (75.00)	58 (78.40)		
H/o hypertension	Present	22 (29.70)	22 (30.60)	24 (32.40)	0.13	0.936
	Absent	52 (70.30)	50 (69.40)	50 (67.60)		
H/o dyslipidemia	Present	8 (9.50)	7 (9.70)	6 (9.46)	0.004	0.998
	Absent	66 (90.50)	65 (90.30)	68 (90.50)		

*CO=Control, **LI=Lifestyle interventions, ***MIT=Multi interventional therapy, PIH=Pregnancy induced hypertension

Table 3: Mean, standard deviation (SD), One-way ANOVA, and paired t of physiological parameters among control (CO), Lifestyle intervention (LI), and Multi Interventional Therapy (MIT) Group (*n*=220)

Variable	Time	CO (*n*=74)		LI (*n*=74)		MIT (*n*=72)		f	*p*
		Mean (SD)	Paired "*t*" (*p*)	Mean (SD)	Paired "*t*" (*p*)	Mean (SD)	Paired "*t*" (*p*)		
Weight (kg)	Pretest	62.30(1.80)	0.00 1.00	61.20 (1.20)	22.74 0.00	61.30 (1.20)	14.58 0.00	0.19	0.83
	Posttest	62.30 (1.80)		54.20 (1.00)		54.60 (0.90)		12.09	*p*<0.001
Body mass index (kg/m^2)	Pretest	26.40(0.50)	1.33 0.19	26.40 (0.50)	19.39 0.00	26.50 (0.50)	12.98 0.00	0.08	0.93
	Posttest	26.50 (0.50)		23.60 (0.40)		23.70 (0.30)		15.57	*p*<0.001
Waist circumference (cm)	Pretest	95.00 (1.00)	2.36 0.02	95.10 (1.00)	17.01 0.00	94.90 (1.00)	22.48 0.00	0.00	1.00
	Posttest	95.20 (1.00)		88.30 (0.80)		87.90 (0.80)		22.37	*p*<0.001
Systolic blood pressure (mmHg)	Pretest	142.30 (1.80)	1.43 0.16	141.70 (1.90)	27.37 0.00	141.80 (1.80)	22.50 0.00	0.03	0.97
	Posttest	142.60 (1.80)		131.50 (1.80)		118.00 (1.30)		54.83	*p*<0.001
Diastolic blood pressure (mmHg)	Pretest	90.10 (0.90)	1.18 0.24	89.70 (1.00)	15.84 0.00	89.80 (0.90)	21.08 0.00	0.06	0.95
	Posttest	90.40 (0.90)		85.50 (0.90)		78.30 (0.60)		57.87	*p*<0.001

*CO=Control, **LI=Lifestyle interventions, ***MIT=Multi interventional therapy, ANOVA=analysis of variances

were found to be equally effective in reducing BP.[25] These studies strongly support the findings of the present study, and reflexology foot massage can be recommended along with LI for reducing BP among women with metabolic syndrome. One strength of this study is that it includes three groups of women, with two intervention groups and one control group. Another strength of the study is that it is one of the first few studies conducted in India among middle-aged self-help group women where the metabolic syndrome is addressed. The intervention was provided by the trained researcher. The study is limited to middle-aged women, and enactment of the interventions was assessed through monitoring the self-reported activity checklist and dietary diary.

Conclusions

The study results added more evidence to support the use of MIT as well as LI for reducing body weight, BMI, waist circumference, and BP among women with metabolic syndrome. The findings suggest that LI alone or MIT for a period of 12 weeks helps to reduce the physiological parameters of metabolic syndrome. Clinicians should incorporate these measures while treating patients with metabolic syndrome.

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Conflicts of interest

Nothing to declare.

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