Original Article

Yoga and nutritional therapies for promoting health-related quality of life in persons with metabolic syndrome—An interventional observational study

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Abstract

Introduction: A group of related risk factors known as central obesity, elevated blood pressure, impaired fasting glucose, elevated triglycerides (TGs), and low levels of high-density lipoprotein (HDL) are collectively referred to as metabolic syndrome (MetS). A low quality of life (QoL) in terms of health is linked to MetS. This study sought to determine how lifestyle modifications affected the health-related quality of life (HRQoL) of primary care patients with MetS. **Materials and Methods:** In this study, we randomized 300 subjects diagnosed with MetS as per the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria, into control, yoga, and yoga + diet groups according to their intervention which was given for 6 months. Socio-demographic, anthropometric, and physiological and biochemical parameters were collected at baseline, 3 months, and 6 months. The 36-Item Short Form Health Survey (SF-36) was also used to assess HRQoL. **Results:** The results of this study indicate that yoga + diet and yoga intervention led to significant decrease in metabolic risk factors, such as waist circumference (WC), systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting blood glucose (FBG), TGs, and increase in HDL at 3 months and 6 months from baseline. SF-36 score also showed increment (from 0 score to 100) at 3 months and 6 months, which indicates improvement in HRQoL. **Conclusion:** Dietary changes and yoga are useful strategies for reducing the risk of MetS, which improves QoL in relation to health. Incorporating yoga practices and advocating a balanced diet within primary care systems can significantly benefit individuals with or at risk of MetS.

Keywords: Diet, health-related quality of life, metabolic syndrome, –SF-36, yoga

Introduction

With –pro-atherogenic metabolic irregularities, the metabolic syndrome (MetS) is a complicated and unpleasant condition. Additionally, it is a significant, global public health and clinical concern that is getting worse. Many clinical issues, such as dyslipidemia, insulin resistance, abdominal obesity, elevated triglycerides (TGs), a decrease in high-density lipoprotein (HDL), hypertension, and the presence of inflammation, are often present in association with MetS.[1,2] The primary risk factors for MetS are believed to be excess weight and central obesity. Changes in lifestyle, such as a diet heavy in carbohydrates and fats, a lack of recreational physical exercise, and alcohol and tobacco use, have been connected to this illness.[3,4] The quality of life (QoL) is lower for those with MetS in terms of their health. Health-related quality of life (HRQoL) is a term used to describe, more broadly, all facets of life that go beyond health, such as social interactions and education. Contrarily, HRQoL is used to evaluate how accurately one sees one's own health or sickness status and to make distinctions between aspects of one's life that are health-related.[5]

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By measuring QoL, one may personally assess the effects of a condition and the effectiveness of various therapies. An essential result in assessing a technique's therapeutic value is an increase in HRQoL.[6,7]

It is critical to emphasize that MetS may cause changes in how a person perceives their own health, which for many people may be more significant than the comorbidities connected to MetS. Despite the fact that the exact cause of MetS is unknown, it is thought to be a complex health condition that can result in psychological, emotional, and physical problems.[8] Practices, such as yoga and meditation, have been proven to be efficient tools for enhancing HRQoL. Regular yoga and meditation sessions were linked to variables that support health and well-being, with long-term meditation sessions having more advantages.[9] QoL deteriorates due to unhealthy lifestyle or disease. Continuous yoga practice is linked to better diets and better control over emotional eating.[10] In addition to lowering some of the barriers to starting and maintaining physical activity more generally, yoga poses have the potential to directly increase energy expenditure because they can improve physical function, isometric strength, cardiorespiratory fitness, and balance in addition to reducing back and joint pain. Educating patients about the benefits of yoga and a healthy diet can prevent the onset or progression of MetS. Primary care providers can offer guidance and resources on incorporating these lifestyle changes. Yoga practices and dietary interventions into primary care systems can significantly enhance the QoL for MetS patients. These interventions offer holistic approaches, address multiple facets of health, and empower patients to actively participate in their health management, leading to improved overall well-being. Thus, the purpose of this study was to evaluate the impact of a lifestyle intervention (diet and yoga) on the HRQoL at the primary level for people with MetS.

Materials and Methods

Study design

In this experimental interventional study, we allocated subjects randomly divided into three groups using computerized random number generator: (i) control group, (ii) yoga group, and (iii) yoga + diet group.

Study setting

This study was conducted in the Physiology Department of the RUHS College of Medical Sciences and Associated Hospitals, Jaipur, from November 2021 to October 2022. Recruitment of subjects was conducted in the initial 3 months, and from the first day of recruitment, their intervention was started as per protocol. The study received permission for ethical conduct from the RUHS College of Medical Sciences' Institutional Ethics Council in Jaipur (EC/P-59/2021).

Participants

Participants were gathered from affiliated hospitals and the outpatient department (OPD) of the RUHS College of Medical Sciences' medical department. Every patient was evaluated based on the inclusion and exclusion standards.

Inclusion criteria: Those with three or more of the following cardio-metabolic risk factors were considered to have MetS and were enrolled in the study based on the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III)[11] criteria—(1) waist circumference (WC) greater than 35 inches for women and more than 40 inches for men; (2) a TG level more than 150 mg/dL; (3) lower high-density lipoprotein cholesterol (HDL-C) levels: <40 mg/dL in men and <50 mg/dL in women; (4) high diastolic blood pressure (DBP) >85 mmHg and/or systolic blood pressure (SBP) >130 mmHg; and (5) higher fasting plasma glucose (FPG) >100 mg/dL) in the 18–60 age range for both sexes.

Exclusion criteria

The study excluded patients with cardiac conditions (myocardial ischemia, cardiomyopathy, and atherosclerosis), respiratory, musculoskeletal, and renal problems, as well as pregnant and lactating women. Furthermore, people with severe disabilities, such as osteoarthritis, scoliosis, or kyphosis, were not eligible, nor were those who had just been hospitalized within the previous 3 months.

Sample size

The study's estimated sample size was 94, with a margin of error of +/-10%, a sample percentage of 50%, and a confidence level of 95%. The sample size of the study was 100 individuals due to dropouts or non-responding subjects for each group.[12] A written informed consent was acquired from each participant who was willing.

Intervention

Yoga and dietary intervention were given as per groups in which subjects were randomly allocated [Tables 1 and 2]

(i) Yoga + diet group: In this group, the given intervention was yoga asana and pranayama with tailored diet plan.
(ii) Yoga group: In this group, the given intervention was yoga asana and pranayama only.
(iii) Control group: No intervention was given to this group.

All groups received medical treatment as usual.

Outcome measures

Age, sex, socioeconomic status (as measured by the modified Kuppuswamy socioeconomic scale and this scale consists of a composite score which includes the education and occupation of the family head along with income per month of the family, which yields a score of 3–29), marital status, and level of education were all questions that participants had to answer when they enrolled up for the study.[13]

The evaluation was conducted using the 36-Item Short Form Health Survey (SF-36), a HRQoL questionnaire. An 8-category

Table 1: Yoga Protocol

S.No.	Activity (Sanskrit Name)	Time
	Asanas	
1.	Prayer	2 min
2.	Tadasana	2 min
3.	Virabhadrasana	2 min
4.	Urdhava mukha svanasana	3 min
5.	Utkatasana	2 min
6.	Eka pada apanasana	3 min
7.	Jathara paravritti	2 min
8.	Apanasana	3 min
9.	Shavasana	8 min
	Breathing practices (pranayama)	
1.	Nadi sodhana	3 min
2.	Kapalabhati	4 min
3.	Kukkuriya Pranayama	2 min
4.	Bhastrika Pranayama	2 min
5.	Savitri	3 min
6.	Pranava Pranayama	2 min
7.	Bhramari Pranayama	2 min
Total time		45 min

Table 2: Daily Diet Plan for the combine (yoga+dietary) intervention group

Timing	Diet
Early Morning	1 cup tea or coffee, 2 pieces marialite/digestive/ nutritive choice
Breakfast	1 glass Milk, 1 bowl Veg Poha/Upma/Daliya/ Sewaiyan/Oats or 2-3 pcs Idli + Chutney/2 pcs Uttapam + Chutney or 1 Chapati + 1 bowl Vegetable, 5 Almonds, 2 Walnuts (soaked overnight).
Mid-Morning	1 glass Buttermilk/Coconut water/Lemon water, 1 Seasonal Fruit.
Lunch	1 big bowl salad or soup, 2 missi chapati, 1 bowl dahi or veg raita, 2 bowl seasonal vegetable (Less of Oil)
Evening Tea	1 cup tea or coffee, 1 bowl roasted chana chaat/ sprout, chaat (Add lots of salad in it)
Dinner	1 big bowl salad soup, 2 chapati, 1 bowl dal, 2 bowl seasonal vegetable (Less of Oil).

self-report multidimensional questionnaire called the SF-36 is used to evaluate a patient's health. Physical functioning, role limitations due to physical health, energy/fatigue, and pain, emotional well-being, social functioning, overall health, and health change are these domains. Higher SF-36 scores are predictive of improved HRQoL and are calculated on a scale from 0 to 100.[14]

Stadiometer and calibrated weighing scales were used to measure the subjects' weight (kg) and height (cm), respectively, in accordance with the National Health and National Examination Survey (NHANES) criteria. The weight (kg)/height (m2) formula was used to determine body mass index (BMI). The respondents were asked to stand with their heels together and measure their waist and hip circumferences using a linen measuring tape at the level of the umbilicus and the maximum protrusion of the hip, respectively.[15] Following a 15- to 30-minute period of sitting still, the sphygmomanometer was used to measure both SBP and DBP.[16] The biochemical parameters of each research participant were measured, including fasting blood glucose (FBG), total cholesterol, low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), TGs, and HDL-C.[17,18] For the biochemical testing, they were instructed to arrive after an overnight fast of 8 to 10 hours.

Statistical analysis

Microsoft Excel was used to organize the collected data. For data that were normally distributed, mean ± SD was computed. Using IBM SPSS Statistics, version 24 (IBM Corporation, NY, USA), analysis of variance (ANOVA) was used to determine the level of statistical significance ($P < 0.05$) to determine the level of difference at 3 months and 6 months after intervention from baseline. Descriptive data were also presented in percentages. Data were presented in the form of suitable tables as according data. Primary outcome data were also presented in required tabular formats.

Results

Descriptive results

Demographic characteristics of MetS subjects at baseline, 3 months, and 6 months are shown in Figure 1. Of 300 subjects at baseline, there were 60% males and 40% females. Most of the MetS subject's population belongs to the urban geographical area (85%) and married marital status (83%). Most of MetS subjects belong to the upper-lower, lower-middle, and upper-middle class according to socioeconomic status.

Table 3 depicts that there was no significant difference in the mean value of age and height of MetS subjects of the control, yoga, and yoga + diet groups ($P > 0.05$). Significant decrement was seen in the mean value of weight and BMI of the yoga + diet group ($P < 0.05$) in comparison with the control and yoga groups at 6 months. No significant difference was seen at 6 months in the mean values of waist, hip, and waist-hip ratio of the control, yoga, and yoga + diet groups. Significant decrement was seen in mean blood pressure (SBP and DBP), FBG, and HbA1c values at 6 months from baseline in all groups ($P < 0.05$). Significant decrement was seen in the mean values of total cholesterol, LDL, VLDL, and TG values of the yoga and yoga + diet groups than controls. Significant increment in mean HDL was seen in the yoga and yoga + diet groups ($P < 0.05$).

Table 4 depicts the score of SF-36. In the MetS individuals, in the control group, there was a progressive decline in the mean scores across every domain of the SF-36 scale, while the mean scores for the whole domain of the SF-36 scale gradually increased significantly in the MetS participants' yoga and yoga + diet groups.

Table 3: Descriptive statistics of anthropometric and biochemical parameters of the control, yoga, and yoga+diet groups at baseline, 3 months, and 6 months

Parameters	Groups	Baseline	3 Months	6 Months	*F*	*P*
Age (years)	Control	41.76±11.94				
	Yoga	44.7±11.04			1.82	0.16
	Yoga + diet	42.3±11.71				
BMI (Kg/m^2)	Control	27.96±4.80	28.20±4.81	28.46±4.86	0.27	0.76
	Yoga	27.73±3.64	27.25±3.58	26.65±3.40	2.33	0.09
	Yoga + diet	28.81±4.85	28.12±4.77	26.46±4.36	6.70	0.00
Waist (inches)	Control	39.08±4.16	39.20±4.18	39.30±4.41	1.01	0.36
	Yoga	39.69±3.61	39.20±3.56	38.62±3.52	2.27	0.10
	Yoga + diet	40.78±3.80	40.53±3.79	39.86±3.82	1.56	0.21
SBP (mmHg)	Control	139.98±23.17	132.54±15.15	127.84±12.72	12.11	0.00
	Yoga	143.90±20.36	137.82±14.85	132.42±11.02	13.08	0.00
	Yoga + diet	139.32±12.99	135.64±10.92	128.54±6.67	27.93	0.00
DBP (mmHg)	Control	89.16±12.30	85.04±7.25	81.24±3.91	21.48	0.00
	Yoga	90.96±11.66	87.32±8.18	84.12±6.34	14.46	0.00
	Yoga + diet	89.22±6.74	86.66±5.74	82.60±4.06	35.25	0.00
FBG (mg/dl)	Control	136.06±51.71	108.45±27.75	89.65±14.58	44.70	0.00
	Yoga	132.48±53.14	119.39±41.71	105.77±28.54	9.95	0.00
	Yoga + diet	130.90±40.97	115.21±28.98	95.77±20.01	31.84	0.00
TC (mg/dl)	Control	192.21±38.95	200.59±39.72	210.30±40.67	5.18	0.00
	Yoga	204.78±37.28	199.51±34.03	180.05±25.27	15.97	0.00
	Yoga + diet	207.69±40.68	187.42±31.61	162.60±46.55	31.73	0.00
HDL (mg/dl)	Control	38.50±10.58	38.06±10.57	37.57±10.50	0.19	0.82
	Yoga	39.08±10.91	40.34±9.65	43.64±9.02	5.68	0.00
	Yoga + diet	43.31±13.58	45.50±11.68	48.93±11.53	3.38	0.03
LDL (mg/dl)	Control	114.24±32.07	121.36±32.55	129.76±34.12	5.56	0.00
	Yoga	124.87±31.07	120.24±28.22	104.25±21.89	15.66	0.00
	Yoga + diet	125.43±35.79	110.07±27.58	87.52±15.02	48.09	0.00
VLDL (mg/dl)	Control	39.46±16.21	41.17±16.24	42.97±15.93	1.18	0.31
	Yoga	40.83±16.59	38.93±15.20	32.16±10.33	10.16	0.00
	Yoga + diet	38.95±16.71	31.85±13.11	22.60±8.29	38.78	0.00
TG (mg/dl)	Control	180.68±52.53	188.33±52.18	197.59±50.69	2.67	0.07
	Yoga	170.21±54.52	154.50±46.47	128.70±32.32	21.33	0.00
	Yoga + diet	170.79±47.23	147.38±39.15	104.13±22.92	79.99	0.00

*BMI=body mass index; WHR=waist-hip ratio; SBP=systolic blood pressure; DBP=diastolic blood pressure; FBG=fasting blood glucose; HbA1c=glycated hemoglobin; TC=total cholesterol; HDL=high-density lipoprotein; LDL=low-density lipoprotein; VLDL=very low-density lipoprotein; TG=triglyceride. *Significant (P<0.05)

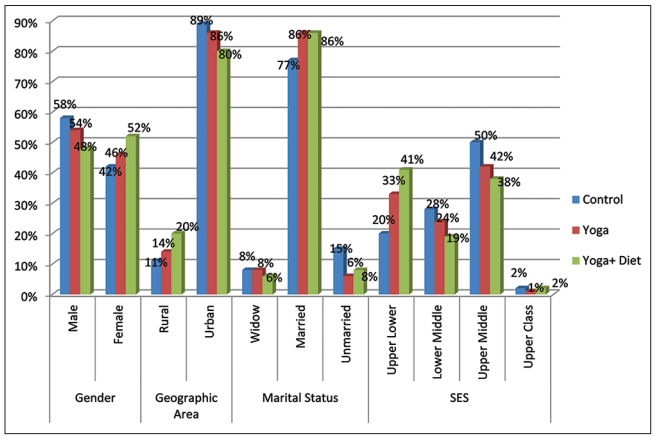

Figure 1: Distribution of demographic data of metabolic syndrome population of the control, yoga, and yoga+ diet groups at baseline

Patient dropout data

A total of 300 MetS (control = 100; yoga = 100; yoga + diet = 100) subjects were included in the study. The Consolidated Standards of Reporting Trials (CONSORT) study flow diagram is shown in Figure 2. The total number of individuals screened for this study from OPD was 1145. Of these individuals, the patients were randomized and enrolled to achieve the required sample size of 300. The rest of the individuals was excluded because of either of the following reasons:

(1) refusal to participate (255), (2) unable to establish contact (247), (3) did not meet inclusion criteria (167), and (4) other reasons—(a) renal diseases (38), (b) plan of pregnancy (4), (c) taking other treatments (56), and (d) having other comorbidities (78).

The baseline data were collected from a total of 300 individuals, who were further randomized into three different categories of 100 each: (a) control, (b) yoga intervention, and (c) yoga + diet intervention groups. Each of these groups had 100 patients who were scheduled for follow-up twice at 3-month interval (i.e. after 3 months and 6 months).

At third-month follow-up of the control group, two individuals dropped out because of loss of follow-up, thereby reducing

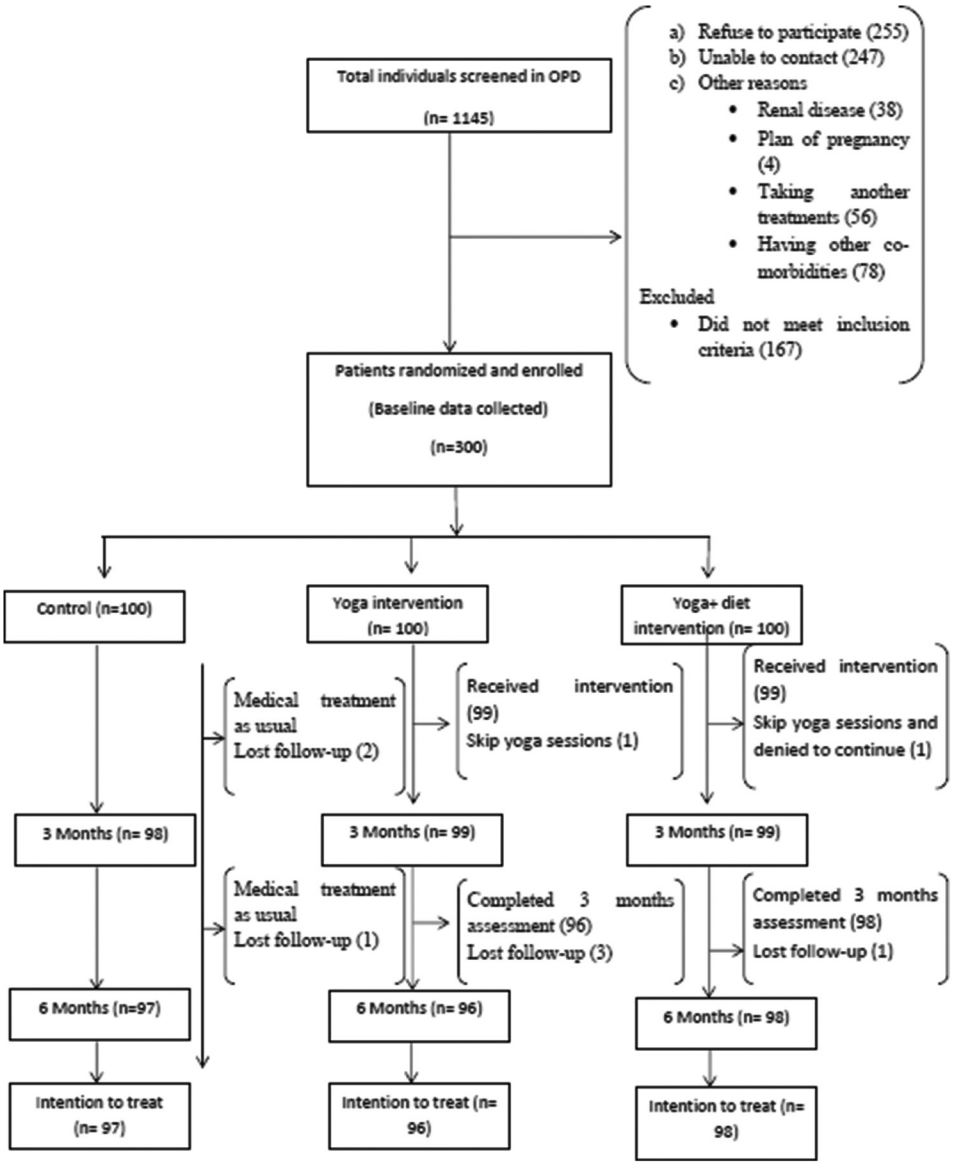

Figure 2: CONSORT study flow diagram

the sample size to 98. After 3 months (at sixth month), one individual did not report for follow-up resulting in final number of 97 in the control group. In the yoga intervention group at 3-month follow-up, it was seen that one patient skipped yoga session, reducing the number of patients to 99. Further, after 3 months of study (at sixth month), three patients did not visit for follow-up, thereby reducing the final number of patients to 96 in the yoga intervention group.

The yoga + diet intervention group had 99 patients by the end of 3 months during follow-up session because one skipped yoga sessions and denied to continue further with the study. Again, after 3 months (at sixth month), one patient did not visit the hospital for assessment. Therefore, the final number of patients in the yoga+ diet intervention group by the end of 6 months became 98.

Discussion

In this interventional observational study, we assessed the patients attending OPD of the RUHS College of Medical Sciences and Associated Hospital, Jaipur, for MetS. Insulin resistance and MetS are quite common in India. According to studies, the age-adjusted prevalence of MetS in the urban Indian populations was shown to be over 25% overall (around 31% in women and 18.5% in men).[19] Over the past 3 decades, there has been a lot of interest in the question, whether MetS affects people in South Asian countries, especially India.[20] Type 2 diabetes mellitus (T2DM), cardiovascular illnesses, and all-cause mortality are all directly increased by the MetS, a group of connected physiological, biochemical, clinical, and metabolic variables.[21] The study results show that MetS is more prevalent in males in comparison with

Table 4: Descriptive statistics of SF-36 scores of the control, yoga, and yoga+diet groups at baseline, 3 months, and 6 months

SF-36 components	Group	Baseline	3 Months	6 Months	*F*	*P*
PF	Control	82.25±13.66	75.25±12.42	71.4±12.08	18.65	0.00
	Yoga	78.5±15.37	82.6±12.01	90.7±8.35	25.69	0.00001
	Yoga + diet	74.9±18.31	82±15.84	93.3±8.48	39.25	0.00001
PH	Control	31.75±23.26	26.50±21.5	14.75±15.53	18.23	0.00
	Yoga	47.5±27.18	68.25±22.43	81.50±18.67	55.39	0.000
	Yoga + diet	30.75±22.71	58±22.72	81.85±16.81	145.81	0.000
Energy	Control	41.65±14.29	38.1±13.23	36.05±11.15	4.78	0.009
	Yoga	38.75±12.60	50.65±13.81	70.05±13.08	143.88	0.000
	Yoga + diet	42.70±15.17	58.25±14.67	83.65±12.57	212.47	0.000
Pain	Control	59.02±24.54	57.44±24.32	56.15±24.57	0.344	0.71
	Yoga	82.5±19.61	87.15±14.83	94.20±7.15	15.88	0.000
	Yoga + diet	55.50±24.16	78.43±18.30	93.53±7.70	112.08	0.000
RE	Control	23.66±26.93	19.66±24.66	9.33±19.57	9.55	0.00
	Yoga	28±30.98	52.33±23.83	78.01±21.30	94.71	0.00
	Yoga + diet	20.99±21.53	61.34±22.60	88.01±17.41	267.40	0.00
EW	Control	48.60±11.60	45.94±11.57	44.52±11.32	3.24	0.04
	Yoga	50.04±10.02	59.66±10.11	73.84±13.02	115.24	0.00
	Yoga + diet	51.20±13.65	62.36±12.90	82.80±12.13	154.04	0.00
SF	Control	53.38±17.84	46.88±14.90	45.63±14.25	6.98	0.00
	Yoga	56.38±18.42	67.68±17.94	79.88±15.48	45.99	0.00
	Yoga + diet	53.38±19.04	72.30±16.51	89.88±11.74	129.31	0.00
GH	Control	47.85±12.99	44.65±11.66	43.3±12.04	3.64	0.02
	Yoga	48.95±1.22	61.45±12.86	77±13.18	115.27	0.00
	Yoga + diet	44.05±12.55	64.95±11.13	85.55±11.3	315.72	0.00
HC	Control	29.55±16.42	18±15.11	11±12.47	40.28	0.00
	Yoga	40±18.80	61.5±17.2	77.25±18.5	105.81	0.00
	Yoga + diet	30.05±20.09	65±16.28	86.50±15.66	266.39	0.00

*PF=physical functioning; PH=limitation due to physical health, energy/fatigue, and pain; RE=role limitation due to emotional well-being; EW=emotional well-being; SF=social functioning; GH=general health; HC=health change. *Significant (P<0.05)

females [Figure 1]. However, Prasad D *et al.* discovered that women had considerably greater incidences of MetS than men did (52.2%; n = 307 vs. 34.2%; n = 202).[22] The prevalence of MetS varied by gender, with females having a greater prevalence (35%; 95% CI: 31%–38%) than males (26%; 95% CI: 22%–29%).[23]

Numerous studies have discovered gender disparities in the frequency of MetS. It might be because separate cut-off values, such as WC and HDL, were established as per the MetS criteria.[24] Males have been observed to have greater amounts of visceral and hepatic adipose tissue than females. These results could help to explain why men have higher levels of insulin resistance, as could the lack of any protective effects of estrogen and lower levels of adiponectin.[25]

In this study, most of the MetS subject population belongs to the urban geographical area (85%) than rural (15%) [Figure 1]. Rapid dietary changes, lifestyle changes, socioeconomic shifts brought on by rising wealth, urbanization, mechanization, and rural-to-urban migration are the key factors contributing to the syndrome.[26]

In our study, the majority (83%) of the study population is married [Figure 1]. Troxel *et al.* found that women who were unhappy in their marriage had a higher prevalence of MetS than women who were either widowed or satisfied with their marital status. This finding may suggest that having a partner or a healthy relationship provides both psychological and physical support, particularly during stressful times.[27]

This study shows that the prevalence of MetS was very high among those belonging to upper-middle class (43.33%) followed by upper-lower class (31.33%), lower-middle class (23.67%), and then upper class (1.67%) [Figure 1]. According to Matthews *et al.* and Zhan *et al.*, those with lower socioeconomic level have a higher risk of developing MetS.[28,29] Prasad *et al.* found that those with greater socioeconomic level had higher risks.[21]

In this study, significant decrease was seen in the BMI after 6 months in subjects who were given yoga+ diet intervention [Table 3]. According to McDermott *et al.*, there was a significant weight loss, a decrease in WC, and a rise in psychological health.[30] A regular yoga practice has been demonstrated to lower anxiety and may enhance general health in addition to lowering BMI.[31]

The results of this study showed that significant decrement was seen in the blood pressure (SBP and DBP) after the intervention in both yoga and yoga + diet groups [Table 3]. Similar findings

were made by Ankad *et al.* in healthy persons.[32] Yoga was also shown to lower heart rate, SBP, and DBP, perhaps by direct vagal stimulation, the recovery of baroreceptor sensitivity, and a reduction in felt tension and anxiety.[33] Yoga dramatically lowered mean arterial blood pressure (2.37%), diastolic (1.49%), systolic (2.26%), and resting heart rate (4.16%), according to Divya TS *et al.*[34]

In this study, there was significant decrement seen in FBG and lipid profile parameters (total cholesterol, LDL, VLDL, and TG) but significant increment was seen in HDL at 6 months from baseline in the yoga and yoga + diet groups [Table 3]. As a result of yoga, Kanayan *et al.* also noted improvements in FBG, HbA1c, LDL cholesterol, and HDL values.[35] Yoga has been proven to be helpful in treating MetS by lowering blood pressure, improving lipid and glycemic profiles, and reducing WC.[36] Yoga dramatically lowered blood glucose levels while fasting and after meals.[37]

The main finding of this study is that MetS was associated with poorer HRQoL in participants with MetS at baseline. Participants with MetS had significantly lower scores on all the components of SF-36 in all the three groups [Table 4]. In line with our study, Hjellset *et al.* suggested that there was a correlation of MetS with worsening physical functioning, overall health, and body pain.[38] People with MetS scored poorer on the physical and social components of the SF-36, according to data from a previous study by Frisman *et al.*[39] Obesity and a number of chronic illnesses may be contributing factors to the likelihood of a link between poor mental health and MetS. The combination of obesity and low leptin levels is linked to depression.[40] Patients with diabetes were reported to often experience psychiatric illnesses, such as sadness and anxiety, and these patients were more susceptible to HRQoL impairment.[41]

Although the exact cause of MetS is unknown, it is thought to be a complicated health issue that can lead to psychological, emotional, and physical issues. As a result, MetS increases the likelihood of developing psychological stress, including depression and anxiety, as well as the reverse.[42] Numerous causes could be the source of this lower HRQoL in MetS patients. Several articles report that obesity among individuals with MetS regularly interfered with their ability to do everyday duties as planned; high specific pain (SP) frequently caused discomfort; and changes in blood glucose levels led to weakness and exhaustion. As a result, these issues not only have a negative impact on a person's ability to perform in social situations, but also significantly lower HRQoL.[43] In this study, the significant improvement was seen on all the SF-36 components in the yoga and yoga + diet groups after intervention but in controls, decrement or no significant change was seen in 6 months [Table 4]. Comparably, our study's modest impacts on energy levels, the physical component of life quality, and social functioning are in line with earlier findings.[44,45] It has been established that unhealthy lifestyle choices, such as insufficient exercise and inadequate stress management, increase the risk of MetS and vice versa. To treat MetS holistically, a continuum of nutrition and lifestyle changes is needed. Eliminating the MetS's causal risk factors is the primary treatment for the condition.[46] In primary healthcare settings, healthy lifestyle interventions, such as yoga and diet, have been shown to reduce metabolic risk (via improvements in blood pressure, WC, FBG, and lipid profile). This, in turn, improves HRQoL and can be used as a conjunctive therapy with conventional medicines.

Strengths and limitations

Notably, this study contains several strengths that are uncommon in other research looking at how yoga and dietary interventions affect the HRQoL of individuals with MetS. These study results will be helpful for general primary care providers and family physicians. It is a three-armed study in which we observed individual effect of different interventions on metabolic risk factors and on QoL. All the subjects were equally matched from the same population. The only indicators of social standing and family support that we utilize are education level, marital status, and socioeconomic status. The model does not account for comorbidity or other risk factors that might be associated with a worse HRQoL. Adults with MetS, however, typically have a number of concomitant conditions. More likely to act as a mediator than a confounding factor is comorbidity. Despite its limitations, this was a study in which we observed patients two times after the implementation of intervention in 3 and 6 months to understand the clear picture of effects. We also took into account the impact of variations in physical activity. In addition, a representative sample drawn at random from the community comprised the study population. Additionally, the SF-36, a measure whose validity and reliability have been extensively studied, was a useful instrument for measuring HRQoL.

Conclusion

According to this study, among individuals with MetS, MetS was a risk factor for adverse changes in HRQoL. In conclusion, incorporating yoga practices and advocating a balanced diet within primary care systems can significantly benefit individuals with or at risk of MetS. These lifestyle modifications, coupled with medical interventions when necessary, can contribute to better management and prevention of this condition. The combined effect of yoga and dietary changes is more effective for improving HRQoL and lowering the risk of MetS than yoga alone in primary care setting. Yoga and nutritional treatments help to maintain excellent health by controlling BMI, enhancing biochemical processes in the body, assisting in overcoming the difficulties of obesity, and lowering metabolic risk factors, thus improving HRQoL of MetS patients in primary care setting.

Author contributions

JS designed the study and acquired the data. SK analyzed the collected data. NS involved in entering the acquired data, evaluated the collected data, and drafted the manuscript. MK involved in text writing and collected the data. Every author

made a personal contribution to the manuscript's writing and data interpretation. The final manuscript was read and approved by all authors, who also agreed to take full responsibility for the entire project.

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Conflicts of interest

There are no conflicts of interest.

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