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Ameliorative Impact of Nutrition - Exercise Intervention Strategies on Metabolic Syndrome in the Punjabi Community

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Abstract

Metabolic Syndrome (MS) is a worldwide emerging problem including a combination of symptoms like abdominal obesity, fatty liver, high blood pressure and impaired lipid profile. It was hypothesized that these risk factors can be largely reversed through alteration in dietary habits and by increasing physical activity. The aim was to fabricate an interventional strategy based on diet and exercise for women of Punjabi Community diagnosed with Metabolic Syndrome and to study its impact. A sample size of Fifty adult women (18 - 55 years) of Punjabi community of New Delhi were selected for the present research work. A non-experimental cross-sectional survey was done to obtain the required information which helped to identify subjects diagnosed (17 subjects i.e. 35%) using IDF criterion. Then the participants diagnosed with MS were divided into two groups test (diet and exercise intervention N=7) and control groups (N=10) respectively. The test group showed positive changes in the nutrient intake. The significantly decreased consumption of energy, macronutrients and macro minerals like calcium, iron and increase in fibre and water was seen in interventional group. Simultaneously, a marginal rise in HDL-Cholesterol, while significant decline was observed in serum total cholesterol and LDL-Cholesterol levels.

Keywords

Metabolic Syndrome, Punjabi community, Hypertension, Cholesterol, Diet, Exercise

Introduction

There is an important role of nutrition and exercise to lead a healthy life to avoid non-communicable degenerative diseases that are emerging as global pandemics in recent years. As per report of IOTF (2010), proportion of problems related to weight gain has reached to endemic levels. Obesity is one of the major risk factor in developing Metabolic Syndrome (Misra & Khurana, 2008). Asian women including India are more prone to weight gain. In Asians including Indians a significantly higher rate has been observed for

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non-communicable diseases like obesity, diabetes, mental illness, heart diseases, hypertension, etc. (Haffner & Taegtmeyer, 2003; Terzic & Waldman, 2011). The Metabolic Syndrome is a group of disorders that may lead to problem of non-communicable diseases (Eckel, 1992; Alberti et al., 2009). Many researchers have shown increasing gradient of Metabolic Syndrome on human population (Beltrán-Sánchez, 2013; Pucci et al., 2017). Unhealthy dietary patterns and a sedentary lifestyle led to rising incidences of non-communicable diseases in affluent societies (Wang et al., 2016). Indian women have been seen to have frequent snacking of high energy foods with imbalanced diet and sedentary lifestyle (Gupta et al., 2004; Misra et al., 2005). Use of ghee and butter is seen to be a common practice of cooking in Punjabi community. In this regards, Deen (2004) provided some practical suggestions to decrease the risk of Metabolic Syndrome as following -

Abnormality	Diet and physical activity interventions
Abdominal obesity	• Reduce weight by reduction in portion size • Increase physical activity by 30 min. of intense activity daily
Hyperglyceridemia	• Reduce total carbohydrate intake & increase intake of low glycaemic index foods by replacing refined carbohydrate with legumes & whole grains • Increase Omega-3 fatty acids by fish consumption • Limit alcohol consumption • Avoid soda and fruits juices
High blood pressure	• Reduce weight by reduction in portion sizes and increase in physical activity • Reduce saturated fat intake by reducing red meat & increase low fat dairy products • Limit salt consumption • Fresh fruits and vegetables are more beneficial • Alcohol consumption need to be limited
Fasting hyperglycemia	• Weight reduction by reduction in portion sizes and increase in activity • Limit carbohydrate consumption by replacing carbohydrate with mono saturated fat • Increase fibre intake (>30g per day) by adding legumes and fruits • Replace refined carbohydrate with legumes, whole grains and mono saturated fats

Table 1: Lifestyle changes in Metabolic Syndrome

Lifestyle modifications have shown a proven benefit in control of symptoms associated with Metabolic Syndrome. Therefore it may prove a cornerstone in the treatment protocol of Metabolic Syndrome. Regular exercise is also associated with reduced android obesity with a more appropriate composition of body. Therefore exercise should be prescribed as a part of treatment.

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Therefore the aim of the research work was planned to provide dietary and exercise interventions to ameliorate the condition of Metabolic Syndrome in female of Punjabi Community belonging to the same geographical area.

Aim

- To use interventional strategies based on nutrition and exercise and study its effect on women of Punjabi community with Metabolic Syndrome

Research Methodology

With a view to achieve goals of the present study, the research methodology was designed into following phases -

- Sample selection: Participants were observed for Metabolic Syndrome using IDF (International Diabetes Federation) criterion
- Intervention: Experimental study design was used dividing the participants into two groups: nutrition-exercise group and control group and then implementation of nutrition-exercise intervention program on the nutrition-exercise group was done
- Statistical analysis of data was done

Phase 1: Sample selection by identification of Metabolic Syndrome

A non-experimental, cross sectional design was adopted to screen 50 females residing at Karol Bagh, New Delhi for Metabolic Syndrome and a structured pre tested questionnaire was used to obtain information pertaining to demographic status and family history of non-communicable diseases and dietary habits.

Criteria for selection of sample

Inclusion criteria

- People of Punjabi community
- Participants between 18 - 55 years of age
- Willingness to participate

Diagnostic criteria: As per International Diabetes Federation (IDF), to recognize Metabolic Syndrome, any 3 out of 5 risk factors have to be deranged

1. Abdominal obesity (high waist circumference)
    - Men≥90cm / 36 inches
    - Women≥ 80cm / 32 inches

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2. Plus any two indicators as given below:
    - High triglycerides: ≥150mg/dL
    - Low HDL cholesterol: <40mg/dL (men)
      <50mg/dL(women)
    - Hypertension:
      Upper BP ≥130 mm Hg
      Lower BP ≥85 mm Hg
    - High fasting blood glucose: ≥100mg/dL

Exclusion criteria

- Participants suffering from medical complications (transient ischemic attack, bypass surgery, kidney diseases), overt cardiovascular disease or diabetes
- Pregnant women
- Age group below 18 years or more than 55 years
- Participants on treatment with drugs that may interfere with test results

The study tenure

- It was done for a six months period in which interventional phase was of three months

Phase1: Screening Punjabis for Metabolic Syndrome

- **Anthropometric assessment**

  To screen females for Metabolic Syndrome, their weight was recorded using a digital weighing balance in minimum clothing and by following standard guidelines to take weight. Formula to calculate BMI is Weight (kg)/ Height (m^2).

  A non-stretchable flexible measuring tape was used to measure waist circumference. Cut off values for waist circumference were based on the study of Misra and Khurana, 2009. Family history of diseases was also noted
- **Biochemical assessment**

  Blood samples were drawn from the mid-cubital vein after 12 hours overnight fast for measurement of lipid and fasting plasma glucose levels. The following biochemical parameters were assessed in the study

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Estimation of plasma glucose levels using the GOD/POD enzymatic method, Serum total cholesterol, triglycerides and HDL-Cholesterol were estimated using enzymatic kit method.

- **Measurement of Blood Pressure**

  It was checked by using an automatic digital BP monitor

Phase 2: Interventional phase:

Out of 50, 17 participants were found to have Metabolic Syndrome as per IDF criterion. These 17 patients were divided into following groups:

- Seven participants were allocated to the control group
- Ten participants as Experimental (nutrition and exercise) group

A pre-test, post-test comparison was done between the two groups.

Experimental procedure

Nutrition and exercise was imparted with the aim of improvement in nutritional status of the Punjabi community, through education on healthy diet habits, elimination of consumption of calorie dense junk foods, promoting physical activity and lifestyle modification.

The combined effect of individualized dietary and exercise was investigated on metabolic syndrome. Experimental group received individualized diet and exercise counselling. Participants were assessed at baseline and after a period of three months for anthropometric, biochemical and dietary parameters. It was hypothesized that people with Metabolic Syndrome obtaining dietary and exercise intervention would show improvement in the assessed parameters.

People diagnosed with Metabolic Syndrome were provided with nutrition, exercise and awareness information on Metabolic Syndrome as shown in figure 1, 2 and 3 respectively as shown below -

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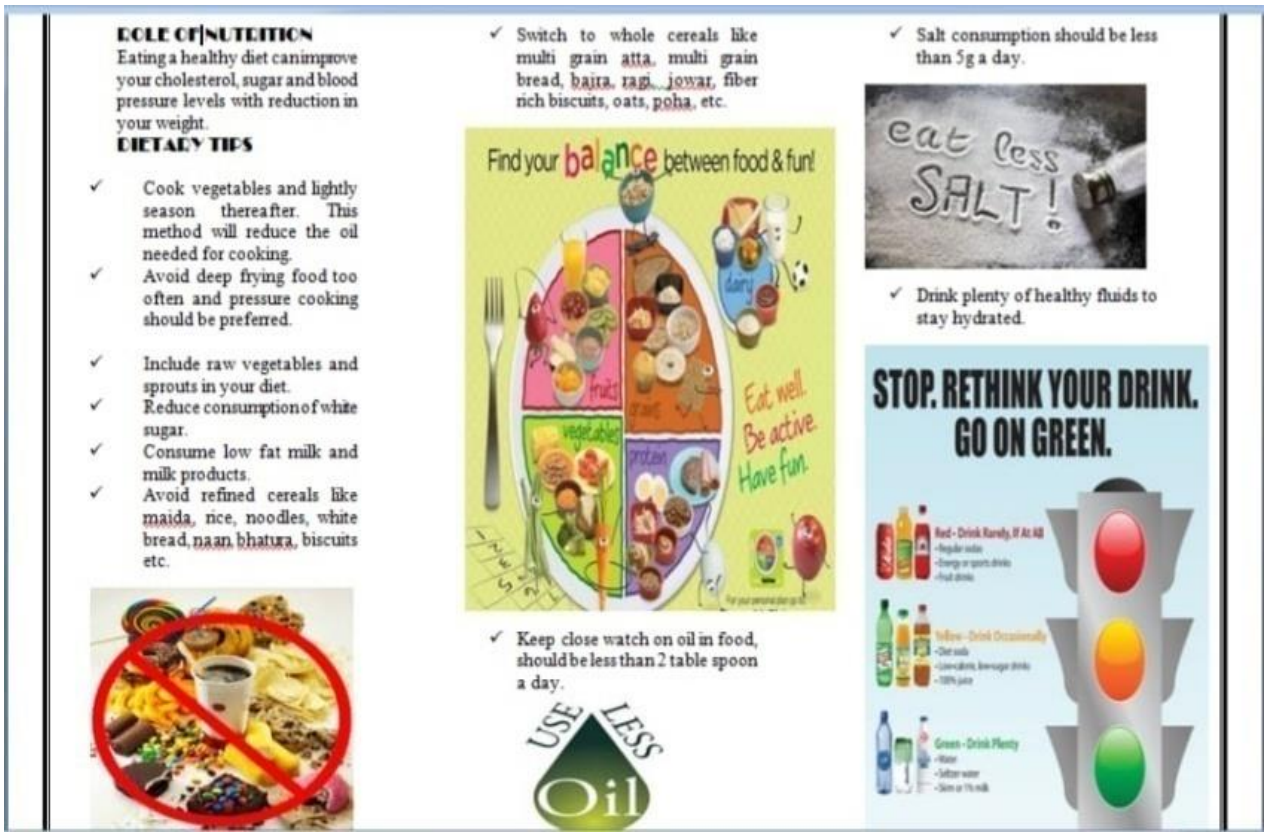

Figure 1: Nutrition pamphlet

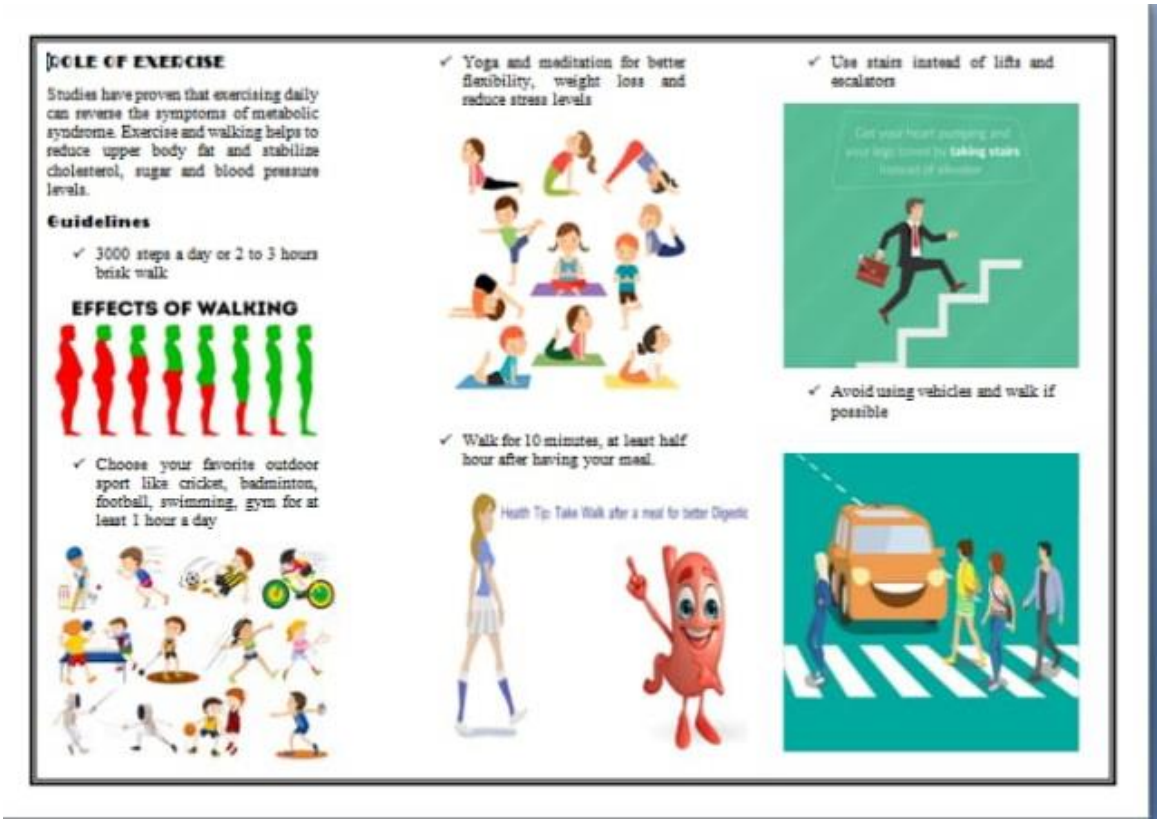

Figure 2: Exercise pamphlet

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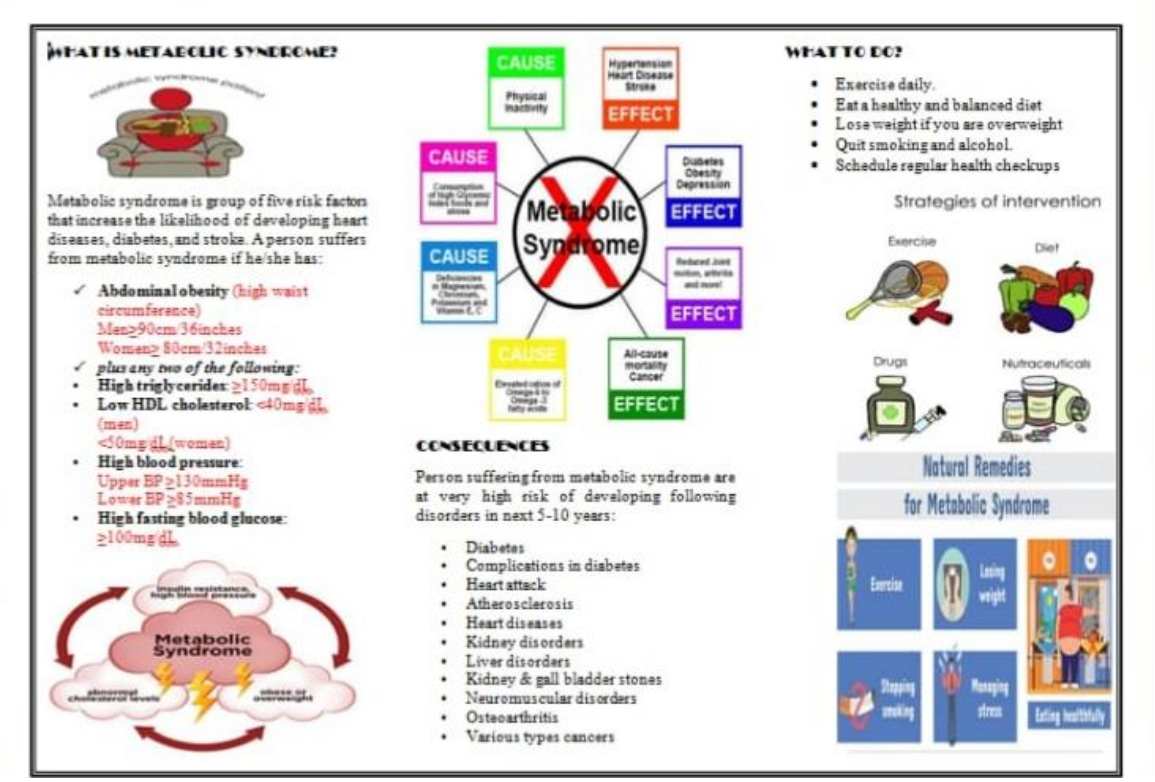

Figure 3: Metabolic Syndrome awareness pamphlet

The counselling sessions were organized for the participants twice every week for a period of three months (90 days). Telephonic reminders and SMS alerts were given regularly to all subjects asking them about their record of dietary habits and exercise done and the individual record was kept to check the progress of the people.

Nutrition Intervention Program

Name: Age: Sex: Location:

Parameters	Pre-intervention diagnosis:	Post-intervention diagnosis:
Weight (Kg)		
Height (cm)		
Waist Circumference (cm)		
Hip circumference (cm)		
Blood Pressure (mm/Hg)		
Total triglycerides (mg/dL)		
HDL cholesterol (mg/dL)		
Fasting blood glucose (mg/dL)		

Table 2. Recording of data to see effect of nutritional intervention

Similar format was use to find out effect of exercise intervention programme.

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Nutritional Counselling (90 days)

Any important considerations in dietary habits:
Recommended type of diet plan:

Sessions	Nutritional Counselling Remarks
1st counselling	
2nd counselling	
3rd counselling	
4th counselling	
5th counselling	
6th counselling	

Table 3: Format for recording data related to nutritional counselling

Overall remarks (if any):

(Response of the participant)

How was this nutrition program helpful in improving your health?
Answer:

Similar format was used for multiple counselling for exercise intervention programme.

Personalized Diet Plan

Name: Age: Sex: Location:

Parameters	
Energy (Kcal/day)	
Protein (g/day)	
Fat (g/day)	
Fibre (g/day)	

Special considerations:

Early morning
Breakfast
Mid-morning
Lunch
Evening
Dinner

Table 4: Format for personalized diet chart

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Recommended eating tips to be considered:

Data monitored through Google fit mobile app

Days	Time	Days	Time	Days	Time	Days	Time
1		24		47		70	
2		25		48		71	
3		26		49		72	
4		27		50		73	
5		28		51		74	
6		29		52		75	
7		30		53		76	
8		31		54		77	
9		32		55		78	
10		33		56		79	
11		34		57		80	
12		35		58		81	
13		36		59		82	
14		37		60		83	
15		38		61		84	
16		39		62		85	
17		40		63		86	
18		41		64		87	
19		42		65		88	
20		43		66		89	
21		44		67		90	
22		45		68			
23		46		69			

Table 5: Data monitored through Google fit mobile app

Type of physical activity used by the participant:

(Response of the participant)

How was this exercise program helpful in improving your health?

Answer:

Format for data recording using Google fit mobile app

The data was systematically recorded as per format shown in table 2 for nutrition and exercise intervention. Personalized diet charts were given to them regularly as per table 4 and to oversee their exercise performance they were asked to install Google Fit app in their android phones and to send screenshots daily. Data was recorded as per table 5.

After the completion of three months they were again assessed to check whether the present hypothesis has been proven right or not.

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Results & Discussion

The data collected has been presented under following headings -

Phase 1: Screening of patients for Metabolic Syndrome

Metabolic Syndrome was considered present in individuals with three or more components. BMI, total-cholesterol and LDL-cholesterol were also measured as these measurements are important indicators of cardiovascular health. Risk factors for metabolic syndrome and cardiovascular disease were considered as 200 mg/dL for total cholesterol and >100mg/dL for LDL-cholesterol with BMI above 24.9 kg/m^2.

Metabolic Syndrome	Number of components present	N=50	Percent
Presence	3	4	8
	4	3	6
	5	10	20
		17	**34**

Table 6: Percent distribution of participants based on the presence or absence of Metabolic Syndrome

Fifty women of Punjabi community residing in Karol Bagh, New Delhi in the age range of 18 - 55 years were analyzed for Metabolic Syndrome. Among 50 participants screened, 17 were found to have Metabolic Syndrome, therefore the prevalence was 34%.

Implementation and evaluation of the nutrition and exercise intervention

Out of 50, 17 participants (18 - 55 years old women) who met the criteria of metabolic syndrome were divided into two groups- one test and one control group. The test group received individualized nutrition and exercise intervention. The another second group served as control group and received only one time education for nutrition and activity pattern. Participants were assessed at baseline and after three months for anthropometric measurements, blood pressure levels, biochemical parameters and dietary intake. It was hypothesized that participants with Metabolic Syndrome obtaining dietary and exercise intervention would show improvement in the assessed parameters.

The demographic profile of the participants who took part in the intervention is presented in table 7.

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Particulars		N=17	%
Age	18-24 years	3	17.64
	24-30 years	4	23.52
	30-36 years	4	23.52
	36-42 years	2	11.76
	42-50 years	2	11.76
	50- 55 years	2	11.76
Marital status	Unmarried	7	41.17
	Married	10	58.82
	Separated	0	0
	Divorced	0	0
	Widowed	0	0
Educational qualification	No schooling	3	17.64
	< primary school	4	23.52
	Primary school completed	4	23.52
	High school completed	2	11.76
	College, pre- university, university degree done	4	23.52
Smoking	Yes	0	0
	No	0	0
Alcohol use	Yes	10	58.82
	No	7	41.17
Physical activity	More than 60 min	3	17.64
	30-60 min	4	23.52
	20-30min	4	23.52
	Less than 20 min	6	35.29

Table 7: Demographic profile of the participants

The demographic profile of the participants presented in table indicates that 23.52 percent of the participants were of age 24-30 years and 30-36 years each, 17.64 percent of the participants lie in the range of 18-24 years and 11.76 percent of the participants are in the age group of 36-42 years, 42-50 years and 50-55 years each. 58.82 percent of the participants were married while remaining 41.17 percent of the participants were unmarried. Fifty seven percent9 participants were studied below college level, while 23.5% participants showed education at graduation or higher level. Seventeen percent of the participants did not even complete any formal schooling. No participants smoked while 58.82 percent participants consumed alcohol. Majority of participants (35.29%) were engaged in physical activity for less than 20 min while only 17.64 percent of the participants were engaged in physical activity for more than 60 min. 23.52 percent of the participants were engaged in 30-60 min and 20-30 min each.

The mean anthropometric measurements, blood pressure levels and biochemical profile of the participants who took part in the intervention is presented in table 8.

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Particulars	Mean ± SD
Age (Years)	45.03±5.53
Height (cm)	163.60±4.78
Body weight (kg)	84.07±10.55
Waist circumference (cm)	96.93±6.52
Body Mass Index (kg/m^2)	28.07±3.75
Systolic blood pressure (mmHg)	134.50±8.4
Diastolic blood pressure (mmHg)	84.25±6.25
Total cholesterol (mg/dL)	188.91±26.83
Triglycerides (mg/dL)	166.36±75.80
HDL cholesterol (mg/dL)	25.50±6.20
LDL cholesterol (mg/dL)	118.025±22.66
Fasting plasma glucose (mg/dL)	126.68±29.08

Table 8: Mean anthropometric measurements, blood pressure levels and biochemical profile of the participants (n=17)

The mean age of the participants was 45.03±5.53 and results presented in the table 8 indicate that mean for BMI and waist circumference was found on a higher side for participants in comparison to normal values. The mean waist circumference was 96.93±6.52 and mean BMI was found 28.07±3.75.The mean systolic and diastolic blood pressure was 134.50±8.4 and 84.25±6.25 respectively which indicates that the participants were in pre hypertensive stage. The lipid profile analysis of the participants showed 188.91±26.83, 166.36±75.80, 25.50±6.20 and 118.025±22.66 levels for total cholesterol, serum triglycerides, HDL cholesterol and LDL cholesterol respectively. The mean fasting glucose level was found to be 126.68±29.08 including glucose intolerance.

Nutrition and exercise intervention - Test group

The participants of test group received an intensive counselling for diet and exercise for a three months period. The intervention was designed to assist individuals in adopting healthy eating behaviours and and an healthy physical activity pattern in daily routine. The nutrition and exercise intervention was carried out on 10 participants. The participants were counselled individually daily on a telephonic conversation. The participants were encouraged to set a long term goal and the impact of the intervention on the anthropometric measurements, blood pressure levels and lipid profile was evaluated at the end of 90 days.

Control group

The control group (7 participants) received only one time general advice regarding the importance of lifestyle modifications for controlling Metabolic Syndrome and the participants did not deviate from their habitual diets.

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The data collected for anthropometry, blood pressure levels, lipid profile and diet intake has been presented under following subheadings:

1. Anthropometric measurements

1.1. Mean values of anthropometry at pre and post intervention phase in test group

The mean values for different anthropometric parameters of the females of Punjabi community in test group at pre and post interventional phase have been presented in table 9.

Anthropometric measurements	Mean ± SD	
	Before	After
Body weight (kg)	84.07±10.55	80.07±6055
Body Mass Index (kg/m^2)	28.07±3.75	24.07±0.75
Waist circumference (cm)	96.93±6.52	92.93±2.32

Table 9: Mean anthropometric measurements of the participants in test group before and after the combined diet and exercise intervention

Table 9 indicates table the combined diet and exercise intervention results in significant changes in anthropometric measurements of the participants.

1.2. Mean values of anthropometry at pre and post intervention phase in test group

These have been presented in table 10 for control group.

Anthropometric measurements	Mean ± SD	
	Before	After
Body weight (kg)	78.09±12.28	79.09±13.28
Body Mass Index (kg/M2)	26.37±3.62	26.67±3.92
Waist circumference (cm)	92.54±6.84	93.01±6.04

Table 10: Mean values of anthropometry at pre and post intervention phase in test group

Table 10 indicates a marginal increase in the mean values in anthropometry of control group. The mean body weight was increased to 79.09 kg from 78.09 kg. The mean body mass index was also increased to 26.67 kg/m^2 from 26.37 kg/m^2. The mean waist circumference of the participants was increased to 93.01 cm from 92.54 cm.

1.3. Comparison of the mean difference in the anthropometric measurements between the intervention groups at the end of the study period

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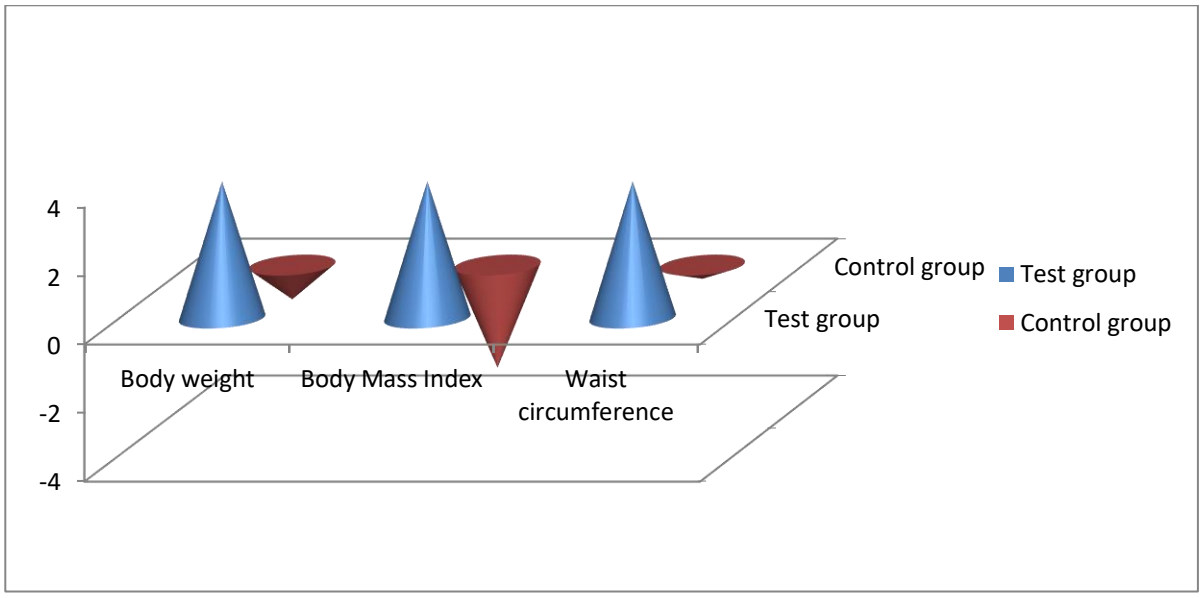

Fig.4: Comparison of the mean difference in the anthropometric measurements between the intervention groups at the completion of study

Comparison of mean anthropometric values showed significant difference when test group was compared to control group. The mean value indicate the diet and exercise intervention helped in significant reductions.

2. Blood Pressure Levels

2.1. Mean blood pressure levels of the participants in test group before and after the combined diet and exercise intervention

The mean blood pressure levels of the participants in test group before and combined diet and exercise intervention is presented in table 11:

Parameters	Mean ± SD	
	Before	After
Systolic blood pressure (mmHg)	119.26±9.54	114.16±4.19
Diastolic blood pressure (mmHg)	86.09±11.351	79.05±12.551

Table 11: Mean blood pressure levels of the participants in test group before and after the combined diet and exercise intervention

Compared to baseline measurements the combined diet and exercise intervention brought about significant reductions in levels of blood pressure. The levels of systolic and diastolic pressure were initially 119.26 mmHg and 86.09 mmHg respectively that decreased to 114.16 mmHg and 79.05 mmHg at the end of the intervention. The significant reduction enabled the participants to move close to the desirable blood pressure levels at the end of the intervention.

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2.2. Mean blood pressure levels of the participants in the control group at initial and final phase of study: It is presented in table 12.

Parameters	Mean ± SD	
	Before	After
Systolic blood pressure (mmHg)	138.48±13.68	139.69±12.02
Diastolic blood pressure (mmHg)	87.69±9.042	89.69±7..003

Table 12: Mean blood pressure levels of the participants in the control group at initial and final phase of study

Table 12 indicates that the participants of the control group were in the pre hypertension category as their baseline blood pressure values were 138.48 mmHg and 87.69 mmHg for systolic and diastolic blood pressures respectively. At last stage of study, these levels increased to 139.69 mmHg for systolic and 89.69 mmHg for diastolic blood pressure, but these changes were not found to significantly significant.

2.3 Comparison of the mean blood pressure at initial and final phase of study: It has been presented in figure 5.

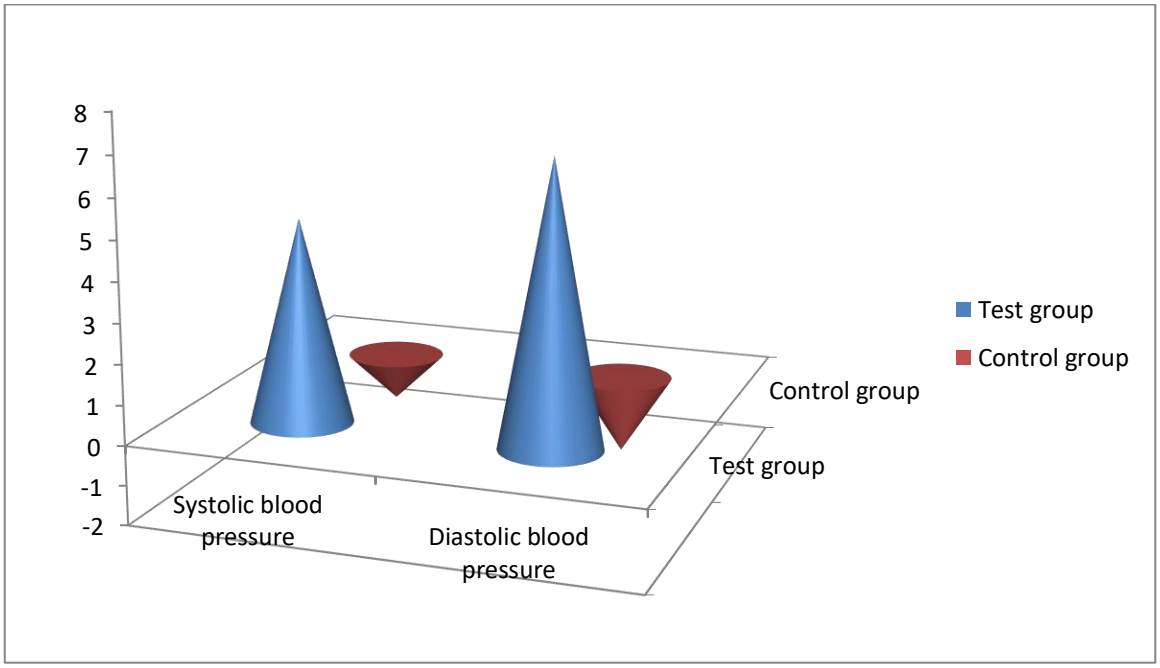

Fig.5.Comparison of the mean blood pressure levels between the two groups at the end of study

It was observed that test group showed a consistent decrease in both systolic and diastolic levels, whereas there was an increase in the blood pressure level at the end of the study period.

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3. Serum Lipid Profile

3.1. Mean values of serum lipid in test group at pre and post intervention phase.

The mean serum lipid values and fasting plasma glucose level of the participants in test group before and after the intervention is presented in table 13

Parameters	Mean ± SD	
	Before	After
Total cholesterol (mg/dL)	181.86±32.809	181.45±30.87
Triglycerides (mg/dL)	118.30±36.484	106.60±20.074
HDL-cholesterol (mg/dL)	30.22±17.586	32.32±16.126
LDL-cholesterol (mg/dL)	116.87±22.358	104.92±19.868
VLDL-cholesterol (mg/dL)	27.74±5.312	25.44±2.312
Fasting plasma glucose (mg/dL)	88.75±14.464	86.75±11.464

Table 13: Serum Lipid data

Lipid profile: Compared to baseline measurements, combined intervention of diet counselling and exercise resulted in significant changes in the lipid parameters. Lipid profile showed significant reduction. Results indicate a significant increase in HDL-cholesterol. Thus results indicate that the combined diet and exercise intervention shows cardio- protective benefits in the participants at the end of the intervention period. It can be said that by maintaining normal body weight through lifestyle modification may become a cornerstone treatment for individuals identified as having dyslipidemia.

Fasting plasma glucose: The combined diet and exercise intervention brought about significant reduction in the plasma glucose levels of the participants in test group.

3.2. Mean values of serum lipid & fasting glucose in control group at pre and post intervention phase.

Serum lipid profile and fasting plasma glucose at pre and post interventional phase have shown in table 14.

Parameters	Mean ± SD	
	Before	After
Total cholesterol (mg/dL)	220.62±36.573	229.32±35.863
Triglycerides (mg/dL)	195.24±92.613	215.0±76.32
HDL-cholesterol (mg/dL)	46.47±17.451	46.02±18.051
LDL-cholesterol (mg/dL)	139.12±33.175	144.02±39.105
VLDL-cholesterol (mg/dL)	47.14±26.531	51.51±33.618
Fasting plasma glucose (mg/dL)	145.46±58.831	149.31±58.981

Table 14: Mean values of serum lipid & fasting glucose in control group at pre and post interventional phase

Lipid profile: Results indicate that the baseline values of all lipid parameters were higher than normal values. Mean serum total cholesterol and serum triglyceride was found to be

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significantly different but Serum HDL-cholesterol level was not found to be significant. Mean LDL and VLDL cholesterol for found to be increased non - significantly.

Fasting plasma glucose: The mean fasting plasma glucose was higher than the cut off value at the starting and it continued to increase till the last stage of the study.

3.3. Comparison of the mean difference in the serum lipid profile & fasting glucose levels between the two groups at the completion of study

The comparison of the mean difference in the serum lipid profile and fasting plasma glucose level between the intervention groups at the completion of study is presented in figure 6.

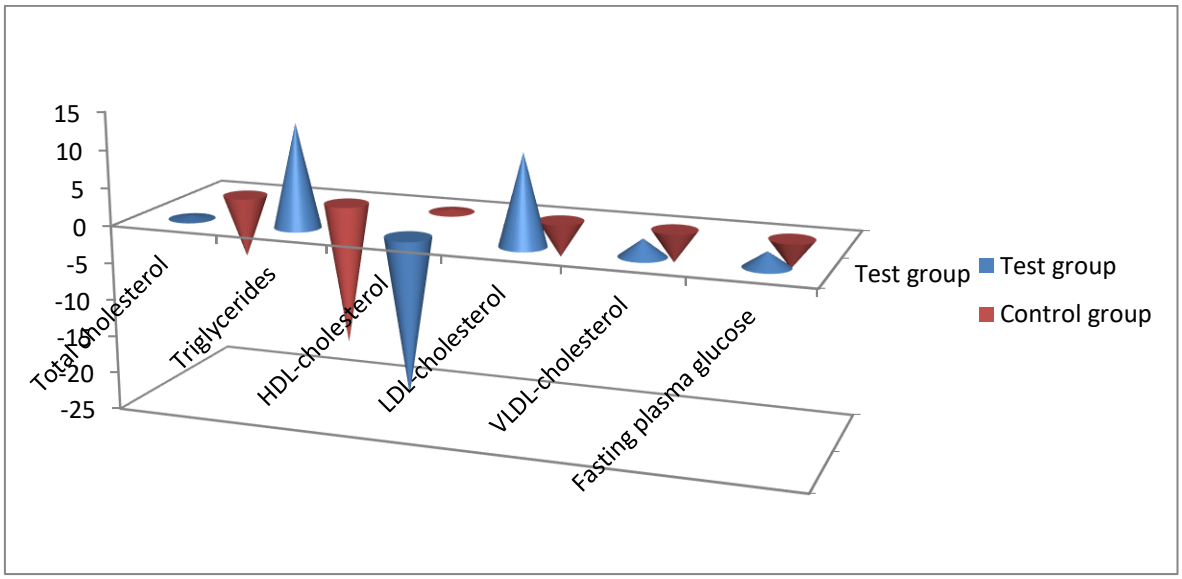

Fig.6:Comparison of the mean difference in the serum lipid profile after completion of interventional phase

The combined intervention plan for diet and exercise exerted remarkable influence in lowering the anthropometric measurements, blood pressure and biochemical tests performed for blood glucose and lipid profile in comparison to control counterparts.

The diet and exercise intervention helped the participants in achieving a better lipid profile and glucose control by better managing their body composition.

4. Comparison of the mean energy and nutrient intake before and after the study period:

The same is been shown in table 15.

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Groups	Nutrient intake	Mean ± SD	
		Before	After
		2584.08±716.96	2294.23±697.64
	Protein (g)	71.94±3.2716	61.94±4.35
	Fat (g)	83.94±48.813	68.40±45.54
	Carbohydrates (g)	371.89±122.45	309.40±57.21
	Fibre (g)	26.64±11.112	33.40±15.70
	Calcium (mg)	588.40±279.22	570.21±250.15
	Iron (mg)	26.7±21.37	20.81±18.31
Control group	Energy (kcal)	2424.35±631.0	2690±695.38
	Protein (g)	73.75±38.58	80.90±27.28
	Fat (g)	75.65±42.4	72.50±43.46
	Carbohydrates (g)	336.70±97.0	357.50±64.0
	Fibre (g)	30.04±14.19	26.95±12.0
	Calcium (mg)	587.30±13.11	561±15.81
	Iron (mg)	29.34±19.47	30.37±18.41

Table 15: Comparison of the energy and mean nutrient intake of the participants before and after the study period

Table 15 indicates that test group showed positive changes in the nutrient intake at the completion of study. Participants of test group, who received diet and exercise intervention showed significant changes in energy, carbohydrate, fat and fibre intake.

Comparison of nutrient intake after completion of intervention phase: It has been presented in table 16.

Energy/ Nutrient intake	Mean difference in the nutrient intake	
	Test group	Control group
Energy (kcal)	289.81±19.32 (decrease)	-265.65±64.38 (increase)
Protein (g)	10±1.228 (decrease)	-7.15±11.3 (increase)
Fat (g)	15.54±3.273 (decrease)	3.15±1.06 (decrease)
Carbohydrates (g)	62.49±65.24 (decrease)	-20.8±33.0 (increase)
Fibre (g)	-6.76±4.588 (increase)	3.09±2.19 (decrease)
Calcium (mg)	18.19±29.07 (decrease)	26.3±2.7 (decrease)
Iron (mg)	5.89±3.06 (decrease)	-1.03±1.06 (increase)

Table 16: Comparison of nutrient intake after completion of intervention phase

Intervention program was aimed at providing awareness on healthy eating habits and adding physical activity such as walking to interfere with the development of Metabolic Syndrome. Results indicate that dietary and exercise intervention provided to subjects of test group showed desirable reduction in total calorie intake, carbohydrate, fat and increase in fibre intake at the end of the study period. This indicates that educating individuals on healthy eating practices such as meeting calorie and nutrient intake can help in bringing a change in one's dietary habits thus decreasing the risk for developing metabolic Syndrome. This supports the results of the present study which is evident in the test group.

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The present study has demonstrated that the individualized dietary intervention by combined dietary and exercise intervention as a non-pharmacological treatment for Metabolic Syndrome may be effective in controlling or alleviating the risk of the individual Metabolic Syndrome components. This clinical trial has shown that a group of participants with Metabolic Syndrome can be promoted to make comprehensive changes in lifestyle. Therefore, lifestyle intervention may be a safe strategy in prevention and treatment of reversal symptoms of metabolic syndrome.

Conclusion

Although lifestyle of Punjabi community is often romanticized, it is inherently demanding community. They have an higher incidence of cardio- metabolic risk components like high blood pressure, dyslipidemia, obesity, diabetes, smoking and sedentary lifestyle. All of which frequently coexist to cause Metabolic Syndrome. This study brings to light the ameliorative role of nutrition and lifestyle on Metabolic Syndrome.

Participants in this study were women of Punjabi community from the Delhi city. Fifty women of Punjabi community of 18-55 years participated in this study. A non-experimental, cross sectional design was adopted and a structured pre tested questionnaire was used to obtain information pertaining to demographic status and family history of non-communicable diseases and dietary habits. To assess the impact of diet and exercise intervention, patients with Metabolic Syndrome were assessed for their relevant anthropometry, blood pressure and lipid profile at the time of initiation and completion of the study.

Seventeen out of 50 participants were tested positive for metabolic syndrome. These 17 participants were divided into two groups: combination of diet and exercise group (10 participants) and control group (7 participants) to evaluate effect of intervention program on Metabolic Syndrome.

Impact of the Diet and Exercise intervention

Test group: Combined diet and exercise counselling was offered to the participants of test group. A significant reduction was seen in anthropometry, blood pressure, fasting glucose levels, at the completion of intervention.

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Control group: In the control group, undesirable changes in all the risk factors were found at the completion of study. Remarkable increase in anthropometric measurements, serum cholesterol, triglyceride, LDL & HDL-C and fasting blood sugar was observed. Further, non-significant increases in LDL-C, VLDL-C and blood pressure was observed.

A higher percent reduction in serum cholesterol, LDL-C, triglyceride, HDL-C, fasting blood sugar, systolic and diastolic blood pressure was observed among subjects of test group. On the contrary, anthropometric measurements, blood pressure levels and biochemical profile increased in the control group at the completion of study.

The research work demonstrates that lifestyle modifications brought about by individualized nutritional counselling, motivation to be physically active and follow a healthy lifestyle are able to reverse or lower the incidence and severity of Metabolic Syndrome and CVD within a relatively brief period of time. The combined diet and exercise intervention was effective in treatment of Metabolic Syndrome.

Strength of the study:

In this study all the cardio-metabolic risk factors were assessed using standardized anthropometric and clinical parameters rather than relying on self- reported measures thus eliminating concerns about reporting bias. The individualized approach that was adopted in the dietary intervention to motivate the participants to make changes in the lifestyle habits is also a significant aspect of the study.

Limitations of the study:

The intervention could have been implemented for longer duration.

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