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Effect of Managing Metabolic Syndrome on Reversing Selected Determinants among Patients with Metabolic Syndrome

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Abstract: Metabolic syndrome (MetS) prevalence is greedily increasing; fortunately, managing determinants of unhealthy intake, inactivity, obesity, hypertension, and hyperlipidemia can reverse the problem. **Purpose:** To evaluate effect of managing metabolic syndrome on reversing selected determinants among patients with metabolic syndrome. **Methods:** A purposive sample of 100 patients were selected. **Setting:** Medical and diabetic out-patients' clinics in Menoufia University Hospital, Egypt. **Design:** A quasi-experimental design was utilized. **Instruments:** Five instruments were used including: characteristics of patients structured interviewing questionnaire, food frequency questionnaire, international physical activity questionnaire short form, self-reported compliance sheet, and metabolic syndrome determinants' diagnostic evaluation sheet. **Results:** Intake of coffee, fat, sweets, and processed meat was reduced from 42%, 43%, 46%, and 60% preintervention to 6%, 10%, 14%, and 5%, respectively, postintervention, by six months. patient's percent who practiced physical activity and walking preintervention were 6% and 3%, then increased to 86% and 49%, respectively, postintervention by six months. Moreover, triglycerides and fasting blood glucose were reduced from 74% and 42% pre-intervention to 3% and 14%, respectively, six months post-intervention. **Conclusions:** Managing metabolic syndrome determinants helped the patients to be more physically active, eat healthier foods, reduce their waist circumferences, blood triglyceride, low-density lipoprotein, and total cholesterol, and smoke fewer cigarettes each day. They also maintained regular laboratory check-ups, with physiological measurements monitored. This eliminated the three modifiable MetS determinants, and patients became with two instead of five MetS determinants. **Recommendation:** Determinants management should be applied to all patients with metabolic syndrome, utilizing this the study steps.

Key words: *managing metabolic syndrome, and reversing selected determinants.*

Operational definitions:

1) Managing metabolic syndrome: Introducing a nursing-led educational and training program consisted of consuming healthy, proper intake, being physically more active, reducing their weight, blood bad lipids, smoking cigarettes/day, and regular periodical laboratory check-ups with monitoring of physiological measurements.
2) Reversing selected determinants: Eliminating the three modifiable MetS' determinants, including abdominal obesity, elevated triglyceride, and reduced high-density lipoprotein levels.

Introduction

Metabolic Syndrome (MetS) is the presence of any three out of five determinants, include obesity around the abdomen, high blood pressure, increased TG (TriGlyceride), hyperglycemia, and a reduction in HDL (high-density lipoprotein) level. In contrast, metabolic health indicating those without or with ≤ 2 MetS' determinants (Buono et al., 2020). Numerous diseases' risk as diabetes mellitus, cardiovascular disorders and cancer increases with MetS. Its development usually duplicated when risk factors number increases, individual with even single risk factor should be classified as metabolically unhealthy. In the presence of one or two risk factors, the adjusted MetS hazard ratios are elevated 3–16 times more than in people without risk variables (Klitgaard et al., 2020).

Modifiable determinants such as obesity, hyperlipidemia, sedentary life and access to inexpensive unhealthy intake are involved in the pathogenesis of MetS (Amirfaiz & Shahril 2019 and Fabiani et al.,2019). Nurses play an important role in managing modifiable determinants by guiding, educating and coaching patient about prevention, reversion, monitoring and inhibition of disease complication. So, all patients should be complied with the nursing led intervention of how to manage their stress, associated comorbidities, obtain adequate sleep hours, engage in physical activity allover week days, gradually lose weight, correct their lipid profile (TG, HDL-CHOL) and abdominal obesity, stop smoking and monitor their blood glucose level and blood pressure (Diabetes. Co.uk, 2019).

Individualized intake is the first determinant that will reverse a patient's condition when they adjust their rate and improve their component quality with increased activity. The first reasonable goal is to lose 10% of weight, followed by gradual weight reduction to reduce coagulation activation factors (Razavi et al., 2020). Food-saturated fat must be omitted with an allowance of only 7% unsaturated fat. Also, diabetic-matched complex carbohydrate with high fiber is recommended because high carbohydrate, especially the simple type, will worsen the problem (Pletsch-Borba et al., 2021). Activity determinants are beneficial for MetS caloric balance, reduce insulin resistance, and increase physical fitness. In relation to comorbidity control, hypertension is modified through favorable Na intake, weight

reduction, and decreased saturated fat and caffeine (Balasubramaniam & Hewlings, 2021).

Most MetS patients complain of impaired fasting glucose, glucose intolerance, or being prediabetics, so the goal is to prevent the conversion of these disorders to diabetes through a 10% weight reduction with an elevation of activity level to at least 150 minutes per week of moderate activity. This will cut the conversion cycle to diabetes in half. But for patients who are already diabetics, they must keep their HbA1c level less than 7%, avoiding hypoglycemia, as it is a life-threatening problem. Compliance with continuous monitoring will also decrease the macro- and microvascular diseases' risk (Babagoli et al., 2021).

Significance of study:

Egyptians have a high prevalence (55%) of metabolic syndrome; 85.6% of cases are found among diabetics, and 76.6% are found among hypertensive patients (Bassyouni etal., 2023). Determinants management are frequently used to prevent MetS, but nothing is known about using the same management technique to reverse/eliminate MetS determinants that has already occurred. Thus, the purpose of this study was to evaluate effect of managing metabolic syndrome on reversing selected determinants among patients with metabolic syndrome.

Purpose of study:

To evaluate the effect of managing metabolic syndrome on reversing selected determinants among patients with metabolic syndrome.

Hypotheses:

- Patients who apply the metabolic syndrome management plan are expected to have a healthier intake rate and components post-intervention than pre-intervention.
- Patients who apply the metabolic syndrome management plan are expected to have a higher level of physical activity post-intervention than pre-intervention.
- Patients who apply the metabolic syndrome management plan are expected to be more adherent to regular laboratory and physiological monitoring post intervention than pre intervention.
- Patients who apply the metabolic syndrome management plan are expected to have fewer determinants post intervention than pre intervention.

Methods

Design :

Quasi-experimental research design (one group pre- and post-test).

Setting:

Medical and diabetic outpatients' clinics of Menoufia University Hospital, Egypt.

Sampling:

A purposive sample of 100 patients with the following inclusion criteria were selected

- Adults of both genders
- Having the five Met'S determinants of abdominal obesity, hypertension, hyperglycemia, elevated triglyceride, and decreased high-density lipoprotein levels.
- Adhering to follow-up appointments.

- Cooperative and able to interact.
- Without psychiatric disorders.

Exclusion criteria

- Unable to engage in physical activity to avoid motion hazards.
- Pregnant to avoid maternal or fetal hazards
- Comply with medications or a diet for weight loss as they may influence the results of the study.

Sample size calculation

The calculated sample size was 100 participants based on the study practical phase, which was conducted over the course of two months, with a total of around 134 cases during this time. The patient flow rate was approximately 50 patients per month. The following formula was used by Epi Info Program 7 to determine the sample size with a power of 80% and a confidence level of 95%.

Sample size

$$n = [DEFF*Np(1-p)] / [(d2/Z21-\alpha/2*(N-1) +p*(1-p)]$$

where **N** is the population size, **p** is the hypothesized frequency of the outcome factor in the population, **d** is confidence limits, and **DEFF** is the design effect (for cluster surveys).

Instruments:

Instrument one: Characteristics of patients structured interviewing questionnaire:

It was designed by researchers rely on reviewed related literature (Suliga et al., 2022) to assess the bio-demographic data of the studied patients. It included age, sex, educational level, job nature, disease onset, the numbers of smoked cigarettes / day, and family history.

Instrument Two: Food Frequency Questionnaire (FFQ):

It was adopted from Dehghan et al. (2012) to assess the intake rate and components. It consisted of seven groups, including whole grains, red and processed meat, fruit and vegetables, sweets and sugar, animal fats, coffee, and alcohol intake.

Scoring system:

With respect to the overall daily total intake, each group had a Likert scale of three-points: One (given low score), two (given moderate score), and three (given high score). Then the total score was categorized as 1–7 (low intake), 8–14 (moderate intake), and 15–21 (high intake).

Instrument Three: International Physical Activity Questionnaire Short Form (IPAQ-SF):

It was adopted from Oh et al. (2017) to measure the hours of physical activity, walking, sitting, and sleeping at night / day.

Scoring system:

Each variable was on a three-point Likert scale. One for low, two for moderate, and three for high activity level. Then the total activity level score was categorized as low (1–4), moderate (5-8), and high (9–12).

Instrument Four: Self-reported compliance sheet:

It was adopted by Ali et al., (2017) to evaluate patients' compliance with the given interventions of intake rate and

components, activity level, regular periodical laboratory checkups, and monitoring blood pressure.

Scoring system:

For each variable, a two-point Likert scale was used. One for compliance to some extent, and two for complete compliance with the given interventions.

Instrument Five: Metabolic syndrome determinants' diagnostic evaluation sheet:

Including anthropometric measurement (WC), physiological measurement (SBP and DBP), and laboratory investigation (FBG, HDL-CHOL, and TG) pre- and post- intervention by three and six months.

Instruments validity and reliability :

Validity:

Instruments' face and content validity were tested by a jury of five experts in medical surgical and family and community health nursing at the Faculty of Nursing, Menoufia University. The instruments were assessed for clarity, accuracy, relevance, competency and completeness and their recommended modifications were taken into consideration.

Reliability

The reliability of the five instruments was examined using Cronbach's co-efficiency alpha to find out the extent to which the instruments' elements were related to one another. The estimated reliability of instruments I, II, III, IV and V was 0.95, 0.89, 0.93, 0.85 and 0.93 respectively. As a result, it is possible to conclude that the instruments are highly reliable.

Ethical Considerations

- Formal approval was obtained from the Research and Ethics Committee at the Faculty of Nursing at Menoufia University. (No 847). Also, official permission was obtained from the authorities of the diabetic and medical outpatient clinics after explaining the purpose of the study and method of data collection
- Formal written consent was obtained from patients regarding their acceptance to participate in this study after explaining the purpose of the study. Patients were reassured about the confidentiality of their information that will used only for study. Also, the researchers reassured patients their participation in the study was entirely voluntary and that the that the anonymity of their data would be protected through its coding. Also, patients were informed that refusal to participate would not affect their care.

Pilot study:

Prior to data collection, a pilot study was done on 10 patients (10%) to assess the usability and clarity of the instruments. Necessary refinement had been made, participants in the pilot study were excluded.

Procedure:

An official letter was sent from the Dean of the Faculty of Nursing at Menoufia University to the directors of diabetic and medical outpatient clinics after explaining the purpose of the study and method of data collection.

Data collection started from January 2023, to September 2023 through four phases:

- **Assessment phase:**

❖ All patients were interviewed in the outpatients' clinics in two days / week (Monday and Wednesday), with each day about 5 to 7 patients with approximately 10-15 patients / week and 50 patients / month. Depending on the patient's educational level and comprehension, each interview lasted between 35 to 45 minutes.

❖ The patient's database was collected using all structured instruments: - a structured interviewing questionnaire, an international physical activity questionnaire short form (IPAQ-SF), a self-reported compliance sheet and a metabolic syndrome determinants' diagnostic evaluation sheet.

❖ Waist circumference was measured by measuring tape taken midway between the lowest rib and the iliac crest. A blood sample was obtained from the antecubital vein while the patient was in the setting position after fasting for at least 8 hours and sending a laboratory test for lipid profiles and FBG. Also, measure blood pressure while the patient is in a sitting position with the blood pressure apparatus at the heart level.

❖ The researchers obtained patients telephone numbers. This phase lasted for two months.

- **Planning phase:**

❖ With respect to the priority of care, goals were set and a health education program was planned. An illustrative structured colored booklet is used for guidance about Met'S relevant information and reversing interventions. For patients who cannot read or write, pictures were used to clarify instructions.

- **Implementation phase:**

❖ Patients divided for groups, ten for each. The determinants' content was provided in 5 sequential sessions. Every session is conducted two days / week.

❖ The 1st session was used to inform patients with Met'S definition, modifiable determinants/ risks factors, manifestations, required investigations, diagnostic criteria, complications and how the determinants management is reversing their metabolic syndrome. The 2ed session included detailed healthy intake (component and rate) for prevention or /and managing diabetes or/and hypertension. Also reversing hypercholesterolemia, obesity and such reversed risk factors. The seven groups of intakes were included 1. Whole grains such as cereals, dark bread, groats and oats. 2. Processed red meat: In which consumption of beef, pork, liver, Franks, ham, bacon ,sausage and such foods were analyzed. 3. Fruit and vegetables: As apples, bananas, oranges, green leafy vegetables, broccoli, beetroots, raw cabbage, carrots, garlic, onions, and tomatoes. 4. Sweets and sugar: As cookies, chocolate, cakes, candies, sweetened juices, and soft drinks. 5.Animal fats: As lard and butter.6. Coffee intake: Measured by serving (250 ml cup) / day. 7. Alcohol

intake: Estimating the consumption average of alcohol and the frequency of its use for both genders.

- ❖ The 3ed session included increasing patients' activity and exercise performance for losing excess weight, maintain healthy weight and maintain physical fitness. For example, home physical activities include walking for 30 to 45 minutes / day and recording exercise for self-monitoring. The 4th session was about periodical laboratory checkups and measuring blood pressure
- ❖ The 5th session included behavioral modification to reduce anxiety and help in problem solving, smoking cessation or reduction, and coffee moderation 2-3 servings of regular brewed coffee/ day limited to less than 100 mg.
- ❖ At the beginning of each session, the researchers reviewed previous sessions, then started the new topic. Furthermore, the researchers permitted patients to ask any question to reinforce the program application. Phone calls, were conducted with patients to ensure that they followed the discussed health recommendations.

- **Evaluation phase:**

- ❖ Two post intervention tests were conducted. The first one was after 3 months and second test was after 6 months. The same assessment instruments were utilized.

Statistical analysis

Data was collected, tabulated and statistically analyzed using IBM personal computer with Statistical Package of Social Science (SPSS) version 22 (SPSS, Inc, Chicago, Illinois, USA). Quantitative data was presented in form of mean, standard deviation (SD) & range while qualitative data was presented as numbers and percentages. Marginal homogeneity test and McNemar test were used for association between qualitative variables. Wilcoxon signed rank test (nonparametric test) used for comparison between two related groups not normally distributed having quantitative variables. A statistically significant difference was considered if P value <0.05. A highly statistically significant difference was considered if P<0.01 and a very highly statistically significant difference was considered if P P<0.001 (Yang et al., 2012)

Results

Table 1 represents that mean age of the studied patients was 47 years, with about two-thirds of them (63%) being female, but less than half of them (47%, 45%) were housewives and middle-educated, respectively. Also, more than two-thirds of them (73%) had a positive family history.

Table 2 illustrates that intake of coffee as well as fat, sweets/sugar, and processed meat was reduced from 42%, 43%, 46%, and 60% preintervention to 6%, 10%, 14%, and 5%, respectively, postintervention, by six months, with a very high statistically significant difference at P <0.001. On the other hand, the percent of studied patients who consumed

whole grains and fruits / vegetables increased from 4% and 10% preintervention to 62% and 73%, respectively, postintervention, by six months, with a very high statistically significant difference at P <0.001. In sum, total intake of coffee, fat, sweets/sugar, and processed meat decreased from 45% preintervention to 10% six months postintervention, while total intake of whole grains and fruits / vegetables increased from 20% preintervention to 68% six months postintervention, with a very high statistically significant difference at P <0.001. The first hypothesis was supported by these results.

Table 3 explains that the percent of studied patients who practiced physical activity and walking preintervention were 6% and 3%, then increased to 86% and 49%, respectively, postintervention by six months, with a very high statistically significant difference at P <0.001. On the other hand, their percent was reduced from 19% and 9% preintervention to 14% and 6% postintervention by six months, with a high statistically significant difference in relation to sitting and sleeping ≥ 9 hours/night. The second hypothesis was supported by these results.

Figure 1 shows that the percent of smoked cigarettes per day decreased from 8 cigarettes per day to 4 cigarettes per day postintervention by six months, with a very high statistically significant difference at P <0.001.

Figure 2 displays that more than three-quarters of the studied patients 78% and 81% completely complied with the recommended intake rate and activity level, respectively. Also, more than two-thirds of the studied patients, 73% and 67%, completely complied with periodical laboratory check-ups and blood pressure monitoring, respectively. The third hypothesis was supported by this result.

Table 4 reports that in relation to waist circumference, the percent of studied males and females was reduced from 54.1% and 68.3% pre-intervention to 18.9% and 15.9% post-interventions by six months, respectively, with very high statistically significant differences (p value <0.001). Also, patients' percent was reduced from 74% and 42% pre-interventions to 3% and 14% post-interventions by six months regarding triglycerides and fasting blood glucose level, respectively, at p value <0.001. Moreover, 63% and 60% of patients pre-interventions had systolic and diastolic hypertension, but post-intervention, by six months, the percent was reduced to 20% and 23%, respectively, with very high statistically significant differences. The fourth hypothesis was supported by these results.

Table 5 shows a very high statistically significant negative correlation between FBG, SBP, DBP and patients' activity level, periodical laboratory checkups, and blood pressure monitoring, respectively. On the other hand, there was a very highly statistically significant positive correlation between female HDL and periodical blood pressure monitoring at P value of 0.001.

Table (1): Characteristics of studied patients (N=100):

Variables	Studied group	
	No.	%
Age / years (Mean ±SD)	47.2±7.89	
Gender		
• Male	37	37.0
• Female	63	63.0
Educational level		
• Illiterate & basic	30	30.0
• Secondary	45	45.0
• University & above	25	25.0
Job		
• Required physical effort	11	11.0
• Required mental effort	42	42.0
• Housewife/not work	47	47.0
Disease onset		
• <5 years	16	16.0
• 5 – 10	52	52.0
• ≥ 10 years	32	32.0
Family history		
• + Ve	73	73.0
• – Ve	27	27.0

No: number %: percentage.

Table (2): Intake rate and components among studied patients throughout study phases. (N=100)

Variables	Pre-intervention	After 3 months	After 6 months	MH	P value
	No (%)	No (%)	No (%)		
Whole grains					
• Low	90(90.0)	1010.0)	8(8.00)	13.5	P1:<0.001*
• Moderate	6(6.00)	27(27.0)	30(30.0)	13.3	P2:<0.001*
• High	4(4.00)	63(63.0)	62(62.0)	1.21	P3:0.412
Red/processed meat					
• Low	6(6.00)	54(54.0)	65(65.0)	9.55	P1:<0.001*
• Moderate	34(34.0)	36(36.0)	30(30.0)	11.2	P2:<0.001*
• High	60(60.0)	10(10.0)	5(5.00)	2.23	P3:0.021*
Fruit &vegetables					
• Low	51(51.0)	4(4.00)	4(4.00)	9.45	P1:<0.001*
• Moderate	39(39.0)	36(36.0)	23(23.0)	10.1	P2:<0.001*
• High	10(10.0)	60(60.0)	73(73.0)	3.12	P3:0.034*
Sweets &sugar				7.88	
• Low	10(10.0)	63(63.0)	70(70.0)	8.18	P1:<0.001*
• Moderate	44(44.0)	23(23.0)	16(16.0)	1.15	P2:<0.001*
• High	46(46.0)	14(14.0)	14(14.0)		P3:0.165
Animal fats					
• Low	32(32.0)	58(58.0)	77(77.0)	7.85	P1:<0.001*
• Moderate	25(25.0)	32(32.0)	13(13.0)	8.12	P2:<0.001*
• High	43(43.0)	10(10.0)	10(10.0)	4.35	P3:<0.001*
Coffee intake					
• None	17(17.0)	36(35.0)	37(37.0)	20.8	P1:<0.001#
• ≤ 2 serving/ day	41(41.0)	57(57.0)	57(57.0)	28.1	P2:<0.001#
• >2 serving /day	42(42.0)	6(6.00)	6(6.00)	3.22	P3:0.213

Alcohol intake	**Male (N=37)** • None • <30 g • ≥30g	 34(91.9) 3(8.10) 0(.00)	 34(91.9) 3(8.10) 0(0.00)	 34(91.9) 3(8.10) 0(0.00)	0.00	**1.00**
	Female(N==63) • None • <15 g • ≥15g	 63(100) 0(0.00) 0(0.00)	 63(100) 0(0.00) 0(0.00)	 63(100) 0(0.00) 0(0.00)	0.00	**1.00**
Total intake score (1-21)						
• **Low (1- 7)** • **Moderate (8-14)** • **High (15-21)**		45(45.0) 35(35.0) 20(20.0)	12(12.0) 33(33.0) 55(55.0)	10(10.0) 22(22.0) 68(68.0)	10.8 11.2 4.54	P1:<0.001* P2:<0.001* P3:0.003*

*: Significant MH: Marginal homogeneity test. # : Significant Wilcoxon test
P1: Comparison between before and after 3 months
P2: Comparison between before and after 6months
P3: Comparison between after 3 months and after 6months

Table (3): Studied patients' activity level throughout study phases. (N=100):

Variables	**Pre-intervention**	**After 3 months**	**After 6 months**	**MH**	**P value**
	No (%)	**No (%)**	**No (%)**		
Physical activity					
• 30min - 1 hour	37(37.0)	14(14.0)	14(14.0)	8.25	**P1:<0.001***
• > 1 hour - 2hours	57(57.0)	23(23.0)	0(0.00)	8.60	**P2:<0.001***
• >2hours / day	6(6.00)	63(63.0)	86(86.0)	5.98	**P3:<0.001***
Walking					
• ≤ 30 min	51(51.0)	14(14.0)	14(14.0)	7.34	**P1:<0.001***
• 30min – 1 hour	46(46.0)	66(66.0)	37(37.0)	8.79	**P2:<0.001***
• >1 hour /day	3(3.00)	20(20.0)	49(49.0)	5.38	**P3:<0.001***
Sitting					
• <3 hours	24(24.0)	57(57.0)	75(75.0)	5.72	**P1:<0.001***
• 3– 6 hours	57(57.0)	29(29.0)	11(11.0)	6.69	**P2:<0.001***
• >6 hours / day	19(19.0)	14(14.0)	14(14.0)	4.24	**P3:<0.001***
Sleep duration					
• < 7 hours	29(29.0)	43(43.0)	50(50.0)	4.12	**P1:<0.001***
• 7 – 8 hours	62(62.0)	51(51.0)	44(44.0)	4.89	**P2:<0.001***
• ≥ 9 hours /night	9(9.00)	6(6.00)	6(6.00)	2.64	**P3:0.008***
Total physical activity score (1-12)					
• Low (1-4)	56(56.0)	14(14.0)	8(8.00)	4.86	**P1:<0.001***
• Moderate (5-8)	35(35.0)	65(65.0)	62(62.0)	4.74	**P2:<0.001***
• High (9-12)	9(9.00)	21(21.0)	30(30.0)	2.54	**P3:0.005***

Figure (1): Patient's smoked cigarette per day throughout the study phases. (N=100):

Figure (2): Patient's compliance with determinants management throughout the study phases. (N=100):

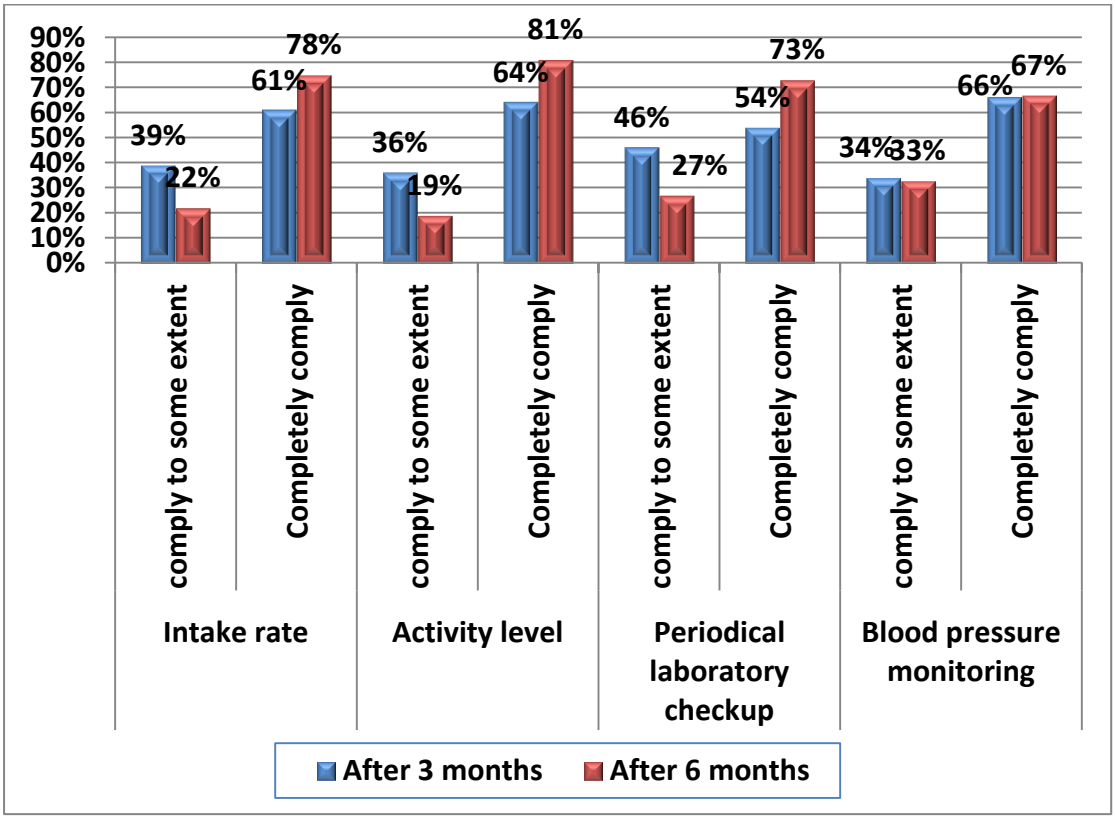

Table (4): Determinants of metabolic syndrome among studied patients throughout the study phases (N=100):

Variables		Pre-intervention	After 3 months	After 6 months	MN	P value
WC	**Male (♂)**					
	• **< 102**	17(45.9)	26(70.3)	30(81.1)	22.1	**P1:<0.001***
	• **≥102**	20(54.1)	11(29.7)	7(18.9)	30.0	**P2:<0.001***
					1.65	P3:0.125
	Female (♀)				33.3	**P1:<0.001***
	• **< 88**	20(31.7)	33(52.4)	53(84.1)	28.2	**P2:<0.001***
	• **≥ 88**	43(68.3)	30(47.6)	10(15.9)	25.0	**P3:<0.001***
HDL-CHOL	**Male**				22.1	**P1:<0.001***
	• **< 40mg/dl**	31(83.8)	14(37.8)	37(100)	28.0	**P2:<0.001***
	• **≥ 40mg/dl**	6(16.2)	23(62.2)	0(0.00)	22.1	**P3:0.008***
	Female				28.0	**P1:<0.001***
	• **< 50mg/dl**	39(61.9)	17(27.0)	6(9.50)	29.0	**P2:<0.001***
	• **≥ 50mg/dl**	24(38.1)	46(73.0)	57(90.5)	27.5	**P3:<0.001***
TG					35.0	**P1:<0.001***
• **<150mg / dl**		26(26.0)	63(63.0)	97(97.0)	69.0	**P2:<0.001***
• **≥150mg/dl**		74(74.0)	37(37.0)	3(3.00)	32.0	**P3:<0.001***
FBG					26.0	**P1:<0.001***
• **<100mg /dl**		35(35.0)	58(58.0)	86(86.0)	48.0	**P2:<0.001***
• **≥100mg/dl**		65(65.0)	42(42.0)	14(14.0)	26.3	**P3:<0.001***
SBP					25.0	**P1:<0.001***
• **<130 mmHg**		37(37.0)	64(64.0)	80(80.0)	41.0	**P2:<0.001***
• **≥ 130mm Hg**		63(63.0)	36(36.0)	20(20.0)	41.0	**P3:<0.001***
DBP					25.0	**P1:<0.001***
• **<85 mmHg**		40(40.0)	67(67.0)	77(77.0)	33.0	**P2:<0.001***
• **≥ 85mm Hg**		60(60.0)	33(33.0)	23(23.0)	35.0	**P3:<0.001***

WC: waist circumference, HDL: High density lipoprotein cholesterol, TG: Triglyceride, FBG: Fasting blood glucose, SBP: systolic blood pressure & DBP: diastolic blood pressure.

Table (5): Correlations between patients' compliance and metabolic syndrome determinants:

Variables		Intake rate and components		Activity level		Periodical laboratory checkup		Periodical blood pressure monitoring	
		r	P value	R	P value	R	P value	r	P value
WC	**Male**	-0.011	0.935	0.191	.0134	0.203	0.111	-0.233	0.078
	Female	-0.189	0.284	0.078	0.253	-0.280	0.108	-0.199	0.258
HDL	**Male**	-0.045	0.568	-0.078	0.352	-0.074	0.563	-0.086	0.153
	Female	-0.055	0.678	-0.094	0.480	-0.002	0.988	0.532	**0.001***
TG		-0.048	0.635	0.085	0.399	-0.157	0.118	-0.126	0.212
FBG		0.006	0.956	-0.760	**0.001***	-0.534	**0.001***	-0.283	**0.004***
SBP		-0.036	0.721	-0.586	**0.001***	-0.372	**0.001***	-0.351	**0.001***
DBP		0.003	0.973	-0.523	**0.001***	-0.310	**0.002***	-0.384	**0.001***

*Significant

Discussion

Physical activity, healthy intake's rate and components, ideal body weight, and healthy behaviors are key determinants for managing MetS. Nurses are responsible not only for educating patients with services in clinical practice but also for coaching them on how to eliminate the modifiable determinants (Wang et al., 2019).

Regarding MetS determinants, the present study found more than half of the studied patients were hypertensive, had increased waist circumference and the majority of them were having elevated fasting blood glucose, low HDL and elevated triglyceride levels. This was consistent with results of Ibrahim et al.,(2020) entitled "Effectiveness of Nurse-Led Lifestyle Intervention on Outcomes of Metabolic Syndrome Patients " which illustrated that more than half of studied subjects were hypertensive , most of them having increased of FBG level, more than half of men and majority of women were having increased waist circumference , more than half of men and half of women were having low HDL cholesterol, more than half of the studied subjects were having elevated triglyceride levels .The cause may be MetS characteristic which include co-existence of central obesity, hypertension, hyperglycemia and dyslipidemia.

In relation to determinants management intervention; the current study found a significant improvement in healthy intake rate and components after three and six months of program application, with respect to reduction in daily intake of processed meat, coffee, fat and cigarettes with increased intake of whole grains, fruits and vegetables. This was in congruent with Zujko et al., (2021)study entitled "Individual diet modification reduces the metabolic syndrome in patients before pharmacological treatment", which found that participants' nutritional education was effective in improving their knowledge, practice of intake and activity levels with significant effect on reducing some MetS risk factors. Furthermore, Suliga et al., (2022)in a study entitled "Lifestyle elements and risk of metabolic syndrome in adults", found elevated odds of not having metabolic syndrome, prevention of MetS (≥3 components) with reversion of metabolic risk factors after reducing saturated fat to < 2 servings/day , coffee cups ≤ 2 / day, ethanol/ day to <30 and sitting time to <6 hours/day .

Concerning activity level, results revealed elevated percent of patients performing moderate to vigorous activity post intervention by six months with high statistically significant difference. This finding was similar to Tan et al., (2023) in their study titled "Effects of exercise training on metabolic syndrome risk factors in post-menopausal women" who stress the non-pharmacological benefits of elevated regular activity level that improve the MetS risk parameters with the spanned interventions 8–10 weeks.

On the other hand, patient's percent was reduced six months post intervention with high statistically

significant difference in relation to sitting time > 6 hours /day and sleeping ≥ 9 hours /night. Which was similar with Suliga et al., (2022)who mentioned a proportion of MetS among women who sit > 6 hours / day and sleep for 9 hours was relatively high, whereas the lowest was among who sit 3 to 6 hours / day and sleep 7–8 hours. This may be related to the fact of , the longer the sleep hours the lower energy expenditure as spending less time doing physical activity, which increases the risk of obesity and MetS .

In relation to anthropometric, lab and physiological evaluations, the current study demonstrated high statistically significant differences between post intervention results of waist circumference, blood pressure, fasting glucose, HDL cholesterol and triglyceride level. These results were consistent with a study of Taha et al., (2022) titled " Effect of Health Promoting Life Style Model on Self-Efficacy for Patient with Metabolic Syndrome" and Zujko et al., (2021) who found a reduction in waist line, fat mass, fasting blood glucose , LDL, HDL and total cholesterol at post-intervention. Also, Ibrahim et al., (2020) reported a statistical significance reduction in blood pressure and FBG post intervention.

Finally, the present study illustrated a significant negative correlation between FBG, SBP, DBP and patients' activity level. These findings agree with Ibrahim et al., (2020) who mentioned a statistically significant correlation between metabolic syndrome and health-promoting lifestyle among studied patients. In the same line Suliga et al., (2022) mentioned a significant negative relation between spending moderate to vigorous activity >2 hours/day and sit 3–6 hours/day, walking and the number of MetS components.

Conclusion:

All study hypotheses were accepted as the study found that managing metabolic syndrome determinants helped the patients to be more physically active, eat healthier foods, reduce their waist circumferences, blood triglyceride, low-density lipoprotein, and total cholesterol, and smoke fewer cigarettes each day, they also maintained regular laboratory check-ups with physiological measurements monitored. This eliminated the three modifiable MetS determinants and patients became with two instead of five MetS determinants.

Recommendations

Determinants management should be applied to all patients with metabolic syndrome, utilizing the steps followed in the study.

Illustrative pamphlets should be routinely distributed among all patients with metabolic syndrome to provide guidance for their management.

In-service, continuous educational programs are required for nurses to update their knowledge about the care of patients with metabolic syndrome.

This study can be replicated with a larger sample size to confirm its efficacy.

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