Effect of Nutritional Intervention on some Metabolic Syndrome Risk Factors among Adults

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ABSTRACT

Metabolic syndrome (MS) is characterized by a combination of metabolic risk factors such as abdominal obesity, raised triglycerides, lowered high-density lipoprotein cholesterol (HDL-c), hypertension and impaired glucose tolerance. This study was carried out estimate the effect of dietary lifestyle intervention on some risk factors of metabolic syndrome among selected adult cases. The study was conducted on 140 adults, (20 – 60 years), males and females suffering from one or more of MS risk factors. Dietary and lifestyle intervention (3 months of adequate diet, healthy lifestyle and nutritional education) for 50 cases selected with high risk factors. Anthropometric, laboratory and dietary assessments were made at baseline and at the end of intervention. Results of dietary and lifestyle intervention showed very high significant changes (p < 0.0001) especially for anthropometric measurements of cases (n=50), weight and BMI were decreased by about 13.7 %, waist circumferences, and hip circumferences were reduced by 13%, and 9 % respectively by the end point of the intervention period. These changes also lead to laboratory improvement in syndrome indicators like FBG (fasting blood glucose), lipid profiles (TC (total cholesterol), TG (triglyceride), LDL-c (low-density lipoprotein cholesterol), and HDL-c). Conclusion: Diet and lifestyle modifications are the first line of treatment in dealing with MS. Decreasing about 10% of body weight is very useful for preventing or reducing metabolic syndrome risk factors and its complications among adults. Recommendation: balanced caloric intake and physical activity to achieve and maintain a healthy body weight as possible are essential.

Key words*: Metabolic syndrome - risk factors - adults - Dietary intervention*

INTRODUCTION

Metabolic syndrome (MS) is a growing cause of morbidity and mortality worldwide and is characterized by the presence of a variety of metabolic disturbances. Although the risk for MS has significantly attributed to adult lifestyle factors such as a person who takes many calories of much saturated fat, and neither gets enough physical activity nor good nutrition, and smoking. MS propagation is rapidly increasing with rising obesity and sedentary lifestyles worldwide especially in low- and middle-income countries (**Walker et al., 2012**).

Prevention, early screening and early intervention of the MS are recognized to be important in decreasing the morbidity and mortality associated with cardiovascular diseases (CVD), diabetes and their complications (**Ahmed et al., 2014**). Due to the limited number of studies or due to variations in definitions /classifications of risk factors between studies a meta-analysis and quantification of the strength of association could not be performed. Generally, the individual disorders that compose the MS are treated separately (**Van Namen et al., 2019**).

The most effective intervention for MS treatment is the caloric restriction that supports 7–10% weight loss as an appropriate goal for people with MS risk factors, unless additional weight loss is desired for other purposes. There is no perfect combination of macronutrients useful for all individuals. Adaptations of dietary recommendations based on socioeconomic factors, food availability, and personal preferences are very important (**Van Namen et al., 2019**).

The main concern about MS is the prevention of diabetes and the associated cardiovascular risk development and achieving weight loss (**Evert et al., 2019**).

The prevalence of MS in the adult population worldwide varies from 8 to 24.4% in males and from 7 to 46.5% in females (**Ahmed et al., 2014**). The prevalence of MS in the adult population worldwide estimated that ~20–25% of the world's adult population have MS (**IDf, 2016**). The prevalence of MS in Egypt is 55% among the whole sample, 85.6% among diabetics and 76.6%

among hypertensive patients (**Khaled** *et al***., 2014**). In Egypt, another recent study (**Maklady** *et al.,* **2014**) done on a sample of 145 inhabitants of the Suez Canal area reported a prevalence rate of MS among adults of 42.1%. Although they reported a lower prevalence rate of MS yet, 11.1% of subjects had all five criteria of MS, which was so exceeded their study. The prevalence of MS among obese Egyptian college students was (24.37%) (**Ahmed** *et al***., 2014**).

This research aimed to estimate the relation between metabolic syndrome risk factors and dietary pattern and to estimate the effect of dietary intervention on some risk factors of metabolic syndrome among selected adult cases.

SUBJECTS & METHODS

This study was conducted on 140 adults aged 20 to 60 years through two phases: **first phase:** Screening for risk factors of metabolic syndrome among (140) adult cases selected from various outpatient clinics. **Second phase:** Dietary intervention (Suitable tailored diet, healthy life style and nutritional education) for 50 cases

that were selected with high risk factors.

 Subjects exposed to:

1- Routine Medical examination including full history, family history of related chronic diseases; blood pressure was also measured (**Owusu** *et al,* **2015**).

2- Anthropometric assessment: (height, weight, BMI, waist and hip circumferences).

3- Dietary assessment as well as 24 hour recall, diet history and food frequency questionnaire. Twenty-four hrs. recall was repeated with selected cases every month and at the end of intervention. The intake of energy and nutrients was computed through the compiled food composition tables of the (**NNI, 2006**). Adequacy of the diet consumed was assessed by comparing the energy and nutrients intake of the individual with his recommended dietary allowances "RDA" using (**FAO and WHO, 2004**) recommendations.

4- Laboratory assessment: Serum lipid profiles (TCH, TG, HDL-c, LDL-c) were determined according to the method described by **Allain et al., (1974), Trinder and Ann (1969), Lopes - Virella et al., (1977),** respectively. Serum LDL were calculated according to **Friedwald et al., (1972)**. Fasting blood glucose determined by **Young et al., (1972)**, Liver function (ALT, AST) estimated by **Reitman and Frankel (1957)**, Kidney function, Creatinine was determined according to the method described by **Faulkner and King (1976)**. Hemoglobin evaluated according to **(Bain *et al*., 2012).**

5- Physical activity also registered as regards the duration and frequency of physical activity and duration of lying down were categorized.

Exclusion Criteria:

- Pregnant or lactating women.

- Who already an unusual restrictive diet
- Subjects with a major illness such as cancer, hepatic or cardiac diseases.
- The inability for physical activity.

Nutrition education program:

The program consisted of two modules that were delivered to the participants at six sessions individually and group discussion.

Module (1) - Basic nutrition, (four sessions, one hour for each session). At the end of these sessions, the participants should be aware of:

- ❖ The food guide pyramid and healthy plate.
- ❖ Food groups like grains, fruits, vegetables, milk, meat & meat substitutes, fat & sugars and lastly fluids.
- ❖ The food items and theirs serving size in each group.

Module (2) - Metabolic syndrome (two sessions, one hour for each session). At the end of these sessions, the participants should be able to:

❖ Define MS and recognize its related risk factors.

❖ Identify the importance of the promotion of a healthy lifestyle (diet and exercise) in the treatment and prevention of MS.

Healthy lifestyle intervention:

An intervention program on diet/lifestyle modifications was implemented for 3 months period on a subsample of the high-risk group (n=50). This group received individualized dietary education including the recommended daily caloric intake, balanced diet, food exchanges and food guide pyramid. The daily caloric requirement was calculated according to body weight, height, sex, age and activity level of each case in the first visit and every follow up visit according to **(IOM, 2005)**. Restriction intake of total and saturated fat to be less than 30% and 10% from total energy consumption respectively were recommended. Low fat milk and meat products were also recommended. All fast foods, soft drinks and junk foods were encouraged to be substituted by healthy foods like whole-grain products and fiber rich vegetables and fruits. All cases were advised to restrict their sedentary lifestyles (i.e., watching television) to less than 1 hour per day and continued everyday home exercise at least 30 minutes per day.

Consent Form

All cases were explained in details about the study and investigation that will be done and signed the informed consent for the study. Their agreements were taken orally. Who agree shared with us.

Statistical Analysis

Data were analyzed by SPSS statistical package version 21. The results were reported as a percentage and mean ±SD. The results were evaluated by using Compare means (paired- samples t test). Statistical significant considered at P < 0.05 **(Snedecor and Cochran, 1967).**

RESULTS & DISCUSSION

The main results of this study as shown in **table (1)** showed that the average studied sample age was (**39.36 ± 18.46**) years and average of their weight was (**92.94 ± 16.000**) kg. The

average of BMI was (**33.59 ± 8.178**) kg/m². Results illustrated that most of the studied sample was obese and had central obesity. Results of waist circumferences and waist to hip ratio which illustrated the presence of central obesity were in matching with **(St-Onge, 2005)** who stated that percent body fat increases, lean mass and bone mineral density decrease in general as individuals age. Furthermore, the increase in fat mass is distributed more specifically in the abdominal region. It has been well documented that as individuals age, body composition changes, even in the absence of changes in body weight. In addition, other studies have shown that fat mass increases and muscle mass decreases with age **Atlantis *et al*., (2008).**

Results of **table (2)** showed that the means of systolic and diastolic blood pressure were (136.33±14.92) and (89.60 ±9.55) mm Hg respectively. Regarding to laboratory findings, results of this table showed that mean of fasting blood glucose was 103.721-±29.69 mg/dl and cholesterol was 184.857-±30.931 mg/dl while LDL-c was 111.340-±23.981

mg/dl at the opposite of HDL, which was 41.764-±6.138 mg/dl, and T.G was 135.15-±56.44 mg/dl. Results of **table (3)** showed that great number of studied sample had risk factors for MS. As more than half (55%) of them had high fasting blood sugar >100 mg/dl; near to two-thirds of them (60.7%) had high blood pressure > 130/85 mm Hg, near to one third of them (33.6%) had high blood triglyceride > 150 mg/dl, and around (37.9%) of them had Low HDL < 40 mg/dl . Results go in harmony with (Magdy *et al*., 2014) who showed that there was an increase in serum TG (33%). Levels of TG are inversely associated with HDL-c and characteristic dyslipidemia with elevated TG and reduced HDL-c levels is regarded as a cardinal sign of insulin resistance. Decreased HDL-c among adults has been associated with factors such as obesity, carbohydrate and fat intake in the diet and decreased physical activity. Results of table (3) matched also with **Mattsson *et al*., (2007)** who reported that an increase in two factors, serum TG and obesity, accounted for much of the increased prevalence of the MS during young adulthood. Our

study results also agree with **James Osei-Yeboah, (2017)** who reported that there is an increase in serum TG (33%) with comorbidity of diabetes with hypertension ranged from 62.96% to 66.67% using the WHO and the IDF/NCEPATP III, respectively. In addition, this study agrees with **Mahrous *et al*., (2018)** who showed that most prevalent MS components high TG levels (40.2%) and reduced HDL-c levels (36.3%). The study results also agreed with those of **Puepet *et al*., (2009); Unadike *et al*., (2009); Nsiah *et al*., (2015) and James, (2017)** who reported that the most predominant component of MS abnormality among population was high blood pressure using the NCEP-ATP III (66.67%) and the WHO (62.96) criteria. A study by **Faramawi *et al*., (2014)** conducted in the USA showed that MS and its components, particularly hyper-tension, increased waist circumference and hyperglycemia, were significantly associated with systolic blood pressure variability. The study results also agree with those of **Obeidat *et al*., (2015)** who found that hypertriglyceridemia was the second most prevalent criterion, with a frequency of 40.2%. However, this result was higher than that of **Ahmed *et al*., (2014)** who found that elevated TG was 28.4% in their study. Other metabolic abnormalities include also low HDL-c levels, which were prevalent in 36.3% of the studied population. This result was in agreement with **Sabir *et al*., (2016)** who found that the prevalence of low HDL-c levels was 41.4%. This study dis agreed with **(Al Dhaheri *et al*., 2016)** who found that the prevalence of impaired fasting glucose among their study population was 9.7%. Also the results seems higher than a study in Egypt by WHO in 2012 which reported 31.3% rate of obesity (≥30 BMI), 39.7% rate of hypertension (SBP140 and or DBP 90), 17.2% rate of raised fasting glycemia and 36.8% rate of raised total cholesterol.

Main results of this study showed high significant relation between metabolic syndrome risk factors and dietary pattern of the studied sample. Results of **table (4)** showed dietary intake adequacy from total energy intake, total protein intake, total fat intake, dietary fiber intake and

dietary intake from selected minerals, as there were more than half of both males and females (54.5%) (56.1%) respectively were took over energy consumption (>120 % from RDA) with significant differences (0.041) between males and females, and near to two-thirds of males and females (63.6%) (64.5%) respectively took over Carbohydrate consumption (>120 % from RDA), on the other hand around half of males and females (48.5%) (58.9%) respectively took over consumption from protein. Also tables showed that around half of males and females (54.5%), (42.1%) respectively took over fat consumption. On the other hand only (6%) (12.1%) from males and females respectively took over fiber consumption (>120 % from RDA) but around three quarters (75.8%), (72%) from males and females respectively took lower fiber consumption (< 75 % from RDA). Regarding to some selected micronutrients intake, around (41.4%) of studied sample took acceptable and adequate intake from iron but around one quarter (25%) of them took lower intake from iron (< 75 % from RDA) and

one third of them (33.3%) took over iron consumption (>120 % from RDA) with statistical significant differences (0.063) between males and females. This table also showed that most of studied sample (81.4%) and (71.4%) took lower Ca and K consumption (< 75 % from RDA) respectively while only (10%) of them took normal Ca consumption (> 75 – 120 % from RDA) and around one quarter (25%) of them took normal intake from K. On the other hand more than half (55%) of the studied sample took over Na consumption (>120 % from RDA) but only around one quarter (25%) of them took lower Na consumption.

Dietary life style intervention with a high risk group (n=50) showed very high significant changes between pre and post intervention for anthropometric measurements at all age categories and sex groups (p < 0.000). Results of **table (5)** showed that weight was decreased about 13.7 % with the same decreasing in BMI because of not changing in their heights before and after intervention. Waist circumferences were decreased about 13% and hip circumferences

were decreased about 9 % by the end of the intervention period. These changes also lead to laboratory improvement in syndrome indicators like fasting blood glucose levels, lipid profile (TC and TG), lipoprotein patterns (LDL-c and HDL-c), among selected cases.

In the present study, most of selected cases already knew their problem of obesity and already need to solve it. This may make them more co-operative and interested of follow up the guidelines of the intervention and may lead to the good results of the intervention. For inactive cases, a progressive increasing in activity to achieve eventually the target was recommended. It was appropriate to start gradually with smaller amounts of physical activity and gradually increasing duration, frequency and intensity over time. It should also be noted that adults who are currently doing low physical activity or doing amounts below the recommended levels achieved more benefits than doing none at all. Study of **Tompkins *et al*., (2011)** provide support for future interventions to shift the focus from reducing obesity to increasing physical

activity for the prevention of T2DM and weight loss in obese youth may reduce the incidence of T2DM. Moreover, in this study, females had significantly higher rate of MS criteria in contradiction with the conclusions of **Morrell *et al*., (2012)**. Comparison between males and females revealed higher rate of central obesity in females as compared to males. Our findings go in harmony with results which reported by the study of ***Ruano Nieto et al.,(2015)*** where increased waist circumferences was more frequently reported in females.

This study agrees with **Kengne *et al*., (2012)** who reported that the leading component of MS among the females with diabetes was abdominal/central obesity and recorded significantly higher measurements of obesity and adiposity among the females with MS compared to their male counterparts. Also **Evert *et al*., (2019)** agrees with this study as he reported that the most effective intervention for MS is caloric restriction. Dietary intervention support a weight loss is an appropriate goal for people with

prediabetes. There is no perfect combination of macronutrients useful for all individuals. Compliance with a healthier lifestyle and dietary intake are more important than a particular dietary pattern. This represents an advantage for patients confronting MS. Individuals can advance with any healthy plan that is easy for them to follow. It also opens the door to adaptations of dietary recommendations based on socioeconomic factors, food availability, and personal preferences. The main concern with regard to MS is the development of diabetes and the associated cardiovascular risk. Patients with MS have a similar benefit to overweight/obese patients with diabetes from the adoption of several dietary patterns. As already stated, the goal in both conditions is achieving weight loss.

Results also showed high significantly differences between dietary adequacy from total energy intake, macronutrients and dietary fiber intake for the subsample studied pre and post intervention compared to their RDA as shown in table (6). Results showed that

near to two-thirds of males and females (62.5%) (61.9%) respectively took over energy pre intervention while only (12.5%) (7.1%)from males and females respectively took over energy consumption post intervention with high significant differences between pre and post intervention, also around 3 quarters of males and females(75%) (73.8%) respectively took over carbohydrate pre intervention while only (12.5%) (9.5%) respectively took over carbohydrate consumption with high significant differences between pre and post intervention. Regarding to protein intake results showed slight changes between pre and post intervention, as around (37.5%) (47.6%) from males and females respectively took over protein consumption pre intervention while around (25%) (31%) respectively took over protein consumption. Also results showed that the most of males and females (75%) (83.3%) respectively took over fat consumption pre intervention while only (25%) (7.2%) respectively took over fat consumption with high significant differences between pre and post

intervention. Regarding to fiber consumption, results showed that near to two-thirds of males and females (62.5%) and (61.9 %) of males and females respectively took low fiber consumption (< 75% from their RDA) pre intervention while only (25%) (33.8 %) of males and females respectively took low fiber consumption with high significant differences between pre and post intervention.

Regarding to dietary adequacy of some selected micronutrients for the studied subsample pre and post intervention compared to their RDA. Results of table (7) showed high significantly differences pre and post intervention compared to their RDA. Results of this table showed that around (37.5%) and (40.4%) of males and females respectively took acceptable and adequate intake from iron pre intervention but around one quarter (25%) and (21.4%) of males and females respectively took higher intake from iron. While around two thirds of males and females (62.5%) and (59.5%) respectively took acceptable and adequate intake from iron post intervention and those who took

lower iron intake were decreased to (0%) and (7.2 %) of males and females respectively, with statistical significant differences between pre and post intervention. This table also showed that around half of males and females (50%) and (52.4%) respectively took lower Ca consumption while only (25% and 28.5 %) of them took over Ca consumption and around one quarter (25%) and (19.1%) of males and females respectively took acceptable and adequate intake from Ca pre intervention. On the other hand, those who took lower Ca intake were decreased to around one quarter or less (25%) and (19.1%) of males and females respectively post intervention, and those who took acceptable and adequate Ca intake were increased to around (62.5%) and (71.4%) of males and females respectively post intervention. Regarding to Na consumption, most of males and females (87.5%) and (85.7 %) respectively took over Na consumption (>120 % from RDA) pre intervention while only (12.5%) and (11.9) of males and females respectively took over Na consumption post intervention with high significant differences between pre and post intervention.

In addition, data of this table showed around (12.5%) and (31%) of males and females respectively took lower K consumption pre intervention while decreased to (0%) of both males and females took lower K consumption post intervention and most of the studied subsample (75%) and (95.2%) of males and females respectively took acceptable and adequate K intake post intervention. These dietary plans agree with those of **Irene and Miguel, (2019)** who reported that energy intake is made up of carbohydrates and lipids. The accepted range of lipid calories in the diet is very broad and is the opposite of carbohydrates. Therefore, low-lipid or low-carbohydrate diets contain very different total amounts of lipids. For all adults, the acceptable macronutrient distribution range of total fat is to be 20–35% of total calorie intake. The amount of fat can influence insulin sensitivity and the risk of developing type 2 diabetes only with intakes greater than 35–40% of total energy intake. A diet that contains 20–40% fat does not change insulin sensitivity, regardless of its effect on weight status. **Evert *et al*., (2013)** and (the American Diabetic Association) (ADA) recommend-ded that the sum of carbohydrates and monounsaturated fatty acids should represent 60–70% of the total energy in the diet. Nevertheless, since the ADA 2014 position statement, there is no "first-line" approach with respect to the optimal carbohydrate quantity in the diet plan, because evidence remains inconclusive. On the other hand, in overweight or obese individuals, low fat diets are equal to but no better than other weight-reducing diets when the goal is weight reduction.

According to laboratory data like fasting blood glucose levels, liver enzymes and kidney function, hemoglobin, and lipid profile (TC, TG, LDL-c, and HDL-c), results showed very high significant differences (p = 0.00) between pre and post intervention. Results of table (8) showed that the mean of fasting blood glucose before intervention was 114.30±34.25 mg/dl and post intervention was 103.18 ±22.11mg/dl. The mean of TG and TC was 150.63 ±79.88mg/dl and 203.41 ±28.86 mg/dl pre intervention and was 132.22 ±

61.68 mg /dl and 185.33 ±22.01mg/dl post intervention respectively. Mean of LDL-c and HDL-c was 127.16±26.73mg/dl and 40.02±7.34 mg/dl pre intervention and was 110.52 ±22.31mg/dl and 46.63±6.43mg/dl post intervention for LDL-c and HDL-c respectively. Also results of this table showed slight changes between pre and post intervention laboratory data of both liver enzymes (ALT, AST), kidney function (Creatinine) and hemoglobin.

Results of figure (1) showed that more than one quarter of the studied subsample (26%) had < 3 risk factors of MS pre intervention while post intervention the percentage increased to more than half of the sample (56%). Near to 3 quarters (74%) of the studied subsample had ≥ 3 risk factors of MS pre intervention but only (44%) of them had ≥ 3 risk factors were of MS post intervention. Also data showed not only significant decreasing in those who had 4 risk factors of MS pre and post intervention but also those who had 5 risk factors of MS were disappeared (0%) post

intervention as shown in table (9). These results agree with those by **Lindstrom and Tuomileho, (2003)** and **Nawaporn et al., (2010)** who demonstrated that lifestyle modification significantly improved metabolic parameters including fasting plasma glucose and cholesterol level of obese subjects. Moreover, found that the lifestyle intervention group maintained greater improvements in weight, fitness, systolic blood pressure and HDL-c levels at the end of intervention period and they indicated that the intensive lifestyle intervention group spent a considerable time at lower CVD risk. These results agreed with *Kelishadi et al., (2007)* who found that in all age groups, 3 factors or more were loaded in persons with the MS like cholesterol /triglycerides, metabolic factors /adiposity, and blood pressure. However, waist circumference was the only variable that was loaded for all groups. Also the results agree with those of **Panagiotakos and Polychrono-poulos., (2005)** and **De Flines and Scheen, (2010)** who mentioned that it would be necessary to pay attention to diet, physical activity, obesity,

components of MS and insulin resistance in MS management. They suggested that lifestyle changes are an adequate method to lead MS components and only in the case that this intervention would be not enough, a pharmacological mediation should be contemplated. In general, it is thought that dietary patterns could play an important role in MS management. In Egypt, a recent study done by **Maklady *et al*., (2014)** on a sample of 145 inhabitants of the Suez Canal area found that 11.1% of subjects had all five criteria of MS which was lower than this study (26%) of studied subsample.

CONCLUSION

Diet and lifestyle modifications are the first line of treatment in dealing with metabolic syndrome as the main recommendations are to balance caloric intake and physical activity to achieve and maintain a healthy body weight as possible. This means that the healthy life style intervention (by encouraging daily physical activities, exercises with balanced low caloric diet and planning to reduce about 10% from body weight) is very useful for

preventing or reducing metabolic syndrome risk factors and its complications among adults.

RECOMMENDATIONS

Lifestyle modifications and individual based recommend-dations:

The main recommend-dations are to balance caloric intake and physical activity to achieve and maintain a healthy body weight as possible as by decreasing body weight gradually even 10% only, Increasing physical activities even few walking daily. Having a healthy and balanced diet even outside home. Consume a diet rich in vegetables and fruits; choose whole-grain, high-fiber foods. Consume fish, at least twice a week and limit intake of saturated fat to <10% of energy, total fat to <30% of energy, and cholesterol to <300 mg/d by choosing lean meats and vegetable alternatives. Fat-free (skim) or low-fat dairy products and minimize intake of hydrogenated fats; minimize intake of carbonated beverages and drinks with added sugars; choose and prepare foods with little or no salt ,Setting a suitable

time for healthy meals, physical activity and limiting screen times.

Governorate-Based Recommendations as:

Providing as possible as protected open areas, sidewalks and open garden zones. Providing health nutritional care programs for effective MS treatment are needed. Widely screening population especially among obese adults is still urgent for detection, diagnosis, and management strategies for metabolic syndrome risk factors.

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Table (1) Descriptive statistics of anthropometric data for the studied sample

Anthropometric data	Mean± Std. Deviation
Age (year)	**39.36 ± 18.46**
Weight (kg)	**92.94 ± 16.000**
Height(cm)	**163.15 ± 7.676**
BMI(kg/m²)	**33.59 ± 8.178**
Waist circumference (cm)	**102.21 ± 16.856**
Hip circumference (cm)	**111.55 ± 18.774**
Waist to hip ratio	**00.92 ± 0.178**

Data expressed as Means ± SD (n=140).

Table (2) Descriptive statistics for blood pressure and laboratory findings

N= 140		Mean± Std. Deviation
Blood pressure (BP)	**Systolic BP (mm Hg)**	**136.330±14.922**
	Diastolic BP (mm Hg)	**89.604 ±9.556**
Laboratory analysis		
Liver enzymes	**ALT (U/ L)**	**25.940 ±14.294**
	(AST)(U/L)	**24.246 ±12.355**
Glucose (mg/dl)		**103.721 ±29.695**
Kidney function	**Creatinine (mg)**	**.882 ±.218**
Hemoglobin (gm/dl)		**12.309 ±.772**
Lipid profile	**TG (mg/dl)**	**135.156 ±56.446**
	HDL-C (mg/dl)	**41.764 ±6.138**
	LDL-C (mg/dl)	**111.340 ±23.981**
	Total Cholesterol (mg/dl)	**184.857 ±30.931**

Data are presented as means ± SDM (n=140); LDL-C: Low density lipoproteins cholesterol; HDL-C: Serum high density lipoproteins cholesterol; TG: Serum triglyceride; AST: aspartate amino transferees; ALT: alanine amino transferees

Table (3): Distribution of risk factors for metabolic syndrome diseases among study subjects

Risk factor		Frequency	Percent %
Glucose			
fasting blood sugar >100 mg/dl	Yes	77	55
	No	63	45
Blood pressure			
High blood pressure > 130/85 mm Hg	Yes	85	60.7
	No	55	39.3
TG			
High blood triglyceride > 150 mg/dl	Yes	47	33.6
	No	93	66.4
HDL			
Low high density lipoprotein < 40 Mg/dl	Yes	53	37.9
	No	87	62.1

Table (4): Distribution of dietary intake of energy, macronutrients and selected micronutrients for the studied sample compared to their RDA.

Energy, Macronutrients & micronutrients		Male N=33	Female N=107	Total N= 140	Sig
Kcal	Low intake	4 (12.2%)	25 (23.3%)	29(20.7%)	0.041
	Normal intake	11 (33.3%)	22 (20.6%)	33 (23.6%)	
	High intake	18 (54.5%)	60 (56.1 %)	78 (55.7%)	
Carbohydrates	Low intake	5 (15.2%)	26 (24.3%)	31 (22.1%)	0.114
	Normal intake	7 (21.2%)	12 (11.2%)	19 (13.6%)	
	High intake	21 (63.6%)	69 (64.5%)	90 (64.3%)	
Protein	Low intake	6 (18.2%)	23 (21.5%)	29 (20.7%)	0.231
	Normal intake	11 (33.3%)	21 (19.6%)	32 (22.9%)	
	High intake	16 (48.5%)	63 (58.9%)	79 (56.4%)	
Fat	Low intake	7 (21.2%)	37 (34.6%)	44 (31.4%)	0.878
	Normal intake	8 (24.2%)	25 (23.3%)	33 (23.6%)	
	High intake	18 (54.5%)	45 (42.1%)	63 (45%)	
Fiber	Low intake	25 (75.8%)	77 (72%)	102 (72.9%)	0.286
	Normal intake	6 (18.2%)	17 (15.9%)	23 (16.4%)	
	High intake	2 (6%)	13 (12.1%)	15 (10.7%)	

* Percent of intake from RDA

< 75 %   from RDA   unacceptable level of consumption (low intake)

> 75 – 120 % from RDA   acceptable and adequate level of consumption (normal intake)

> 120 %   from RDA   over consumption   (High intake)

Adjusted from (DNPCNCD, 2008)

Table (5): Comparing of pre and post intervention per sex and age according to anthropometric measurements for subsample.

Anthropometric measurements		Male N=8		Female N=42		Total N=50		Sig.
		20-<40 N=6 Mean ± Std	40-< 60 N=2 Mean ± Std	20-<40 N=31 Mean ± Std	40-< 60 N=11 Mean ± Std	20-<40 N=37 Mean ± Std	40-< 60 N=13 Mean ± Std	
Weight (K.gm)	Pre	103.24±17.32	101.37± 16.22	102.26±15.92	103.62±14.2	102.16±17.97	102.95±16.24	0.00
	Post	89.36±15.62	87.82±15.31	87.21±16.41	89.97±14.45	87.90±17.64	89.22±15.35	
	Change ratio	13.44 %	13.36%	14.71%	13.17%	13.95%	13.33%	
Waist circumfe rence (cm)	Pre	110.23±16.46	116.82±14.91	109.13±17.87	111.12±15.81	109.72±18.69	111.22±16.29	0.00
	Post	99.12±15.26	102.23±13.13	98.21±16.54	97.17±14.81	98.32±16.73	97.14±14.65	
	Change ratio	10%	12.48%	10%	12.55%	10.39%	12.66%	
Hip circumfe rence (cm)	Pre	114.19±18.34	112.73±14.87	119.47±17.14	118.14±15.86	118.82±18.83	117.72±15.31	0.00
	Post	106.36±16.69	104.28±13.31	109.51±15.87	109.09±13.78	108.08±13.98	109.11±15.29	
	Change ratio	6.8%	7.5%	8.33%	7.66%	9%	7.31%	

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Table (6): Distribution of dietary intake of energy, macronutrients pre and post intervention compared to their RDA.

Macronutrient		Male N=8 (%)		Female N=42		Total N= 50		Sig
		pre	post	Pre	post	pre	post	
Kcal	Low intake	0 (0%)	0 (0%)	1(2.4%)	3 (7.1%)	١(2%)	٣(6%)	.000
	Normal intake	3 (37.5%)	7 (87.5%)	15 (35.7%)	36 (85.8%)	١٨(36%)	٤٣ (86%)	
	High intake	5 (62.5%)	1(12.5%)	26 (61.9%)	3 (7.1%)	٣١(62%)	٤ (8%)	
Carbohydrate	Low intake	0 (0%)	1 (12.5%)	3 (7.1%)	2 (4.8%)	٣ (6%)	٣ (6%)	.000
	Normal intake	2 (25%)	6 (75 %)	8 (19.1%)	36 (85.7%)	١٠(20%)	٤٢(84%)	
	High intake	6 (75%)	1 (12.5%)	31 (73.8%)	4 (9.5%)	٣٧ (74%)	5 (10%)	
Protein	Low intake	2(25%)	1 (12.5%)	8 (19.1%)	5 (11.9%)	١٠(20%)	٦ (12%)	.000
	Normal intake	3(37.5%)	5 (62.5%)	14(33.3%)	24(57.1%)	١٧ (34%)	٢٩ (58%)	
	High intake	3(37.5%)	2 (25%)	20(47.6%)	13(31%)	٢٣(46%)	١٥ (30%)	
Fat	Low intake	1(12.5 %)	2 (25%)	3 (7.2%)	9(21.4%)	4 (8%)	11 (22%)	.000
	Normal intake	1 (12.5 %)	4 (50%)	4 (9.5%)	30 (71.4%)	5 (10%)	34 (68%)	
	High intake	6(75 %)	2 (25%)	35 (83.3%)	3 (7.2%)	41(82%)	5 (10%)	
Fiber	Low intake	5(62.5%)	2 (25%)	26(61.9%)	10(33.8%)	31(62%)	12 (24%)	.000
	Normal intake	1(12.5%)	3(37.5%)	11(26.2%)	21 (50%)	12 (24%)	24 (48%)	
	High intake	2(25%)	3(37.5%)	5(11.9%)	11(26.2%)	7 (14%)	14 (28%)	

* Percent of intake from RDA   < 75 %   from RDA   unacceptable level of consumption (low intake)

≥ 75 – 120 % from RDA   acceptable and adequate level of consumption (normal intake)   > 120 %   from RDA   over consumption   (High intake)

Table (7): Distribution of dietary intake of selected micronutrients for the studied sample pre and post intervention compared to their RDA.

Micronutrient		Male N=8 (%)		Female N=42		Total N= 50		Sig
		pre	Post	Pre	post	pre	post	
Iron	Low intake	3(37.5%)	0(0%)	16(38.2%)	3 (7.2 %)	19(38%)	3 (6%)	0.059
	Normal intake	3(37.5%)	5(62.5%)	17(40.4%)	25(59.5%)	20(40%)	30(60%)	
	High intake	2(25%)	3(37.5%)	9(21.4%)	14 (33.3%)	11(7.9%)	17 (34%)	
Ca	Low intake	4(50%)	2(25%)	22(52.4%)	8 (19.1%)	26(52%)	10(20%)	
	Normal intake	2(25%)	5(62.5%)	8(19.1%)	30(71.4%)	10(20%)	35(70%)	
	High intake	2(25%)	1(12.5%)	12 (28.5%)	4 (9.5%)	14(28%)	5 (10%)	0.069
Na	Low intake	0 (0%)	3(37.5%)	2(4.8%)	6(14.3%)	2(4%)	9 (18%)	
	Normal intake	1(12.5%)	4(50%)	4(9.5%)	31(73.8)	5 (10%)	35(70%)	
	High intake	7(87.5%)	1(12.5%)	36(85.7%)	5(11.9%)	43(86%)	6(12%)	0.042
K	Low intake	1(12.5%)	0 (0%)	13 (31%)	0 (0%)	14(28%)	0(0%)	
	Normal intake	4 (50%)	6(75%)	24 (57.1%)	40(95.2%)	28(56%)	46(92%)	
	High intake	3(37.5%)	2(25%)	5 (11.9%)	2(4.8%)	8(16%)	4(8%)	0.067

* Percent of intake from RDA

< 75 %   from RDA   unacceptable level of consumption (low intake)

≥ 75 – 120 % from RDA   acceptable and adequate level of consumption (normal intake)

> 120 %   from RDA   over consumption   (High intake)

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Table (8): Comparison of laboratory findings for sub-sample pre and post intervention.

Laboratory analysis			Mean ± S.D N= 50	Sig
Glucose **(mg/ dI)**		**Pre**	114.30±34.25	0.00
		Post	103.18±22.11	
Lipid profile	**T.G** **(mg/ dI)**	**Pre**	150.63±79.88	0.00
		Post	132.22±61.68	
	LDL-c **(mg/ dI)**	**Pre**	127.16±26.73	0.00
		Post	110.52±22.31	
	HDL-c **(mg/ dI)**	**Pre**	40.02±7.34	0.00
		Post	46.63±6.43	
	Cholesterol **(mg/ dI)**	**Pre**	203.41±28.86	0.00
		Post	185.33±22.01	
Liver enzymes	**ALT** **U/ L**	**Pre**	28.51±10.16	0.00
		Post	26.96±7.96	
	AST **U/ L**	**Pre**	21.05±8.68	0.00
		Post	19.10±5.39	
Kidney function	**Creatinine** **(mg/dl)**	**Pre**	0.87±0.18	0.00
		Post	0.85±0.15	
Hemoglobin (gm/dl)		**Pre**	11.91±0.87	0.00
		Post	12.41±0.53	

Data are presented as means ± SDM (n=50);   LDL-C: Low density lipoproteins cholesterol; HDL-C: Serum high density lipoproteins cholesterol; TC: Serum total cholesterol; TG: Serum triglyceride; AST: aspartate amino transferees; ALT: alanine amino transferees
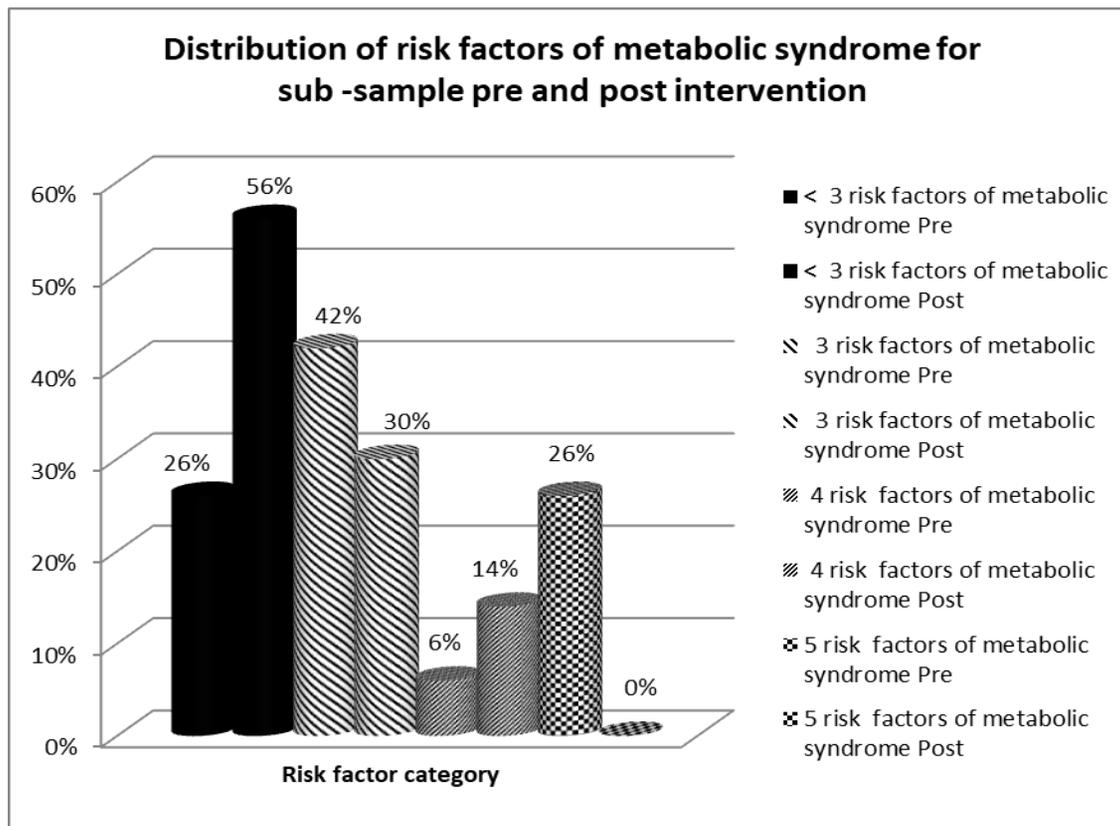
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Figure (1): Distribution of risk factors of metabolic syndrome for sub -sample pre and post intervention

تأثير التدخل التغذوي على بعض عوامل الخطورة الخاصة بالمتلازمة الايضية بين البالغين

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الملخص

المتلازمة الايضية هي مجموعة من عوامل الخطورة تحدث معظمها في وقت واحد مثل السمنة المركزية، ارتفاع ضغط الدم ،ارتفاع نسبة السكر في الدم، انخفاض نسب الكولسترول عالى الكثافة وارتفاع مستوى الدهون الثلاثية. تهدف هذه الدراسة الى تقييم اثر التدخل الغذائي ونمط الحياة الصحي علي بعض عوامل خطورة المتلازمة الايضية بين البالغين. شملت الدراسة ١٤٠حالة من البالغين من الجنسين من عمر ٢٠ الى ٦٠ سنة وتم التدخل بنظام غذائي مناسب ونمط حياه صحي لعدد ٥٠ حالة مختارة من الحالات الاكثر اصابة بعوامل الخطورة. تم عمل المقاييس الجسمية والتقيم المعملي و الغذائي قبل وبعد التدخل. اوضحت نتائج الدراسة وجود إختلاف كبير قبل وبعد التدخل الغذائي للحالات التي شملها التدخل (٥٠حالة) في القياسات الجسمية والتحاليل المعملية حيث اظهرت النتائج أن الوزن ومؤشر كتلة الجسم انخفض بنسبة 13.7 % تقريبا ومحيط الوسط و الأرداف انخفضا بنسبة 13%و ٩% على التوالي في نهاية فترة التدخل. كما ان هذه التغيرات ايضا أدت إلي تحسن مستويات نسبة السكر الصائم و مستوي نسب دهون الدم بين الحالات التي تم التدخل معها. **الخلاصة:** تعديل نمط الحياة والنظام الغذائى يعد الخط الأول في علاج عوامل الخطورة للمتلازمة الايضية حيث ان التحكم في المأخوذ المتوازن من مصادر الطاقة وزيادة النشاط الجسماني للوصول إلي الوزن الصحي والتخطيط لتخفيض ١٠ % من وزن الجسم يساهم بشكل كبير في منع او تقليل عوامل الخطورة للمتلازمة الايضية لدي البالغين. **التوصيات:** الالتزام بالنظام الغذائي المتوازن وزيادة النشاط البدني لتحقيق والمحافظة على وزن الجسم صحي وطبيعي وتقليل وجود عوامل الخطورة الخاصة بالمتلازمة الايضية بين البالغين.

الكلمات الدالة : المتلازمة الايضية ـ عوامل الخطورةـ البالغين ـ التدخل التغذوي

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