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Comparison between Mediterranean, Low Fat and Balanced Diet on Blood cholesterol in Obese Women

Naglaa Gadallah Mohammed Gadallah[1],Wdida Hassan[2], Omaima Kattabei[3],Aliaa Atia Diab[4] and Eman Ahmed Sultan[5].

[1]Physical Therapist, Master degree in physical therapy, Faculty of Physical Therapy, Cairo University, Diploma in medical laser applications, the department of medical application of laser of national institute of laser enhanced sciences, Cairo University, Obesity management Diploma, National Nutrition Institute, Egypt.
[2] Professor of Physical Therapy, Basic Science Department, Faculty of Physical Therapy, Cairo University, Egypt.
[3]Vice dean for post graduate studies and scientific research, Faculty of Physical Therapy, Deraya University, Professor of Physical Therapy, Basic Science Department, Faculty of Physical Therapy, Cairo University, Egypt.
[4] Assistant Professor of Physical Therapy, Basic Science Department, Faculty of Physical Therapy, Cairo University, Egypt.
[5] Lecturer endocrinology and metabolism, National Nutrition Institute.

Abstract: Back ground: The link between diet and human health has been known since long time. Over the last 50 years, the effect of specific dietary patterns and foods which have higher nutritional dense on the human health and well-being of persons has been studded with ecologic, observational, case control studies, prospective cohorts, and randomized clinical trials. These studies ensure that nutrition and nutritional factors play strong roles in the prevention/development of chronic diseases, such as Dyslipidemia, obesity and cardiovascular disease as well as mortality.**Purpose**: The Purpose of current study is to determine the most effective diet model (restricted Mediterranean diet, restricted low fat diet, or restricted balanced diet) combined with endurance training exercise in management of blood total cholesterol (TC). **Subjects:** 60 obese women with age of 20-40 years. Their body mass indexes (BMI) were ranged from 30-34.99 kg/m2 they were randomly divided into three groups (A, B and C) each group included 20 subjects. **Methods:** (group A) included those on restricted Mediterranean diet (1200 cal /day, daily) and endurance training exercise (moderate intensity, three times / week), (group B) included those on restricted low fat diet (1200 cal /day, daily) and endurance training exercise (moderate intensity, three times / week) and (group C) included those on restricted balanced diet (1200 cal /day, daily) and endurance training exercise (moderate intensity, three times / week). The biochemical changes in serum TC was measured at the beginning of the study and after 12 weeks. **Results:**The results of the current study showed that there were significant improvement in TC in the three groups but restricted Mediterranean diet combined with endurance training exercise was more powerful, favorable and effective in controlling TC abnormality (the percentages of improvement were: group A -- 13.14 % (P=0.0001), group B --12.79 % (P =0.0001) and group C --7.86 % (P =0.0001).**Conclusion:** this study stated that Mediterranean diet with endurance training exercise, low fat diet with endurance training exercise and balanced diet with endurance

training exercise have great and clear effect on TC in obese women but Mediterranean diet with endurance training exercise have the highest and the most powerful effect.
Key words :(restricted calorie diet, Mediterranean diet, Low Fat diet, Balanced diet, total Cholesterol, obesity).

1. Introduction:

Obesity is defined as an excess accumulation of subcutaneous fat, leading to a body mass index(BMI) greater than 30 kg/m^2.Increased BMI has a strong relationship with increased morbidity and mortality [1].Obese and overweight subjects have an increased incidence of heart disease, such as myocardial infarction(MI), angina, heart attack, congestive heart failure, sudden cardiac death, and abnormal heart rhythm more often than those that have a healthy BMI[2].The incidence of heart disease increases because of obesity bad effect on blood lipid levels, which increase in obese patients and then, in turn lead to increase triglycerides (TG) levels and high density lipoproteins cholesterol (HDL) or "good cholesterol. People with an excessive amount of body fat have higher levels of TG and low density lipoproteins cholesterol (LDL) or "bad cholesterol" as well as lower levels of HDL in the blood. This in turn creates optimal conditions for developing heart problems[2].

Dyslipidemia is abnormal levels of blood lipids total cholesterol (TC), TG or both carried by lipoproteins in the blood. This term includes hyperlipoproteinemia (hyperlipidemia) which refers to abnormally high levels of TC, LDL, or TG, as well as an abnormally low level of HDL [3].The level of TC is only a general guide to the risk of atherosclerosis. Levels of the components of TC particularly LDL and HDL are more effective. An increased level of LDL increases the risk. An increased level of HDL decreases the risk (3).The American Heart Association, The National Cholesterol Education Program (NCEP) and the American College of Cardiology (2001) recommend diet and lifestyle modification as the first line of defense against blood lipids abnormality. These recommendations include a diet low in total fat especially saturated fat, and cholesterol; diet high in fiber content ; maintain healthy body weight; increased physical activity; smoking avoidance ; increased intake of plant sterols and daily use of a low-dose aspirin. Drug therapy may be required for high-risk individuals[4]. Supporting these recommendations Marinangeli et al. had said that abnormal blood lipids are most commonly treated with lipid-altering pharmacological therapy. However, safety concerns regarding the use of these agents have prompted the need for safe and effective non pharmacological lipid-altering therapies.One such natural therapy is the combination of plant sterols and endurance training. This combination lifestyle intervention has been shown to decrease TC [5].

An inverse relationship between Mediterranean diet and the presence of cardiovascular disease (CVD) risk factors was observedin a cross-sectional analysis of 3204 asymptomatic high-risk patients [6]. Moreover, a 4-month trial of Mediterranean diet followed by significant reductions in TC was observed in patients with mild blood lipids abnormality [7]. Epidemiological and biochemical researches indicate that the Mediterranean diet, in which olive oil is the main source of fat, reduces the risk of coronary heart disease (CHD) by reducing the blood lipids [8].

Moreover,a diet that contains 30% of total calories as fat is advised for weight loss that is because the weight loss has many favorable effects on risk factors for many chronic diseases. There is no doubt that weight loss alone has very good effect on many risk factors [9]. So in controlled nonrandomized study tested the effects of weight loss achieved by using two dietary patterns at the extremes of macronutrient composition, a good effects of weight loss on TC (4.7%)was observed in both groups. And more reduction trend was observed in the low-fat diet pattern [10].

Alteration in Life style, in the form of dietary and physical activity modification are effective means of managing and treating high serum levels of TC in individuals diagnosed with abnormal blood lipids. Such interventions should always be given as the initial step in the management and treatment of lipid abnormalities, especially when TC levels are just above the ideal range [11].

The acute effects of physical activity on blood lipid levels are greatest with respect to elevating the levels of HDL concentration. Many researchers have shown that HDL levels increased by 40-43% with exercise [12].But the decreasing effect of chronic exercise on LDL levels is small around 8 % but with the addition of a weight-reduction by diet contains little amount of fat to exercise significantly improve LDL and TC [13,14].

Regular physical activity combined with appropriate nutrition can safe-guard against increase body weight and the health risks associated with obesity including abnormal blood lipids [15].So life style modification includes healthy diet combined with regular physical activity (non pharmacological interventions) for treatment of dyslipedemia is strongly recommended.

Many studies examined the effect of restricted Mediterranean diet, restricted low fat diet and /or restricted balanced diet on TC but the comparison between these three healthy diets on TC is strongly needed to determine the most effective one, so the purpose of this study is to determine the most effective diet model (restricted Mediterranean diet , restricted low fat diet, or restricted balanced diet) combined with endurance training exercise in management of obese patients suffering from highTC level.

This study will also help the physical therapist working in obesity management field to manage the obese patient suffering from increase of TC level with safe effective and legal management and protect the physical therapist from using illegal intervention to improve the physical therapy service.

2. Subjects, Materials and Methods:

This study was pre and post experimental design that was conducted to determine the best type of diet between the three diet models (restricted Mediterranean diet, restricted low fat diet and restricted balanced diet) with endurance training exercise to improve TC in obese women, in this study 60 obese women with age of 20-40 year, their BMI were ranged from 30 -34.99 kg/m2 according to WHO classification (2010) were assigned randomly into three groups each group consists of 20 subjects using closed envelop method.

Table (1): the testing groups and the three diet models used in the study.

(Group A)	Received restricted Mediterranean diet (1200 cal /day, daily) and a program of endurance training exercise (moderate intensity, three times / week).
(Group B)	Received restricted low fat diet (1200 cal /day, daily) and a program of endurance training exercise (moderate intensity, three times / week).
(Group C)	Received restricted balanced diet (1200 cal /day, daily) and a program of endurance training exercise (moderate intensity, three times / week).

All women were subjected to full clinical history and full clinical examination for exclusion of any of the following: hepatic disease, cardiac disease, chest disease, sever life limiting illness (e.g. cancer, renal failure), using of weight loss medications, under treatment for dyslipidemia, endocrinal disorders, smokers or follow any other training exercise program. The Patients had been evaluated at base line before treatment and after 12 weeks at completion of the treatment by using weight and height scale (Healthy scale 200 kg) to measure the height and weight to calculate BMI and by blood lipid analyzer (Roche Hitachi 912 Chemistry Analyzer) to evaluate TC level pre and post treatment. So the patients were referred to the lab for taking blood samples after 9-12 hours fasting and for measuring TC before starting program and after the program.

During the program, Follow-up of the patients each week through the study period to evaluate their body weights and to change the diet model by giving them suitable diet model for each week by using 36 diet models were given to the patients after dividing into three groups, 12 diet models for each group through the 12 week of the program. 12 restricted Mediterranean diet models (1200 cal/day) included whole grains (bread, cereals& pastes), fruit, fruit juices, vegetables, vegetable oils (especially olive oil), low-fat dairy, legumes and nuts (especially walnuts) (according to Mediterranean pyramid guide lines)(16).As present in table (2).

Table (2): Percentages of fat, carbohydrate and protein in Mediterranean diet models.

	fat	**Carbohydrate**	**protein**
Calories percent	**40%**	**45%**	**15%**

Twelve restricted low fat diet models (1200 cal/day) included whole grains (bread, cereals& pastes), fruit , fruit juices, vegetables, vegetable oils, low-fat dairy and meat products and food content according to mypyramid (2005)(17). As present in table (3).

Table (3): Percentages of fat, carbohydrate and protein in low fat diet models.

	Fat	Carbohydrate	protein
Calories	**20%**	**65%**	**15%**

And 12 restricted balanced diet models (1200 cal/day) included whole grains (bread, cereals& pastes), Fruit, fruit juices, vegetables, vegetable oils, low-fat dairy and meat products according to mypyramid (2005)(17).As present in table (4).

Table (4): Percentages of fat, carbohydrate and protein in balanced diet models.

	Fat	Carbohydrate	protein
Calories	**30%**	**55%**	**15%**

All females who participated in the three groups attended a program of endurance training with moderate intensity 3 times/week by using of stationary bicycles, exercise duration was 30 min without rest in the first week (1-3 session), 45 min without rest in the second week (4-6 session) and 60 min without rest from the third week to the end of the program (7-36 session) and the compliance was assessed by recording the subject's attendance at each session. If a training session was missed, the subject was required to make up for the missed session during the same week.

Ethical approval:

Ethics committee of faculty of physical therapy Cairo University, Egypt ethically approved this study and all patients assigned a consent form before starting the program.

3. Results:

A. General characteristics of the subjects:

The current study was conducted on 60 women. They were assigned randomly into three equal studies groups. (Group A) consisted of 20 women with mean age and height values of 31.3±6.33 years and 158.35±3.95 cm respectively. (Group B) consisted of consisted of 20 women with mean age and height values of 30.65±5.37 years and 158.95±3.53cm respectively. (Group C) consisted of 20 women with mean age and height values of 31.05±4.08 years and 158±3.58 cm respectively. As indicated by ANOVA, there were no significant differences ($p>0.05$) in the mean values of age and height among the three tested groups as in figure (1) and (2).

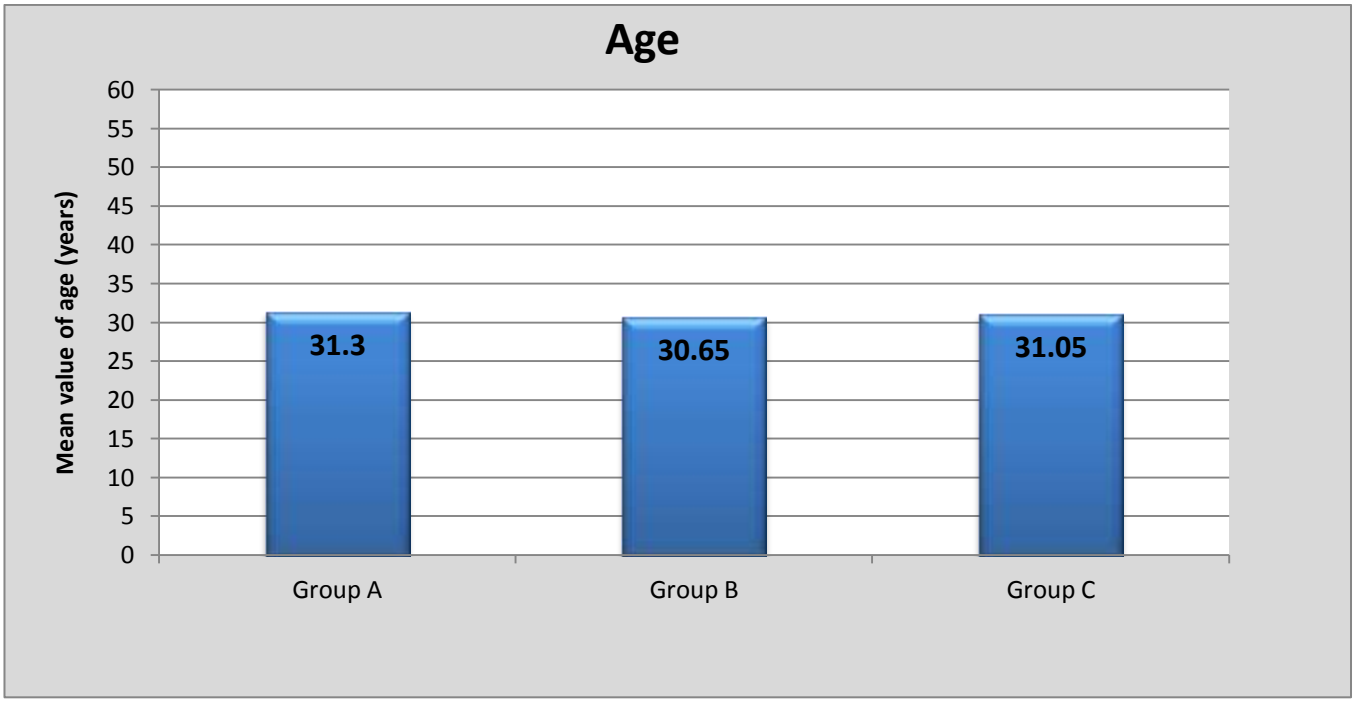

Figure (1): Mean values of age in each group.

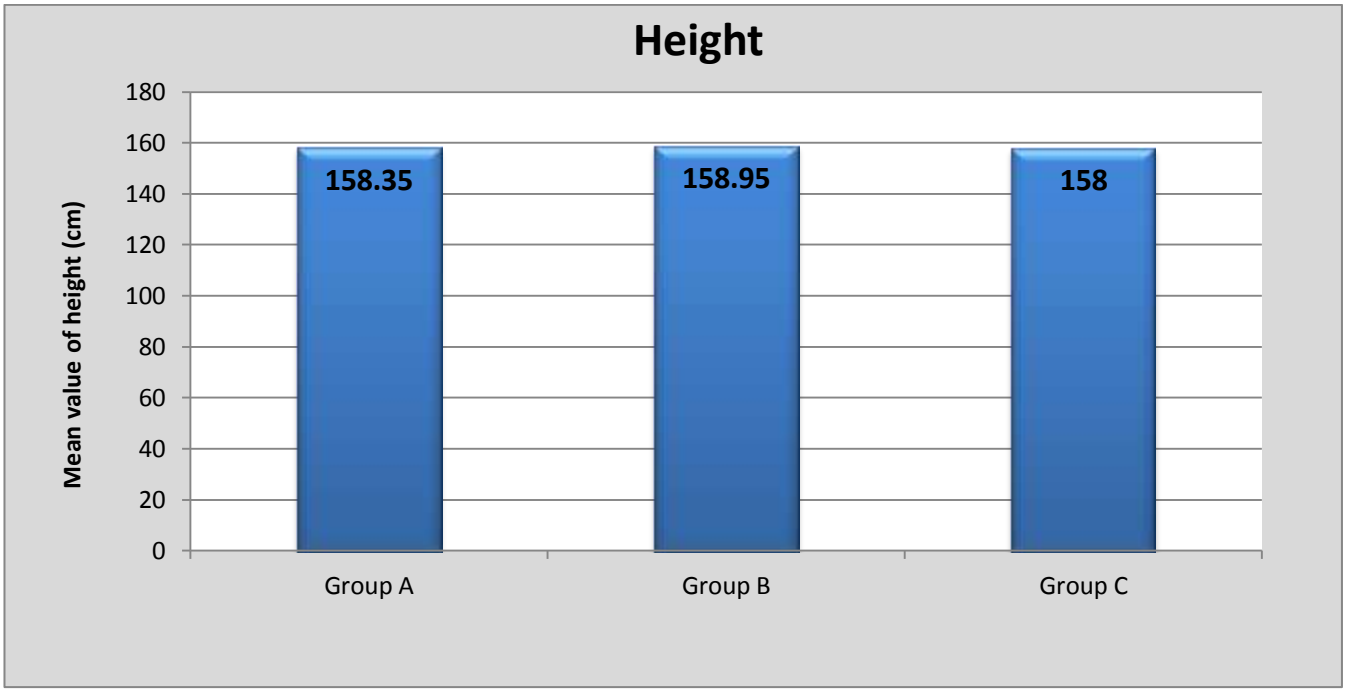

Figure (2): Mean values of height in each group.

B. Overall effects:

Statistical analysis using 3x2 mixed design MANOVA indicated that there was significant effects of the tested group (the first independent variable) on TC (F=3.728, P=0.0001). In addition, there were significant effects of the measuring periods (the second independent variable) on the tested dependent variables (F1088.259, P=0.0001). Also, the interaction between the two independent variables was significant, which indicates that the effect of the tested group (first independent variable) on the dependent variables was influenced by the measuring periods (second independent variable) (F=62.253, P=0.0001).

C. Overall results:

Table (5): Descriptive statistics and 3×2 mixed design MANOVA for total cholesterol at pre and post treatment among the three groups.

Cholesterol (mg/dl)	**(Group A) (Mean ±SD)**	**(Group B) (Mean ±SD)**	**(Group C) (Mean ±SD)**
Pre	192.85 ±23.63	202.45±12.26	200.9±16.23
Post	167.5 ±20.29	176.55 ±12.20	185.1 ±15.35
Mean difference	25.35	25.9	15.8
% of change	13.14%	12.79%	7.86%
Multiple pairwise comparisons between pre and post treatment values for total cholesterol at the three groups			
Pre Vs. post	**(Group A)**	**(Group B)**	**(Group C)**
p-value	0.0001*	0.0001*	0.0001*
Multiple pairwise comparison tests (Post hoc tests) for the total cholesterol among different groups at pre and post treatment			
	(Group A) Vs.(group B)	**(Group A) Vs. (group C)**	**(Group B) Vs. (group C)**
Pre (P-value)	0.292	0.489	1.00
Post (P-value)	0.253	0.004*	0.308

***Significant at alpha level <0.05**

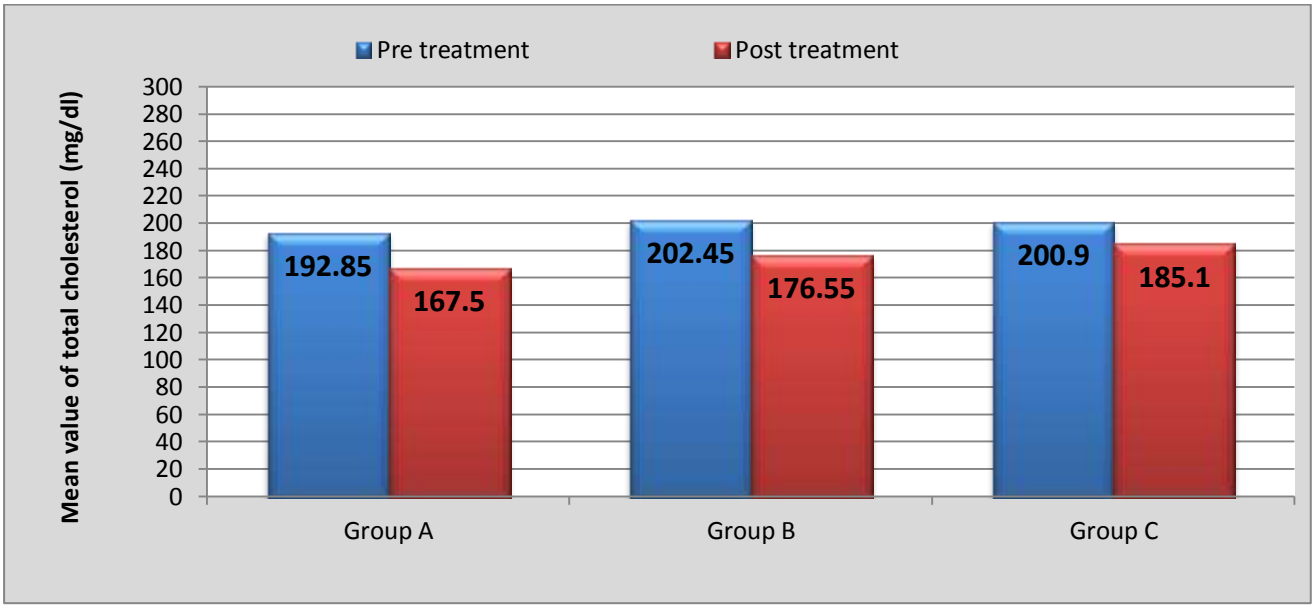

Figure (3): Mean values of total cholesterol pre and post-treatment in each group.

4. Discussion:

The present study was conducted to determine the most effective diet model (restricted Mediterranean diet, restricted low fat diet, or restricted balanced diet) with endurance training exercise in management of TC. With the hypothesis that there was no significant difference among the effects of the three diet models on TC.The result of this study showed that TC was statistically significantly lower after the program in the three groups and the percentages of improvement of the three groups (after 12 weeks) present in table (6).

Table (6): The final study results of the three groups in percentages.

The effect on TC level			
(Group A)	**-- 13.14 %** Best improvement	significant reduction	(P =0.0001*)
(Group B)	-- 12.79 %	Significant reduction	(P =0.0001*)
(Group C)	-- 7.86 %	Significant reduction	(P =0.0001*)
The difference between the groups in TC level			
(group A) versus (group B)	No significant differences		(P = 0.253)
(group A) versus (group C)	significant differences		(P=0.004*)
(group B) versus (group C)	No significant differences		(P=0.308)

***Significant at alpha level <0.05**

The results of the current study showed that (group A) was more powerful, favorable and effective in controlling TC that was due to higher content of monounsaturated fat present mainly in olive oil and poly unsaturated fat (omega 3 and omega 6) present mainly in fatty fish on which Mediterranean diet based.

At present, dyslipidemia is most commonly treated with drug therapy. However, because safety concerns regarding the use of pharmaceutical agents have arisen, a need for alternative non pharmacological therapies has become increasingly apparent. The NCEP Adult Treatment Panel III (ATP III) recommends lifestyle therapies, which include a combination of diet and exercise modifications, in place of drug treatment for patients who fall into an intermediate range of CHD risk [16].Role of nutrition in the prevention of CVD has been extensively reviewed [17,18,19]. Strong evidence of the influence of dietary factors in atherogenesis both directly and throughеffects on traditional risk factors, such as TC (20).A number of dietary interventions showed that TC can be improved independently of weight loss according to the type of diet intervention[21,22,23,24,25].Moreover, Healthy diet combined with physical activity, decreased TC by 8–26 %, so it was suggested that combination Healthy diet and physical activity are an efficacious, preliminary means of improving TC levels in those diagnosed with dyslipidemia, and should be implemented in place of drug therapy especially when TC levels fall just above the normal range[16].

In agreement with present study results, several reviews have previously reported the good effect of the Mediterranean diet on obesity [26] metabolic syndrome (MetSyn) , blood lipids[27] and CVD[28], In A systematic review studied the effect of a Mediterranean diet on cardiac problems, diabetes and obesity prevention (cardiodiabesity) dated scientific evidence available In this review, Of the 37 studies reviewed in this report, 33 studies found a strong link between adherence to a Mediterranean diet and CDV, MetSyn and obesity [29].That is because, the new Mediterranean diet is the result of an international consensus based on the latest scientific findings on human nutrition and health, and provides important item for the quantitative and qualitative selection of foods[30,31]. Also, Analytical and experimental trials ensured the relationships between the consumption of certain foods and CVD. Mediterranean diet patterns have long been associated with a reduced risk of major diseases and many favorable health outcomes. Data from observational, longitudinal, and randomized controlled studies have confirmed that Mediterranean diets can reduce MetSyn risk factors, decrease cardiovascular morbidity and CHD mortality, and also reduce all causes of mortality.

Nowadays, Evidence supporting the Mediterranean diet and the potential cardio protective role of healthier diets in the workplace are reviewed and promising strategies to improve metabolic and cardiovascular health outcomes are also provided [32].Many of the reviewed studies provided strong evidence on the association between following to a Mediterranean diet and CVD, MetSyn and obesity, remarking the link between all these Inter connected illnesses, cardiac problems and obesity. The results of the current review of epidemiological and clinical trial studies support the role of the Mediterranean diet in the prevention of cardiac problems including dyslipidemia and obesity. The prevention of these diseases by good adherence to the Mediterranean diet is confirmed by the latest most solid scientific evidence, and further by its low environmental footprints and economic accessibility in Mediterranean countries. Furthermore, the high palatability of the Mediterranean diet makes this dietary pattern very useful for preventive strategies applied to the general population in primary care medicine for ideal collaborative management of these patients [33].This protective effect of the Mediterranean diet observed early since long time and is similar to the effects of statin and antihypertensive drug treatments but

without their harmful effects[34].Also in Several groups have demonstrated an association between Mediterranean diet adherence and reduced prevalence of CVD risk factors such as dyslipidemia, [35,36]. Also, In a cross-sectional analysis of 3204 asymptomatic high-risk patients, an inverse relationship between Mediterranean diet and the occurrenceof CVD risk factors was observed[37]. Moreover, significant reductions in TC, was observed in patients with mild dyslipidemia following a 4-month trial of Mediterranean diet [7].

Associations of Mediterranean diet with improved cardiovascular health are not limited to Mediterranean nations. The Northern Manhattan cohort Studyinvolving 2568 participants, also found that higher adherence to a Mediterranean diet correlated with decreased risk of MI, vascular disease, and stroke [38].Also, in 21study (7 cross-sectional studies, 3 cohort studies, and 11 intervention studies). [13] reported that adherence to an Mediterranean diet significantly reduced the probability of overweight/obesity, promoted weight loss, or resulted in more weight loss than a control dietwhich leads to TC reduction[26].On other wards, Individuals with a higher adherence to the Mediterranean diet were 51% less likely to be overweight/obese, other studies found that individuals with a high Mediterranean diet adherence were 39% less likely to be obese which protect them against dyslipidemia[39].

In contrast with this study, a recent meta-analysis showed that current evidence does not support cardiovascular guidelines that encourage diet high in polyunsaturated fatty acids and low in total saturated fats. However, it should be remarked that the PREDIMED study demonstrated with the highest level of scientific evidence that the Mediterranean diet is a useful in prevention of CVD end-points in high-risk individual [29,40].Despite the beneficial effects of the Mediterranean diet, there are discrepancies among nutrition experts because of the high-fat content of this diet (up to > 40% of total energy intake), which is in conflict with the usual recommendation to follow a low-fat diet in order to avoid overweight/obesity and to avoid CHD risk factors such as elevated level of TC [41,42,43]. The results from the Seguimiento Universidad de Navarra–Follow-up University of Navarra study did not find any association between weight and the Mediterranean diet[44].

Low fat diet has many benefits on vascular health which are paralleled to improvements in several CHD risk factors including high TC level[45,46]. Studies suggest that a high intake of saturated fat has direct bad effects on arterial endothelial function by decreasing the anti-inflammatory potential of HDL (47). In a meta-analysis by Yu-Poth et al (1999)(48),the effects of low saturated fat diets on blood lipid levels were examined systematically and resulted these facts decreases in total and saturated fat intakes affect primarily TC concentrations. Also Normanet al [49]**.** Showed that high fat diet and low fat diet had differential effects for each diet on plasma lipids were observed. For instance, in the Low fat diet group, TC concentration was reduced post-intervention. In contrast, in the high fat diet group, TC increased[50]. Also, In Sandhofer et al[51] persons who received High fat diet lost more weight (-6.6 ± 0.5 kg) than persons who received low fat diet (-4.7 ± 0.6 kg). However, fat mass and waist circumference were significantly reduced in Low fat diet subjects only which have favorable effect on TC level. In study compared between an Atkins-type diet (low-carbohydrate, high-protein, and high-fat diet) versus a restricted calorie, high-carbohydrate, and low-fat diet." For weight management in 63 obese men and women and after 6 months, subjects in both groups have significant weight reduction which then in tern improve all blood lipids including TC [52].

Moreover, in a randomized trial compared between Atkins (carbohydrate restriction,), Zone (macronutrient balance), Weight Watchers (calorie restriction), or Ornish (fat restriction) diet groups. By Dansinger et al[53] with known dyslipidemia,each popular diet modestly decreased body weight and several cardiac risk factors such as blood lipids after one year but the beast improvement was in fat restriction group. Among 4587 men and women at risk for CVD, 3 weeks of following low-fat, high-complex-starch, high-fiber diet, in combination with daily moderate-to-vigorous aerobic exercise, reduced TC by 23%[54]**.** Supporting previous research, Edwards and Moore [55]found in their trial that low-fat diet on TC is effective but generally less than those reported for statin therapy.Both restricted Mediterranean diet andrestricted low fatdiet had decreasing effect onbody weightwhich has good effect on coronary risk factors including TC with more effect was in restricted Mediterranean dietgroup[56,57]**.**

Reductions in total calories or portion sizes(restricted calorie diet), or on increasing or decreasing isolated nutrients, an emphasis on overall diet quality according to types of foods consumed has the strongest evidence-base for reducing adiposity and preventing CVD and dyslipidemia[58,59]. Elevated levels of LDL, excessive reactive oxygen species generation, hypertension and diabetes are all potential causes for the development of endothelial dysfunction, a precipitating the progression of atherosclerosis. These factors are

believed to start an inflammatory response in the injured endothelial tissue. caloric restriction for long period is associated with sustained reductions in factors related to endothelial dysfunction in humans, such as reduced levels of TC and TG [60].Also, long-term caloric restriction in humans supports the feasibility of using caloric restriction as a protective effect against atherosclerosis by showing a 40% reduction in carotid artery intima-media thickness [61].In study examined obese subjects who were randomly divided into one of four groups: diet alone (1,200–1,300 kcal/day),exercise alone, exercise and diet, and controls. The results showed that subjects in diet and exerciseand diet lost 7.8 ± 0.7 and 8.1 ± 0.6 kg, with no significant change for exercise group relative to control group. TC and TG improved in both dietand in exercise and diet after 12 weeks of intervention, andwere most strongly related to weight loss [62].

Six months of caloric restriction significantly reduced blood lipids in Lefevre et al [63].Exercise however has favorable effects on blood lipids and lipoproteins, even with unchanged body weight [64,65,66,67,68]or clinically insignificant weight loss [69,70].In a meta-analysis of 27 studies and Similarly in another meta analysis of 72 studies concluded that aerobic exercise was associated with a small but statistically significant beneficial effect on abnormal blood lipids[64,68].Also,in one study of Asian Indians with type II diabetes Misra et al (2008) reported that 12 weeks of resistance exercise training decrease TC (8.5%) [67]. Similarly in a randomized trial on overweight, sedentary, and dyslipidemic men and women and after 8 months of exercise training (varying in amount and intensity) improved 11 different lipid and lipoprotein [70].In study examined the effect of exercise with diet low in total and saturated fat, observed changes in lipid and lipoprotein concentrations may be exaggerated while statistically significant and practically important improvements were observed for TC, TC/HDL ratio [71,72].

To the available knowledge there is no research detected any negative effect of low fat diet or exercise on TC.

Conclusion:

Within the limitations of this study which are:

1. Psycho-physiological status of subjects during period of the study had been affecting the results.
2. Small sample.

The following conclusion was made:

Restricted Mediterranean diet combined with endurance training exercise is more effective and powerful than restricted low fat diet combined with endurance training exercise and restricted balanced diet combined with endurance training exercise. Also, restricted low fat diet combined with endurance training exercise has more effect than restricted balanced diet combined with endurance training exercise on TC in obese women after 12 weeks of applying the treatment program.

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