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Dietary Intervention Rich in Omega-3 Fatty Acid to Reduce Risk Factors of Cardiovascular Diseases at High Risk Patients

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Abstract Background: Cardiovascular Disease (CVD) is the number one killer in developed countries. In Egypt, CVD deaths account for 21.7% of total deaths. Patients at high risk have higher CVD mortality and morbidity following a cardiac event. Hypertension, Diabetes Mellitus (DM), Dyslipdemia and lack of physical activity have been identified as CAD risk factors. Also, inflammatory response and diet have been identified as additional factors that may influence the development of CAD. The relationship between inflammatory reaction and risk of CVD events is consistent and independent of other risk factors. There is evidence about the benefits of omega-3 fatty acids on CVD. Omega-3 fatty acids improve heart health by reducing triglyceride levels, decreasing the growth of atherosclerotic plaques, improving arterial endothelial function, lowering blood pressure, and reducing the risk of thrombosis. Further research is needed to confirm the cardio protective benefits of omega-3 fatty acids. Thus, the purpose of the current study was to examine the effect of dietary intervention rich in omega-3 fatty acids on reducing CAD risk factors for high risk patients. Methods: A quasi experimental (Pre- post test) design was used. Sample: A convenience sample of 100 patients with one or more risk factors of CAD. Setting: the study was conducted in the out-patient clinics at Menoufia University Hospital at Shebein El- Kom City. Tools: a) Interviewing Questionnaire; b) Cardiovascular Risk Assessment Scale (CVRAS); c) Obligatory Exercise Questionnaire; d) Serological level of Interleukin-2 (IL-2), C-reactive proteins, lipid profile and blood glucose level. Results: There was a statistically significant reduction in CAD risk score post intervention (13.50 ± 2.95) compared to pre intervention (22.94 ± 3.13). There was a statistically significant reduction in the inflammatory response, IL-2 (23.55 ± 4.44); C-reactive proteins (2.71 ± 1.39) post intervention compared to pre intervention (31.90 ± 4.80); (4.10 ± 1.38) respectively and physical activity (Paired t- test 10.71, P= 0.05). Conclusion: Omega-3 fatty acids can favorably decrease cardiovascular risk-factor, for primary and secondary prevention of CVD. Recommendation: A diet rich in Omega-3 fatty acids should be included when designing a dietary intervention targeting individuals at high risk for CVD.

Keywords: *omega-3 fatty acid, cardiovascular risk, dietary intervention, inflammatory response, physical activity, BMI, blood glucose, blood pressure*

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1. Introduction

Cardiovascular disease (CVD) is a significant global health problem. Cardiovascular diseases are a group of disorders of the heart and blood vessels and are mainly caused by a blockage that prevents blood from flowing to the heart or brain. It was estimated that 17.3 million people died from CAD in 2011, about 85% of these deaths occurred in low and middle income countries. In the United States, CAD continues to be the leading cause of death for men and women [1]. In Egypt, CAD deaths reached 23.73% of total deaths [2]. CAD is both the dominant health problem and the major cause of mortality for adult patients, claiming the lives of nearly 500,000 patients annually [3]. In developing countries, half of all deaths of patients over age 50 are due to CAD and stroke [4]. The American Heart Association [5] has identified the major modifiable risk factors that have been shown to increase the risk of cardiovascular disease as smoking, high cholesterol level, Hypertension, Diabetes Mellitus, obesity and physical inactivity [6].

Hypertension is a major risk factor for CAD. There is a positive correlation between hypertension and CVD, stroke, heart failure, and kidney failure [6]. According to the American Diabetes Association (ADA), about 20-60% of diabetic patients have high blood pressure [7]. When the risk factors of obesity, smoking, high cholesterol level, or diabetes occur with hypertension, the risk of heart disease or stroke increases [1].

Diabetes Mellitus is associated with a markedly increased risk for cardiovascular disease. This increased risk occurs even if the person maintains control of blood glucose levels. The risk of heart disease is even greater if blood glucose is poorly controlled [8]. About 75% of people with diabetes die of some form of heart or blood vessel disease. In addition, the risk for CAD among persons with diabetes is two to three times higher among persons without diabetes. CAD accounts for 48% of all deaths among persons with diabetes [9].

Obesity is also a major risk factor for the development of type 2 diabetes, which is the most important risk factor for CAD. Obesity is associated with an increased mortality rate from CAD and stroke. Excess weight is also linked with an increased incidence of hypertension, insulin resistance, DM, and dyslipidemia [9]. Central obesity appears to be a stronger predictor of CVD than peripheral or subcutaneous obesity. Women with a waist greater than 35 inches and men with a waist greater than 40 inches have a higher risk for CVD [1]. Lack of physical activity is a significant factor in the development of heart disease. When lack of regular exercise is combined with obesity, high cholesterol levels can result and further increase the risk for heart disease. Regular moderate to vigorous physical activity helps prevent cardiovascular disease. [5].

Inflammatory Response: serum levels of high-sensitivity C-reactive protein (hs-CRP) are useful to identify the presence and severity of inflammation. Recent studies report that moderate elevations of hs-CRP correlate with future cardiovascular events and validate the use of this test to assess cardiovascular risk [10]. The relationship between a patient's baseline level of CRP and future vascular risk has been consistent in studies from the United States and Europe, and in most cases, has proven independent of age, smoking, cholesterol levels, blood pressure, and diabetes, the major "traditional" risk factors evaluated in daily practice. These effects are present among women as well as men, among the elderly as well as those in middle age, among smokers and non-smokers, and among those with and without diabetes [10]. Several prospective studies demonstrate that CRP levels additionally predict incidents of type II diabetes [11,12]. This data further links inflammation, atherothrombosis, and diabetes as tightly interrelated disorders of the innate immune system and may help to explain why diet and exercise are so important to the prevention of both diseases.

Reducing the risk factors for CVD is crucial to prevent CAD [13]. National Center for Chronic Disease Prevention and Health Promotion [14] found that consuming 3 g/day of omega-3 fatty acid, being physically active, maintaining a healthy weight, controlling blood pressure, and controlling blood glucose levels can greatly reduce a person's risk of developing CAD. Omega-3 fatty acids intake is a top priority for prevention of CAD of high risk groups [15]. Regular intake of omega-3 fatty acids may lead to regression of coronary atherosclerosis after one year. In addition, consumption of omega-3 fatty acids were found to reduce risk factors for heart disease such as lowering blood pressure in untreated hypertension, reducing blood glucose levels in diabetic patients, decreasing central obesity and increasing physical activity [16,17]. Thus, the purpose of the current study was to examine the effects of a dietary intervention rich in omega-3 fatty acid in reducing risk factors of cardiovascular diseases for high risk patients.

Research Hypotheses:

1. Patients who will receive the dietary intervention rich in omega-3 fatty acids are more likely to have less CAD risk scores than patients who will not receive the intervention.
2. Patients who will receive the dietary intervention rich in omega-3 fatty acids are more likely to have decreased inflammatory responses (IL-2 and C-reactive proteins) than patients who will not receive the intervention.
3. Patients who will receive the dietary intervention rich in omega-3 fatty acids are more likely to have an increased physical activity level than patients who will not receive the intervention.
4. Patients who will receive the dietary intervention rich in omega-3 fatty acids are more likely to have a reduction in body mass index than patients who will not receive the intervention.

2. Definition of Variables

Cardiovascular Risk: is theoretically defined as "the percentage estimate of a person's chance of developing a Cardiovascular disease event over the next 5 to 10 years" [18]. In the present study, cardiovascular risk was operationally defined as the individual obtained score of the Cardiovascular Risk Assessment Scale (CVRAS).

Inflammatory Response: is theoretically defined as "intense inflammatory reaction when Myocardial necrosis induces complement activation and free radical generation, triggering a cytokine cascade initiated by Tumor Necrosis Factor (TNF)-α release [19]. In the present study, inflammatory response was operationally defined as the individual obtained score of the serological level of C-reactive proteins (0 to 2mg/dL) and the Interleukin-2 (IL-2), (20 pg/ml), which are the recommended initial screening parameters to detect increased inflammatory response [20].

Diabetes Mellitus (DM) is theoretically defined as "a syndrome caused by an imbalance between insulin supply and demand". [21]. In the present study, DM was operationally defined as the individual obtained score of the fasting blood glucose level of 120 mmol/L or greater).

Hypertension (HTN) is theoretically defined as "a persistent elevation of systolic blood pressure of 140 mm Hg or above. Hypertension is the single most important predictor of cardiovascular risk related to increased severity of atherosclerosis, stroke, and congestive heart failure" [22]. In the present study, hypertension was operationally defined as the individual obtained score of systolic blood pressure ≥ 140 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg.

Hypercholesterolemia is theoretically defined as the presence of high levels of cholesterol in the blood ≥ 200mg dl. [23]. In the present study, hypercholesterolemia was operationally defined as the individual obtained score of lipid profile according to Fredrickson classification of Hyperlipidemias [24].

Body Mass Index (BMI) is theoretically defined as a clinical indicator of obesity; determined by dividing the weight in kilograms by height in meters squared = Weight (kg) / Height (m) ^{2} [2,25,26]. In the present study, obesity was calculated using the equation of BMI = Weight (kg) / Height (m)^2.

3. Methods

Research Design: A quasi experimental (Pre /Post-test) design was used. Setting: The study was conducted at the outpatient clinics of Menoufia University Hospital, at Shebin El-Kom, Menoufia Governate, Egypt. Sample: A convenient sample of 100 adult patients who were attending to the outpatient clinics approached over a 6-month period (from September 15th, 2014 to February 28th, 2015). Patients who met the study inclusion criteria, which included: a) adult person with an age range from 19 to 65 years of age; b) Body Mass Index (BMI) greater than 30 kg/m2; c) Confirmed diagnosis of Diabetes Mellitus (random blood glucose level > 200 ml/dl); Confirmed diagnosis of hypertension (systolic blood pressure greater than 140 and diastolic blood pressure greater than 90 mmHg) were enrolled in the study. Patients were excluded if they had any of the following conditions: a) confirmed diagnosis of CAD; b) any malignancy and c) pregnant women. Patients with such conditions were excluded from the study because these conditions may influence the study outcomes. One hundred participants completed the planned three follow-up measurement points.

4. Tools of Data Collection

A) Interviewing Questionnaire to collect data on age, marital status, educational level, monthly income, place of residence, occupation, medical and family history and medication taken. Data was collected by the investigator using a semi-structured demographic sheet at the initial data collection point through face to face interview.

B) Cardiovascular Risk Assessment Scale (CVRAS) to estimate a person's chance of developing CAD over the next 10 years [27]. The scale is based on the Framingham Heart Study. This risk assessment tool assigns points based on age, gender, cholesterol level, presence of diabetes, blood pressure and smoking status. Based on points, a 10-year CVD risk percentage will be assigned.

Subjects respond on a likert-type scale ranging from “0" to “100%” with zero indicating no cardiac risk and more than 20% indicating high CAD risk, higher scores indicate greater CAD risk. The Cardiovascular Risk Assessment Scale scores as low CAD risk (less than 10%), moderate (10 to 20%), and severe (greater than 20%). Internal consistency was evaluated using Cronbach’s alpha and was 0.95 for the total scale. The reliability of the scale also reported in the study of Four Hundred Ninety women complained of diabetes mellitus [28] in which the Cronbach’s alpha was 0.97 for the total scale. In the present study, test- retest reliability of the total CVRAS was 0.94.

C) Obligatory Exercise Questionnaire was used to measure physical activity [29]. The Obligatory Exercise Questionnaire consists of 20 questions, answered on a four point Likert scale, always (4), usually (3), rarely (2), never (1). The scale takes approximately 5 minutes to complete. The sum of all ten items gives a total score with a range of 24-50. The total scores categorized into five levels, a score of 30 or less indicates not doing exercise. Scores between 30 and 40 indicate there is reason for mild concern. Scores between 40 and 50 suggest may have moderate exercise. Scores above 50 consider finding ways to moderate the exercise. Joann, [30] reported coefficient alpha reliability of 0.92 for the Obligatory Exercise Questionnaire in a 73,743 sample of obese women. In the present study, test-retest reliability of the Obligatory Exercise Questionnaire was found to be 0.91.

D) Biophysiological Measurements:

a) Body Mass Index

Body Mass Index was calculated based on the following formula, body mass index (BMI) = Weight (kg) / Height (m) ^{2} (kg/m^2). Body mass index is a direct guide to obesity [25].

b) Blood Pressure: Blood pressure was measured by a mercury sphygmomanometer in a sitting position after 5 minutes of rest to measure resting blood pressure. Two blood pressure readings were taken at a two minute interval by a qualified nurse, between which pulse rate was palpated for one minute. Blood pressure readings were averaged across the two appointments. High blood pressure was defined as SBP>140mm Hg or DBP>90 mm Hg or taking antihypertensive medications. Readings were taken in the morning before 11 a.m.

E) Biochemical Values

a) Blood Glucose: Venous blood sample was drawn by a laboratory technician using the standard vacuum-tube system to test the blood glucose level while the patient rested in a supine position for 10 minutes. All analyses were carried out within 4 hours of collection. Blood sample was drawn in the morning after 10-12 hours of fasting over night on day one and at the end of the intervention (after 3 months).

b) Inflammatory Response: Serological level of Interleukin-2 (IL-2) and C-reactive protein (CRP).

c) Total Lipid Profile. Lipid profile including: total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and triglyceride were collected after a 12-hour overnight period, water-only fast.

4.1. Ethical Consideration

An official permission was obtained from the Faculty of Nursing and hospital directors to conduct the study prior to the initiation of data collection. An oral consent was obtained from patients to participate in the study. During the initial interview, the purpose, nature of the study and data collection procedure were explained to the participants. The participants were assured that all information would be confidential and participation in the study is voluntary and that they can withdraw from the study at any time. The researcher also explained that there will be no costs to participate in the study and participants would benefite from the free laboratory tests.

4.2. Pilot Study

A pilot study was conducted to test the feasibility and practicability of the questionnaires and to detect the problems that may be encountered during data collection. It also helped to estimate the time needed to complete the study questionnaires. The pilot study was conducted on 10 adult patients whom were excluded from the final analysis of the results.

5. Data Collection Procedures

Participants were interviewed in the outpatient clinics to collect data about 1) socio demographics, which included age, marital status, educational level, income, residence, occupation, past medical and family history and medications taken; 2) Cardiovascular Risk Assessment Scale (CVRAS) to estimate cardiovascular risk within ten years; 3) The Obligatory Exercise Questionnaire to assess the physical activity; 4) Biophysiological measurements which include: Body Mass Index, and Resting Blood Pressure; 5) Biochemical Values which include Blood Glucose Level, serological levels of IL-2, C-reactive Protein, and total lipid profile. The overall interview took 25- 30 minutes. Participants were given a list of a variety of foods rich in omega-3 fatty acids to choose from such as eggs, milk, tuna, fatty fish, beef, salmon, sardines, spinach, green beans, cauliflower, shrimp, walnuts, lettuce, strawberries, etc. The list included the amount of omega-3 fatty acids in grams and the recommended quantity from each item in the list. Participants were given the freedom to create their own combination of items for the total of 3g of omega-3 fatty acids per day. Participants were also instructed to record the combination of items they ate in a daily record sheet. For participants who cannot read or write, the researcher scheduled a weekly follow up phone call to ask them about the foods they consumed over the week. The researcher met with the participants once a month to collect the food diary sheets and sent these sheets to a dietitian to analyze and calculate the amount of omega-3 fatty acids in grams per day for each participant. The participants were instructed to follow this regimen for three months (duration of the intervention). Participants were asked not to change their physical activity, dietary intake, routine medications and lifestyle throughout the time of intervention. After three months and the end of the intervention, researchers interviewed the participants to complete the questionnaires again (CVRAS, Obligatory Exercise Questionnaire, BMI, Systolic and Diastolic Blood Pressure, blood glucose level, IL-2, C-reactive protein and total lipid profile).

6. Results

Characteristics of the Sample: One hundred adult patients were enrolled in the study. The mean age of the participants was 50.69 ± 5.95 years old. Most of the participants (61%) were males and 70% were married. The majority of the participants in the study sample (70%) have primary education and 82% of the participants were working.

Table 1. Socio-Demographic Data of the Sample

Variables	N=100	%
Age		
• Mean ±SD	50.69±5.95	
• Range	42 - 60 years	
Sex		
• Male	61	61.0
• Female	39	39.0
Residence		
• Rural	68	68.0
• Urban	32	32.0
Marital Status		
• Single	4	4.0
• Married	70	70.0
• Widow	20	20.0
• Divorced	6	6.0
Educational Level		
• Read and write	4	4.0
• Primary	70	70.0
• Secondary	20	20.0
• University Graduate	6	6.0
Occupation		
• Working	82	82.0
• Not working	18	18.0

Table 2. Cardiovascular Risk Factors of the Participants

Variables	(N=100)	%
Hypertension	75	75.0
Diabetes Mellitus	79	79.0
Obesity	14	14.0
Hypercholesterolemia	30	30.0

Table 2 showed that 75% of the participants suffer from hypertension and the majority of the study sample (79%) has Diabetes Mellitus. Only 14% of the study sample classified as obese and 30% has Hypercholesterolemia.

Table 3. Distribution of Cardiovascular Risk of the Study Sample

CVRAS	No	%
• Low	15	15
• Intermediate	33	33
• High	52	52

Table 3 illustrated that more than half (52%) of the study sample are at high risk for cardiovascular diseases, 33% classified as intermediate risk and only 15 % have low risk of cardiovascular diseases.

Table 4. Effect of the Dietary Intervention on Cardiovascular Diseases Risk Scores and the Inflammatory Response Post Intervention

Variable	Pre (N=100)	Post (N=100)	Paired t-test	P value
	Mean ± SD	Mean ± SD		
CVD Risk Score	22.94 ± 3.13	13.50 ± 2.95	4.94	<0.001(HS)
Inflammatory Response				
• Interleukin-2	31.90 ± 4.80	23.55 ± 4.44	2.92	<0.001(HS)
• C-reactive Proteins	4.10± 1.38	2.71 ± 1.39	2.03	<0.001(HS)

Table 4 indicated that there was a statistically significant decrease in the CVD risk scores from 22.94 (3.13) pre intervention to 13.50 (2.95) post intervention, P <0.001. Also, there was a statistically significant reduction in the inflammatory response of interleukin-2 (IL-2) and C-reactive protein from 31.90 (4.80); 4.10 (1.38) pre intervention to 23.55 (4.44); 2.71(1.39) post intervention respectively, P < 0.001.

Table 5 Showed that there was a significant statistical difference in the Systolic and Diastolic BP pre intervention 151.33 (2.91), 94.93(0.912) respectively compared with post intervention 123.50 (8.42), 81.67(6.26) respectively, P <0.001. Also, there was a significant statistical reduction of blood glucose level pre intervention 137.40 (7.86) compared with post intervention 98.97 (5.49), P < 0.001. In addition, there was a significant statistical increase in physical activity level pre intervention 29.40 (2.47) compared with post intervention 37.10 (2.39), P <0.001.

Table 5. Effect of the Dietary Intervention on Blood Pressure, Blood Glucose Level and Physical Activity Pre and Post Intervention

Variable	Pre (N=100)	Post (N=100)	Paired t test	P value
	Mean ± SD	Mean ± SD		
Blood Pressure				
Systolic BP	151.33 ± 2.91	123.50 ± 8.42	2.76	<0.001(HS)
Diastolic BP	94.93 ± 0.912	81.67 ± 6.26	3.11	<0.001(HS)
Blood Glucose	137.40 ± 7.86	98.97 ± 5.49	3.63	<0.001(HS)
Physical Activity	29.40 ± 2.47	37.10 ± 2.39	60.38	<0.001(HS)

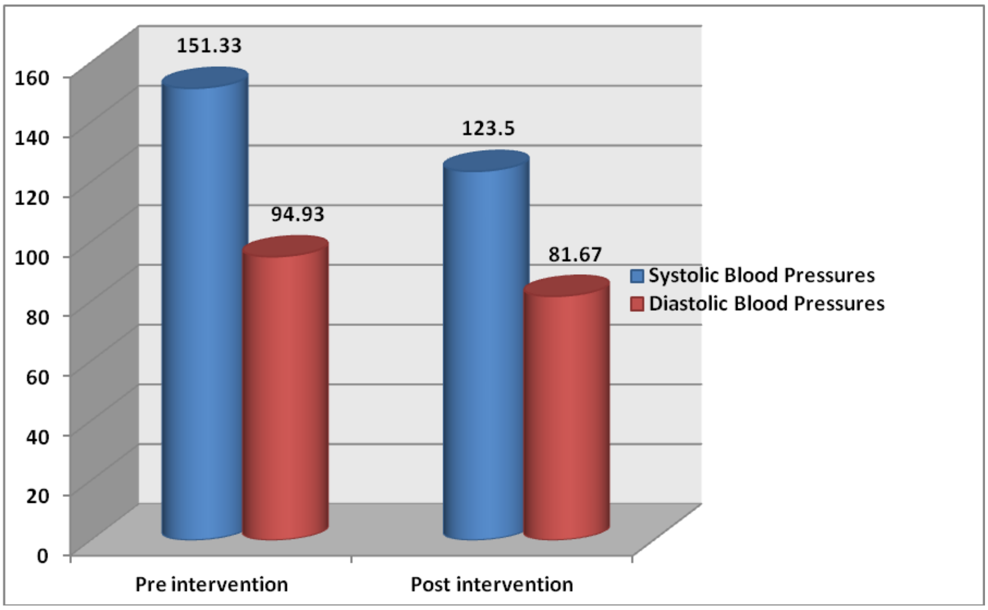

Figure 1. Effect of the Dietary Intervention on Blood Pressure Pre and Post Intervention

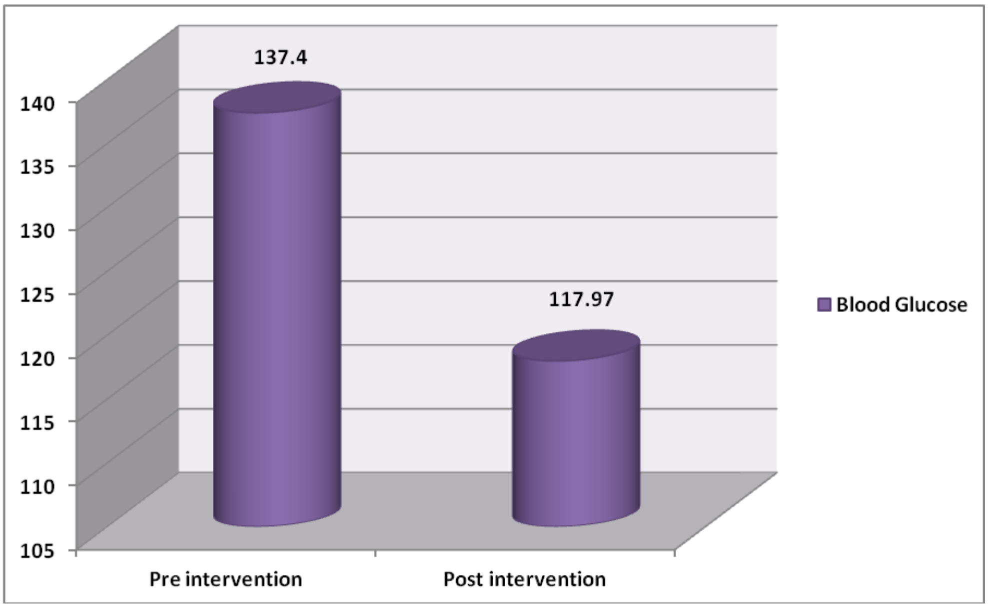

Figure 2. Effect of the Dietary Intervention on Blood Glucose Level Post Intervention

Figure 1 illustrated that there was a statistically significant difference between systolic and diastolic BP post intervention compared with pre intervention.

Figure 2 illustrated that there was a statistically significant difference in blood glucose level post intervention compared with pre intervention.

Table 6 Showed that there was a significant statistical difference in the body mass index post intervention 32.75 (8.85) compared with 36.95 (5.05) pre intervention, P <0.001. Also, there was a significant reduction of body weight post intervention 92.58 (5.75 compared with 96.06 (5.99) pre intervention, P < 0.01. Also, there was a significant reduction of skin fold thickness pre intervention 23.06 (1.38) compared with post intervention 20.53 (1.54), P <0.01. In addition, there was a significant reduction of mid arm circumference pre intervention 37.08 (2.22) compared with post intervention 932.43 (2.20), P < 0.01.

Table 6. Effect of the Dietary Intervention on Body Mass Index Post Intervention

Variable	Pre (No=100)	Post (No=100)	Paired t test	P Value
	Mean ±SD	Mean ±SD		
Body Mass Index	36.95± 5.05	32.75± 8.85	2.71	<0.001(HS)
Body Weight	96.06 ± 5.99	82.58 ± 5.75	3.32	<0.01(S)
Skin Fold Thickness	23.06 ± 1.38	17.53 ± 1.54	1.63	<0.01(S)
Mid Arm Circumference	37.08 ± 2.22	30.43 ± 2.20	4.98	<0.01(S)

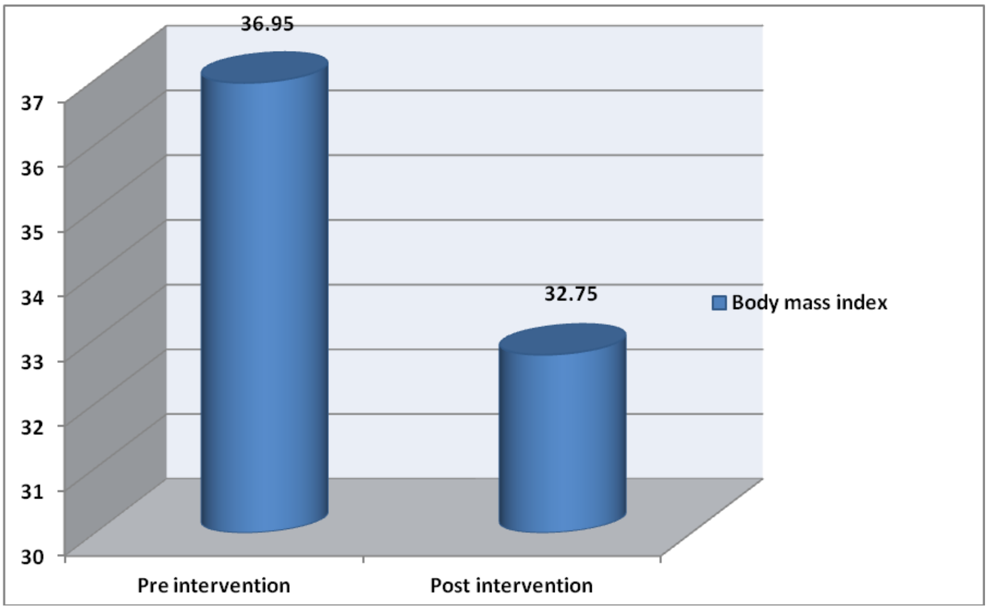

Figure 3. Effect of the Dietary Intervention on Body Mass Index Post Intervention

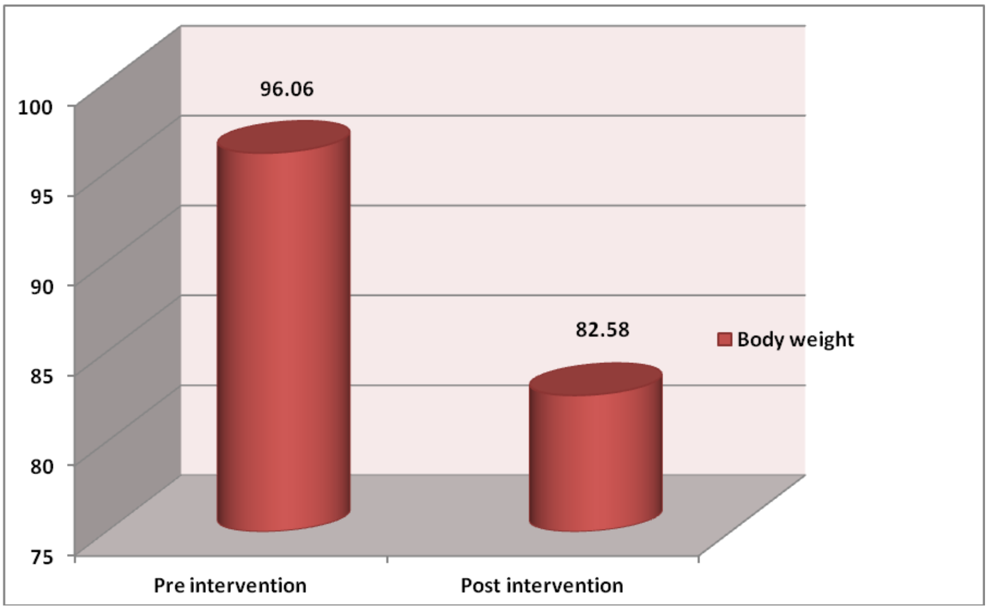

Figure 4. Effect of the Dietary Intervention on Body Weight Post Intervention

Figure 3 illustrated that there was a statistically significant difference in the body mass index post intervention compared with pre intervention.

Figure 4 illustrated that there was a statistically significant difference in the body weight post intervention compared with pre intervention.

7. Disscusion

The current study examined the effect of dietary intervention rich in omega-3 fatty acid on cardiovascular diseases risk scores, inflammatory responses, physical activity and body mass index among patients at high risk for coronary artery diseases.

7.1. The Effect of the Dietary Intervention on Cardiovascular Diseases Risk Scores

The primary goal of cardiovascular screening is the identification of high-risk individuals who can be targeted for smoking cessation, diet, exercise, and blood pressure control. It is well established that compliance with lifestyle recommendations is directly related to the absolute risk perceived by individual patients. The current study hypothesized that patients who will receive the dietary intervention rich in omega-3 fatty acid are more likely to have less CVD risk scores than patients who will not receive the intervention. The present study findings revealed that there was a statistically significant reduction in cardiovascular risk scores post intervention compared with pre intervention. The findings of the present study are similar to what was reported by Mozaffarian, et al., [31] who studied the effects of dietary intake of omega-3 fatty acid on CVD risk factors reduction for high risk people and found that the dietary intake of omega-3 fatty acid had the potential of positively impacting the health status and reduced risk of CAD for high risk people. Also, similar findings have been reported by Chowdhury, et al. [32] who examined the effects of increased dietary intake of omega-3 fatty acid among individuals at high-risk of CAD in the primary care setting and found that the increasing cardio protective effect of omega-3 fatty acid is associated with a marked decrease in CAD risk scores and the overall CVD mortality.

7.2. The Effect of the the Dietary Intervention on Blood Glucose Level

The present study findings revealed that there was a statistically significant reduction in blood glucose level post intervention compared with pre intervention. The findings of the current study are similar to what was reported by Singh,et.,al. [33]; Appel ,et al. [34] and Lai, et al. [35] who found that regular intake of omega-3 fatty acids has a great impact on reducing blood glucose levels among patients with diabetes mellitus. Also, the findings are similar to Nettleton and Katz [36] findings that omega-3 fatty acids can decrease blood glucose levels in adults with impaired glucose tolerance (IGT). However, the study findings are different from what was reported by Leena, et al. [37] who reported that food rich with omega-3 fatty acids is not effective in reducing blood glucose levels among older patients with diabetes mellitus. A possible explanation of their findings may be due to the fact that the study population was elderly people over 75 years old who cannot adhere to consuming the recommended amount of food rich in omega-3 fatty acid.

7.3. The Effect of the Dietary Intervention on Blood Pressure

The present study findings revealed that there was a statistically significant reduction of blood pressure post intervention. The findings of the present study are similar to what was reported by Engler, et al. [38]; Grobbee, et al. [39]) who examined the effects of omega-3 fatty acids on blood pressure among adult patients with hypertension and found that omega-3 fatty acids intake had a positive impact on health status and lowered blood pressure among adult patient with hypertension. Similar findings have been reported by Harper, et al. [40] who reported that a reduction of systolic blood pressure of 10 -12 mm Hg and 5-6 mm Hg reduction in diastolic BP indicates a reduction in the risk of CVD of 16-19% within a few months from the beginning of omega-3 fatty acids intake. However, the present study's findings are different from what was reported by Pazoki [41] who examined the effectiveness of omega-3 fatty acids in reducing blood pressure for 8-weeks and found that there was no statistically significant difference between pre intervention and post intervention. This can be explained by the short duration of their intervention. Also, the current findings are different from what was reported by Barbara, et al. [42] who examined the effects of omega-3 fatty acids on reducing blood pressure and found no statistically significant decrease in blood pressure post intervention compared with pre intervention. A possible explanation of their findings may be due to the fact that they used small doses of omega-3 fatty acids (1g/day) which is less than the recommended dose of daily intake (3 g/day).

7.4. The Effect of the Dietary Intervention on Inflammatory Responses

Studies show that lifestyle factors can modulate CRP. Omega-3 fatty acids have anti-inflammatory properties and studies suggest that eating fish high in omega-3 fatty acids may lower CHD risk. The present study hypothesized that patients who receive dietary intervention rich of omega-3 fatty acids are more likely to have reduced inflammatory responses compared with patients who will not receive the intervention. The findings of the present study revealed that there was a statistically significant decrease in the mean score of the IL-2 and the C-reactive protein levels post intervention compared with pre intervention. Similar findings were reported by Mozaffarian et al., [32]; Faezeh et al., [43] who examined the effects of dietary intake of omega-3 fatty acids on the inflammatory responses and found that there was a statistically significant decrease in the inflammatory responses post intervention compared with pre intervention. In addition, Liu et al., [44] findings showed that dietary intake of omega-3 fatty acids led to reduction of C-reactive protein >44% and interleukin 2 > 57%, especially if maintained for long term and the incidence of CAD risk was reduced by 34% in the study group compared with the control group. Also, Adams et al., [45] examined the relationship between dietary intake of omega-3 fatty acids and the reduction of inflammatory response in people with new-onset of CAD and found that the inflammatory response was 54% lower in people taking omega-3 fatty acids.

7.5. The Effect of the Dietary Intervention on Physical Activity

The present study hypothesized that patients who receive diets rich in omega-3 Fatty Acids are more likely to have increased physical activity levels post intervention compared with pre intervention. The findings of the present study supported the study hypothesis and revealed that there was a statistical improvement in the mean scores of physical activity post intervention compared with pre intervention. The findings of the current study are consistent with what was reported by Kris-Etherton, et al. [16]; Lewis, et al. [46] and Sanders, et al. [17] who studied the effects of omega-3 fatty acid on physical activity among people at high risk of CAD and found that there was a statistical increase in physical activity levels post intervention compared with pre intervention.

7.6. The Effect of Dietary Intervention on Body Mass Index

Weight control should be encouraged to achieve a body mass index (BMI) between 18.5 and 25 kg/m^2 and a waist circumference <80 cm for females to avoid coronary artery disease. The present study hypothesized that patient who will receive diets rich in omega-3 fatty acids are more likely to have a reduction in body mass index post intervention compared with pre intervention. The findings of the current study supported this hypothesis and revealed that there was a statistically significant decrease in body mass index post intervention. Findings of the present study are similar to what was reported by Joshi, et al., [13]; Critchley and Capewell [15] and Leeder, et al. [47] who studied the effects of omega-3 fatty acids on obesity and reported that there was a statistically significance reduction of the body mass index post intervention compared with pre intervention.

7.7. Limitation of the Study

The findings of the current study are limited in its ability to generalize because of the convenience sample, small sample size and using a single setting for data collection. One drawback to convenience sampling is that the group answering the questionnaire may not be typical of the population of people at high risk of CVD in other locations [48]. Another limitation is the lack of random sampling which may contribute to sample selection bias and limits the generalization of the findings.

8. Conclusions and Recommendations

The dietary intervention that was rich in omega-3 fatty acids led to a favorable decrease in cardiovascular risk factors such as blood pressure, blood glucose level, BMI and an increase of physical activity which ultimately decreased the cardiovascular risk scores among people at risk.

A diet rich in omega-3 fatty acids should be included when designing a dietary intervention targeted toward individuals at high risk for cardiovascular diseases. Increase nurses' awareness about the importance of omega-3 fatty acids intake for reducing cardiovascular risk factors among people at high risk.

CRP seems to be a stronger predictor of cardiovascular events than LDL cholesterol. Thus, adding CRP to standard cholesterol evaluations may provide a simple and inexpensive method to improve global risk prediction and compliance with preventive approaches.

The study period should be extended more than three months. Extending the follow-up period will provide more comprehensive information about the beneficial effect of omega 3 fatty acid over a long period of time among patients at high risk for coronary artery diseases.

Replication of this study is recommended with several design changes such as, using a larger sample size; use of randomized selection to achieve appropriate representation of the population; and conducting the study on a larger scale to include multiple locations.

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