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# A Comparison of Serum Omega - 3 Fatty Acid Concentrations Between Patients with Coronary Heart Disease and Healthy Subjects

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**Abstract:** Blood levels of eicosapentaenoic (EPA) and docosahexaenoic acids (DHA) are independently associated with elevated risk of death from coronary heart disease (CHD). The aim of this study was to compare the serum omega 3 and omega 6 fatty acid levels between patients with CHD and control subjects. The mean serum levels of triglyceride (TG) total cholesterol (TC) and low density lipoprotein cholesterol (LDLC) were higher in patients as compared with health subjects. The mean serum levels of alpha-linolenic acid (ALA), EPA, and DHA were significantly lower in the patients than in the control subjects. The mean serum concentrations of the ALA, EPA and DHA in patients were 3.04±0.75, 3.33±2.04, and 6.50±1.79 µg/dL, meanwhile the mean serum concentrations of the ALA, EPA and DHA in healthy subjects were 3.43± 0.50, 4.19±1.79, and 9.78±2.47 µg/dL. In contrast, the mean serum level of arachidonic acid (AA) was higher in the patients as compared with control subjects. The mean serum concentration of AA in patients and healthy subjects was 7.58±1.09 and 6.80±1.31 µg/dL, respectively. The ratio of serum omega-3/omega-6 fatty acids (FAs) was significantly lower in the patients than in the control subjects. In conclusion, the patients with CHD had low concentrations of Omega-3 FAs as compared with health subjects. In contrast, the level of AA is high in patients as compared with healthy subjects. These data suggest that it is important to maintain omega-3 fatty acids level in serum of subjects, especially who are at risk of CHD for the purpose of preventing CHD.

**Key words:** Omega 3, omega 6, eicosapentaenoicacid, docosahexaenoic acid, arachidonic acid, coronary heart disease

## Introduction

The relationship between intake of omega-3 fatty acids and risk of developing Cardiovascular diseases (CVD) began to emerge in the late 1970s (Dyerberg *et al*., 1978; Bang *et al*., 1980; Balk *et al*., 2006). Many studies have reported a negative relation between intake of omega-3 fatty acids (FAs) and CVD incidence and/or mortality (Osler *et al*., 2003; Ervin *et al*., 2004; Psota *et al*., 2006). Omega-3 polyunsaturated fatty acids (PUFAs) are one of dietary substrates that have reported cardioprotective benefits. Omega-3 PUFAs generally exert their cardioprotective effects through changes in lipids and lipoproteins. In addition, omega-3 FAs especially EPA and DHA contribute benefits through their antiarrhythmic, anti-inflammatory, antithrombotic effects. Moreover, EPA and DHA also improve vascular endothelial function and help lower blood pressure, platelet sensitivity (Wijendran and Hayes, 2004). There are three major types of omega 3 fatty acids including alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). The major sources in human diet are fish, especially dark fleshed fish, and, if consumed, fish oil supplements. ALA is a plant form of omega-3 fatty acid (Kris-Etherton *et al*., 2002; Balk *et al*., 2006). In Saudi Arabia there are insufficient data on which to draw conclusions about the status of omega-3 FAs in patients with CHD. Therefore, the objective of this study was to compare the serum omega 3 and omega 6 fatty acids of the patients with coronary heart disease (CHD) and of the control subjects.

## Materials and Methods

The study was carried out in 30 females who had coronary heart disease (CHD), defined as those who had ever been told by a doctor that they had a heart attack, heart failure, or used medicine for a weak heart during the 6 months prior to the baseline study. Patients were randomly chosen from the 2 hospitals in Almdenah Almonorah city. A total of 57 age-matched healthy females also were provided blood samples for comparison of serum lipids and FA analysis. Concentrations of serum total cholesterol, TGs, LDLC, and HDLC were measured by enzymatic methods on an auto-analyzer. The serum concentrations of fatty acids were measured by gas liquid chromatography. The data are presented as means ± SD. The statistical analysis included means; standard deviations were analyzed by SSPS version 10 and differences were tested for significance ($P < 0.05$).

## Results

Characteristics of the subjects are presented in Table 1. Mean body weight and BMI were slightly higher in

patients as compared with healthy subjects. A comparison of serum lipids of the patients and the controls is presented Table 2. The mean serum levels TG, TC, and LDLC were higher in patients as compared with health subjects. In contrast, the mean serum concentration of high density lipoprotein cholesterol (HDLC) was slightly higher in health subjects as compared with patients. The fatty acid concentrations in the serum of the study populations are shown in Table 3. The mean serum concentrations of the ALA, EPA and DHA were significant higher in healthy subjects as compared with patients. In contrast, the mean serum concentrations of the AA was significant higher in patients as compared with health subjects. The mean serum concentrations of the ALA, EPA and DHA in patients were 3.04 ±.75, 3.33 ± 2.04, and 6.50 ±1.79 µg/dL, meanwhile the mean serum concentrations of the ALA, EPA and DHA in healthy subjects were 3.43± 0.50, 4.19 ±1.79, and 9.78 ±2.47 µg/dL respectively. In contrast, the mean serum concentrations of AL and AA in healthy subjects were 36.26 ± 9.83 and 6.80 ±1.31, while the mean serum concentrations of AL and AA in patients were 35.99 ±8.90 and 7.58 ±1.09. The ratio of serum omega-3 / omega-6 fatty acids was significantly lower in the patients than in the control subjects. The ratio of serum omega-3/omega-6 fatty acids in the control subjects was 0.4, while the ratio of serum omega-3 / omega-6 fatty acids in patients was 0.3.

Table 1: Characteristics of the study population (mean ± S.D.)

| Parameter | Patients (n=30) | Controls (n=57) |
|---|---|---|
| Number | 30 | 57 |
| Age (year) | 53.23±6.71 | 51.7±6.5 |
| Hight (cm) | 156.3±5.6 | 158.4± 6.1 |
| Wight (kg) | 65.24±14.3 | 58.2±11.5 |
| BMI (kg/m$^2$) | 26.8±6.6 | 25.2±3.66 |

BMI ; body mass index

Table 2: Serum lipid concentrations of the study subjects (mean ± S.D)

| Parameter | patients (n=30) | controls (n=57) |
|---|---|---|
| TG (mg/dl) | 137.89±70.09 | 119.7±63.10 |
| Cholesterol (mg/dl) | 191.78±45.38 | 173.8±36.85 |
| LDLC (mg/dl) | 116.62±40.01 | 106.74±27.91 |
| HDLC (mg/dl) | 43.91±16.34 | 46.6±13.04 |

Table 3: Serum omega-3 and omega-6 FAs of study populations (mean ± S.D.)

| Parameter | patients (n=30) | controls (n=57) |
|---|---|---|
| Omeg-3 | | |
| ALA (µg/dL) | 3.04±0.75 | 3.43±0.50* |
| EPA (µg/dL) | 3.33±2.04 | 4.19±1.79* |
| DHA (µg/dL) | 6.50 ±1.79 | 9.78 ±2.47* |
| Omega-6 | | |
| LA (µg/dL) | 35.99±8.90 | 36.26±9.83 |
| AA (µg/dL) | 7.58±1.09 | 6.80±1.31* |
| omega-3/omega-6 | 0.3±0.06 | 0.4±0.08* |

ALA, alpha-linolenic acid; EPA, eicosapentaenoic acid; DHA, docosahexaenoic acid. LA, linoleic acid; and AA, arachidonic acid . * significant difference patients and controls ($p< 0.05$)

## Discussion

The primary finding of this study was that healthy subjects had higher concentrations of omega-3 including EPA, DHA, and ALA than did patients. In contrast, patients had the concentrations of AA higher as compared with healthy subjects. We could attribute the low serum levels of omega-3 among patients as compared with healthy subjects to low intake of omega-3 among patients as compared with healthy subjects (data not shown). Our findings support those of Hojo *et al.* (1998) who found that eicosapentaenoic acid was significantly lower in the patients than in the control subjects, whereas, arachidonic acid was significantly higher in the patients than in the control subjects. In addition, Albert *et al.* (2002) found that whole blood levels of EPA and DHA were lower in cases of sudden cardiac death (3.8%) than in controls (4.2%), The evidence for a beneficial coloration between omega-3 FAs and lower risk for death from CHD is strong (Wang *et al.*, 2006), and it was reported that EPA might independently have a protective effect on the progress of coronary atherosclerosis. Moreover Low blood concentration of EPA and DHA is an independent predictor of elevated risk for acute coronary syndrome (Harris *et al.*, 2006). The ratio of serum omega-3 / omega-6 fatty acids was significantly lower in the patients than control subjects. Similarly Hojo *et al.*, 1998 found that the ratio of serum omega-3 / omega-6 fatty acids was significantly lower in the patients with stenosis than in the control subjects. The most likely mechanism by which omega-3 FAs may reduce risk for CVD is through a reduction in myocardial susceptibility to lethal arrhythmias (Leaf *et al.*, 2003). In addition, EPA and DHA may promote plaque stability (Thies *et al.*, 2003), and may be anti-atherosclerotic through a variety of other mechanisms (Von Schacky, 2003). In addition, omega-3 FAs especially EPA and DHA contribute benefits through their antiarrhythmic, anti-inflammatory, antithrombotic effects. Moreover, EPA and DHA also improve vascular endothelial function and help lower blood pressure, platelet sensitivity (Wijendran and Hayes, 2004). Potential Mechanisms by which omega-3 Fatty Acids may reduce risk for cardiovascular disease include reduce adhesion molecule expression, reduce platelet-derived growth factor, promote nitric oxide-induced endothelial relaxation, and reduce susceptibility of the heart to ventricular arrhythmia (Connor, 2000). Supplemental omega-3 FAs have long been known to reduce serum TG levels and TG concentrations are inversely associated with endogenous EPA and DHA levels (Harris *et al.*, 2006). Vasandi *et al.* (2002) observed that dietary omega-3 PUFA markedly reduced TGs and cholesterol ester levels in the liver and the level of apoB-containing lipoproteins in the plasma of LDL-

receptor-deficient mice. These data suggest an important mechanism by which dietary (n-3) PUFAs lower plasma TGs. Omega-3 FAs lower plasma TG concentrations, particularly in people with hypertriglyceridemia by suppressing the synthesis of TG and very-low-density lipoprotein (VLDL) cholesterol in the liver (Harris *et al*., 1997).

In this study, the mean serum level of TG was higher in patients than control subjects and the mean serum concentrations of AA was higher in the patients as compared with healthy subjects. AA levels relate to CHD because of the influence on blood coagulation rather than the progress of atherosclerosis because AA is the precursor of thromboxane $A_2$ (Hojo *et al*., 1998).

In conclusion, the results of this study support the conclusion that patients with CHD had low concentrations of omega-3 fatty acids as compared with health subjects. In contrast, the level of AA is high as compared with healthy subjects. These data suggest that it is important to maintain omega-3 fatty acids level in serum of subjects who at risk of CHD for the purpose of preventing CHD. Therefore, it is important to increase intake of omega-3 to maintain omega-3 fatty acids level in serum for the purpose of preventing CHD.

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