

Comparison of the Intake of Omega-3 Fatty Acids and Its Relation to the Incidence of
Non Fatal Myocardial Infarction in Two Samples from Different Geographical
Locations in Saudi Arabia

By

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DISSERTATION TITLE

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University of Nebraska, 2004

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Evidence shows that omega-3 fatty acids (n-3 FAs) may help in preventing heart disease. The purposes of this current study were to investigate the consumption and the food sources of n-3 FA in two groups of elderly men living in different geographic location (coastal and internal regions) of Saudi Arabia; and to examine the relationship between n-3 FA intakes and non fatal myocardial infarction and the presence of risk factors for heart disease. The coastal region is close to the Arabian Gulf and the internal region represents the Central Part of Saudi Arabia. Sixty elderly men from coastal and internal regions of Saudi Arabia were randomly selected from the telephone directory. All subjects contacted volunteered to participate in the study.

During the summer of 2001, each volunteer was interviewed and provided demographic information, 24-hour dietary recalls and 2-day food records. During the interview a nutritionist provided instructions on estimating serving size using plastic food models. Dietary intake was analyzed using the Food Processor Plus computer program software (ESHA Version 0.7, Salem, Oregon, 2002). Histories of non fatal myocardial infarction and heart disease risk factors were collected from medical files.

During summer of 2002 each volunteer completed a food frequency questionnaire. Data were analyzed using Statistical Package for the Social Sciences computer program software (SPSS for Windows, Version 11.0, SPSS, Inc, 2002).

Descriptive statistics, student t-test, chi-square, and point-biserial correlation were used to analyze the data.

The mean age of coastal residents was greater than the mean age of internal residents ($P < 0.05$). Education and income levels were also different for residents of the two regions ($P < 0.05$). Residents of the internal region had less education and higher incomes.

Total n-3 FA intakes and the intakes of alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were greater in residents in the coastal than the internal region ($P < 0.05$). Walnuts, salmon, canola oil, malabar cavalla and king mackerel were the top five foods contributing to the intake n-3 FAs in the coastal region. Seafood was a major contributor to the intake of n-3 FAs in the coastal region as three-fourths of the residents in this region consumed 5-7 seafood servings/week.

The top five foods contributing to the n-3 FA intakes in the internal region were walnuts, lamb, whole milk, baked beans and chicken. After walnuts, the plant foods contributing the most to the intake of n-3 FA in the internal region were zucchini squash, potato, spinach, cherries, cantaloupe, apple and baked beans provided a total of 0.28 g/day.

Rates of nonfatal myocardial infarction, high serum cholesterol, and high blood pressure were higher in the internal than the coastal region, but differences were not significant. There was a negative correlation between n-3 FA intakes and rates of non fatal myocardial infarction in both the coastal ($p < 0.01$) and internal

($P < 0.05$) regions. Results also indicate a negative correlation between n-3 FA intakes and rates of high serum cholesterol in both regions ($P < 0.01$). There was a negative correlation between n-3 FA intakes and rates of high blood pressure in the coastal region ($P < 0.05$), but not in the internal region.

In conclusion, in this study the food consumption patterns for n-3 FAs differ by location. N-3 FA intakes of elderly men living in the coastal region of Saudi Arabia were higher than those of men living in internal region of the country. Seafood consumption may be one of the reasons for higher intakes of n-3 FA in the coastal region. However the food contributing the most to the intakes of n-3 FA in both regions was walnuts.

Intake of n-3 FAs were negatively correlated with non fatal myocardial infarct and with at least one primary risk factor of heart disease in both regions. Higher intakes of n-3 FA for individuals living in the coastal region may be one of the reasons for lower rates of non fatal myocardial infarction, serum cholesterol and blood pressure.

Future studies may include both men and women and variety of age in Saudi Arabia. Nutrition education intervention is needed for increasing the consumption of n-3 FAs in residents of internal region. Research is needed to study effects of n-3 FAs on cardiovascular disease (CVD) in Saudi Arabia. Likewise it might be worth while to investigate effects of geographic location on the consumption of n-3 FAs in the United States and other countries.

Khalid

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INTRODUCTION

PREVIEW

Introduction

The purpose of the current study is to investigate the source and intake of omega-3 fatty acids (n-3 FAs) in two samples of elderly men living in two diverse geographical locations (coastal and internal regions) in Saudi Arabia, and to determine the relationship between n-3 FA intakes and non fatal myocardial infarction and some cardiovascular disease (CVD) risk factors.

Saudi Arabia lies at the furthestmost part of south-western Asia. It occupies about 80% of the Arabian Peninsula, with a total area of over 2,250,000 square kilometers (Statistical Yearbook, 1999), and is at the crossroads of three continents-Europe, Asia and Africa. It extends from the Red Sea in the west to the Arabian Gulf in the east. To the north, it borders on Jordan, Iraq, and Kuwait, and to the south, on Yemen and Oman. To the east lie the United Arab Emirates, Qatar and Bahrain.

Saudi Arabia's terrain is varied but on the whole it is fairly barren and harsh, with salt flats, gravel plains and sand dunes and only a few lakes or permanent streams. In the south is the Rub Al-Khali (Empty Quarter), the largest sand desert in the world. In the southwest, the mountain ranges of Asir Province rise to over 9,000 feet. The east and west regions comprise coastal areas which have slightly different climates than the rest of the country. The main cities in the east coastal region (known as Al-Sharqia) include Dhahran, Dammam, Jubail, Khobar, Qatif, and Hofuf, while Jeddah, Yanbu, Debah, Hail, and Rabigh are the prominent cities and towns located in the west coastal region (known as Al-Garbia) (Saudi Arabian Information Recourse, 2003). A quite large portion of Saudi population lives in these coastal cities, some of which are major trade and commerce centers.

Cardiovascular disease rates vary around the globe (WHO CVD Strategy, 2001/2002). Hypertension, hypercholesterolemia, diabetes mellitus, obesity and smoking are among the foremost established atherogenic risk factors. Cardiovascular disease is a leading cause of death in both the developed and developing countries (WHO CVD Strategy, 2001/2002).

According to WHO estimates, 17 million people around the world die of CVD each year. In 1998 there were 7.3 million deaths from heart attack and 5.1 million from stroke. Another 15 million each year survive minor strokes. Six hundred million people with high blood pressure are at risk of heart attack, stroke and cardiac failure (WHO, CVD Strategy, 2001/2002). In 1999, CVD contributed to one third of global deaths. Low- and middle-income countries contributed to 78% of CVD deaths. By 2010 CVD is estimated to be the leading cause of death in developing countries (WHO, CVD Strategy, 2001/2002).

Cardiovascular diseases rank as America's No. 1 cause of death, claiming the lives of over 40 percent of the nearly 2.4 million Americans who die each year. Almost sixty - two million Americans have some form of CVD. This includes diseases of the heart, stroke, high blood pressure, congestive heart failure, congenital heart defects, hardening of the arteries and other diseases of the circulatory system (Heart Facts, 2002).

Studies have shown that the risk of death from heart diseases increases with age in all races. The number of elderly male Saudis in 1999 appeared to be 355,553 which constitutes about 5 % of the total Saudi male population. Although most CVD occurs in people over 65, a large number of premature deaths have lead to extensive research regarding the prevention of CVD (Healthy People, 2010). A current report from the

Ministry of Health (MOH), Kingdom of Saudi Arabia, indicated that cardiovascular diseases were the second cause of death during 1997 and 1998 (Annual Health Report, MOH, KSA, 1998). Investigating the prevalence of CVDs risk factors in Saudi Arabia, as well as dietary habits and the mechanisms of nutrient interaction, are essential for planning successful nutrition intervention strategies for primary prevention and control of CVDs (Osman and Al-Nozha., 2000).

Diet has been the most pronounced cause among environmental determinants of heart diseases. Epidemiological and clinical trials suggest that omega-3 fatty acids have a significant role in the prevention of coronary heart disease (CHD). N-3 FAs are long-chain polyunsaturated fatty acids and are essential fatty acids that cannot be manufactured by the body. For this reason, n-3 FAs must be obtained from food (Horrocks and Yeo, 1999). N-3 FAs can be found in fish and certain plant oils such as canola oil and flax oil. There are three major types of n-3 FAs that are ingested in foods and used by the body: alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). Once eaten, the body converts ALA to EPA and DHA (Holub, 2002). Extensive research indicates that n-3 FAs reduce inflammation and help prevent certain chronic diseases such as heart disease and arthritis. These essential fatty acids are highly concentrated in the brain and appear to be important for cognitive and behavioral function.

The potential of nutrients to modulate arterial and vascular functions is currently the focus of cardiologists and nutritionists. Endothelial dysfunction of the arteries is characteristic of major cardiovascular risk factors including hyperlipidemia, hypertension, diabetes, smoking and obesity (Nestel et al., 2000). Of the various nutritional

interventions that have shown improvement as preventive measurements from cardiovascular diseases, the intake of antioxidant vitamins, folate and fish oil (Nestel et al., 2000) are more prominent.

Fish is a major dietary source for n-3 FAs, however, vegetable sources, including grains and oils, offer an alternative source. While fish oils are rich in eicosapentaenoic acid and docosahexaenoic acid, plants are rich in alpha-linolenic acid. The intake of saturated fat was postulated to be the main environmental factor for CVDs. Intervention trials, either in coronary patients or even in primary prevention, showed that when the diet is enriched with n-3 FAs, especially alpha-linolenic acid, cardiac death is reduced (Lanzmann-Petithory, 2001).

A major limitation to the assessment of CVD risks and their relationship to the dietary sources and intake in Saudi Arabia, is the lack of data and published material for various population groups. The public health system, participating groups, and the public in general can benefit from rigorous research to understand the source, consumption, and the effects of dietary components containing omega-3 fatty acids and their impact on CVD risks. Better preventive measures to minimize the CVD risks can be introduced to Saudi public by collecting and comparing relative information on the dietary sources and their effects on health. Public awareness regarding the importance of some fundamental nutrients, such as n-3 FAs, can be enhanced by properly investigating their effects among the subjects and between the population groups living in the same or different vicinity.

PURPOSE AND SIGNIFICANCE

PREVIEW

Purpose and Significance

The purpose of the current study is to investigate the source and intake of n-3 FAs, in two samples living in two diverse geographical locations (coastal region versus internal region) in Saudi Arabia, and to determine the relationship between omega-3 fatty acid intakes and non fatal myocardial infarction and some heart disease risk factors.

Since there was no published research data available on the dietary intakes of n-3 FA in Saudi Arabia and not much has been done on the effect of geographic location on the consumption of n-3 FAs in the United States and other countries, this study will help to document the intakes of n-3 FA in Saudi Arabia and document the effect of geographic location on the consumption of n-3 FAs.

The research will provide information assist in the design and implementation of educational interventions for people who have low n-3 FA intakes or those who are at potential risk of heart disease.

REVIEW OF LITERATURE

PREVIEW

Review of Literature

What are omega-3 fatty acids?

Burr and Burr (1929) made the discovery of the importance of long-chain polyunsaturated fatty acids, at University of Minnesota Medical School. In 1930, the essentiality of polyunsaturated fatty acids (PUFA) (linoleic and alpha- linolenic acids) in terms of growth promotion and prevention of dermatitis was reported in fat-free diet fed to rats (Burr and Burr, 1930).

Fat is an essential component of the diet; on essential fatty acid-free diets rats do not grow or reproduce (Horrocks and Yeo, 1999). Essential fatty acids include linoleic acid containing 18 carbon atoms and 2 double bonds, and its omega-6 derivative, arachidonic acid containing 20 carbon atoms and 4 double bonds. Alpha- linolenic acid contains 18 carbon atoms and 3 double bonds, and its omega-3 derivative DHA contains 22 carbon atoms and 6 double bonds (Fig.1) (Horrocks and Yeo, 1999). Alpha- linolenic acid (ALA) in animals and humans can be elongated and desaturated to long chain polyunsaturated omega-3 fatty acid, EPA, containing 20 carbon atoms and 5 double bonds and DHA, and linolenic can also be elongated and desaturated to long chain polyunsaturated fatty acids (Fig. 2) (Lanzmann-Petithory, 2001).

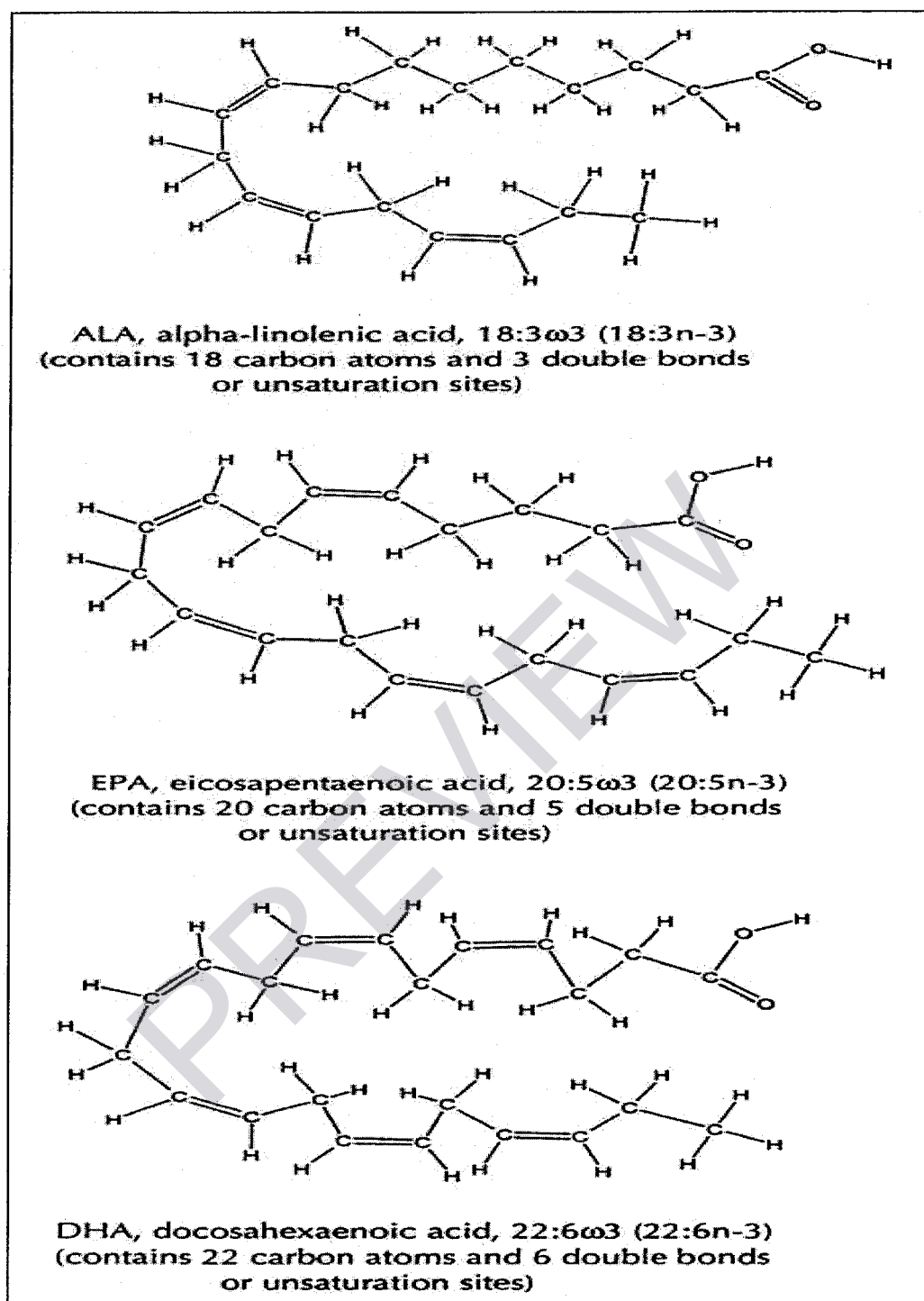


Fig.1: Chemical structures of alpha-Linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (Holub, 2002).

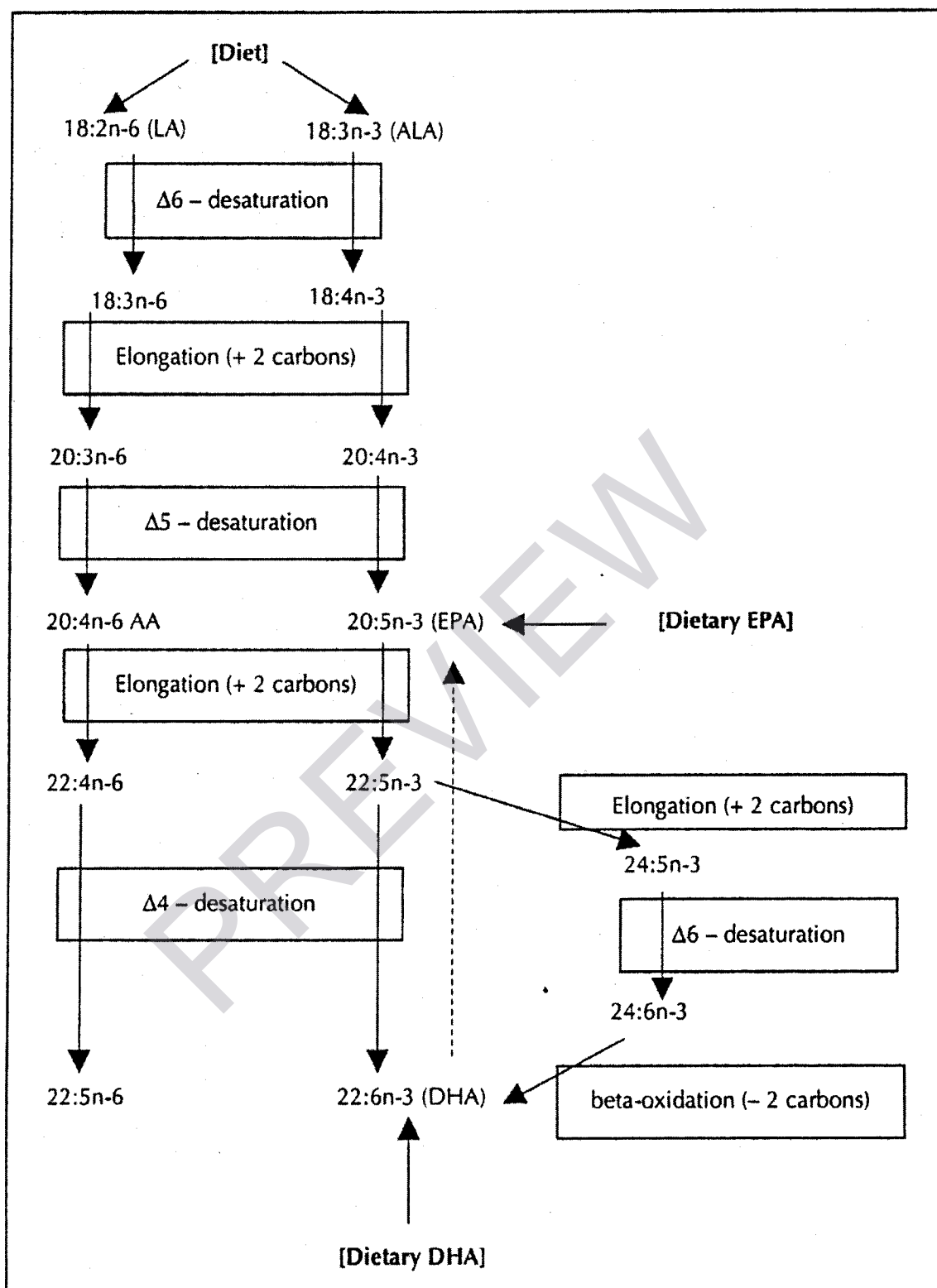


Fig.2: Essential fatty acids metabolism (Holub, 2002)

Effect of Omega-3 Fatty Acids on Cardiovascular Diseases

Diet composition has played an important role in the prevention of CVD.

Scientists observed have that Greenland Eskimos exhibited, significantly, lower rate of mortality from coronary heart disease compared with Danes. The researchers suggested that this could be due to high intake of fish, which are rich sources of fatty acids, especially omega 3- fatty acids.

Epidemiological and clinical studies indicated that consumption of fish or fish oil is associated with lower rate of heart disease. Coronary heart disease (CHD) is the major cause of death from cardiovascular diseases (Moshan, 1999). In a study involving 11,324 patients who survived recent myocardial infarction, the results indicated that fish oil consumption in subjects with existing cardiovascular diseases lead to enhanced survival through multiple mechanisms including improving lipoprotein profile, lowered arterial pressure, diminished thrombogenicity (GISSI.,1999).

In a case control study, 334 patients with primary cardiac arrest were compared with a group of 493 control subjects free of prior clinical heart disease, aged 25- 74 years. The results indicated that, patients who consumed 5.5 gram (g) per month of dietary eicosapentaenoic and docosahexaenoic acid, the equivalent of four fatty fishmeals per month, had red blood cell membrane n-3 FAs level of 4.3 % of total membrane fatty acids. This resulted in a 50% risk reduction in primary cardiac arrest when compared with those individuals who had no seafood intake (Siscovick et al., 2000).

Eicosapentaenoic acid and docosahexaenoic acid act on platelet aggregation mainly through its role in eicosanoid synthesis. The thromboxanes produced by platelets and prostaglandins produced by vascular endothelium are involved in regulating