

**Omega-3 Fatty Acids and Athletics**  
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EIB            exercise-induced bronchoconstriction

n-6            omega-6

n-3            omega-3

FROM ABSTRACT

Human beings evolved consuming a diet that contained about equal amounts of n-6 and n-3 essential fatty acids.

Today, in Western diets, the ratio of n-6 to n-3 fatty acids ranges from approximately 10:1 to 20:1 instead of the traditional range of 1:1 to 2:1.

Studies indicate that a high intake of n-6 fatty acids shifts the physiologic state to one that is prothrombotic and proaggregatory, characterized by increases in blood viscosity, vasospasm, and vasoconstriction, and decreases in bleeding time.

N-3 fatty acids, however, have anti-inflammatory, antithrombotic, antiarrhythmic, hypolipidemic, and vasodilatory properties.

Excessive radical formation and trauma during high-intensity exercise leads to an inflammatory state that is made worse by the increased amount of n-6 fatty acids in Western diets, although this can be counteracted by eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).

For the majority of athletes, especially those at the leisure level, general guidelines should include EPA and DHA of about 1 to 2 g/d at a ratio of EPA:DHA of 2:1.

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## THIS AUTHOR ALSO NOTES

"The health of the individual and population is determined by the interaction between their genetic endowment and a number of environmental factors."

"Both diet and exercise are two environmental factors of major importance."

Eating healthy, alone, is not enough for health, one must also exercise. "If there is any deficiency in food or exercise the body will fall sick." "Diet and exercise are essential components for health."

"N-3 fatty acids are essential for normal growth and development and play an important role in the prevention and management of coronary heart disease (CHD), and are beneficial in the management of hypertension, diabetes, arthritis and other autoimmune disorders, and cancer."

The human diet has had major changes in the past 150 years, yet the genetic profile has changed very little, if any, in the past 10,000 to 15,000 years.

"The present Western diet is deficient in n-3 fatty acids with a ratio of n-6 to n-3 fatty acids of 10:1 to 20:1 instead of 1:1 as is the case with wild animals and (presumably) human beings."

"Human beings evolved on a diet in which there was a balance between the n-6 and n-3 fatty acids, which is a more physiologic state because both n-6 and n-3 polyunsaturated

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fatty acids (PUFA) influence cellular metabolism and gene expression.”

Both n-6 and n-3 fatty acids are important components of animal and plant cell membranes.

“When humans ingest fish or fish oil, the ingested eicosapentaenoic acid (EPA; 20:5n-3) and docosahexaenoic acid (DHA; 22:6n-3) partially replace the n-6 fatty acids (especially arachidonic acid [AA; 20:4n-6]) in cell membranes, especially those of platelets, erythrocytes, neutrophils, monocytes, and liver cells.”

Ingestion of EPA and DHA from fish or fish oil leads to:

- 1) Decreased production of prostaglandin E2
- 2) Decreased concentrations of thromboxane A2, a potent platelet aggregator and vasoconstrictor
- 3) Decreased formation of leukotriene B4, an inducer of inflammation

“Because of the increased amounts of n-6 fatty acids in the Western diet, the eicosanoid metabolic products from AA, specifically prostaglandins, thromboxanes, leukotrienes, hydroxy fatty acids, and lipoxins, are formed in larger quantities than those formed from n-3 fatty acids, specifically EPA.”

The eicosanoids from AA contribute to:

- 1) The formation of thrombi and atheromas
- 2) The development of allergic and inflammatory disorders

A diet rich in n-6 fatty acids increases in blood viscosity, vasospasm, and

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vasoconstriction.

“As the ratio of n-6 to n-3 fatty acids increases, the prevalence of type 2 diabetes also increases.”

Fatty acids are important cell-signaling molecules because they can act as second messengers.

“It has been shown that fatty acids rapidly and directly alter the transcription of specific genes.”

Exercise or physical activity is associated with lower risk for cardiovascular disease, hypertension, obesity, and diabetes.

The effects of n-3 fatty acids and physical activity are similar and are “opposite of those of the effects of the aging process.”

“N-3 fatty acids are essential for overall health of the athlete.”

Both n-3 fatty acids and exercise increase the production of endogenous antioxidant enzymes such as catalase, glutathione peroxidase, and superoxide dismutase.

Both n-3 fatty acids and exercise increase oxygen delivery to the heart muscle “so that the heart does not have to work as hard to get the oxygen it needs for work.”

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During exercise there is an increase in the generation of superoxide radical, and trauma to the muscles.

“Excessive radical formation and trauma during high-intensity exercise leads to a state of inflammation that is made worse by the increased amounts of n-6 found in the Western diet.”

Fish oil concentrates rich in EPA and DHA counteract the effects of the inflammatory state.

The majority of athletes should use fish oils (EPA and DHA) “of about 1 to 2 g/d at a ratio of EPA to DHA of 2:1.”

“The background diet should be balanced in n-6 and n-3 fatty acids by lowering n-6-rich oils such as corn oil, sunflower, safflower, cottonseed, and soybean oils.”

“Changes and improvements in the background diet and an additional 1 to 2 g/d of EPA and DHA should prevent the inflammation in muscles and joints. For the elite athlete, the above prophylactic measures are essential.”

Training increases the incorporation of n-3 fatty acids into muscle membranes, while reducing their n-6 content.

“Dietary fish oil supplementation has a markedly protective effect in suppressing exercise-induced bronchoconstriction (EIB) in elite athletes, and this is most likely attributed to EPA and DHA anti-inflammatory properties.”

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Fish oil supplementation in the amount of 5.4 g per day had a "significant protective effect in suppressing EIB in elite athletes, most likely due to the anti-inflammatory properties of the n-3 fatty acids."

## CONCLUSIONS

"Essential fatty acids, both n-6 and n-3, have been part of our diet since the beginning of human life. Before the agricultural revolution 10,000 years ago, humans consumed about equal amounts of both. Over the past 150 years this balance has been upset."

"Current estimates in Western cultures suggest a ratio of n-6 to n-3 fatty acids of approximately 10:1 to 20:1 instead of 1:1 or 2:1 as was the case during evolution and prior to agribusiness and modern agriculture that led to the production of vegetable oils high in n-6 fatty acids."

"Eicosanoids derived from n-6 fatty acids have opposing metabolic properties to those derived from n-3 fatty acids. A balanced intake of both n-6 and n-3 fatty acids is essential for health."

"Many of the effects of n-3 fatty acids are similar to the effects of exercise."

Both n-3 fatty acids and exercise increase basal metabolic rate, insulin sensitivity, nitric oxide production, erythrocyte deformability, heart rate variability, and bone density, and decrease the risk of metabolic syndrome, bone fractures, platelet aggregation, and depression.

"N-3 fatty acids decrease EIB in the athletes and counteract the inflammatory state

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brought on by exercise.”

“For the majority of athletes, especially those at the leisure level, general guidelines should include fish oils EPA and DHA of about 1 to 2 g/d at a ratio of EPA to DHA of 2:1.”

“The background diet should be balanced in n-6 and n-3 fatty acids by lowering n-6-rich oils such as corn oil, sunflower, safflower, cottonseed, and soybean oils.”

1 to 2 g/d of EPA and DHA per day should prevent the inflammation in muscles and joints.

“In the athletic setting, the n-3 fatty acids are essential for overall health of the athlete.”

#### KEY POINTS

- 1) The human diet has had major changes in the past 150 years, yet the genetic profile has changed very little, if any, in the past 10,000 to 15,000 years.
- 2) Human beings evolved consuming a diet that contained about equal amounts of n-6 and n-3 essential fatty acids.
- 3) Today, in Western diets, the ratio of n-6 to n-3 fatty acids ranges from approximately 10:1 to 20:1 instead of the traditional range of 1:1 to 2:1.
- 4) Excessive free radical formation and trauma during high-intensity exercise leads to an inflammatory state that is made worse by the increased amount of n-6 fatty acids in Western diets, although this can be counteracted by the n-3 fish oils eicosapentaenoic

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acid (EPA) and docosahexaenoic acid (DHA).

- 5) Most athletes should include 1 to 2 g/d EPA / DHA fish oil.
- 6) The ratio of EPA:DHA should be 2:1.
- 7) "Diet and exercise are essential components for health."
- 8) "N-3 fatty acids are essential for normal growth and development and play an important role in the prevention and management of coronary heart disease (CHD), and are beneficial in the management of hypertension, diabetes, arthritis and other autoimmune disorders, and cancer."
- 9) Ingestion of EPA and DHA from fish or fish oil leads to:
  - A)) Decreased production of prostaglandin E2
  - B)) Decreased concentrations of thromboxane A2, a potent platelet aggregator and vasoconstrictor
  - C)) Decreased formation of leukotriene B4, an inducer of inflammation
- 10) The increased amounts of n-6 fatty acids in the Western diet increase the eicosanoid metabolic products from arachidonic acid, specifically prostaglandins, thromboxanes, leukotrienes, hydroxy fatty acids, and lipoxins. Eicosapentaenoic fish oil is the primary inhibitor of this arachidonic cascade.
- 11) The eicosanoids from arachidonic acid contribute to the formation of thrombi, atheromas, and the development of allergic and inflammatory disorders.

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- 12) A diet rich in n-6 fatty acids increases in blood viscosity, vasospasm, and vasoconstriction.
- 13) "Fatty acids rapidly and directly alter the transcription of specific genes."
- 14) The effects of n-3 fatty acids and physical activity are similar and are "opposite of those of the effects of the aging process."
- 15) "N-3 fatty acids are essential for overall health of the athlete."
- 16) Both n-3 fatty acids and exercise increase the production of endogenous antioxidant enzymes such as catalase, glutathione peroxidase, and superoxide dismutase.
- 17) Both n-3 fatty acids and exercise increase oxygen delivery to the heart muscle "so that the heart does not have to work as hard to get the oxygen it needs for work."
- 18) During exercise there is an increase in the generation of free radicals.
- 19) Fish oil concentrates rich in EPA and DHA counteract the effects of the inflammatory state.
- 20) "The background diet should be balanced in n-6 and n-3 fatty acids by lowering n-6-rich oils such as corn oil, sunflower, safflower, cottonseed, and soybean oils."

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21) "Changes and improvements in the background diet and an additional 1 to 2 g/d of EPA and DHA should prevent the inflammation in muscles and joints. For the elite athlete, the above prophylactic measures are essential."

22) "Dietary fish oil supplementation has a markedly protective effect in suppressing exercise-induced bronchoconstriction (EIB) in elite athletes, and this is most likely attributed to EPA and DHA anti-inflammatory properties."

23) "Essential fatty acids, both n-6 and n-3, have been part of our diet since the beginning of human life. Before the agricultural revolution 10,000 years ago, humans consumed about equal amounts of both. Over the past 150 years this balance has been upset."

24) "Eicosanoids derived from n-6 fatty acids have opposing metabolic properties to those derived from n-3 fatty acids. A balanced intake of both n-6 and n-3 fatty acids is essential for health"

25) Both n-3 fatty acids and exercise increase basal metabolic rate, insulin sensitivity, nitric oxide production, erythrocyte deformability, heart rate variability, and bone density, and decrease the risk of metabolic syndrome, bone fractures, platelet aggregation, and depression.

26) "In the athletic setting, the n-3 fatty acids are essential for overall health of the athlete."