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VITAMINS / SUPPLEMENTS

Breakthrough Study Suggests Additional Way Omega-3 Fats May Reduce Breast Cancer Risk

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The association between intake of various fats and oils and the risk of breast cancer has been the subject of many studies. The body of evidence suggests a protective role of the omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), the main components of fish oils.

As an example, in one human prospective study, researchers at the Italian National Cancer Institute followed a total of 4,052 postmenopausal women for an average of 5.5 years. During this time, 71 cases of invasive breast cancer were diagnosed. The cancer patients were matched with 141 controls. All study participants had blood samples drawn and red blood cell (erythrocyte) membranes were analyzed for their fatty acid content. It is well-established that erythrocyte membranes are good biomarkers for not only dietary fat intake, but also for other dietary and hormonal factors. Results of the study showed that women with DHA concentrations in the highest tertile had less than half the risk of breast cancer than women in the lowest tertile.[1]

In vitro and animal studies have also shown that different fatty acids can influence breast cancer cell biology or mammary carcinogenesis. In general, cell-culture and animal studies have shown a stimulatory effect of linoleic acid (LA), an (n-6) PUFA, on tumor cell growth in contrast to inhibitory effects provided by omega-3 fats such as docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). *In vitro* experiments demonstrated increased proliferation of breast cancer cells as well as normal human mammary epithelial cells in the presence of LA. By comparison, diets enriched with omega-3 fatty acids EPA and DHA suppress both tumor growth and metastasis in nude mice (mice that have no thymus gland) bearing transplantable human breast cancers.[2]

LA is found in high concentrations in common vegetable oils such as corn oil, sunflower seed oil, safflower seed oil and mixed vegetable oils. Exceptions include olive oil and canola oil, which are high in oleic acid (a monounsaturated fat) and flaxseed oil (which is high in alpha-linolenic acid, an omega-3 fatty acid that the body can convert into EPA and DHA).

Omega-3 fats have demonstrated a number of physiological and biological effects through which they may reduce the risk of breast cancer and other cancers. Some studies indicate that cell membrane-bound omega-3 fats are converted into prostaglandin hormones (prostaglandin series-3) that decrease the rate of cell division. Slowing the rate of cell division is associated with decreased cancer risk. Conversely, cells that replicate faster are more prone to generating cancerous mutations and demonstrate an inability to halt cell division to allow DNA repair enzymes to correct these mutations. As well, omega-3 fats have been shown to inhibit the conversion of arachidonic acid (an omega-6 fat) into prostaglandins (prostaglandin series-2) that increase the rate of cell division.[3-7]

Omega-3 Fats Also Inhibit Activation of Epidermal Growth-Factor Receptors

In addition to these protective effects, Lisa D. Yee and fellow researchers (2005) revealed another

way in which omega-3 fats may suppress the development of breast cancer in women who have genetic risk factors for this disease.[2] It is widely known that women whose breast cells over-express the human epidermal growth-factor receptor, HER-2/neu, are much more prone to breast cancer development than are women who have lower concentrations of these protein receptors on the cell membranes of their breast cells.

In healthy tissue, protein receptors transmit a signal to the cell to grow when a smaller protein, called a growth factor or ligand, binds to the receptor. (Ligands can be hormones, other growth factors, dietary agents, etc.) Ligand binding induces a change in the shape of the receptor, which causes receptors next to each other to connect. This change in shape results in the connection between two receptors on the outside of a cell acting like a domino falling over and starting a chain reaction throughout the cell, causing the cell to grow.

Thus, all that is needed to signal a cell to grow is a connection between two receptors. Such a connection between receptors can occur spontaneously (without the growth factor binding to a receptor) if there are a lot of receptors on the surface of the cell, such that they frequently bump into each other (auto-stimulation).

Therefore, cells that have abnormally high levels of certain receptors can grow without receiving signals from external growth factors (e.g., hormones). Indeed, the most common abnormality in human cancers involves receptor overproduction. Such overproduction has been reported in breast, prostate, ovarian, bladder and lung cancers. One particular family of receptors called the epidermal growth factor receptors (EGF/ErbB1-4) has been implicated more than any other. In approximately 30 percent of breast cancer patients, the ErbB2 receptor (HER-2) is overproduced, resulting in aggressive and uncontrolled growth of tumor cells.[8,9]

The study by Yee, et al., is believed to be the first report to indicate a potent effect of fish oil prolonging tumor latency and reducing tumor multiplicity in HER-2/neu over-expression-positive, estrogen receptor-negative breast cancer in a transgenic model of mammary tumorigenesis. This effect was seen by solely modulating dietary fat composition.

These researchers showed that the addition of omega-3 fats to the diet (25 percent calories from fish oil) of mice that were bred to overexpress HER-2 (and were known to have increased propensity for breast cancer), significantly reduced the development of breast cancer in these mice, compared to the mice fed a diet high in linoleic acid (25 percent calories from corn oil). The study revealed that by some mechanism(s), omega-3 fatty acids were able to suppress HER-2/neu, signaling pathways involved in the pathogenesis of breast cancer. Researchers indicate in this study that omega-3 fats demonstrated a strong suppressive effect on HER-2/neu-positive breast cancer, suggesting a gene-nutrient interaction of critical importance for mammary carcinogenesis.

Although this study was performed on transgenic mice, it provides further insight into potentially important mechanisms through which omega-3 fats may reduce the risk of breast cancer and may be especially significant to women who carry a high genetic risk for this disease.[2] The study by Yee, et al., will undoubtedly prompt additional studies that will help clarify if omega-3 fats can suppress HER-2 activation in human breast cells and in human subjects who over express this receptor.

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