Deficiency in omega-3 fatty acids leads to osteoarthritis.

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Abstract

There is little debate that the majority of Americans do not consume enough omega-3 fatty acids, especially from fatty fish. The Standard American Diet caters to overconsumption of inflammatory omega-6 fatty acids and a dearth of anti-inflammatory omega-3 fatty acids. Public health experts agree that this disparity has given rise to an epidemic of inflammatory disorders. What is not clear is how a deficiency in omega-3 fatty acid intake may lead to osteoarthritis (OA), a debilitating degeneration of joints and cartilage from inflammation. Of the 62 published studies evaluated, 5 were chosen. The studies covered a variety of evidence, elucidating detailed causes and preventive therapies. The evidence was not conclusive in showing that omega-3 deficiency can lead to OA. There was a paucity of evidence overall. Some of the evidence was marred by industry funding. Other evidence was presented with too few subjects. The evidence did present where researchers should continue to pursue to make a more definitive conclusion. For example, three studies presented evidence that there is a lack of omega-3 fatty acid intake in the diets of most Americans. The evidence suggests that this could lead to inflammatory disorders, in which OA falls under this category. As to whether fish or fish oil can act as a preventive and/or treatment for OA is less certain. One study found low dose fish oil to be more effective than high dose fish oil for OA. Another study presented encouraging evidence concerning resolvins, chemicals responsible for the anti-inflammatory effect of fish and fish oil. Ultimately, the evidence to date is sparse, so to make any conclusions from this review about omega-3 deficiency leading to OA would be premature.

Keywords: osteoarthritis, omega-6:omega-3 ratio, resolvins, fish oil, fatty fish, omega-3 fatty acids, omega-6 fatty acids, Standard American Diet, inflammation, eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), oxidative stress.

Introduction

Public health experts suggest that the ratio of omega-6 fatty acids to omega-3 fatty acids in the United States is highly skewed towards omega-6. One of the reasons why Americans consume so much more omega-6 fatty acids is the structure of the Standard American Diet (SAD), which allows little room for fatty fish consumption, one of the few sources of omega-3 fatty acids that do not need to be broken down enzymatically. Complementary and Alternative Medicine (CAM) has lamented the inflammatory nature of omega-6 fatty acids, while lauding the anti-inflammatory benefits of omega-3 fatty acids, especially in the form of fish oil. The purpose of this study is to assess whether deficiency of omega-3 fatty acids can lead to osteoarthritis (OA). Surprisingly, little substantive research has been done on the subject. After reviewing the current data, many questions still remain concerning the link between omega-3 deficiency and OA.

Results

In this article, Papanikolaou, Brooks, Reider, and Fulgoni (2014), found that Americans 19 years or older are not consuming enough fatty fish to meet basic requirements for omega-3 fatty acids. Papanikolaou, Brooks, Reider, and Fulgoni examined not only fatty fish intake, but also individuals consuming supplemental fish oil. The study covered a large sample size over a five year period, which is longer than most. There were significant limitations of this study. Examining data from NHANES is controversial as some researchers don't seem to trust the data. The study uses only two 24 hour dietary data intake forms, which may not be enough of a daily sample size. Many Americans only eat fish once or twice a month, so if they are not surveyed on the day they eat the fish, they would be tabulated as zero intake. The project was funded by

Pharmavite, who do manufacture fish oil supplements. Several of the authors also work for Pharmavite.

Thomas, Browne, Mobasheri, and Rayman (2018) reviewed the existing data of numerous diet and nutrition-related substances and their effects on OA, including vitamin D, K, and omega-3 fatty acids. The researchers found a benefit of adding fatty fish or fish oil to prevent OA. Additionally, they presented the common imbalance between overabundance of inflammatory omega-6 and a dearth of anti-inflammatory omega-3 fatty acids. The authors mentioned that there is a paucity of evidence linking fatty fish and fish oil to OA prevention or as a treatment for pain. However, their review was performed under ethical standards and received no industry funding. Authors had no conflicts of interest.

It was suspected that high dose fish oil (4.5 g/day) would be more effective than low dose fish oil (0.45 g/day) in subjects with knee OA over a two year period. Surprisingly to Hill et. al (2016), the double-blind study concluded that while both treatments were effective in lowering OA pain and improving function, the low dose was more effective at doing so. There was no change in cartilage volume in either dose. There was no change in C-reactive protein levels in either dose. Serum fatty acid levels only rose slightly in the low dose fish oil, while the high dose fish oil elevated serum fatty acids significantly. Surprisingly, high-dose fish oil subjects gained a significant amount of weight. Adverse effects were mostly gastrointestinal, which led to subjects dropping out, although the number was not significant. However, the number of subjects used, 202, is a very small sample size. Researchers postulated that the placebo effect could have resulted in changes to pain and function. Thus, the authors suggest much more evaluation is

needed. The authors had no conflicts of interest. The study was funded by the Australian government.

The relatively new discovery of resolvins, components of omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), have been examined to bring inflammation resolution. Benabdoune et. al (2016) completed the first in vitro study exhibiting a beneficial effect of resolvin D1 for OA, and suggested utilizing it as a preventive for inflammation. Benabdoune et al. used human chondrocytes from OA patients. Resolvin D1 was not cytotoxic to OA chondrocytes. Resolvin D1 was successful in lowering IL-1beta-induced COX-2, iNOS and MMP-13 expression, as well as PGE2 and NO generation. Resolvin D1 prevented apoptosis in OA chondrocytes. Resolvin D1 increased antioxidant activity by raising glutathione levels significantly. Resolvin D1 was also found to be potent inhibitors of inflammatory mediators via NF-kB, and p38/MAPK inactivation. The authors postulate that in OA chondrocytes, resolvin D1 prevents oxidative stress-induced apoptosis and inflammation, offering not only as a potential therapy, but a preventive. There were no competing interests. All funding was public.

Baker et al. (2012) found that subjects with the highest levels of the omega-6 fatty acid arachidonic acid (AA) had the highest exacerbation of synovitis as measured by synovial thickening. Alternatively, subjects with the highest omega-3 fatty acids, specifically DHA, had the lowest patellofemoral cartilage loss. The team used plasma phospholipid fatty acid analysis to assess fatty acid levels and magnetic resonance imaging (MRI) to ascertain cartilage loss and synovitis severity. Baker et. al were surprised that while omega-3's did not accelerate synovitis, it did not reduce it either. The team also questioned why cartilage loss was only seen in

patellofemoral cartilage and not found in tibiofemoral cartilage as well. They postulated that synovitis is much more common in the parapatellar area. The authors did allude to the fact that there is a wide disparity between omega-6 fatty acids and omega-3 fatty acids consumed in the Western diet. Balancing the ratio more equally could be an inexpensive, effective tactic to prevent OA. The authors stated no conflicts of interest in this study.

Discussion

It seems the data supports the idea that omega-3 deficiency exists. However, the idea that omega-3 deficiency can lead to OA is inconclusive. There were several reasons for this.

One study, which found many Americans, especially young persons, were deficient in omega-3 fatty acids because of overconsumption of omega-6 fatty acids, used data from NHANES and was funded by a supplement manufacturer that makes fish oil. NHANES is limited in scope by what data it provides. Industry funding for research, no matter how independent Pharmavite may claim they were in this study, is not ideal to cite from. On the other hand, two studies without any conflicts of interest alluded to the connection between omega-3 deficiency and OA. One study that found a degradation of patellofemoral cartilage in subjects consuming the highest amount of omega-6 fatty acids shows a direct connection between omega-3 fatty acid dearth. The other study found a benefit of adding fatty fish or fish oil to prevent OA, and even alluded to the dietary disparity between omega-3 and omega-3 fatty acid consumption. These three studies were the only ones of significance that could be examined.

While fish oil seems to be an exciting preventive, as well as treatment for OA, once again, much more research needs to be performed. The one study that is most often cited regarding the effectiveness of fish oil for ameliorating OA was an unexpected result. Low dose

fish oil was more effective than high dose, and the effect was marginal at best. The most encouraging finding was the research on resolvins, which if harnessed in high concentrates, may be an effective preventive, as well as therapeutic, option for OA. Surprisingly, resolvin research was more copious than fish oil for OA.

Conclusion

The evidence does not point to an inextricable link between omega-3 deficiency and OA. While the current disparity between omega-6 fatty and omega-3 fatty acid consumption is undeniable, researchers need to perform more studies, with more subjects, for longer periods of time, to assess the preventive effect of righting a deficiency to protect from OA degeneration. It would make sense to emphasize highly concentrated resolvins for OA prevention, as they are the chemicals responsible for the anti-inflammatory effect of omega-3 fatty acids. While it would have been optimal to definitively show the active role omega-3 deficiency plays in OA, we will have to wait a bit longer for to be able to espouse its benefit.

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