

Lecture II: Health Benefits of Omega-3, Therapeutic Use in Dogs and Cats, Healthy Aging & Cognition

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Therapeutic benefits of fish oil in dogs and cats

In dogs, and to a lesser extent in cats, studies using various dietary amounts of fish oils for skin, cardiovascular, renal, lipid, joint and metabolic disorders have been previously published. Supplemental amounts of EPA+DHA using fish oils based on the animal's metabolic body weight adjusted by means of multiplication factors ranging from 115 to 310 have been recommended (Table). A general rule of thumb for omega-3 therapeutics is as follows:

A general rule of thumb for fish oil mega-3 therapeutics for dogs is to use intermediate amounts for skin, anti-inflammatory, kidney, heart and high triglyceride problems with higher amounts of osteoarthritis issues. *Cat supplemental amounts should not exceed 400 mg EPA+DHA/day (500 mg if >10 lbs)*

Therapeutic fish oil dosages using factors (A) of metabolic body weight in adult dogs (dosage = [A] * [Wt kg]^{0.75}). Resultant dosages refer to the amount of combined EPA+DHA in mg recommended for each disorder listed based on published studies. Adapted from Bauer, JAVMA, 239,1441-1451 (2011)..

Clinical disorder	Metabolic Body Weight Factor (A)
Idiopathic hyperlipidemia	120
Kidney disease	140
Cardiovascular disorders	115
Osteoarthritis	310
Inflammatory or immunologic (atopy or IBD)	125
NRC recommended allowance	30
NRC safe upper limit	370

Dosages may be increased (depending on the severity and chronicity of the disorder) up to the National Research Council safe upper limit (5). For use under veterinary supervision.

Regarding modifying of the inflammatory response, newly discovered metabolites of EPA & DHA have provided additional perspectives on omega-3 metabolic benefits. It was previously thought that resolution of inflammation was a passive process. It has now been shown that omega-3 fats serve as additional substrates for what are known as specialized pro-resolving lipid mediators (SPMs). SPMs now known to actively prevent “over inflammation”

Involves “turning off” specific pathways as healing occurs. This is an active rather than a passive process. It acts as a cellular “brake” to support healthy healing
For example: Acute inflammation initiated in tissues by prostaglandin and leukotrienes can be modified by a “metabolic switch” produces SPMs from Omega-3s that can slow or help terminate an inflammatory process. To date, there is one pilot study in dogs demonstrating recovery from inflammation associated with the production of one of the SPMs (i.e. Resolvin) from DHA.

Healthy Aging & Cognition in Dogs and Cats

Diet studies: Dietary trials in dogs and cats have been evaluated in older animals in a few studies. One study by Hadley et al fed 0.1% DHA from algae to older Beagles and measured learning ability and visual processing. They found that the control dogs performed less efficiently needing more training sessions and made more errors during these sessions than the DHA group.

Pan et al also studied older Beagles feeding a 0.24% EPA and 0.21 % DHA diet for a 92 day training period. These authors also reported better performance vs controls on discrimination earning tasks and reversal learning tasks. This is equivalent to approximately 800 mg/day.

In another study in cats, Pan et al fed 0.28% EPA and 0.27% DHA for 30-345 days. The omega-3 group performed significantly better on 3 out of 4 tasks assessing learning, discrimination, reversal learning, and acquisition of spatial memory.

Taken together these studies support that EPA and DHA omega-3 diets demonstrate improvement of brain function in elderly dogs and cats.

Cell senescence and aging

Regarding the aging process an association between telomere shortening and fatty acids has been observed. Telomeres are a DHA segment that repeats itself at the ends

of chromosomes as cell replicate normally (called telomere attrition). These structures are essential for chromosome stability and cell replication. This process occurs over time as cells turnover. However, at some stage, telomeres reach a critically short length and this results in a DNA damage signal occurring that induces cell senescence or aging.

Normally telomeres are maintained by an enzyme known as telomerase that adds telomeric DNA to shortened telomeres. Yet, oxidative stress and pro-inflammatory mediators may play a role in telomere attrition. Because omega-3 fatty acids support less inflammation, they may have a role in this process helping to prevent cell senescence.

Studies in support of this possibility have been published in both humans and dogs. In humans a double-blind 4-month trial of healthy sedentary overweight middle-aged and older adults received either (1) 2.5 g/day n-3 PUFAs, (2) 1.25 g/day n-3 PUFAs, or (3) placebo capsules (Kiecolt-Glaser et al). It was found that supplementation significantly lowered oxidative stress measured by F2-isoprostanes (from ARA, $p=0.02$). Group differences for telomerase and telomere length were nonsignificant. Changes in the n-6:n-3 PUFA plasma ratios found telomere length increased with decreasing n-6:n-3 ratios, $p=0.02$. The data suggest that lower n-6:n-3 PUFA ratios can impact cell aging.

In canines, Fick et al reported that domestic dogs show parallels in telomere biology to humans, with similar telomere length, telomere attrition, and absence of somatic cell telomerase activity. In this study white blood cell telomere length was measured and found to be a strong predictor of average life span among 15 different breeds ($p < 0.0001$), consistent with telomeres playing a role in life span. Future studies examining telomere length similarly using an omega-3 feeding study may thus be possible and provide new information on this question.

Overall take home message from Lectures I and II by Professor John Bauer:

- Vegetable based dietary oils supply both LA, omega-6 and ALA, omega-3 but these types compete for conversion to longer chains (AA, EPA and DHA)
- However....Omega-3 conversion is inefficient
- Thus a dietary supply of EPA & DHA omega-3 is needed .
- EPA and DHA provide numerous health benefits such as:
 - Overall omega tissue balance for healthy life stages
 - Therapeutic benefits for dogs and cats
 - Development, visual function and cognition in puppies
 - Healthy aging and cognition in older dogs
- Future studies will provide new omega-3 metabolic insights for companion animals