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GOOD EATS
Nutritional factors have been shown to modify some of the underlying processes involved in arthritis.

CONTINUING EDUCATION

NUTRITION

Osteoarthritis: Getting Patients Moving Through Nutrition

MEET THE AUTHOR

Kara M. Burns, MS, MEd, LVT, VTS (Nutrition)
Academy of Veterinary Nutrition Technicians

Kara Burns is an LVT with master's degrees in physiology and counseling psychology. She began her career in human medicine as an emergency psychologist and a poison specialist for humans and animals. Kara is the founder and past president of the Academy of Veterinary Nutrition Technicians and has attained her VTS (Nutrition). She is the editor in chief of *Today's Veterinary Nurse*, works as an independent nutritional consultant, and is a past president of NAVTA. She has authored many articles, textbooks, and textbook chapters and is an internationally invited speaker.

Osteoarthritis is the most common form of joint disease recognized in mammals.[1] It often leads to physical incapacity, pain, and a subsequent reduction in pets' quality of life. It is also challenging to treat due to the difficulty of recognizing signs early and its inevitably progressive pathology.[2] Veterinary nurses are uniquely positioned to identify potential changes in mobility with pet owners and bring this information to the veterinarian. Management of osteoarthritis requires a multimodal approach, including identification and management of obesity, as well as therapeutic nutrition.

PATHOPHYSIOLOGY

Osteoarthritis is a slowly progressive condition characterized by 2 main pathologic processes: degeneration of articular cartilage with a loss of proteoglycan and collagen, and proliferation of new bone. Additionally, there is an inflammatory response within the synovial membrane.[3] In North America, age-specific prevalence values range from 20% in dogs older than 1 year to 80% in dogs older than 8 years, based on radiographic and clinical data from referral settings.[4,5] In adult cats, the prevalence of osteoarthritis is 33%, rising to 90% in senior cats.[6]

Inflammation and Cartilage Degradation

Inflammation plays a fundamental role in the pathophysiology of osteoarthritis. Arachidonic acid (AA)

and eicosapentaenoic acid (EPA) are polyunsaturated fatty acids that act as precursors for the synthesis of eicosanoids, a significant group of immunoregulatory molecules that function as local hormones and mediators of inflammation. The amounts and types of eicosanoids synthesized are determined by the availability of the fatty acid precursor and by the activities of the enzyme systems that synthesize them. Eicosanoids produced from AA are proinflammatory and, when produced in excess, may result in pathologic conditions. In contrast, eicosanoids derived from EPA promote minimal to no inflammatory activity.[7]

Cartilage degradation begins with loss of cartilage aggrecan and is followed by loss of cartilage collagens. This results in the loss of ability to resist compressive forces during movement of the joint.

Risk Factors

Risk factors for pets to develop osteoarthritis include age, breed, genetics, developmental orthopedic disease, trauma, and obesity. The radiographic prevalence of canine hip dysplasia, a leading cause of osteoarthritis in dogs, has been reported to be as high as 70% in golden retrievers and Rottweilers.[8] The incidence and severity of osteoarthritis secondary to canine hip dysplasia can be significantly influenced by environmental factors such as nutrition and lifestyle.[9,10]

Obesity is also a risk factor for the most common traumatic cause of osteoarthritis in dogs, ruptured cruciate ligaments. Overweight or obese dogs have a 2 to 3 times greater prevalence of ruptured cruciate ligaments compared with normal-weight dogs.[11]

In 2 studies, overweight cats, compared with optimal-weight cats, were 3 times as likely to be taken to the veterinary hospital because of lameness.[12,13] Obese cats were also 5 times as likely to develop lameness requiring veterinary care.

As the only risk factor for osteoarthritis that can be managed, obesity is a prime target of treatment.

STAGES

Osteoarthritis has 4 stages.[14] These stages are more easily defined for dogs.

- **Stage 1:** Patient experiencing early signs that are often difficult to identify. These signs are most common in growing dogs or young adult dogs and are typically sporadic, lasting a few seconds/minutes.
- **Stage 2:** Patient experiencing intermittent signs, which are considered the first flare-ups. These signs are intermittent, lasting a few hours, and are easy for owners to rationalize and ignore. This stage is typically seen in young adult dogs.
- **Stage 3:** Patient experiencing performance impairment. This stage, characterized by exercise intolerance and progressive loss of the ability to perform activities of daily living, is more recognizable by the owner. This stage is often seen in adult dogs.
- **Stage 4:** Patient experiencing loss of mobility along with loss of strength and fitness. This stage is much harder for the owner to manage.

It is important to remember that both young and old dogs can be in any of these stages. Historically, most dogs with osteoarthritis have been diagnosed in stage 3 or 4. Ideally, veterinary teams must be cognizant of and recognize the signs of osteoarthritis in the earlier stages.

CLINICAL SIGNS

Clinical signs of arthritis include difficulty rising from rest, stiffness, or lameness. A thorough disease-specific history taken at every visit may reveal evidence of subtle changes early in the course of osteoarthritis, such as reluctance to walk, run, climb stairs, jump, or play.[15] Consistent use of an owner questionnaire may facilitate early detection of osteoarthritis.

Dogs

In dogs, signs may be as inconspicuous as lagging behind on walks, reluctance to walk on tile or hardwood floors, and no longer wanting to go for car rides, if that was once a favorite activity. Yelping, whimpering, and personality changes such as withdrawal or aggressive behavior may be indicative of the chronic pain of osteoarthritis. Veterinary teams must listen to owners when they describe such behavior changes and recognize their significance, as owners are often unaware of the correlation between behavior changes and arthritis.

Additionally, the veterinary team may uncover subtle signs unnoticed by the owner, such as longer nails, indicating the dog is not walking and the nails are not being "worn" by hard surfaces, or abnormal fur patterns over joints, indicating the dog has been licking the area, which is often due to osteoarthritis pain.

Cats

Recognizing signs of osteoarthritis in cats is much more difficult. Cats often suffer in silence, and the veterinary healthcare team must rely upon the owner's evaluation and a thorough history to discover potential signs of osteoarthritis. Often, the changes noted by owners fall into 4 categories:

- **Mobility.** Mobility changes include reluctance to jump, not jumping as high, and changes in toileting behavior due to inability to climb into the litter box.
- **Activity level.** Activity level changes manifest in decreased playing and hunting and a change in sleep patterns.
- **Grooming.** Grooming changes may be noticed when the cat develops mats in its fur or is unable to groom certain areas. Claws may be overgrown because the cat cannot stretch out to scratch.
- **Temperament.** Changes in temperament are demonstrated by the cat hiding from owners or other pets in the house and seeming "grumpy."[15,16]

Many of these signs are attributed to "old age" in the cat by the owner. Thus, it is important for the veterinary nurse to take a thorough history and ask open-ended questions that may help uncover otherwise overlooked signs of osteoarthritis. It is also important to remind cat owners that old age, in and of itself, is not a disease.

DIAGNOSIS

Diagnosis of osteoarthritis involves a combination of history, physical examination findings, and radiographic evidence of joint disease, particularly in dogs. In cats, the history taken with the pet owner plays a significant role. Because historical clues, although essential to creating an index of suspicion, may be elusive and clinical signs may be subtle on routine veterinary examination, veterinary nurses play an extensive role in assessing and managing joint disease.

OBESITY AND OSTEOARTHRITIS

In 2018, the Association for Pet Obesity Prevention found nearly 56% of dogs and 60% of cats to be clinically overweight or obese.[17] Pets that are overweight or obese are at higher risk for osteoarthritis, with one long-term study finding the prevalence of osteoarthritis to be greater in overweight or obese dogs than in ideal-weight dogs (83% versus 50%).[9,15] Given these statistics, it is reasonable to assume a significant portion of arthritic pets will be overweight or obese and vice versa. Managing these comorbid conditions presents a variety of challenges.

> Overweight or obese dogs have a 2 to 3 times greater prevalence of ruptured cruciate ligaments compared with normal-weight dogs.[11]

Role of Obesity in Osteoarthritis

Historically, the stress of excess weight on the skeletal system was thought to be the primary offender in the pathophysiology and progression of osteoarthritis. Now, adipose tissue is no longer considered simply a storage site for energy; rather, it is recognized as a multifunctional organ that plays an active role in a variety of homeostatic and pathologic processes.[18]

Recent studies have found that adipocytes secrete several hormones, including leptin and adiponectin, and produce a diverse range of proteins called adipokines. Among the currently recognized adipokines is a growing list of mediators of inflammation: tumor necrosis factor-α, interleukin-6, interleukin-8, and interleukin-10.[18] These adipokines are found in human and canine adipocytes. Their production is increased in obese animals, suggesting that obesity is a state of chronic low-grade inflammation. Low-grade inflammation may contribute to the pathophysiology of a number of diseases commonly associated with obesity, including osteoarthritis. This might explain why relatively small reductions in body weight can result in significant improvement in clinical signs of osteoarthritis.

Diagnosis of Obesity

Osteoarthritis and obesity present diagnostic challenges for very different reasons. Clinical signs of osteoarthritis are often not obvious on examination, particularly early in the disease process. Signs of overweight and obesity may be readily apparent, but are often overlooked or dismissed as insignificant. Diagnosing obesity is of the utmost importance to initiating diagnostic, curative, and preventive strategies that may be otherwise lost.

Canine Mobility Questionnaire

1. Behavior
- Tell me about your dog's interaction with you and the rest of the family.
- Does your dog enjoy car rides?
  - Describe how he/she gets into the vehicle.
- What changes in toileting have you noticed?
- Give me examples of changes in your dog's behavior that are unlike his/her normal behavior.

2. Activity Level
- Describe your dog's exercise regimen. Has it changed over time?
- Tell me about your dog's play behavior.
  - Has he/she appeared to be less interested in playing/interacting with human or animal members of the family?
- Does your dog's enjoyment of activity seem to have changed?
  - What is preventing your dog from taking walks?
  - What is preventing your dog from interacting with you?
- Does your dog appear to tire easily?
  - Is he/she lying around more than in the past?
  - Demonstrate how your dog rises from rest.
  - Tell me how this differs from prior behavior.

3. Eating and Sleeping
- Tell me about your dog's appetite.
  - Have you noticed any changes in your dog wanting to eat?
  - Is your dog able able to finish their meal?
- Tell me about your dog's sleeping behavior.
  - Tell me how this differs from prior behavior.
  - Does your dog frequently adjust his/her position to try to be more comfortable?

4. Environment
- Tell me about the flooring in your home.
- How many stairs are in your house?

Weight of dog: _____

Body condition score:_____

Muscle condition score:_____

To download a printable questionnaire, go to todaysveterinarynurse.com/resources/clinic-resources.

The first step to diagnosing overweight/obesity is consistent recording of both body weight and body condition score (BCS) at every examination. Body weight alone does not indicate how appropriate the weight is for an individual animal. The BCS is a subjective assessment of an animal's body fat that takes into account the animal's frame size independent of its weight, thus putting body weight in perspective for each specific patient. For example, a Labrador retriever weighing 30 kg may be underweight, optimal weight, or overweight.

One long-term study found that the prevalence and severity of osteoarthritis were greater in dogs with a BCS above normal compared with dogs maintained at an ideal body condition throughout life.[19] Over the life span of these same dogs, the mean age at which 50% of the dogs required treatment for pain attributable to osteoarthritis was significantly earlier (10.3 years, $P < 0.01$) in the overweight dogs than in the dogs with normal BCS (13.3 years).[19]

In both human and veterinary medicine, timely identification of obesity by primary care providers remains the crucial initial step in management.

Risk Factors for Obesity

Risk factors for obesity in dogs include age; breed; neuter status; consumption of a semi-moist, homemade, or canned food as the major diet source; and consumption of "other" foods such as treats or table scraps. Dogs found to be overweight at 9 to 12 months of age were 1.5 times more likely to become overweight adults.[20-23] Golden retrievers, Rottweilers, pugs, and Labrador retrievers are overrepresented in the population of overweight and/or obese dogs.[24] Owners of dogs at risk for obesity and osteoarthritis should be educated on the importance of lifelong weight management.

Treatment of Obesity

Understanding the correlation between maintaining their pet at a healthy weight and decreasing the risk of disease may be a powerful motivator for many owners. The benefits of maintaining optimal weight are quite clear and of utmost importance. In the author's opinion, a high BCS, in all probability, dramatically and negatively affects a pet's propensity for osteoarthritis and severity of disease. In overweight pets with osteoarthritis, weight loss should be a primary treatment rather than an afterthought.[2]

Feline Mobility Questionnaire

1. Mobility
- Tell me about your cat's behavior.
- Does your cat still want to interact by jumping to the table, chair, etc?
- Tell me about your cat's ability to jump up to or down from higher places.
- Does your cat jump to the chair first and then to a higher or lower place?
- Tell me about any changes in toileting behavior.
- Please describe your litterbox:
  - Height
  - Width
  - Cleaning frequency
  - Type of litter used

2. Activity Level
- Describe your cat's sleeping behavior.
- Does your cat frequently adjust his/her position to try to be more comfortable?
- Tell me about your cat's playing/interaction with members of the family.
  - Human or animal?
  - Have you noticed any changes?

3. Grooming
- Describe your cat's grooming behavior.
- Describe your cat's coat/fur.
- Does your cat have difficulty reaching certain areas to groom or clean?
- Have you noticed if your cat's claws are overgrown?
- How often do you clip your cat's claws?

4. Temperament
- Is your cat hiding from family members?
- Does the cat appear to be "grumpy" and irritable?

Weight of cat:_____

Body condition score:_____

Muscle condition score:_____

To download a printable questionnaire, go to todaysveterinarynurse.com/resources/clinic-resources.

Physical activity levels of dogs and cats often mirror levels in their human companions. Owners should be encouraged to respond with play activities or praise rather than food rewards. An exercise regimen should be instituted for all overweight or obese patients. Instituting a weight management clinic in the practice can help with creating individual patient plans and encouraging owner compliance.[24]

TREATMENT

Despite being considered the most common chronic pain condition in dogs and cats, osteoarthritis is difficult to recognize early and inevitably progressive, making it challenging to treat. The objectives of treatment are multidimensional:
- Reduce pain and discomfort
- Decrease clinical signs
- Slow the progression of the disease
- Promote the repair of damaged tissue
- Improve the pet's quality of life

As with many conditions, the best results come from a multimodal approach. In patients with osteoarthritis, this approach includes a combination of anti-inflammatory and analgesic medications, disease-modifying osteoarthritis agents, nutraceuticals, weight reduction, exercise programs, physical therapy, and nutrition. Applying an individualized combination of these management options to each patient will enhance quality of life, which is the ultimate goal of therapy.

NUTRITIONAL MANAGEMENT

As with many disease conditions, nutrition plays a role in managing joint disease. Nutritional factors can modify some of the underlying processes involved in arthritis, including modulation of the inflammatory response, provision of nutrients for cartilage repair, and protection against oxidative damage. Additionally, nutritional management may help to reduce or eliminate the need for conventional drugs, some of which are associated with adverse secondary effects. Veterinary nurses must understand how certain nutrients play a role in managing osteoarthritis, whether these nutrients are provided separately or are part of a food aimed at managing osteoarthritis.

Omega-3 Fatty Acids

As mentioned earlier, immunoregulatory eicosanoids derived from EPA (an omega-3 fatty acid) promote

EPA inhibits the upregulation of cartilage-degrading enzymes by blocking the signal at the level of messenger RNA.[31,32]

minimal to no inflammatory activity, in contrast to those produced from AA (an omega-6 fatty acid).[7] However, AA is the principal precursor for eicosanoids, and EPA competes with AA for the same enzyme systems. Ingestion of foods containing omega-3 fatty acids results in a decrease in membrane AA levels because omega-3 fatty acids replace AA in the substrate pool. This produces an accompanying decrease in the capacity to synthesize eicosanoids from AA. Studies have documented that inflammatory eicosanoids produced from AA are depressed when dogs consume foods with high levels of omega-3 fatty acids.

Omega-3 fatty acids also play a direct role in the resolution of inflammation. This process involves a switch in the production of lipid-derived mediators over time, from proinflammatory products of omega-6 fatty acid metabolism to pro-resolution omega-3 derived mediators known as *resolvins* and *protectins*.[25] These mediators act in several ways, including preventing inflammatory cell recruitment and removing inflammatory cells from the site. The identification of resolvins and protectins may clarify the mechanisms that underlie the many reported benefits of dietary omega-3 fatty acids. Absence of sufficient dietary levels of omega-3 fatty acids may contribute to "resolution failure" and perpetuation of chronic inflammation, so long-term omega-3 supplementation may be consideration for osteoarthritis patients.

The ratio of omega-3 to omega-6 fatty acids in therapeutic osteoarthritis diets for dogs is <1:1. However, this ratio should be interpreted with caution because it does not reflect the total amount or the type of omega-3 fatty acids present in the diet. Some therapeutic osteoarthritis diets contain adequate amounts of n-3 fatty acids, and additional supplementation is not needed. However, each therapeutic diet approaches management differently; therefore, when discussing nutritional management with owners, veterinary nurses should be familiar with the nutritional profile of each product and how it approaches osteoarthritis management.

When it comes to omega-3 supplements, not all are created equally, and not all are intended for use in dogs and/or cats. To help ensure that any supplement used is appropriate for a given pet, the author recommends using those from veterinary companies that have research and scientific evidence behind them.

Important potential adverse effects of omega-3 fatty acid supplementation to watch for in veterinary patients include altered platelet function, gastrointestinal adverse effects, unfavorable effects on wound healing, lipid peroxidation, weight gain, altered immune function, and effects on glycemic control and insulin sensitivity.[26]

Dogs

Nutritional supplementation of omega-3 fatty acids should be part of the management of dogs with osteoarthritis. Four randomized, double-blinded, controlled clinical trials using client-owned dogs support the use of one therapeutic diet with high levels of total omega-3 fatty acids and EPA to improve the clinical signs of canine osteoarthritis.[27-30] In total, more than 500 dogs with osteoarthritis were studied. Participating dogs were diagnosed with osteoarthritis based on history, clinical signs, and radiographic evidence and were fed either a typical commercial dog food or the therapeutic diet, which had higher concentrations of total omega-3 fatty acids and EPA and lower omega-3:omega-6 fatty acid ratios. Subjective and objective veterinary evaluations and subjective owner evaluations were used to assess the dogs' responses.

EPA can also considerably decrease the loss of aggrecan in canine cartilage. In normal canine cartilage, synthesis and degradation of cartilage matrix are balanced processes. In arthritic joints, damage to chondrocytes leads to inflammation, pain, and the destruction of cartilage. EPA inhibits the upregulation of cartilage-degrading enzymes by blocking the signal at the level of messenger ribonucleic acid.[31,32]

Cats

Nutritional supplementation of omega-3 fatty acids should also be part of overall management of cats with

osteoarthritis. As in dogs, high levels of these acids control inflammation in cats; however, in cats, docosahexaenoic acid (DHA) is the inhibitor of the enzymes responsible for cartilage degradation.[14,33]

The efficacy of therapeutic nutrition for cats with osteoarthritis is also supported by research.[34-36] One study looking at therapeutic nutrition containing high levels of DHA, natural sources of glucosamine and chondroitin, methionine, and manganese found that veterinarian-assessed arthritis scores improved in 70% (33/47) of cats and owner-evaluated mobility scores improved in 96% (45/47) of cats after 1 month of therapy.[34]

Another randomized, controlled clinical trial looked at this same therapeutic nutritional profile in cats with moderate to severe arthritis.[35] Alterations in both the ability to jump and the height of jump were the most frequent signs of disease. After 1 month of therapy, 61% of owners noted marked improvement in their cat's clinical signs. Activity monitors worn by the cats documented significant increases in activity in the cats on the osteoarthritis diet. This study also evaluated a variety of biomarkers. Cats on the osteoarthritis diet had decreased biomarkers and metabolomic markers of inflammation and cartilage degradation.

Green-Lipped Mussel

Shellfish supplements have been used to manage arthritis in humans, and, in recent years, interest has focused on the potential benefits of a nutritional supplement prepared from the New Zealand green-lipped mussel (GLM), *Perna canaliculus*.[37] GLM is known to contain anti-inflammatory components and other nutrients that benefit joint health; however, heat processing has been shown to destroy its activity. Therefore, GLM processing and incorporation into food products require special techniques.

GLM is a rich source of nutrients, including glycosaminoglycans, vitamins, minerals, and omega-3 fatty acids. GLM has been shown to contain a unique omega-3 fatty acid, eicosatetraenoic acid, which appears to inhibit AA oxygenation and, therefore, inflammatory response through 2 different pathways.[38-40]

A study of a therapeutic food containing GLM for cats with osteoarthritis found that owners of cats in both the study and control groups reported improved mobility in their cats.[41] However, differences were reported between the groups in the activity monitor data. Activity monitors indicated a significant decline in activity in the control diet group and a significant increase in activity in the therapeutic nutrition group. The finding of decreased activity in the control group was unexpected and the cause unidentified.

Protein

Amino acids, the building blocks of proteins, play a role in the structure of tissues and organs. Methionine is an amino acid that also produces several important molecules essential for the proper functioning of cells. Methionine is a building block for cartilage and protein synthesis and aids in maintaining the viability of chondrocytes.[42]

Carnitine is a crucial amino acid that facilitates the conversion of fat into energy.[14] Carnitine aids in maintaining muscle and transporting long-chain fatty acids and their derivatives into the mitochondria of cells. The severity of joint disease may be lessened by strengthening skeletal muscle and turning fat into energy.

Additional Nutrients

Hyaluronic acid. Hyaluronic acid is a principal component of synovial fluid that works to preserve joint viscosity, support lubrication of the joint, and aid in shock absorption.

Antioxidants. Antioxidants, like vitamins C and E, neutralize free radicals to increase mobility.

N-Acetyl D-glucosamine. This polysaccharide "shortcuts" the glycosaminoglycan pathway to maintain healthy joint structure and function.

Manganese. Manganese is an essential nutrient involved in numerous chemical processes in the body, including bone formation. In joints, manganese supports the health and maintenance of bone and cartilage as well as collagen formation. Like methionine, manganese is a building block of cartilage and supports chondrocyte viability.

CONCLUSION

Prevention and successful treatment of osteoarthritis require a comprehensive, multimodal strategy, of which therapeutic nutrition is an effective, safe component supported by multiple clinical studies and trials in

arthritic pets. Documenting a diagnosis of overweight/obesity is critical. Early diagnosis of osteoarthritis and developmental orthopedic disease enables early intervention, which often improves the long-term outcome for the patient. Consistent use of a thorough, disease-specific history questionnaire may raise awareness of subtle changes early in the course of osteoarthritis. TVN

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CONTINUING EDUCATION

Osteoarthritis: Getting Patients Moving Through Nutrition

TOPIC OVERVIEW

The goals of medical management of osteoarthritis (OA) include: (1) mitigation of risk factors, (2) controlling clinical signs, (3) moderating progression of the disease, and (4) improving the pet's quality of life. Nutrition plays a critical role in the successful long-term management of patients with OA. Prevention or reversal of obesity is one of the most effective mechanisms for reducing risk and modifying disease progression. Nutrients and their role in managing OA are presented and show how nutrition helps to mitigate pain and slow the progression of OA.

LEARNING OBJECTIVES

Identify the goals of managing OA in cats and dogs, describe specific nutrients and their effect on OA, and identify and communicate risk factors for OA in cats and dogs.

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1. **Age-specific prevalence values range from __ in dogs older than 1 year up to __ in dogs older than 8 years.**
   a. 20%, 33%
   b. 80%, 20%
   c. 20%, 80%
   d. 33%, 90%

2. **Which is considered the most common chronic pain condition in dogs and cats?**
   a. Obesity
   b. Osteoarthritis
   c. Chronic kidney disease
   d. Stiffness

3. **Which of the following is not a typical clinical sign of advanced arthritis in dogs?**
   a. Changes in grooming
   b. Stiffness
   c. Lameness
   d. Difficulty in rising

4. **Which of the following is not a treatment objective for osteoarthritis?**
   a. Reduce pain and discomfort
   b. Decrease clinical signs
   c. Slow the progression of the disease
   d. Delay the repair of damaged tissue

5. **Symptoms of osteoarthritis in cats are generally categorized into 4 groups, not including:**
   a. Mobility
   b. Activity level
   c. Grooming
   d. Eating habits

6. **Which is not a risk factor for pets to develop osteoarthritis?**
   a. Age
   b. Environment
   c. Genetics
   d. Obesity

7. **In cats, which fatty acid inhibits the aggrecanase enzymes responsible for cartilage degradation?**
   a. EPA
   b. ETA
   c. DHA
   d. GAA

8. **Which of the following works in the joint to preserve joint viscosity, support lubrication of the joint, and aid in shock absorption?**
   a. Antioxidants
   b. Hyaluronic acid
   c. Glucosamine
   d. DHA

9. **Which amino acid facilitates turning fat into energy?**
   a. Methionine
   b. Carnitine
   c. Manganese
   d. EPA

10. **In studies, obese cats were ____ times as likely to develop lameness requiring veterinary care.**
    a. 3
    b. 5
    c. 6
    d. 10