

## **Diet and Environment**

### **Revision by Korrin Saker, DVM PhD DACVN**

Dogs prosper on many different diets. How can you be assured the diet you choose will provide adequate nutrition for your dog? AAFCO, the American Association of Feed Control Officials, has developed policies for regulating the manufacture, labeling, distribution and sale of animal feeds. The *Nutrition Claim* or *Nutrition Statement* on all pet food labels will state if and to what extent the manufacturer has followed AAFCO guidelines in the formulation and testing of that diet. You will be able to ascertain, to some extent, if the diet is appropriate for your dog at a particular life-stage. Most commercially available diets (dry, semi-moist, or canned) are formulated to provide "complete" nutrition for a specific life stage. A separate category of commercial diets, termed "therapeutic or prescription" are formulated to address specific health concerns. Diets that are formulated to provide "complete and/or balanced nutrition" do not require supplementation with vitamins, minerals or other nutrients for maintaining adequate health. Some owners prefer to prepare the diet for their dog from ingredients from the market. Homemade recipes have their place in pet nutrition, but can easily be incomplete or "unbalanced"; therefore, it is important that you discuss your dog's diet with your veterinarian to be sure it provides all the nutrients the dog will need to maintain good condition. The National Academy of Sciences maintains a website for pet owners on the subject of dog and cat nutrition. It contains information on nutrient requirements and nutrient problems. The website (called "Petdoor") is worth a visit if you have questions about nutrition and diets for your Westie. It is found at The National Academy of Sciences, Board of Agriculture and Natural Resources site (<http://www.dels.nas.edu/banr/petdoor.html>).

In general, most dogs thrive on the same diet – day after day. In fact, some dogs don't do very well if their diet is changed from one food to another, and will sometimes get stomach upsets and diarrhea if their diet changes. Most owners realize that there are some dietary no-no's – too much food (exceeding body needs and leading to weight gain), doggie junk food and snacks, and fatty scraps. Although they love them, many dogs will get upset stomachs and diarrhea if they eat bones. Soft bones, such as those from poultry, may actually be a danger to dogs. These soft bones can be broken into sharp pieces during chewing and injure the digestive tract and mouth of dogs. All of these should be avoided.

Numerous pet food companies maintain very good information on dog nutrition on their websites. They also provide information for dog owners on their products. Pet food websites and product information can be obtained by accessing the American Academy of Veterinary Nutrition (AAVN) web-site ([www.aavn.org](http://www.aavn.org)).

Dogs need clean, fresh water. Dogs should have their water changed several times daily, and regularly checked by their owner for debris, cloudiness or discoloration that might indicate the water is unpalatable or potentially contaminated. Water bowls made of stainless steel are generally easier to keep clean and to resist chewing by enthusiastic dogs.



One of the most important things owners can do to insure the health of their animal is to keep it in a safe environment. Dogs that are allowed to run free may encounter other dogs with potentially infectious diseases. Although Westies have the courage of African lions and will stand their ground against much larger dogs, they may get severely injured in dog or cat fights. Dogs that run free also run the risk of being struck by automobiles, ingesting dangerous substances (like antifreeze, for example), or being injured from falls or from malicious acts. So, keep your Westie safe!

## **You and Your Veterinarian**

You and your veterinarian are a team dedicated to maintaining the health of your Westie. Veterinarians-to-be take four years of classes and mentored practice experiences before they take licensing examinations and begin to practice veterinary medicine. Most new veterinarians will work with more seasoned practitioners to hone their skills. Some veterinarians will take additional years of training (as interns and residents) to learn a veterinary specialty like dermatology, oncology (the study of cancer), or orthopedic surgery. If you are interested in veterinary training or in the scope of the veterinary profession, several very good websites are maintained by The American Veterinary Medical Association ([www.avma.org](http://www.avma.org)) and the American Animal Hospital Association ([www.healthypet.com](http://www.healthypet.com)). These websites also contain a wealth of information on the health of companion animals (such as dogs, cats, and horses) and you may want to visit them.

Regular visits to your veterinarian are critical in maintaining the health of your Westie. These visits allow the veterinarian to get to know your dog and to know you. The visits allow you to communicate to the veterinarian what a special dog you have and to allow the dog to understand the environment and examination procedures. It is well known that dogs that know their veterinarian and his practice environment are more at ease with visits. This lowers the stress levels your dog might have when going to a place where there are other dogs and cats,

strange people and strange smells. Regular visits also help the veterinarian do a good job in assessing the health of your dog, because they can develop a baseline of health and potential medical problems, detect diseases at early stages, and, most importantly, gain the trust of you and your Westie.

How often you and your Westie visit your veterinarian depends on the age and the health of your dog. Most veterinarians would like to see your dog frequently (every few months) as a puppy, for vaccination against infectious diseases, to provide information on diet, to detect early signs of health problems, and to assess whether or not your puppy is affected by parasites. When dogs become mature (between 1-2 years) visits to the veterinarian may only be needed every 6-12 months. Of course, you and your dog should always see the veterinarian if there are any health problems, so they can be accurately diagnosed and treated.

Most dogs in the United States are now regularly maintained on medication to prevent the development of canine heartworm disease ("dirofilariasis"), a disease spread from one dog to another by mosquito bites. Veterinarians may also recommend the use of medications applied regularly to minimize the effects of fleas and ticks on dogs that go outdoors.

### **Breeding, spaying and neutering**

Breeding, spaying and neutering are critical topics for discussion between you and your veterinarian.

If you are an experienced dog breeder, you have a wealth of knowledge regarding breeding – perhaps more than your veterinarian. Most veterinarians will readily acknowledge this and will be happy to learn from your experiences. They may also have questions and observations that will foster dialogue, including optimum timing for breeding, frequency of breeding, suggestion on nutrition for dam, sire and pups, vaccination schedules and protocols (to optimize puppy immunity), and a number of other topics. The outcome of breeder and veterinarian dialogue is happy, healthy Westie pups, Westie moms, and their human families!

If you do not intend to breed your dog, then spaying and neutering may have important health consequences for your dog and for the dog population in general. We are sure most people realize there is a serious problem of pet overpopulation in the United States. Although this is rarely a problem for Westies (because they have very devoted owners!), there are many dogs that do not have homes and which may stray. Pet owners who spay and neuter their pets play a major role in preventing pet overpopulation.

Spaying your female dog ("ovariohysterectomy") removes the ovaries and the uterus of the dog, so that she will not have puppies. Neutering male dogs removes the testis, and these dogs are sterile. These operations are done by your veterinarian in his hospital. Veterinarians first examine your dog to be sure that the dog is healthy enough for surgery, and then schedule the operation. Dogs that are spayed/neutered are given a general anesthesia and prepared for sterile (aseptic surgery). After the operation, dogs will have a portion of their fur shaved, a sutured/stapled surgical site, and will require observation and aftercare. This will all be discussed with you by your veterinarian.

As noted above, there are important health consequences of spaying and neutering. Several studies have noted that the incidence of uterine infections ("pyometra") and mammary gland tumors is markedly reduced in female dogs that have been spayed. The beneficial effect on the development of canine mammary gland tumors is seen in dogs that are spayed in the first year of life and somewhat in dogs spayed between 1-2 years of age. Female dogs of any age have a reduced risk of developing uterine infections and inflammation ("pyometra"), since the spaying operation removes the uterus.

The benefits (aside from preventing pet overpopulation) of neutering male dogs may be a reduction in the incidence and growth of some types of skin tumors ("perianal gland adenoma"), decreased incidence of perianal fistula and on problems associated with benign enlargement of the canine prostate, including prostatic cysts and abscesses. Recent research has not shown that neutering of male dogs decreases prostatic cancer in dogs; in fact, some data shows that neutered male dogs may be at a slightly increased risk for developing this very uncommon tumor.

The effect of spaying and neutering on the development of other diseases and on pet behavior (such as aggression) is less clear cut. Once again, a discussion of these topics with your veterinarian will help you make important decisions on pet breeding and pet neutering.

### **How Breed Influences Health in Dogs**

One of the many things that are very important in determining the health of every dog is their genetic make-up. Each cell in every dog (and person and everything else) contains a "blueprint" for the cell and for the dog. These "blueprints" are made up of DNA, formed into specific genes contained in chromosomes. The entire set of genes that contain the "blueprint" for each individual dog is known as its genome. The genome specifies how cells are made, how the cells form tissues, and how the tissues (like the heart or skin) function.

Selective breeding of dogs, following domestication from wild dogs and wolves, has resulted in the evolution of specific dog breeds, like the West Highland White Terrier. The genome of one Westie is likely to be very similar to other Westies, because selective breeding over several hundreds of years has focused the genome on certain desirable characteristics that make them Westies. For example, the pale and white coat color of Westies, the shape of their body, and even things like their lifespan are encoded in their genome (Westies tend to live longer than Great Danes!).

It is very likely that the differences in the genome of Westies from other dog breeds are small and caused by the variable expression of certain key genes. These variations in gene expression are termed "mutations" or "polymorphisms" by genomic scientists. Many such variations in the genome are good, conferring selective advantages in appearance, performance and health. On the other hand, some variations are not advantageous for dogs. It is well known that cancer, for example, is the result of mutation in certain specific genes that control cell growth, cell division, and cell lifespan.

Unfortunately, some breeds of dogs, as a result of selective breeding, develop diseases that are associated with their breed. Two examples are shown below to illustrate this. The information is a little technical, but it helps show strong associations between breed and disease. How this all relates to Westies follows these examples.

### **Example: Breed predispositions as a significant factor in the development of ML**



Golden Retrievers, in comparison to many other dog breeds, are disproportionately affected by neoplasms as causes of morbidity and mortality. In 1998, the Golden Retriever Club of America (GRCA) developed and distributed a questionnaire-based health survey to Club members (Glickman, 1998). Health, husbandry, morbidity, and mortality data was received from 746 dog owners, documenting information on 1444 dogs. Pet owners confirmed information on morbidity and mortality of dogs with veterinary practitioners.

The results of this survey indicated that approximately 61.4% of all deaths reported in Golden Retrievers were caused by neoplasms. In dogs that died, the lifetime risk of developing a neoplasm was 1 in 2, with the risk of development of

hemangiosarcoma (the most common tumor) being 1 in 5, and of developing ML 1 in 8. According to survey results, only about 12% of dogs which developed ML were cured by therapy. ML ranked as the most significant Golden Retriever disease in terms of years of potential life lost in the study population, and caused roughly 4 times more potential years lost than any other single cause of mortality.

Other data also indicates Golden Retrievers may be more likely to develop ML than other breeds. The five most popular breeds of dogs (2003-4, in descending order) were Labrador Retrievers, Golden Retrievers, German Shepherd Dogs, Beagles, and Yorkshire Terriers (Source: American Kennel Club registration data, 2005). These breeds have been among the most popular for more than a decade. They accounted for 15.6%, 5.6%, 4.8%, 4.8%, and 4.4%, respectively, of the total of 1,873,711 purebred dogs registered in those years. If all breeds had a similar risk for the development of ML, one would expect that the proportion of cases of ML recorded in databases would be roughly proportional to breed popularity. For example, one would expect that Labrador Retrievers would contribute about 3x more cases of ML to the database than Golden Retrievers.

However, an examination of data in the VCR database indicates a substantially increased risk for ML in Golden Retrievers. Currently, there are 1,141 cases of ML in the database (18% of the total cases). Labrador Retrievers account for 8.2% of the ML cases, while Golden Retrievers account for 10.2%. Based solely on breed registrations (representing numbers of popular purebred dogs) it appears that Golden Retrievers may be 3 times more likely than Labrador Retrievers to develop ML (**Table, below**). Unfortunately, actuarial data, including estimates of the total 'at risk' canine population, and reports of causes of death do not exist, making calculation of incidence, prevalence, or frequency, difficult and imprecise.

	AKC reg. (%)	ML in VCR (%)	Obs/Exp
Labrador Retriever	15.6	8.2	1.2
Golden Retriever	5.6	10.2	4.0
German Shepherd	4.8	3.7	1.7
Beagle	4.8	2.2	<b>1.0</b>
Yorkshire Terrier	4.4	0.6	0.3

**Table.** Representation of different dog breeds among total AKC registrations, and cases of ML in the Veterinary Cancer Registry. The ratio of observed ML frequency to expected ML frequency (based on AKC registration) is normalized relative to Beagle.

The overrepresentation of ML in the Golden Retriever breed was confirmed in a retrospective study of ML at our institution. Three hundred ninety-five (395) dogs were diagnosed with ML in a 15-year period of study (1986-2001). This comprised 1.2% (n=32,823) of all canine admissions. More than 80 breeds of dog were diagnosed with and treated for ML. Breeds diagnosed with ML included: Mixed Breed (n=79), Golden Retriever (n=38), Labrador Retriever (n=31), Cocker Spaniel (n=23), Rottweiler (n=16), German Shepherd Dog (n=12), Doberman Pinscher (n=11), Boxer (n=11), Shih Tzu (n=11), and other breeds (n=157). Of the total number of cases in our study population, Golden Retrievers accounted for 9.6% of total cases seen, a figure close to that represented in the VCR database.

It is entirely possible that phenotypic selection of desirable characteristics in some breeds may have also selected for genomic abnormalities associated with the development of ML. As previously noted, the fundamental basis for all neoplasms is mutation of critical genes that control growth and differentiation. Conventional pedigree-based linkage studies have been used successfully to identify genes that are associated with a variety of canine disorders, including a rare cancer (reviewed by Sutter and Ostrander, 2004).

## References

Glickman, L, Glickman, N, Thorpe, R, "1998-1999 Golden Retriever Club of America National Health Survey", Golden Retriever Club of America Health and Genetics Committee, 1998

Sutter NB, Eberle MA, Parker HG, Pullar BJ, Kirkness EF, Kruglyak L, Ostrander EA, "Extensive and breed-specific linkage disequilibrium in *Canis familiaris*," Genome Res 14: 2388-96, 2004

## Example: Breed predispositions in the development of brain tumors in dogs



Spontaneous primary brain tumors are common in dogs, accounting for 1-3% of all deaths in aged dogs where necropsy is performed (Koestner, et al, 2002). In one study, an incidence rate of 14.5 cases/100,000 dogs at risk was reported, although this may be somewhat imprecise as actuarial data is not collected on dogs at the time of death (Vandeveld, 1984). Over 70% of primary tumors occur in dogs aged 6 years or more, a period in lifespan comparable to middle age in humans. Astrocytomas, oligodendrogliomas and meningiomas are most common, with astrocytomas accounting for approximately 10% of primary brain tumors in some series

(Luginbuhl, H et al, 1968). Astrocytomas classified as grades II-IV in the revised WHO Classification system have been recognized and reported in dogs, and are histologically identical to similarly graded tumors in humans (Kleihues, P et al, 1993). Most canine astrocytomas occur as cortical lesions, with many forming in the temporal and frontal regions. An increased incidence of gliomas has been noted in brachycephalic breeds (Boston Terriers, Boxers, Bulldogs) (Summers, BA, et al, 1995) as well as in the Golden Retriever, Doberman Pinscher, Scottish Terrier and Old English Sheepdog breeds (Summers, BA, et al, 1991). Both the clinical presentation and progression of these astrocytomas is similar to humans (LeCouteur, RA, 2001). Unfortunately, patterns of survival are also similar, likely a combination of limitations in providing therapy to veterinary patients and inherent tumor behavior.

Despite the known predisposition of certain breeds to specific tumors, there have been no definitive investigations of gene expression in normal canine brain tissue. Extrapolating from the human experience, it is possible that some dog breeds have inherited defects in tumor suppressor gene function or may be predisposed to over-express other critical growth regulating genes, eventually leading to tumor development.

## **References**

Koestner, A, Higgins, RJ, "Tumors of the nervous system," in Tumors of Domestic Animals, 4<sup>th</sup> ed., Meuten, DJ (ed.), Iowa State University Press, Ames, IA, 2002, p. 697

Vandeveld, M, "Brain tumors in domestic animals: An overview," Proceedings of the Conference on Brain Tumors in Man and Animals, Research Triangle Park, NC, September, 1984

Luginbuhl, H, Fankhauser, R, McGrath, JT, "Spontaneous neoplasms of the nervous system of animals," Prog Neurology Surgery 2: 85-164, 1968

Kleihues, P, Burger, PC, Scheithauer, BW, "The new WHO classification of brain tumours", Brain Pathology 3: 255-268, 1993

Summers, BA, Cummings, JF, De Lahunta, A, "Tumors of the central nervous system," in Veterinary Neuropathology, Mosby-Year Book Publishers, Inc., St. Louis, MO, 1995, p. 364

Summers, BA, Kornegay, JN, et.al, "Analysis of survival in a retrospective study of 86 dogs with brain tumors," J Veterinary Internal Medicine 5: 219- 226, 1991

LeCouteur, RA, "Tumors of the nervous system," in Small Animal Clinical Oncology, 3<sup>rd</sup> ed., Withrow, SJ, MacEwen, EG, (eds), WB Saunders Co, Philadelphia, PA, 2001



### **How does this relate to Westies?**

There are some diseases that occur in Westies that are more common than in other breeds. The reason for this is undoubtedly tied up in the genome of the breed. Selective breeding over hundreds, if not thousands of years, has developed the Westie with certain characteristics such as size, stature, coloration and even personality. At the same time that these desirable characteristics were selected by careful breeding, other less desirable characteristics also developed. Some of these less desirable mutations were linked (literally, in the DNA and chromosomes) to more desirable breed characteristics – sort of ‘hitching a ride’ in the Westie genomic pattern. Because of these linked mutations, Westies are predisposed to the development of some diseases, just like Golden Retrievers get more malignant lymphoma and Bulldogs get more brain tumors. We know that while dogs may be predisposed genetically to developing some diseases, there are also many identified and unidentified environmental influences on disease development, expression and severity. This complex interplay between genome and environment is an area of intense scientific study.

A very good first step in making progress in understanding which diseases are common and for beginning the study of genome-environmental relationships are health surveys, conducted by the Westie Foundation of America and also the West Highland White Terrier Club of America. The results of recent studies are a kicking off point for discussion of diseases that follow.

It is now our job to find the specific genes in the Westie genome that are related to common diseases. Once this is done, more effective treatments for these diseases can be found, and concerned breeders, owners, veterinarians and scientists can work together to eliminate these problem genes, while maintaining happy, healthy populations of Westies for centuries to come.

With all this background information down, we are now ready to discuss some **Common diseases of Westies**. The information is organized by disease topic. Before each topic, there is a brief summary of information which may help readers understand some of the terminology and concepts used in the discussions.

### **Common diseases of Westies**

The Westie Foundation of America (WFA) and the West Highland White Terrier Club of America (WHWTCA) have each conducted several surveys of Westie

owners and breeders to identify common diseases. The fact that owners and breeders recognize diseases that occur more commonly in Westies means that there are likely to be complex genomic factors and environmental factors that interact to produce disease.

In 1999 (and again in 2004) the WFA conducted a health survey of Westies. The results of the 1999 Survey were both interesting and important in terms of focusing research on Westie health problems. Owners and their veterinarians were asked to report the disease both by importance to them and prevalence. A response rate on this survey (27.1%) is considered low for the purposes of statistical analysis. According to the 1999 WFA Westie Health Survey

Diseases ranked by importance as reported by Westie owners:

1. **Atopic Dermatitis**
2. **Pulmonary fibrosis**
3. Copper toxicosis and **Legg-Calve-Perthes** (tied)
4. Addison's disease (hypoadrenocorticism)
5. Aggression
6. Diabetes mellitus
7. White-shaker syndrome
8. Dry eye (keratoconjunctivitis sicca)
9. Allergies
10. Luxated patella
11. Globoid Cell Leukodystrophy
12. **Cancer**

Targeted diseases were ranked by prevalence (mainly diagnosed by veterinarians) as follows:

1. **Atopic Dermatitis**
2. Aggression
3. Luxated patella
4. Dry eye (keratoconjunctivitis sicca)
5. **Legg-Calve-Perthes**
6. Cranial mandibular osteopathy
7. **Pulmonary fibrosis**
8. White-shaker syndrome, diabetes, Addison's disease (hypoadrenocorticism) (tied)
9. Copper toxicosis
10. Juvenile cataracts
11. Globoid Cell Leukodystrophy
12. Deafness

According to WHWTCA, the following diseases have been identified as of particular concern to Westie owners (these diseases are listed alphabetically, not in order of occurrence or importance) (**bolded items** are discussed in this first draft of the Westie E-book):

### **Alphabetical listing of diseases of concern to Westie owners**

Aggression  
Addison's disease (Hypoadrenocorticism)  
**Atopic Dermatitis**  
**Bladder Cancer (TCC)**  
Cleft Palate  
Copper Toxicosis (CT)  
Craniomandibular Osteopathy (CMO)  
Deafness  
Diabetes Mellitus  
Ear Infections  
Epidermal Dysplasia  
Globoid Cell Leukodystrophy (GCL)  
Heart Disease  
Hip Dysplasia  
Immune System  
Inflammatory Bowel Disease (IBD)  
Hernia (inguinal and umbilical)  
Juvenile Cataracts  
Keratoconjunctivitis Sicca (KCS, Dry Eye)  
Kidney Disease  
**Legg-Calve-Perthes**  
Luxated Patella  
Portosystemic Shunt  
**Pulmonary Fibrosis (Westie Lung Disease)**  
Pyruvate Kinase (PK) Deficiency  
Seborrhea, Primary and Secondary  
Skin and Allergy Problems  
Teeth and Gums  
White Shakers Syndrome

### **Common diseases of Westies, categorized by Body System**

Alimentary (Digestive) System  
    Cleft Palate  
    Copper Toxicosis  
    Craniomandibular Osteopathy  
    Diabetes Mellitus

Inflammatory Bowel Disease (IBD)  
Pyruvate Kinase (PK) Deficiency  
Teeth and Gums

#### Cardiovascular System

Heart Disease  
Portosystemic Shunt  
Pulmonary Fibrosis (Westie Lung Disease)

#### Endocrine System

Addison's disease (Hypoadrenocorticism)

#### Immune System

#### Locomotor System

Hip Dysplasia  
Legg-Calve-Perthes  
Luxated Patella

#### Nervous System

Aggression  
Globoid Cell Leukodystrophy (GCL)  
White Shakers Syndrome

#### Special Senses

Deafness  
Ear Infections  
Juvenile Cataracts  
Keratoconjunctivitis Sicca (KCS, Dry Eye)

#### Skin and Soft Tissue

Atopic Dermatitis  
Ear Infections  
Epidermal Dysplasia  
Hernia (inguinal and umbilical)  
Keratoconjunctivitis Sicca (KCS, Dry Eye)  
Seborrhea, Primary and Secondary  
Skin and Allergy Problems

#### Urogenital System

Bladder Cancer (TCC)  
Kidney Disease

## **Common diseases of Westies, categorized by underlying pathologic process**

### Congenital/Developmental

- Atopic Dermatitis
- Cleft Palate
- Craniomandibular Osteopathy (CMO)
- Deafness
- Globoid Cell Leukodystrophy (GCL)
- Heart Disease
- Hip Dysplasia
- Hernia (umbilical)
- Juvenile Cataracts
- Legg-Calve-Perthes
- Luxated Patella
- Portosystemic Shunt
- Seborrhea, Primary and Secondary

### Hemodynamic

### Infectious

- Ear Infections

### Inflammatory

- Epidermal Dysplasia
- Inflammatory Bowel Disease (IBD)
- Keratoconjunctivitis Sicca (KCS, Dry Eye)
- Pulmonary Fibrosis (Westie Lung Disease)
- Skin and Allergy Problems (Atopic dermatitis)
- White Shakers Syndrome

### Metabolic/Endocrine

- Addison's disease (Hypoadrenocorticism)

### Neoplastic

- Bladder Cancer (TCC)

### Nutritional/Toxic

- Copper Toxicosis (CT)
- Diabetes Mellitus
- Globoid Cell Leukodystrophy (GCL)
- Pyruvate Kinase (PK) Deficiency

### Other/Unknown

Aggression  
Hernia (inguinal)  
Legg-Calve-Perthes  
Luxated Patella  
Pulmonary Fibrosis (Westie Lung Disease)  
Teeth and Gums  
White Shakers Syndrome