

## ANALYSIS OF FACTORS AFFECTING THE QUALITY AND LENGTH OF LIFE OF DOGS

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### ABSTRACT

The dog is a diverse species both in terms of behavior, size and lifespan. There are many factors that affect the lifespan of dogs. This paper examines, among others, the effect of breed on the length and quality of a dog's life, the effect of owner and social environment on a dog's quality of life, the effect of utility on a dog's quality of life, and the effect of nutrition on a dog's length and quality of life. The size of a dog is a well-known factor affecting the length of its life. Purebred dogs are known to have higher health burdens and shorter life spans than non-breed dogs and inter-breed hybrids of the same size. The length and quality of life of dogs is also affected by the quality of the bond with the owner and the owner's awareness of preventive veterinary care. A stimulating environment, and proper nutrition taking into account the dog's specific breed or health requirements, are also important for the quality and length of canine life.

**Key words:** ageing, dogs, ageing model

### INTRODUCTION

Of all domesticated animals, man has established the closest relationship with the dog. Initially, the ancestors of dogs fed on scraps left by humans. The friendliest individuals were tamed and used by humans as a hunting aid. With the development of civilization, dogs began to perform more and more functions – they guarded herds of animals, helped with herding, and became guardians of the property. There was also a diversification of hunting dogs – through modifications of natural hunting behavior, dogs specialized in a specific function (such as staging game), or in specific animals (such as terriers used for hunting burrowing animals). In most cultures, the dog is considered man's best friend, a symbol of fidelity and courage, and in many primitive cultures dogs received divine worship. Over the centuries, the treatment of dogs has changed. Since the turn of the 20th century, there have been improvements in the treatment of dogs. The dog has become nearly a member of the family, and sustaining quality of life and health is a priority for dog owners. Communicating with dogs can have therapeutic qualities, as they give shy people courage, teach affection and

gratitude, and provide lonely people with companionship. They serve as guides for the disabled and as an aid to the uniformed services. The diversity in the use of dogs has given rise to more than 400 breeds of dogs classified into 10 groups:

1. shepherd and herding dogs
2. pinscher- and schnauzer-type dogs, molossers and Swiss shepherd dogs
3. terriers
4. dachshunds
5. spitzes and primitive breeds
6. hounds and scent hounds
7. pointing dogs
8. retrievers, flushing dogs and water dogs
9. companion dogs
10. greyhounds

The dog population has become very diverse both phenotypically and genetically. Dogs also vary in life expectancy and in the rate of aging. Learning about the factors affecting the lifespan and rate of aging of dogs can

extend their lives and provide many answers also about geriatric processes in humans.

The aim of the study is to analyze selected factors affecting the aging of dogs. The basis for such an analysis is based on my own observations and experiences in the field of breeding and use of dogs, as well as a rich literature especially related to the research problem undertaken on the above topic.

### Dog as a model for aging research

Aging is a process that involves all living organisms. The aging process is the subject of scientific research to improve people's lives and extend their lives. This research is also increasingly important in veterinary medicine.

The most popular model for aging research has been the house mouse, but the population of laboratory mice is strongly inbred and maintained in a sterile environment that does not allow the animals to develop a properly functioning immune system. Data obtained from mouse studies can be misleading and impossible to relate to an uninbred and environmentally exposed human population [Glimore and Greer 2015]. The best model for studying aging processes would be an animal:

- which has closely related species and/or high individual variability within the species with naturally occurring variations in lifespan,
- for which medical procedures exist,
- whose genome has been well-studied,
- does not require an artificial environment,
- allows for the collection of a large amount of data in a relatively short period of time.

A species that meets these assumptions is the domestic dog. Dogs are the most diverse animals in terms of body weight (e.g., a Chihuahua weighs an average of 2 kg, a Leonberger 60–80 kg and a Great Dane 80 kg) and life expectancy (e.g., an Irish Wolfhound 6–7 years; a toy poodle 16 years) and cause of death [Glimore and Greer 2015]. The dog has shared the same ecological niche with humans since the last Ice Age. The human social structure and the heavily anthropogenic environment are the dog's natural habitat [Jung and Poertl 2017, Wojtaś et al. 2018].

Modern canine veterinary care is relatively advanced. In terms of specialization and services, it is not very different from human medicine. From the day of birth, dogs' health is monitored and measured in detail. Dogs also share habits with their owners. There are many studies and sources of information on dog genetics. Analysis of the canine genome allows us to gather data on various geriatric patterns in their population. Knowledge of the canine genome is more useful to humans because it is, in terms of gene sequences, closer to the human genome than the genes of the domestic mouse [Glimore and Greer 2015].

Analysis of geriatric patterns is easier within breeds with less genetic variation than in a population with a richer gene pool. There are breeds with higher levels of inbreeding compared to other breeds, and their ancestry and medical data have been collected for generations. Dogs and humans suffer from many similar disease entities, such as obesity, joint disease and autoimmune diseases. A whole range of human diseases have their counterparts in dogs, for example, muscular dystrophy, night blindness and narcolepsy. Tumors occurring in dogs are important biological models. Tumors occurring in dogs often have identical histology and response to therapy as tumors in humans [Glimore and Greer 2015]. Because of these similarities, dogs are an excellent model for aging research, testing new surgical techniques and drug trials.

Finding the genes responsible for the complex aging process is a difficult thing [Greer et al. 2007]. Despite the growing population of geriatric dogs, the factors affecting aging are not well understood. Nutrition or physical activity can affect the rate of aging in dogs and their welfare. Life expectancy also depends on the breed (on average, purebred dogs live 12 years, hybrids live to 22–24 years) and the environment shared with humans. In feral dogs, a shorter lifespan is expected due to environmental pressures; however, data is scarce [Szabó et al. 2016].

The concept of healthy aging is also an issue. There are symptoms that are considered typical, covering most cases, and pathological ones. Most studies of aging processes in dogs focus on cognitive impairment specifically to limited abilities to acquire information, process it, retain it and use it in decision-making. The most typical neurological and psychological changes are increased nervousness, increased fear of new situations, vocalization and nocturnal motor agitation. The impact of some changes is minimal, such as increased time to learn new commands. However, there are disorders that can seriously disrupt a dog's functioning [Szabó et al. 2016]. Dogs can suffer from such complex diseases as Alzheimer's disease [Glimore and Greer 2015b], and cognitive processes can degrade to the point where the dog cannot identify its owner. Behavioral changes in elderly dogs are caused not only by neurological changes but also by mental changes and various health factors. Indwelling urination can occur both in a bacterial infection, as well as a disorder of sphincter control, or be caused by discomfort in the dog's movement. Limiting aging processes to only neurological changes and bypassing somatic diseases is a serious mistake. [Szabó et al. 2016].

In view of the growing awareness of animal owners and guardians, the question of verifying the quality of life of animals has arisen. This term should be defined broadly and include all factors that affect the comfort of the animal's life. Chronic diseases and disability negatively affect health, however, they are not always asso-

ciated with a decrease in the quality of life of the dog. Factors such as the need for satisfaction, a sense of control over one's own body, social relationships, freedom from physical and mental discomfort and an appropriate amount of stressors should also be included. Quality of life is a complex trait and hard to quantify, but creating an appropriate survey could be a helpful tool for dog owners. Surveys could be a source of information on factors affecting the quality of life of animals and could be helpful in deciding whether to proceed with therapy or euthanasia. A sick animal's poor quality of life is often a reason for euthanasia. It is important that studies of companion animal quality of life consider the balance of comfort and discomfort. Questions should be thematically arranged and cover topics such as happiness, comfort, physical fitness, or mental state [Lauan 2013].

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### **The effect of breed on the length and quality of dog's life**

The breeding of herding dogs has been known to humans since antiquity, although prehistoric cultures also encountered dogs of various specialties. The first specialization of herding dogs was recorded in the oldest historical sources dating back about 6,000 years. The earliest pedigrees of molosses come from Ancient Assyria, where they served as hunting and military dogs. One of the most famous Greek philosophers – Aristotle, in his work *Historia Animalum* (350 BC) described 7 breeds of dogs then known in Ancient Greece. He focused on their performance, characteristics and problems related to their reproduction, nutrition and diseases that occurred. Collumelli – a Roman specialist in agriculture and hor-

ticulture wrote that the guard dog, guarding possessions, was a symbol of prosperity in Ancient Rome [Jung and Poertl 2017].

The specialization of dogs has resulted in significant modification of their natural behavior patterns and exteriors. For example, retrievers, which were bred to find and bring back intact prey, exhibit a modified pattern of hunting behavior [Przeczek 2018]. Along with changes in the psyche and behavior of dogs, there have also been changes in body structure. Greyhounds are characterized by a different body structure than terriers. Significant anatomical differences between different breeds of greyhounds predispose a breed to sprinting, or long-distance hunting [Jung and Poertl 2017].

Kennel associations began to form to classify and establish breed standards. The largest cynological organization is the International Kennel Federation (FCI), which has 91 member countries and recognizes more than 340 dog breeds. Thanks to modern breeding of pedigree dogs, it has been possible to save from extinction many breeds that are no longer of interest due to their utility – for example, bulldogs, whose popularity declined significantly after dogfighting with bulls was banned [Jung and Poertl 2017].

Each puppy bred in breed purity is given a pedigree, which is information about the ancestry and therefore breeding value of the animal [Kramer 2011]. As a result of selection, carried out for performance traits in dogs, there has been a decline in the health of these animals, while functional traits have improved. This has increased the likelihood of breed-specific diseases. Large dogs such as the hovawart, leonberger, Tibetan mastiff and Newfoundland have a higher incidence of hip dysplasia than other breeds. In addition, Newfoundlands and Tibetan mastiffs suffer more often from eye and eyelid diseases [Przeczek 2018].

Concern for the good health of the breed's gene pool has led to changes in the regulations of FCI-affiliated kynological associations. According to the new regulations, there is an obligation to test dogs for carrying diseases typical of the breed. In addition, dogs with abnormal hip conformation are not allowed to be bred. However, the data contained in pedigrees do not include many key issues for breeding (e.g., life expectancy of the dog, cause of death, diseases). Subjective judging should also be more precisely defined and should not overlook the dog's genetic potential and psyche.

Kramer [2011] writes: "In recent years, confidence in breeders of pedigree dogs has been declining [...]. Puppy breeding focused on quantity and profit does not produce animals that are good enough and properly reared. They are often sick and suffer from various mental disorders. There are breeders not striving for profit but possessed by the ruler of exhibition success [...]". On the territory of Poland, an additional problem is the Law on

the Protection of Animals (Journal of Laws of 2022, item 572), allowing breeders to associate in kynological associations, despite the lack of provisions in their status caring for the health and welfare of dogs, the lack of breed standards and their control, and the lack of control of the origin of dogs.

Thanks to the breeding work carried out, it is possible to predict the appearance and character of the dog, which are described in the breed standard (FCI Breed Patterns). On this basis, it is possible to select a suitable four-legged dog for training, according to its predispositions, such as a dog for service in the military, in the police. In addition, organizations such as Guide Dogs (UK) breed working dogs. In order to obtain puppies of better health with favorable traits of the parent breeds, they use interbreed crosses. Under the phenomenon of heterosis, interbreed hybrids function better than purebred dogs, have fewer health problems, and have lower mortality rates [Caron-Lormier et al. 2016].

The breed affects a dog's lifespan, health and pattern of geriatric processes. According to Aristotle's *Historia animalium*, "The Laconian dog lives about 10 years, and the bitch lives 12. As for the other breeds, most bitches live 14–15 years, and some even 20 years." Georges Cuvier in 1831 wrote that a dog is old when it is 15 years old and rarely lives to be 20 [Jung and Poertl 2017]. Beagles are considered old above the age of 8 (with a life expectancy of 13.3 years). Giant breed dogs enter old age earlier and the shorter life expectancy may be due to higher mortality rates [Szabó et al. 2016]. According to data made available by the Swedish insurance company Agria Insurance, Cavalier King Charles spaniels had a low mortality rate in their early years, with mortality increasing after age 7. Despite this, survival rates were still relatively high, reaching 60% at age 10. A common cause of death or euthanasia among young dogs was heart valve degeneration. Bernese shepherd dogs, boxers, German shepherds had high survival rates at 5 and 10 years of age, while "mixed breeds" had high survival rates throughout the insurance period (up to 10 years of age) [Egenvall et al. 2000]. Shortened lifespan in giant breeds is associated with increased oxidative stress. There is a positive correlation between body weight and IGF-1 concentration and an inverse correlation to lifespan [Szabó et al. 2016]. Research on IGF-1 began in 1993 when IGF-1 levels in the serum of Great Danes and toy poodles were studied. At 6–24 weeks of age, no significant differences were observed in its levels and then it was observed that growth hormone (GH) levels were significantly related to the final size of the dog. GH and IGF-1 levels from puppyhood had no effect on the lifespan of dogs, but longevity appeared to be negatively correlated with body weight and to a lesser extent with height [Glimoure and Greer 2015]. The shorter lifespan of large dogs contrasts with the trend observed in the wild, where

large animals live longer. Domestication and the associated reduction in the size of dogs has resulted in longer lives. Although there is a positive correlation between lifespan and size within taxa, within species, smaller individuals live longer. There is a correlation between dog size and IGF-1 concentration levels, so selection for dog weight may have more strongly engaged IGF-1-related metabolic pathways causing rapid growth and resulting in many side effects – faster telomere shortening, poorer protein metabolism, greater susceptibility to acquiring defects, increased insulin secretion, greater risk of cancer, which shortens lifespan [Szabó et al. 2016].

Selection to produce giant dogs is possible only in an anthropological environment and with ample availability of valuable food. Expression of IGF-1 appears to have a positive effect on the development of the circulatory system, particularly on heart development. Dachshunds and Cavalier King Charles spaniels develop coronary heart disease earlier, and 90% of spaniels acquire cardiovascular disease after the age of 10. Most of the breeds at risk for heart disease are small breeds – under 9 kg. Lower expression of IGF-1-related genes, in addition to reduced body size, has resulted in a smaller heart, by shortening myocytes. Small dogs have larger hearts relative to their body weight. Genes affecting skeletal development also affect the development of the circulatory system [Szabó et al. 2016]. Many small breeds are descended from a common ancestor, who must have been burdened with the possibility of heart defects. Since small dogs live longer than large dogs, it was therefore thought that this was a long enough period of time for heart disease to develop. However, the argument cannot be considered accurate. The beginnings of coronary heart disease can be observed in a 4-year-old dog. A faster aging rate for large dogs would result in more intense disease development at an earlier age [Parker and Kilroy-Glynn 2012]. Increased oxidative stress in large dogs does not stress all systems in the body to the same extent. A study by Inoue et al. [2018] suggests that "dog longevity may not be directly related to breed size." The authors point to the need to analyze life expectancy at the individual breed level, as causes of death and life expectancy vary within breeds. Confirmation of racial differences comes from the study by Adams et al. [2010]. The authors show that smaller races tend to have longer life expectancies compared to large races, and the most common causes of death were cancer (27%), "old age" (18%) and heart disease (11%). Urfer et al. [2020], on the other hand, based on their research and analysis, conclude that there are no significant differences between pure breeds and their hybrids, regarding the impact on morbidity and life expectancy of dogs.



### The effect of the owner and social environment on the quality of dog's life

Dogs are social animals, and their need to form bonds with individuals of the same or other species is particularly strong. The social bond is more important to the dog than food. A special kind of bond is the relationship with humans. No other animal needs contact with a human as much as a dog and seeks his approval [Cherek 2016]. Dogs attach most strongly to the human who spends the most time with them and gives them tasks to perform, rather than the one who feeds them [Jung and Poertl 2017].

Abandoning a dog and depriving it of this bond is a source of great stress for the dog. Abandonment and a new environment can be a source of trauma and future behavioral disorders for the dog. A new environment such as a shelter is full of stressors – warning barks, smells of strange animals, lack of sufficient human contact and lack of access to the people with whom the dog was bonded. Prolonged stay in a shelter can cause mental disorders in the dog by which it will be less attractive to potential new owners. The stress caused by being in a shelter can be reduced by the mere presence of humans. Shiverdecker et al. [2013] noted a reduction in cortisol levels after isolating a dog from shelter noise. They also noted a significant improvement in welfare after 30 minutes of human interaction and recommend it as a strategy to reduce shelter stress in dogs. Lefebvre et al. [2007] write that taking home a police dog by its handler and exercising with it resulted in better dog obedience. Animals treated harshly during exercise (such as with an electric collar) were not more obedient, but their welfare was apparently worse. Genetic potential is not the only factor affecting the quality of a dog's work and welfare. Proper socialization and exploratory behavior are also important. Kuźniewicz [2016] points out that outdoor dog breeding has advantages over indoor breeding because of better physical development, higher fertility, better work performance, faster learning and higher disease resistance. Fialkovicova et al. [2012] noted differences in thyroid hormone levels in dogs kept under different conditions. Thyroid hormone secretion is essential for normal skeletal development, maintenance of normal metabolic activity and the ability to release energy. Due to the need to adapt to environmental conditions, levels of total thyroxine (TT4), the main thyroid hormone, varied in dogs kept outdoors, while those living in apartments remained constant throughout the year.

German Shepherds and Dachshunds showed a correlation between average temperatures and TT4 concentrations, but the group on which the tests were performed was small. The highest concentrations of the hormone were recorded in spring, and the lowest in summer. This was probably due to the body's need for addi-

tional warming. Beagles recorded the highest TT4 concentrations in January, and the lowest in March, August and September. There are also correlations between breed and dog size. Large dogs have lower TT4 levels compared to medium and small dogs, both from those kept indoors and outdoors. The lowest levels of thyroid hormones were recorded in greyhounds. In greyhounds, the reference TT4 level is reduced and similar to that in dogs with hypothyroidism; however, such hormone levels do not cause pathological conditions in greyhounds. Similar observations have been reported in basenji dogs in Australia. Long-term confinement of a dog in a pen [e.g., in a kennel], restriction of space and lack of human contact can result in pen disease and limb neurodermatosis. The quality of the bond between a working dog's handler and its welfare is higher when the handler and dog live together and are physically active together. The relationship of dogs trained using the positive method is better than dogs trained using the contrasting method, according to Mariti et al. [2013]. In Poland, dogs working in the uniformed services are trained using the contrastive method. Poor use of rewards (using them continuously) can cause lack of confidence, lack of absolute obedience and discipline, and the dog will only follow commands to get food. Punishments should be applied immediately after misbehavior. After a long time after the undesirable behavior, the use of punishment is unwarranted, because the dog is not able to associate punishment with the incorrect behavior. Kuźniewicz [2016] writes: "The use of punishment is a great art. It is necessary to convince the dog that its behavior has caused unpleasant consequences for it. Punishments must not be too severe, as they can confuse the dog's work and be the reason for escape. Even mild punishment is expedient only if the duties imposed on the dog do not exceed its abilities." Corporal punishment should not be used, especially in training young dogs. It is important to influence the dog's mind in an appropriate way. Punishment unsuited to the dog (age, condition, temperament, character) can distort its character, causing fear, aggression or timidity [Kuźniewicz 2016].

The dog's caretaker is a major social stimulant that can be a source of both positive relationships and stress. Understanding and liking dogs is a primary factor in a positive relationship with a dog. The owner's mental health is also important. Neurotic owners have dogs with higher cortisol levels than dogs whose owners are calm. Neurotic people are unable to provide dogs with a sense of security, causing dogs to mistrust people and have a low ability to cope with stress. Calm people can be supportive of the dog, so they can be in close contact with each other, which reduces stress. Dogs with calm owners cope more easily with stress, respond better to new situations, and show less stress without the owner present [Schoberl et al. 2016].

A dog's quality of life may also depend on the owners' education, knowledge of dog care, gender, family size and age. Ownership of a pet by elderly people improves their quality of life, but these people are not able to meet all the needs of a dog. Older people devote less time to their pets, and a lack of mobility and proper awareness can translate into poorer veterinary care [Pitteri et al. 2014]. Children can also be a major stressor for dogs. Their lively temperament and excessive excitability are stressful for both pet and therapy dogs, and can cause behavioral responses such as barking and shaking. Some dogs attempt to break up a tense situation with physical contact. Children exhibit many uncomfortable behaviors toward dogs, such as jumping on the dog or disturbing the dog's rest. The dog derives pleasure from reasonably sustained stroking sessions, but prolonged hugging can be a source of stress. Instability of the environment, lack of routine, noise from children and lack of quiet are all potential sources of stress. Walking with a child without an adult guardian can also be stressful. For bad influences, the reason is to be found in the ignorance of parents who do not know how to read the early signs of stress in a dog. Hall et al. [2019] also found play with wheeled toys and play containing unpredictable events to be extremely stressful. Behaviors like, yawning and licking occur during play. Symptoms of chronic stress and related symptoms, such as ear, eye and skin infections, have been observed in the dogs studied living with children. The amount of research on the effects of children on dogs is not large and the samples are relatively small, so no conclusion can be drawn about the unilateral harmful effects of children on dogs [Hall et al. 2019].

The quality of the dogs' lives and their performance on the job is also affected by a suitably stimulating environment. Police dogs that were in a group exercising in a varied park performed better over obstacles than a group of dogs lacking the variety. Dogs not exposed to variety also showed higher levels of cortisol during exposure to novel phenomena and were more likely to present stereotypies than dogs exercised in a varied environment [Borrego et al. 2014]. Milgram et al. [2004] studying the effects of enrichment and an antioxidant-rich diet on slowing dementia in beagles found that the positive effects of diet were enhanced by an appropriately varied environment. Old dogs given variety made fewer mistakes, and young dogs had an additional increase in learning speed. A varied environment has a positive effect on the cognitive functions of geriatric dogs.

### **The effect of usability on the quality of dog's life**

Nowadays, the dog is most often used as a companion animal; however, dogs are also used as herding animals, guard dogs, defense dogs, therapy dogs, guide dogs, tracking dogs, hunting dogs, sporting dogs, draft

dogs and dogs in uniformed services. A good working dog should be confident, courageous, adaptable, easy to train, persistent and confident with strangers [Mariti et al. 2013]. In the uniformed services, they are used by customs, police, border guards, prison service, fire and emergency services. Uniformed services use sentry, patrol and guard dogs, to search for weapons, explosives and drugs; osmotic, tracking, pursuit and search dogs [Kuźniewicz 2016].

Working dogs, especially in the military, police and emergency services, are exposed to stress and danger. Dogs in uniformed services are exposed to various injuries, such as leg wounds, sprains, broken bones, damage to paw pads, etc. [Kuźniewicz 2016].

Dogs searching for survivors of avalanches are irreplaceable. Rescue operations are very exhausting for dogs and cause them to have increased heart and breathing rates and increased cortisol levels. This should not be associated with a decrease in welfare, as physiological parameters return to normal 2 hours after the action, but such work for dogs is a very high effort [Diverio et al. 2016]. A similar phenomenon occurs in sporting dogs. Agility gained popularity 20 years ago and was designed to demonstrate a dog's obedience and physical preparation. Competitions are both a positive experience and a source of stress. Dogs experience excitement, frustration or nervousness during competition. Stressors during competition can include social conditions, noise, exposure to novelty and increased demands on the dog. Pastore et al. [2011] noted that 65% of dogs participating in competitions were anxious. Dogs showed greater excitement and anxiety before the competition began. During the competition, dogs panted more intensely, spun in circles and urinated more frequently. Such stress symptoms can also be the result of excitement, also known as positive stress, and should not be linked to compromised animal welfare.

Dog selection is a key moment – it is designed to exclude anxious and neurotic dogs. Dogs in uniformed services and rescue are constantly exposed to danger, so dogs included in the service are selected for stress resistance. Dogs that show fear do not show much effectiveness on the job, and their well-being will be impaired. [Foyer et al. 2016]. Sherman et al. [2015] noted that emotionally unstable dogs can react negatively to training, and fear can prevent them from doing their jobs correctly.

Dog work is not always performed in comfortable weather conditions. Too low humidity affects the drying out of the mucous areola of the dog's nasal cavity. A large amount of dust, dust, chemical pollutants can cause respiratory and nervous system disorders [Kuźniewicz 2016].

In Poland, the average age of a dog withdrawn from service is 7.4 years (average age of dogs – 8.7 years), gender does not affect the length of a dog's service. Dogs withdrawn from service can be divided into 10 groups. The first group includes dogs missing due to age (after the

age of 8) with general signs of aging. The second group includes dogs cull due to gastroenterological conditions (e.g., broken canines, gastrointestinal torsion, stomach ulcers). The third group includes dogs cull due to musculoskeletal conditions (dysplasias, chronic lameness, degenerative changes). The fourth group includes dogs cull due to nephrological conditions (kidney failure). The fifth group included oncology dogs. The sixth group included dogs with neurological conditions (paralysis, epilepsy, discopathy). The seventh group included dogs with dermatological conditions (skin eczema, dermatoses). The eighth group included dogs with cardiac diseases (heart failure, arrhythmia). The ninth group included dogs with behavioral and psychological problems (neuroses, depression, aggression, lack of enthusiasm for work, lack of acceptance of the handler). The final tenth group included dogs withdrawn from service for reasons that could not be classified in any of the above groups (withdrawal without reasons, escapes, accidents, prostatic hypertrophy, diabetes). Despite the dangerous work that dogs perform in the uniformed service, the largest number of dogs missing belongs to group one [Kuzniewicz 2016].

Guide dogs in the UK leave mostly (84% of dogs surveyed) in a timely manner. The main reason for the dogs' retirement is musculoskeletal problems. Arthritis prevented 45% of withdrawn dogs from continuing to work. The second most common reason for withdrawing dogs was neurological problems. There were also skin problems (atopic dermatitis). Skin problems can reduce the useful life of a guide dog by up to 5 years. Among neurological problems, epilepsy was the most common (it covered 35% of the dogs withdrawn), reducing the service life by an average of 3 years. Breeds used as guides – labrador retriever, golden retriever, German shepherd are breeds prone to joint disease. Hybrids of breeds are characterized by better health, including golden retriever and labrador retriever hybrids are healthier than German shepherd hybrids [Caron-Lormier et al. 2016].

### **The effect of nutrition on the length and quality of a dog's life**

Proper nutrition is an important part of preventive veterinary medicine. Proper nutrition avoids diseases such as obesity, digestive problems, reproductive disorders, joint, urinary or liver diseases [Ceregrzyn et al. 2004].

Obesity is a serious threat to a dog's health and quality of life. In Australia, 20–40% of dogs suffer from obesity. Originally, too much energy intake compared to physical activity was thought to be the cause of obesity. Other factors contributing to the incidence of obesity like slowed metabolism, poorly composed rations in terms of nutrient deficiencies, gender, age, breed, sterilization have also been identified. Another important factor is the

owner's lack of knowledge of dog breed nutrition [Bland et al. 2010].

Differences between representatives of different dog breeds are apparent. There are foods on the market tailored to the needs of popular breeds, that is, breeds that frequently visit our homes (German shepherd, Yorkshire terrier, miniature schnauzer, Labrador retriever, golden retriever, Siberian husky, Chihuahua, border collie, beagle). The lack of conclusive studies makes it impossible to determine the differences in the nutritional needs of dogs of unpopular breeds (Portuguese shepherd, Yakutian laika, otterhound, Japanese terrier, lhasa apso, barak, porcelaine). The most data are available for beagles and border collies, however, the data were obtained from populations maintained only under laboratory conditions. There is no information on differences in nutritional requirements of closely related breeds (such as retrievers). Dogs with dense coats (Shih Tzu, spitzes) consume more protein for skin and coat regeneration, so the reference recommended amount of protein should be increased for such dogs. The specific amount of protein by which the ration should be increased remains unknown. In black-coated dogs, it is recommended to increase the amount of phenylalanine and tyrosine in the ration, since a deficiency causes ruffling of the coat [Ceregrzyn et al. 2004].

The feeding standards for different breeds of dogs require consideration of the puppies' target size and growth rate. The differences in the needs of small and medium breeds (up to 25 kg) and large breeds of puppies relate to energy and calcium requirements, which large breeds need less of. This is to help prevent skeletal deformities. Dogs of many breeds have specific nutritional requirements due to a predisposition to specific breed diseases. Giant schnauzers at 6–12 weeks of age may have trouble absorbing vitamin B12 properly and may need to be injected. Some West Highland terriers, Dobermans, cocker spaniels may have a primary accumulation of copper, which requires a lifetime restriction of copper intake and administration of penicillin as a chelating agent. Bulterriers, Siberian huskies, German hounds, dobermans or Alaskan malamutes may have zinc absorption disorders, causing dermatitis. Miniature schnauzers can suffer from hyperlipidemia, which requires a low-fat, low-energy diet. Dalmatians have a modified purine metabolism, which can put them at risk for kidney stones. Irish Setters often suffer from gluten intolerance and require a diet devoid of wheat, barley, rye and oats. Idiopathic seborrhea has been reported in cocker spaniels, labradors, and miniature schnauzers, probably caused by malabsorption of vitamin A. It is likely that these breeds should be given increased concentrations of the vitamin for disease prevention. Much research is still needed to determine the specific needs of many breeds [Ceregrzyn et al. 2004].

Many dog and cat owners choose to prepare their pets' food themselves. Dogs and cats are very often fed table scraps from the owners' table, which in many cases does not meet their nutritional needs. An inadequately balanced food ration can adversely affect the health of the animal, putting it at risk of obesity. Frequently fed raw foods of animal origin can act adversely due to the presence of microorganisms and parasites. Many products intended for humans can be toxic to dogs, and these products, along with table scraps, can end up in the food of animals. Onions, garlic, chocolate, raisins and grapes, among others, have been shown to have toxic effects on dogs. Pet owners often believe that what is good for their health is also good for their pets. Few dog owners feeding their charges homemade food correctly balance the dietary intake, controlling, for example, the concentration of fiber, calcium, phosphorus, protein, fat and carbohydrates [Ceregrzyn et al. 2004, Callaway 2013].

Poor nutritional awareness among dog owners can lead to obesity. Obesity can negatively affect a dog's health and quality of life [German et al. 2012]. Obesity is a chronic condition caused primarily by an excessive supply of energy relative to the body's requirements. Obesity can affect 24–44% of the canine population and more than 20% of the feline population. Obesity can be predisposed by many additional factors such as gender (higher risk in bitches), breed, sterilization or feeding at will [Ceregrzyn et al. 2004]. Metabolic disorders such as hypothyroidism may also play an important role. The median lifespan of dogs on restricted feeding is significantly longer than that of dogs fed at will. Obesity worsens health by facilitating the development of diabetes, kidney disease, musculoskeletal disease, exacerbates endocrine disorders, respiratory disorders and increases the possibility of cancer. Obese animals suffer more complications during anesthesia, and increased body fat makes surgical interventions more difficult. It is also more difficult to dose anesthesia due to increased drug tolerance.

Awareness of canine nutrition is also necessary in veterinary prevention. Proper nutrition prevents malformations and skeletal diseases. Dogs, especially large breeds, are fast-growing animals. The future performance of bone tissue is most vulnerable to nutritional errors during puppyhood. Poor energy and calcium balance can cause the development of hip dysplasia, elbow dysplasia and osteochondrosis. This can cause lameness and reluctance to move. In addition to genetic predisposition, the development of dysplasia is influenced by being overweight as a puppy. The most important issue in the development of osteochondrosis is the control of calcium intake. Too much calcium supply interferes with cartilage ossification and leads to necrosis and degeneration of joint surfaces. Dogs kept in poor conditions can develop rickets – the causes are to be found in too low a supply of calcium, phosphorus and vitamin D3. The effects of rickets will be

particularly severe in large breed dogs [Ceregrzyn et al. 2004].

A well-balanced diet can have a positive effect on mental and cognitive function. Kato et al. [2012] found a reduction in aggression toward strangers in neurotic dogs after increasing the amount of tryptophan in the dietary intake. Aggression in dogs can have different causes: territorial, from fear, dominance, maternal or pain. Evaluation of the effect of diet on aggression is possible after proper qualification of aggressive behavior. Aggression toward the owner is likely to be due to a desire to dominate rather than fear. Dogs with tryptophan- and caseosepine-enriched diets tolerated stress better (e.g., during a visit to the vet), and urinary cortisol levels were lower. Living in fear of strangers can shorten life expectancy and reduce a dog's quality of life, so dietary awareness in the context of stress reduction is important. Milgram et al. [2004] studied the effects of dietary antioxidant enrichment and environmental effects on cognitive function in beagles. Diets enriched with vitamin E, L-carnitine and vitamin C, along with environmental enrichment, enabled better test scores than the control group. The combination of the beneficial effects of enrichment with proper nutrition proved to be crucial.

## CONCLUSIONS

There are many factors and mechanisms affecting the quality and longevity of dogs, which have both a genetic-physiological and environmental basis. The shorter lifespan of large and huge breeds is probably related to growth rate and IGF-1 concentration, however, this phenomenon requires further research. A dog's lifespan is also influenced by the handler and his knowledge of how to handle the dog, where the dog is kept, and nutrition tailored to breed requirements. The dog is a model species for aging research – learning about factors influencing canine geriatric processes may contribute to a better understanding of human aging.

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## ANALIZA CZYNNIKÓW WPŁYWAJĄCYCH NA JAKOŚĆ I DŁUGOŚĆ ŻYCIA PSÓW

### STRESZCZENIE

Pies jest gatunkiem zróżnicowanym zarówno pod względem zachowania, wielkości jak i długości życia. Istnieje wiele czynników wpływających na długość życia psów. W pracy przeanalizowano między innymi: wpływ rasy na długość i jakość życia psów, wpływ właściciela i środowiska społecznego na jakość życia psa, wpływ użytkowości na jakość życia psa oraz wpływ żywienia na długość i jakość życia psa. Wielkość psa jest znanym czynnikiem wpływającym na długość jego życia. Psy rasowe znane są z większych obciążeń zdrowotnych i krótszego okresu życia niż psy nierasowe oraz mieszańce między rasowe tej samej wielkości. Na długość i jakość życia psów wpływa też jakość więzi z właścicielem oraz świadomość właściciela na temat profilaktyki weterynaryjnej. Dla jakości i długości życia psów ważne jest też stymulujące środowisko, oraz prawidłowe żywienie z uwzględnieniem specyficznych wymogów rasowych lub zdrowotnych psa.

**Słowa kluczowe:** starzenie się, psy, model starzenia się