

DOI 10.7251/VETJEN2101217H

UDK 636.7.083:616.12-008.331.1

Original Scientific Paper

EFFECT OF DIETARY PATTERNS ON VITAL SIGNS (PULS RATE, RESPIRATORY RATE, RECTAL TEMPERATURE) AND BLOOD PRESSURE IN DOG POPULATION DURING WINTER PERIOD

Elvira HADŽIAHMETOVIĆ JURIDA*, Jasmin FERIZBEGOVIĆ,
Marija VUČIĆEVIĆ, Lejla TRLE

The Faculty of Natural Sciences and Mathematics, University of Tuzla,
Federation of Bosnia and Herzegovina, Bosnia and Herzegovina

* Corresponding author: Elvira Hadžiahmetović Jurida, elvira.h.jurida@untz.ba

Summary

Vital signs (puls rate, respiration rate and rectal temperature) and blood pressure play a major role in a general clinical examination of patients in veterinary medicine, with a final purpose to diagnose disease. The general condition of a dog's organism is affected by a number of factors and each organism has its own defense mechanism against the cause of a disease. Oscillations in body temperature (increased or decreased), number of breaths per minute, heart rate and increased or decreased pulse indicate the body's response to the harmful effects of pathogens. Therefore, these parameters are considered to be the first sign of a disease. The obtained study determined the importance of dietary patterns and living conditions of dogs on vital signs and blood pressure in dogs from the City of Tuzla and Lukavac area, based on the results and monitoring performed in 30 dogs during the winter period from November 2014 to January 2015. Many authors, in their professional and scientific publications, indicate that obesity is a possible contributing factor in the development of the diseases, and consequently "obesity epidemic" is involved as a term. A large number of studies conducted in the world point to the fact that hypertension and tachycardia in the human and increasingly in the animal population is serious health problem and a significant risk for occurrence of heart disease, kidney and blood vessels disorders. Although the cause of most cases is unknown, there are a number of possible influencing factors, including inadequate diet and consequent obesity, which significantly affect the occurrence of disease in humans and animals. The study was conducted on two different groups of dogs (30 in total), as group A (15 dogs) included dogs that were fed with a combination of ready to serve and prepared meals, and group B (15 dogs) included dogs that were irregularly fed and malnourished. The study was conducted in accordance with the data of the World Veterinary Association. During the routine examination, rectal temperature, systolic blood pressure, diastolic blood pressure, pulse rate, respiratory rate, as well as gender, breed, body weight, and age of the dog were used as parameters.

Keywords: blood pressure, diet, hypertension

INTRODUCTION

According to diet, zoologists divide all animals into three basic groups: carnivores, herbivores and omnivores. Dogs and their relatives (canids) belong to carnivores. Canids are beasts that hunt for food but do not eat only meat. By living with man for a long period of time, dogs became even more distant from real carnivores because they were forced to eat food provided to them by man. The dogs has thus become omnivorous, since they clean leftovers from human tables, so they had to get used to various products, some of which are extremely harmful to the dog. The life of a city dog rarely exceeds the age limit of 15 years. The average is also much lower, about 11 to 12 years. Different breed characteristics also contribute to this, but food is the biggest reason for such a short lifespan of a city dog. Village dogs often live more than 20 years and even more than 25 years. The reason for the shortened life of the city dogs is in the city environment, which constantly damages their organism. Stray dogs, which are constantly burdened with stress, are especially endangered, and their organism constantly have to adapt without rest and inactivity (Bauer, 1985).

Health is the harmony of all functions of the body, both within the animal organism and in relation to the environment. Disruption of this balance by the action of either external or internal factors leads to the appearance of disease. The disease is a disorder of the balance of functions of the body. The function of individual organs or organ systems can be disrupted by various internal or external factors, including various biological, physical and chemical factors, as well as the influence of the environment in which the dog lives. The general appearance of the dog reveals a harmonious whole where nothing is superfluous or anything is missing. The skin and coat of such dogs is clean and shiny, the eyes are clear and without discharge, as well as the nose which is cold and moist. A healthy dog likes to take food and take moderate amounts of water. In addition to these general characteristics of a healthy dog, one should pay attention to the constitution, condition and temperament. These three components play an important role in veterinary medicine, especially in the general clinical examination that establishes the disease. In addition to these, there are other objective measures by which we can determine the changes caused by a disease. In the first place, this includes the vital signs - body temperature, pulse and respiratory rate. In healthy, adult dogs, the rectally measured temperature ranges from 37.5 to 39°C. The measurement time is about 5 minutes. The pulse is measured on one of the available arteries for palpation and is 60 to 120 pulses per minute, and the number of breaths ranges between 10 and 40 per minute. In estimation of these values, breed characteristics, age as well as physiological conditions in which these parameters may change (pregnancy, extreme effort, dog training) should be taken into account.

Blood pressure is the force by which blood acts on a unit area of a blood vessel (Guyton and Hall, 2003; Guyton, 1989).

With each ejection of blood from the heart (systole), the pressure rises, and with the infusion of blood into the heart (diastole), the pressure decreases. Therefore, two values of blood pressure are measured: the upper value - systolic blood pressure and the lower value – diastolic blood pressure. The term hypertension means an abnormal increase in arterial blood pressure in the blood vessels and organs they supply (Ferizbegović, 2002). It is known that high blood pressure can have significant negative effects, especially damage to various vital organs, such as the heart, kidneys, eyes and central nervous system (CNS). It is interesting to mention that all three forms of hypertension have been reported in the human and animal (dog) population. According to the criteria of the Veterinary Blood Pressure Society, we consider hypertension in dogs if the blood pressure values exceed 150 mm Hg for SBP and 95 mmHg for DBP (Montoya et al., 2006) i.e 160/100 mmHg (Nelson et al., 2003). It is generally accepted that an animal can be considered hypertensive if the measured systolic/diastolic pressures exceed 150/95 mmHg. Obesity is determined as excess body fat followed by frequent results of significant deterioration in health. Although there are many unanswered questions about the mechanisms by which obesity causes hypertension, kidney disease, and other diseases, this problem open questions for future research, especially due to the fact that the world has literally been hit by the obesity epidemic. It is therefore not surprising that obesity is today considered as one of the main factors in the pathogenesis of hypertension in industrialized countries.

The following goals are set in this study: determining differences in the values of basic vital parameters, i.e. vital signs and blood pressure values in relation to the dietary pattern of two groups of dogs that were monitored during this study during the winter period from November 2014 to January 2015.

MATERIALS AND METHODS

This study included and examined a total of 30 dogs of different breeds in the City of Tuzla and Lukavac. Treated dogs were divided into two groups: group (A) domestic dogs of different breeds and group (B) stray dogs. The stray dogs stayed in the shelter during the study. All dogs were treated according to WVA (World Veterinary Association) data (Carr, 2000). The study was conducted at the Veterinary Station Tuzla and the Veterinary Station Lukavac and is based on the examination of vital signs and blood pressure in dogs with the difference established between owner dogs, including different breeds that predominate in Bosnia and Herzegovina, and ownerless dogs that are abandoned and do

not have a balanced diet. This study included and examined a total of 30 dogs of different breeds in the municipality of Tuzla and Lukavac.

Treated dogs were divided into two groups (15 dogs each) depending on the diet:

- Group A (owner domestic dogs that were exclusively fed with a ready to serve meals, properly balanced and with a different commercial names).
- Group B (ownerless, abandoned dogs that were irregularly fed).

All dogs underwent medical-laboratory treatment, which included the measurement of vital signs (body temperature, pulse and respiration rate) and blood pressure using the device:

- a) Glass mercury thermometer graduated to measure the body temperature of dogs
- b) Mindray MEC - 1200 Vet thermal measuring probe
- c) Stethoscope for auscultation
- d) Memoprint Richter Pharma AG A - 4600 WELS for pulse measurement

After preparation of dogs, relevant data related to values of temperature, respiratory rate, blood pressure, pulse, body weight, age of dogs, dog breed and gender were analyzed.

Temperature measurement was performed with a medical glass mercury thermometer and/or with a thermal probe connected to the Mindray MEC-1200 Vet device. Alcohol was used during the measurement to disinfect the thermometer. The measurement was performed for 3 minutes. Several measurements were made, and a mean value was calculated, as the value of body temperature.

Pulse measurements were performed using a Memoprint Richter Pharma AG A - 4600 WELS. The measurement was done by placing a cuff around the front leg of the dog in a way that sensor inside the cuff stick to the artery wall. The values obtained on the screen were an indicator of the heart rate or pulse that we read after the stabilization of the numbers on the screen.

Measurement of respiration was performed in two ways: the first, safest way to determine the frequency of respiration was performed by auscultation of respiratory sounds using a stethoscope. Another way to measure respiratory rate was with the Mindray MEC - 1200 Vet. The measurement was performed by placing a "clamp" in three places on the dog, two clamps behind the front legs on the "Regio Axillaris" and one behind the back leg, i.e. on the "Regio Inguinalis". The values obtained on the screen were an indicator of the frequency of breathing or respiration.

The method used to measure blood pressure was the method of indirect or non-invasive blood pressure measurement. Non-invasive measurement includes auscultatory techniques. Auscultation techniques are generally not used in veterinary medicine, because it is very difficult to monitor the pulse rate in dogs with the assistance of a stethoscope. Therefore, Doppler ultrasound and Oscillometric flow meter are used the

most. Routine measurement of blood pressure in small animals is relevant only in the last 10-15 years. The Memoprint device was used, which measures blood pressure on the principle of oscillometry and registers systolic and diastolic pressure (Marković, 2006).

The cuff was placed on the front of the foot, near the joint - carpus (radial artery), or on the ventral root of the tail (medial caudal artery). The cuff can also be placed on the a. brachialis on the upper part of the front leg.

Oscillometric systems use a modified pneumatic cuff that is placed around the cylindrical part of the target limb (lower or upper leg) or tail. These cuffs also work on the Riva-Rocci principle. Due to the re-entry of blood into the blocked blood vessel, the artery wall vibrates.

These oscillations pass through the soft tissue to the surface of the limb, where they are registered by sensors in the cuff, so it is very important that the cuff is firmly placed. Oscillations indicate systolic blood pressure, diastolic blood pressure and mean arterial pressure. The system's internal microprocessor calculates blood pressure based on this data. The pneumatic cuff is automatically inflated and deflated via the system control unit (Carr, 2000). In small dogs, a Doppler device was used to measure only systolic pressure. The width of the cuff is 0.3-0.4 of limb circumference. On the front leg, the cuff is placed on the distal part of the radius and ulna, and the sensor for measuring the device on the principle of Doppler was placed on the palmar side in the area of the metacarpus where the arteries pass. The cuff should be at the level of the heart base. Three measurements were made, and then the mean value was calculated and it represented the exact value of blood pressure.

The population is affected by factors that can be biotic and abiotic. Abiotic factors were important for this study because they include climatic factors and atmospheric weather, as physico-chemical environmental conditions. The abiotic factor, ie the period in this study were performed, were the winter period, namely the months of November and December 2014. Temperature is one of the most important environmental factors. In November, temperatures were mostly high for this period of year. The highest daily values were up to 22°C, while the lowest recorded were -1°C with an average temperature for the whole month of 8.85°C. The average monthly temperature during the month of December was significantly above the multi-year average and amounted to 3.5°C. The maximum daily was 18°C and the minimum -9°C.

RESULTS AND DISSCUSION

At the Veterinary Station Tuzla and the Veterinary Station Lukavac, the study included a total of 30 dogs from the Tuzla area and analyzed the impact of dietary pattern in stray

dogs and owner dogs and its effect on vital signs including body temperature, pulse and respiration rate as well as systolic and diastolic blood pressure.

We compared the obtained results with the available literature data that treat similar issues.

The results obtained in group A are shown in Table 1.

For statistical analysis of the obtained values, the program for statistical processing SPSS was used. The Kolmogorov-Smirnov test was used to compare the distribution within the groups.

Table 1 Obtained results in group A

Ordinal number	Gender	Breed	Age(months)	Weight(kg)	Temperature (°C)	Blood pressure (mmHg) Systolic	Blood pressure (mmHg) Diastolic	Pulse frequency (bt/min)	Respirator rate/min
1.	♀	German boxer	72	24	37,5	166	111	90	13
2.	♂	German boxer	84	30	38	152	128	74	16
3.	♂	Bichon	4,5	4,2	39,2	133	87	86	16
4.	♂	Pug	96	11.5	39	132	84	106	20
5.	♀	Doberman	66	38	38.6	159	129	123	27
6.	♂	Collie	84	26	38	154	115	111	26
7.	♀	Mix	42	27	39.6	175	112	136	20
8.	♀	Cane corse	17	32	39,2	144	123	123	20
9.	♀	Collie	54	18,5	40.1	148	131	101	21
10.	♀	Bichon	98.4	5,4	39.4	150	115	113	32
11.	♂	Maltese	72	6,2	39.4	162	132	113	27
12.	♀	Collie	36	23	38.6	143	125	116	22
13.	♂	American Staffordshire Terrier	14	27,5	39,2	120	103	82	28
14.	♂	Bernese Mountain Dog	17	53	39,2	170	143	105	35
15.	♀	German shepherd	48	36	38,8	100	66	122	24

- increased values
- decreased values

Table 1 lists the values of body temperature, blood pressure (diastolic and systolic), respiratory and pulse rate as well as gender, breed, age and weight for fifteen (15) examined dogs of different breeds from group A.

Normal temperature values for adult larger dogs are 37.5-38.5 ° C, for adult smaller dogs it is 37.5-39.0°C, while for puppies it is 37.5-39.5°C.

Normal values of systolic blood pressure are 150 mmHg, and the upper limit of physiologically normal diastolic pressure is 95 mm Hg.

Pulse rate in puppies and small breeds of dogs is 120-160 per minute and in dogs over 15 kilograms of body weight this number ranges from 60 to 120 per minute. Increased heart rate - tachycardia is considered to be heart rate in dogs > 180 beats/minute while decreased absolute bradycardia is considered to be heart rate in dogs < 50 beats/minute.

The respiratory rate in dogs is 10-30 per minute. Accelerated breathing or tachypnea is > 40 /min and slow breathing or bradypnea is defined as respiratory rate and in dogs it is <6 /min.

The study results of the examination obtained in group B are shown in Table 2.

Table 2 Obtained results in group B

Ordinal number	Gender	Breed	Age(months)	Weight(kg)	Temperature (°C)	Blood pressure (mmHg) Systolic	Blood pressure (mmHg) Diastolic	Pulse frequency (bt/min)	Respirator rate/min
1.	♀	Mix	4	3.4	38,6	113	87	117	30
2.	♀	Mix	7	7.5	38,4	128	102	72	27
3.	♀	German Terrier	18	12.2	38,6	117	106	150	26
4.	♀	Mix	8	15	39.4	115	86	70	28
5.	♂	Mix	3,5	8	38	104	66	120	24
6.	♀	Mix	3	6.5	38.5	129	116	83	24
7.	♂	Mix	6	10	38.7	127	111	92	37
8.	♀	Mix	3	6.6	38.4	184	131	81	35
9.	♂	Mix	3	6.5	38	156	132	92	40

10.	♀	Mix	6	9.5	38.9	139	96	111	55
11.	♂	Mix	12	10.5	38	142	88	112	24
12.	♀	Mix	18	15	38,6	157	128	128	25
13.	♀	Mix	36	25	38	139	126	84	28
14.	♂	Mix	84	12	39,2	144	124	106	28
15.	♀	Mix	7	9,7	39,5	147	121	91	24

- increased values
- decreased values

Comparative analysis of the results in group A and group B showed higher values of systolic blood pressure in group A (owner dogs) compared to the values of systolic blood pressure in group B (ownerless dogs). The minimum value of systolic blood pressure in group A of the examined dogs (owner dogs) was 100 mmHg, and the maximum value was 170 mmHg, while in group B (ownerless dogs) the maximum and minimum values were 148 mmHg and 104 mmHg. The mean value of the difference in systolic blood pressure between the examined groups A and B was 11.13 mmHg. One of the exogenous factors that affects the values of systolic blood pressure in the examined groups of dogs is diet, because obesity is known to significantly increase the value of arterial blood pressure.

Regarding the value of diastolic blood pressure, it can be seen that there are no significant differences between the dogs of groups A and B. This could be explained by the fact that diastolic blood pressure is the force by which blood acts on blood vessels when the heart rests from contraction, as the second heart tone, ie diastolic, is quieter, shorter, higher and clearer than the systolic (diastolic phase of the cardiac cycle) (Ramadan and Harapin, 1998). The mean value of the difference in diastolic blood pressure between the examined groups A and B was 1.27 mmHg. The minimum value of diastolic blood pressure in group A was 66 mmHg, and the maximum was 143 mmHg, while in group B the minimum was also 66 mmHg, and a maximum of 132 mmHg, which indicates relatively small differences in diastolic blood pressure between group A and group B.

A noticeable difference in systolic and diastolic blood pressure in the two examined groups of dogs was observed. Systolic pressure-maximum or upper pressure occurs during cardiac systole when it reaches its highest value. During cardiac diastole blood pressure drops and reaches its lowest value and is then called diastolic pressure or

minimum or lower pressure. Thus, arterial pressure is a variable that varies depending on the work of the heart, and the difference between systolic and diastolic blood pressure is called the amplitude of tension or "pulse tension" (Bodey et al., 1996).

By pulse frequency we consider the number of beats per minute (Ramadan and Harapin, 1998). There was a noticeable difference in pulse rate values between two examined groups and it was 6 bt/min. The lowest value of pulse rate in group A was 74 bt/min while the highest was 136 bt/min. In group B, the lowest value of the pulse frequency was 70 bt/min and the highest was 150 bt/min. It is possible to notice higher values of pulse rate in group A of the examined dogs, which refers to owner dogs in relation to group B or ownerless dogs. Fear of white coat could be cause.

Respiratory rate complements the general examination of dogs and is determined by counting inhalations or exhalations over a period of one minute (Ramadan and Harapin, 1998). There is a noticeable difference in the values of respiration of the two examined groups of dogs, group A, ie domestic dogs, that were exclusively fed with a ready to serve meals, properly balanced and with different commercial names, and group B, ownerless dogs that were irregularly fed and mostly malnourished. The average difference in respiratory rate values between these two examined groups of dogs was 7/minute, which is a significantly larger difference. The highest value of respiratory rate in group A, with value 35/minute, was in the examined dog under number 14, breed Bernese Mountain Dog, age 17 months, weight 53 kg, which had elevated blood pressure: systolic pressure 170 mmHg, diastolic pressure 143 mmHg which indicates hypertension associated with an increase in all other vital parameters. The lowest value was in dog number 1 with a respiration rate of 13/minute, breed German boxer, weight 24 kg, age 72 months or 6 years with high blood pressure 166/111 mmHg and low heart rate of 90 beats/minute. In group B, the highest value of respiratory rate was in dog number 10 with a frequency of 55/minute, breed mix, weight 9.5 kg and age 6 months, with elevated blood pressure values of 139/96 mmHg and the lowest respiratory rate of 24/minute was observed in four dogs from study group B who had similar age and weight.

The mean value of the difference between the body temperatures of the two groups of dogs was 0.17°C. In group A the lowest body temperature was 37.5°C while in group B it was 38.6°C. When it comes to the highest values of body temperature in group A, it was 40.1°C, while in group B the highest body temperature was 39.5°C. Each organism has its own mechanism of defense against the causative agent of the disease, so the disease is the sum of the visible signs of the organism's reaction and, therefore, the defense in response to the harmful effects of the causative agent. The first visible sign is body temperature (Bauer, 1989). From the obtained results, it can be seen that one dog from group A had a significantly increased body temperature (dog number 9), which was resolved during a

detailed examination of the dog and a diagnosis was made, ie the dog was infected with ticks (piroplasmiasis), which caused such an increase in body temperature.

The results of our study definitely confirmed the existence of hypertension in both groups of dogs. All types of hypertension were mild, moderate and severe hypertension. Out of a total of 30 dogs, 23 (76.67%) had hypertension.

The results show that in only nine dogs the pulse frequency was within normal limits. Out of 30 examined dogs, deviations from normal values were observed in 21 dogs, which is 70%.

Irregular respiratory rate was recorded in 20% of dogs, which proved to be a parameter with minor deviations from normal values.

Body weight is associated with the development of hypertension, tachycardia, and tachypnea, as indicated by Montoya et al. (2006) and proved by our study. However, these results are in some collision with other authors as they argue that the dog breed does not play a major role in the development of hypertension. Study obtained by Meurs et al. (2000) was based on the assumption that the prevalence of hypertension increases with increase of age in dogs as well as in the human. However, it was shown that, in dog, age is not a predisposing factor of hypertension but a primary disease that causes hypertension, which is consistent with our results. Our study has pointed to the importance of routine measurement of vital signs and blood pressure at each patient examination, which serves as a screening for us to take the next step, whether diagnostic or therapeutic.

CONCLUSION

Study has indicated that each examination of the patient should include routine measurement of vital signs and blood pressure, which serves as a screening for us to take the next step, whether diagnostic or therapeutic. Any significant change in body temperature can be declared as a disease and a alteration of the general condition of the organism. The results of our study definitely confirmed the existence of hypertension in both groups of dogs. All types of hypertension were mild, moderate and severe hypertension. Out of a total of 30 dogs, 23 (76.67%) had hypertension. The results show that in only nine dogs the pulse frequency was within normal limits. Given the importance of these parameters in the diagnosis of various diseases in dogs, future study could be obtained to compare the parameters of vital signs and blood pressure in healthy dogs with the results of vital signs and blood pressure in dogs with cancer or other diseases.

Conflict of interest statement: The authors declare that there is no conflict of interest.

REFERENCES

- Bauer M. (1985): Pas moj prijatelj. Zagreb. Sveučilišna Naklada Liber.
- Bodey A. R., Sansom J. (1998): Epidemiological Study of Blood Pressure in Domestic Cats. *J Small Anim Pract.*, 39:567-573.
- Carr A. (2000): Hypertension in der Kleintierpraxis. *Kleintiermedizin*, 263-267.
- Ferizbegović J. (2002): Hipertenzija - pojam, definicija i karakter u populaciji pasa. *Veterinaria*, 48(1-2):121-124.
- Guyton C. A. (1989): Medicinska fiziologija by W. B. Saunders Company, prevod desetog izdanja, Medicinska knjiga Beograd-Zagreb, 342-378.
- Guyton C. A., Hall E. J. (2003): Medicinska fiziologija. 10 izdanje, Beograd, 200-208.
- Markovic M. (2006): Hypertension and endocrine disorders. Klinik fur Interne Medizin und Seuchenlehre Klinisches Department fur Kleintiere und Pferde, Wien.
- Meurs M. K., Miller W. M., Slater R. M., Glaze K. (2000): Arterial Blood Pressure Measurement in a Population of Healthy Geriatric Dogs. *J Am Anim Hosp Assoc.*, 36(6):497-500.
- Montoya J. A., Penelope J. M., Immaculada B., Candelaria M. J., Suarez L., Pena C., Hackett R. M., Rawlings J. (2006): A risk factor associated with weight status in dogs. The WALTHAM International sciences symposia innovations in companion animal nutrition.
- Nelson W. R., Cuoto C. G. (2003): Small animal internal medicine. Mosby, 198-203.
- Ramadan P., Harapin I. (1998): Interna klinička propedeutika domaćih životinja. Zagreb. Veterinarski fakultet Sveučilište u Zagrebu.

Paper received: 22.07.2021.

Paper accepted: 16.11.2021.
