Body condition score (BCS) and metabolic status of shelter dogs

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ABSTRACT: A group of 147 shelter dogs were weighted and assigned a body condition score (BCS) using a 9 point scale system, in order to evaluate the prevalence of obesity in the kennel. More than 60% of the animals showed a BCS≥6 (overweight and obese) and this condition was mainly attributed to an excess of carbohydrates and fat in the diet. In 67/147 dogs, a blood sample was drawn and the effects of BCS, age and time spent in the shelter were evaluated on biochemical parameters. Obese dogs showed significantly higher levels of triglycerides ($P<0.01$), while increasing BCS determined only an increasing non significant trend on cholesterol values. Age influenced creatinine ($P<0.05$) and the oldest dogs scoring BCS≥6 registered significant higher NEFA ($P<0.05$) and CK ($P=0.01$) levels. Time spent in the shelter did not affect any parameter. The dogs' metabolic condition reflects the need of taking more care of the quality of feed administered in the shelters to avoid the negative health effects caused by chronic obesity.

Key words: Shelter dog, Body condition score, Blood parameters, Metabolic status.

INTRODUCTION – Obesity is a common nutritional disorder in dogs which causes detrimental health effects by increasing the prevalence of traumatic and degenerative orthopedic disorders, cardiovascular disease and metabolic alterations (Burkholder and Toll, 2000). Dogs kept in shelters are predisposed to gain weight because they are confined in restricted areas limiting physical activity, they are habitually subjected to gonadectomy and they are fed an unbalanced diet. The management of shelters is usually guaranteed by the activity of animalist associations and food is based on remnants provided by canteens and markets. Therefore, the nutritional traits of the diet are extremely variable, depending on the availability of the ingredients, and it is administered to all the hosted dogs, despite age, breed, size, body condition and occurring disease. Aim of the study was to estimate the prevalence of obesity in dogs housed in a shelter located close to Padova, assessing the effect of BCS, age and time spent in the kennel on their metabolic status.

MATERIAL AND METHODS – The study has been carried out at the kennel located in Presina of Piazzola sul Brenta (PD) where 147 dogs (26 neutered females and 121 entire males) of different breed and age were housed in 45m^2 pens until adoption occurs. Dogs were fed once a day a home-made diet containing various sources of meat, pasta, bread and rice. Due to the housing system (group-pen), neither the amount of feed delivered nor the feed intake were controlled, however 3 samples of the diet were collected for the assessment of the chemical composition and gross energy determination. The first phase of the study aimed at collecting data from all the dogs regarding age, gender, breed, size, weight, body condition score (BCS) and time of arrival at the kennel. The BCS evaluation was based on visual assessment and palpation adopting a 9 point scale system (Laflamme, 1997). Four classes of BCS were considered: BCS 1 to 3 = lean dog; BCS 4 and 5 = ideal dog; BCS 6 and 7 = overweight dog; and BCS ≥8 = obese dog. In the second phase of the study only a selected sample of dogs were submitted to a blood collection for the quantification of biochemical parameters. The inclusion criteria for the dogs to enter phase 2 were: 1) no concomitant diseases, 2) age from 2 to 7 years, 3) housing in the kennel for at least 6 months. Due to a low prevalence of dogs with BCS<4 (4/147), lean dogs were not included in the selected sample. Blood samples were collected in the morning from the cephalic vein of fasting animals and biochemical parameters were measured on serum using an automated analyzer (Hitachi 911, Roche Diagnostic, Switzerland). Biochemical values included total proteins (TP, g/l); albumines (ALB, g/l); globulines (GLOB, g/l); urea (UREA, mmol/l); glucose (GLU, mmol/l); total cholesterol (CHOL, mmol/l); trygliceryds (TG,

mmol/l); NEFA (meq/l); total, direct and indirect bilirubin, (BIL_T, BIL_D, BIL_I, µmol/l); creatinine (CREAT, µmol/l); alanine (AST, U/l); alanine aminotransferase (ALT, U/l); alkaline phosphatase, (ALP, U/l); γ-glutamyltransferase (GGT, U/l), lactate dehydrogenase (LDH, (U/l); creatine kinase (CK, U/l). Statistical analysis on blood parameters aimed firstly at testing the normal distribution of the data with the PROC UNIVARIATE of SAS (1989) using the Shapiro-Wilk test and all the variables that did not show values of $W>0.90$ were submitted to a logarithmic transformation. A linear model was then adopted for the ANOVA within PROC-GLM (SAS, 1989) considering the effects of BCS, age (3 classes: 2-3, 4-5, 6-7 year-old dogs), time spent in the kennel and the interaction between BCS and age. The effect of gender was not included in the statistical model as it blurred the effect of BCS, neutered females being much heavier than entire males. Differences were considered significant at $P<0.05$.

RESULTS AND CONCLUSIONS – At the time of the study, the dogs had been keeping in the shelter for an average of 14 months and more than 60% were overweight or obese (Table 1). Weight gain occurs when an animal cumulates a positive energy balance for an extended period. This may happen because energy intake increases and/or energy expenditure decreases; in our study, the sensible amount of overweight and obese dogs may be primarily ascribed to the former. Indeed, the chemical composition of the diet consisted of 24.4% crude protein, 25.78% ether extract, 38.21% starch, 0.95% crude fiber and 563.4 kcal metabolizable energy/100 gr, on a dry matter basis, indicating a too high content of starch and fat. Among the dogs selected for the blood collection (Table 1), 29.9% had the ideal body condition, 35.8% were overweight and 34.3% grossly obese. Obesity is considered to be the single most contributory factor in the development of insulin resistance and diabetes in dogs. Previous studies (Bailhache *et al*., 2003; Gayet *et al*., 2004) demonstrated that insulin resistance associated with obesity provokes dyslipidemia, which has been observed also in humans and other species. In this study, BCS affected TG (Table 2), obese dogs showing significant higher levels than overweight and normal dogs. As shown by Diez *et al*. (2004) and Yamka *et al*. (2006), TG values fell into the optimal ranges, nevertheless it seems evident that the more weight is gained, the more is the possibility of achieving elevated levels within normal ranges. The same conclusion can be drawn for cholesterol which, despite a non significant difference, showed an increasing trend as BCS increased (Table 2), even though all values were in accordance with the published ranges. Moreover, the oldest dogs (6 and 7 years) scoring BCS≥6, recorded statistically significant higher NEFA values (Table 2). This result is in agreement with previous findings which showed increased plasma NEFA level in obese dogs and humans, due to an elevated rate of lipolysis from the adipose tissue (Gayet *et al*., 2004). Glucose values were below the established range (Table 2), however this may be attributed to the glycolysis, which has been shown to occur at room temperature within one hour from the blood drawing (Joosten *et al*., 1991). Both BCS and age resulted to significantly influence CK activities (Table 2) and the highest values, beyond the optimal range (>150U/l), were observed in the oldest dogs having a BCS≥6. CK is a valuable index of neuromuscular disorder which had already been related to age (Cardinet III, 1997) due to the pathophysiologic hypotrophy and muscular disorders. Moreover, orthopaedic disorders occurring from chronic overweight may be the explanation for higher CK values in overweight and obese dogs. Although published data regarding the effect of age on creatinine are conflicting (Braun *et al*., 2003), a significant difference was reported in this group of dogs (Table 2). Time spent in the shelter did not affect any blood biochemical parameter. We conclude that, although there are evident management problems for the optimal formulation of shelter diets, more care should be addressed to the quality and the amount of feed administered to the dogs, in order to avoid chronic overweight and related negative health effects such as insulin resistance and diabetes. In this shelter specifically, a caloric restriction through starch and fat reduction should be encouraged to promote weight loss and correct the increased biochemical parameters.

Table 1. Percentage of dogs, average body weight, minimum and maximum body weight calculated in all and selected samples of dogs for each class of BCS.

BCS	% of dogs		Average weight (kg)		Minimum value of weight (kg)		Maximum value of weight (kg)	
	All dogs (147)	Selected dogs (67)	All dogs (147)	Selected dogs (67)	All dogs (147)	Selected dogs (67)	All dogs (147)	Selected dogs (67)
1-3	2.7	-	16.05	-	7.1	-	27.4	-
4-5	35.4	29.9	15.31	15.12	6.3	7.0	28.7	28.7
6-7	40.8	35.8	15.07	12.13	4.0	6.7	43.45	28.0
≥8	21.1	34.3	23.96	23.73	6.3	11.15	48.5	33.0

Table 2. Effects of BCS, age and their interaction on some biochemical blood parameters considered.

Blood parameter	BCS (scores)			Age (years)			BCS×Age	RMSE
	4-5	6-7	≥8	2-3	4-5	6-7		
NEFA, meq/l	0.81	1.06	0.91	0.79^{B}	0.80^{B}	1.19^{A}	P=0.02	0.28
CHOL, mmol/	3.58	4.21	4.92	4.13	4.35	4.23	ns	1.36
TG, mmol/	0.45^{B}	0.51^{B}	0.73^{A}	0.49	0.63	0.55	ns	0.36
GLU, mmol/	3.08	3.22	3.08	3.08	3.39	2.91	ns	0.66
CREAT, µmol/l	64.10	76.24	61.94	74.90^{a}	61.87^{b}	65.52^{ab}	ns	13.97
CK, U/l	103.54^{b}	141.17^{a}	156.02^{a}	120.30^{b}	114.43^{b}	167.33^{a}	P=0.01	0.30

a,b = P<0.05; A,B = P<0.01.

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