



# A simple method to evaluate body condition score to maintain the optimal body weight in dogs

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## Abstract

Overweight and obesity induce serious health problems that exert negative effects on dog's welfare. Body condition score (BCS) is a common method to evaluate the body fat mass in animals. By palpating and observing fats under the skin it is possible to predict animal's body fat accumulation condition. BCS is also a useful tool to estimate body fat composition in dogs. However, BCS can be subjective when it was performed by non-professionals like pet's owners. To develop a method to avoid the misevaluation of BCS twenty-four Beagles were enrolled and performed BCS evaluation. In addition, the length of chest and abdominal girths were measured. In correlation analysis, the sizes of chest and abdominal girth were significantly correlated with BCS. Especially, the difference and ratio of the chest and abdominal length were highly correlated with the BCS. With that, we suggested that this simple measurement of chest and abdominal girths by a measuring tape would be an effective method to estimate BCS scores in dogs that helps non-professionals to manage their own dog's nutritional condition by monitoring body fat accumulation condition.

**Keywords:** Body condition score, Dogs, Non-professional, Nutritional management, Weight control, Welfare

## Background

Overweight and obesity have increased during the last decades [1,2]. In dogs, an excessive body fat accumulation has been also a serious concern and became a common health problem that affects on the quality of dog's life [3–6]. Unlike farm animals of which the nutritional balance is systemically managed by the feeding standard to achieve optimal productivity dogs living at home are dependent on owner's feeding regime [7,8]. Most of dog's owners aware the importance of adequate nutrition and activity but it is difficult for them to feed their dogs in an appropriate feeding level because of the variety of diets and sources of information available [9]. In addition, it is not easy for dog owners to accept the necessity of their own dog's weight reduction although they recognize well about the problematics of overweight and obesity [10–12].

For obtaining an absolute percentage of body nutritional condition the gold standard is cadaver analysis. However, it is not possible for live animals including pets [13]. Body condition scoring is the most common indirect method to evaluate the body fat accumulation of pets based on visual observation and palpation. Body condition score (BCS) systems which have different integral scales have similar evaluation standards for which detail descriptions and illustrations are provided for operators' information. Among BCS systems, 9-point scale BCS is commonly used in dogs [1,14,15]. For dogs, the corresponding BCS of obesity is the score 8 and 9, and the ideal weight corresponds to 4 and 5 in the 9-point scale BCS system [15]. According to the American Veterinary Medical Association (AVMA) obesity is when a dog is over 30% above its ideal weight [16].

BCS has been confirmed to be a semi-quantitative tool to assess

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body fat composition related with dog's health condition. Recent studies showed that BCS can estimate the body fat and it was supported by dual-energy X-ray absorptiometry (DEXA) and deuterium oxide (D<sub>2</sub>O) [15,17]. BCS would be also an alternative tool to predict a certain disease. For example, an indirect association with survival time of lymphoma can be reflected by BCS when it is underweight at the time of diagnosis [18]. In addition, dogs have calcium oxalate uroliths when they had significantly greater median BCS [19]. The measurement of interleukin-6 and monocyte chemoattractant protein-1 concentrations in fasting plasma showed that inflammation would be associated with BCS and suggested that certain markers of inflammation increase with BCS [20]. There was also a positive correlation between insulin-like growth factor-1 (IGF-1) and the BCS in healthy dogs and a negative correlation between the ratio IGF-1/26SP and the BCS in chronic diseases [21].

Descriptions and illustrations provided in BCS systems help operators to assess dog's body condition even though they are not experienced veterinarians. However, there are often misvaluations by subjective impression of dog's owner although the evaluation of BCS has to be an objective assessment. It has been reported that the dog's owners evaluated their dog's BCS significantly lower than those by the veterinarians even with BCS description chart [9,11,22]. BCS would be the most convenient method to evaluate the nutritional body status of dogs. However, the subjective opinions of dog's owners can be an obstacle to obtain objective evaluations of BCS. The present study suggested that a simple measurement of body sizes can resolve the misvaluation issue of BCS by eliminating subjective impression, and be an alternative approach to evaluate BCS instead of palpation and observation.

## Materials and Methods

### Ethics statement

All animal experiments were approved by the Institutional Animal Care and Use Committee of the National Institute of Animal Science, Korea (Approval number: NIAS20191665). Animal experiments were followed strictly according to the approved protocols and dogs were monitored by veterinarian in need.

### Animals

All dogs were maintained in separated cages with a temperature and ventilation control system. Two years old of twenty – four healthy Beagles were enrolled. Dogs were fed commercial diets twice a day, provided water *ad libitum* and exercised once a day in outdoor. In the normal weight group dogs (n = 7) were provided 830 kcal/day which is the daily energy requirement and in the gaining weight group dogs (n = 17) were provided 996 kcal/

day which is 20% more than daily energy requirement. The body weights were measured once a week.

### BCS

The nine-scale body condition scoring system was used. BCS was evaluated once a week for 16 weeks that was performed according to the descriptions and illustrations provided by World Small Animal Veterinary Association (WSAVA). For each dog BCS was assessed by at least two persons who were learned the BCS evaluation technique from a veterinarian. The body condition of dogs was classified ; “too thin” which is in BCS 1–3 scales had easily visible and palpable bones with no or less fat, and their waist and abdominal tuck were obvious when viewed from top and side, “Ideal” which is in BCS 4 and 5 scales had bones with slight fat covering and an apparent waist and abdomen tuck, and “Overweight” and “Obese” which are in BCS 6–9 scales had heavy fat covered ribs, absence of waist and obvious abdominal distension.

### Measurement of chest and abdominal girths

The chest and abdominal girths were measured by using a measuring tape with no pulling. The chest girth was measured around the broadest region of the chest and over the back. The abdominal girth was measured around the waist directly in front of rear legs. The body sizes were measured once a week for 16 weeks when BCS was evaluated.

### Statistical analysis

The significant difference between the body size and BCS were statistically analyzed using the PROC GLM of SAS (SAS Inst. Inc., Cary, NC, USA). The post hoc test were performed by Tukey range test to analyze the significant difference among BCS scores. The correlation between the sizes of chest and abdominal girths and the scales of BCS was analyzed by Pearson correlation analysis to investigate the relationship of body sizes and BCS scores.

## Results and Discussion

The excessive body fat accumulation induces overweight and obesity that impairs the quality of life and lifespan in dogs. BCS is a numeric evaluation system and has been used to estimate the body fat accumulation condition. For monitoring the nutritional status of cows BCS has been used to estimate body fat condition. Body energy is stored at like back, tail head, pins, hooks ribs and brisket and it is highly related with the productivity of cows [23]. In dogs, there were also a similar method to examine body fat composition [24]. Since overweight has become one of serious health issues in dogs the need of nutritional cares for individual dogs has been even increased. Global nutrition guidelines of WSAVA provide descrip-

tions, images and movies of the usage of BCS that allow people to learn how evaluate dog’s body condition (www.WSAVA.org). However, there is a problem that the BCS can be misevaluated depending on the operator’s proficiency [11]. Therefore, this study suggested a simple and objective method to estimate BCS in dogs. BCS were evaluated for 16 weeks. All of BCS scores which were evaluated in twenty – four dogs were listed in Table 1. BCS scales were classified into four different categories in which BCS 3 is “too thin”, 4 and 5 are “ideal”, 6 and 7 are “overweight” and 8 is “obese” based on the weight management program of WSAVA. In total, about 46% were the ideal condition (BCS 4 and 6) and 42.2% were in overweight or obese condition (BCS 7 or 8).

BCS is based on the description of the body morphology to

palpate and observe fats under the skin. This non-numeric evaluation of BCS induces subjective opinions from operators [10, 11]. The palpable body fats were evaluated around ribs, lumbar vertebrae and pelvic bones including the abdominal tuck existence. Meanwhile the operators evaluated dog’s waist by bare eyes to check whether abdominal tuck is present or not. To find a solution of the misevaluation problem of BCS we measured the chest and abdominal girths to characterize the detail body sizes of dogs (Table 2). Sizes of chest and abdominal girths were significantly different based on the BCS scores. However, the body sizes of dogs were variable depending on the size of an individual dog. Therefore, a single measurement of chest or abdominal girth is highly relative that would not be an objective parameter to predict BCS in dogs.

In this study we observed that the abdominal tuck is getting decreased during dogs became overweight. The dogs with BCS 7 or 8 had almost a flat torso without the visible abdominal tuck. Next, the difference of chest and abdominal girth was calculated. The difference between chest and abdominal girths was significantly decreased when dogs were become overweight or obesity (Table 2). After that, we investigated the ratio of abdominal to chest girth and the ratio of chest to abdominal girth. The ratios between chest and abdominal girths were significantly related with BCS scores

**Table 1. BCS evaluations in twenty-four dogs for 16-weeks**

	Too thin	Ideal	Overweight	Obese		
BCS (n)	3	4	5	6	7	8
Male	27	41	54	66	21	7
Female	14	29	42	36	19	4
Total	41	70	96	102	40	11

Values are the number of dogs in the scores of BCS for 16-weeks. BCS, body condition score.

**Table 2. The body sizes and BCS evaluations in twenty-four dogs for 16-weeks**

		BCS (means)						SEM	p-value
		Too thin	Ideal	Overweight	Obese				
		3	4	5	6	7	8		
Chest girth (cm)	Female	47.4	47.6	49.3	52.2	53.7	56.4	0.3	< .001
	Male	47.9	48.4	49.4	51.3	52.5	55.1	0.2	
	Pooled	47.7 <sup>e</sup>	48.1 <sup>e</sup>	49.4 <sup>d</sup>	51.6 <sup>c</sup>	53.0 <sup>b</sup>	55.5 <sup>a</sup>	0.2	
Abdominal girth (cm)	Female	32.4	34.6	36.5	40.0	44.3	49.5	0.4	< .001
	Male	34.7	35.6	37.9	40.4	43.9	48.0	0.3	
	Pooled	33.9 <sup>f</sup>	35.2 <sup>e</sup>	37.3 <sup>d</sup>	40.3 <sup>c</sup>	44.1 <sup>b</sup>	48.5 <sup>a</sup>	0.2	
Difference between chest and abdominal girth (cm)	Female	14.9	13.0	12.8	12.2	9.4	6.9	0.2	< .001
	Male	13.2	12.8	11.5	10.9	8.6	7.1	0.2	
	Pooled	13.8 <sup>a</sup>	12.9 <sup>b</sup>	12.1 <sup>c</sup>	11.4 <sup>d</sup>	9.0 <sup>e</sup>	7.0 <sup>f</sup>	0.1	
Ratio of abdominal to chest girth	Female	0.7	0.7	0.7	0.8	0.8	0.9	0.0	< .001
	Male	0.7	0.7	0.8	0.8	0.8	0.9	0.0	
	Pooled	0.7 <sup>e</sup>	0.7 <sup>e</sup>	0.8 <sup>d</sup>	0.8 <sup>c</sup>	0.8 <sup>b</sup>	0.9 <sup>a</sup>	0.0	
Ratio of chest to abdominal girth	Female	1.5	1.4	1.4	1.3	1.2	1.1	0.0	< .001
	Male	1.4	1.4	1.3	1.3	1.2	1.1	0.0	
	Pooled	1.4 <sup>a</sup>	1.4 <sup>b</sup>	1.3 <sup>c</sup>	1.3 <sup>d</sup>	1.2 <sup>e</sup>	1.1 <sup>f</sup>	0.0	

<sup>a-f</sup>Means with different superscripts within the columns are significantly different ( $p < 0.001$ ). BCS, body condition score; SEM, standard error of mean.

**Table 3.** The correlation coefficients between BCS and the body sizes

	BCS	Chest girth	Abdominal girth	Difference between chest and abdominal girth	Ratio of abdominal to chest girth	Ratio of chest to abdominal girth
Pearson's correlation coefficients	1	.718 <sup>*</sup>	.847 <sup>*</sup>	-.569 <sup>*</sup>	.686 <sup>*</sup>	-.689 <sup>*</sup>
p-value	-	0.001	0.001	0.001	0.001	0.001

BCS, body condition score.

<sup>\*</sup>The correlation coefficient is significant at 0.05.

from 3 to 8 (Table 2). To define the correlation between body sizes and BCS the Pearson's correlation coefficient was analyzed (Table 3). We found that the difference and the ratio between chest and abdominal girths are significantly correlated with BCS scales. Together, it suggested that BCS scales can be predicted based on the difference and the ratio between chest and abdominal girths. In terms of simplicity of which subtraction and division the difference of chest and abdominal girths would be a convenient method to predict BCS in dogs.

Excessive energy intake induces the accumulation of extra body fats and would induce various health problems that affect serious impacts on dog's welfare [24]. For maintaining the optimal body fat composition, it is essential to monitor dog's body condition regularly that will prevent dogs from becoming overweight [25]. Although BCS is an effective and a common method to evaluate body fat composition it can be misevaluated when it is performed by a non – professional like pet's owners because of the subjective impression. The present study showed that the body sizes of dogs can be obtained by a simple measuring tape and the difference of chest and abdominal girths is easily calculated. Moreover, the difference of chest and abdominal girth were able to predict BCS scales with a statistical significance. With that, a person who is not a veterinarian or a trained professional can evaluate dog's BCS. In other words, pet dog's owners who have no knowledge of BCS would be able to evaluate their own dog's BCS using this simple method. This finding would contribute to protect dog's welfare against overweight or obesity which could cause serious health problems and expensive veterinary medical cost to dog's owners.

### Competing interests

No potential conflict of interest relevant to this article was reported.

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### Availability of data and material

Upon reasonable request, the datasets of this study can be available from the corresponding author.

### Authors' contributions

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Data curation: Bang HT.

Formal analysis: Kim Mj, Lee YK.

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Writing - review & editing: Lee SD, Reddy KE.

### Ethics approval and consent to participate

The animal study design was approved by IACUC review board (Approval Number: NIAS20191665). We have read and understood your journal's policies, and we believe that neither the manuscript nor the study violates any of these. This manuscript has not been published and is not under consideration by another journal.

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