

Assessment of Overweight and Obesity in Dogs using Five-point Body Condition Scoring and Body Fat Percentage in Maiduguri, Nigeria

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Abstract: This work was designed to investigate overweight and obesity in dogs in Maiduguri using five-point body condition scoring and body fat percentage. The total of 30 dogs of both sexes were randomly selected in residential areas of Maiduguri Metropolis, with 29 dogs finally participated in the study. One dog was later excluded from the study because of obvious signs of canine babesiosis; this is because the main criterion of inclusion of dogs into the study is good health apart from obesity. The results using five-point body condition scoring shows 7(24.1%) were overweight (scale 4) and their ribs were palpable but with difficulty, noticeable fat deposits over lumbar area and base of tail and abdominal tuck were absent. The obese (scale 5) dogs were found to be 2 (6.9%) (Scale 5) which reveals massive fat deposits over thorax, spine and base of tail. Waist and abdominal tuck were absent, obvious fat deposits on the neck and abdominal distention were evident. However, the body fat percentage using anthropometric measurement by applying a gender specific formula reveals 1(3.4%) obesity, none was considered overweight. All the dogs were clustered using dendrogram which indicates most of the overweight and obese dogs were found among the exotic breeds, suggesting that breed is one of the factors that can predispose dogs to overweight and obesity.

Keywords: Body condition scoring, body fat percentage, dogs, Maiduguri, obesity, overweight.

I. INTRODUCTION

Obesity is the accumulation of excessive amounts of adipose tissue in the body [1]; and is the most common nutritional disorder in companion animals [2]. Obesity is usually the result of either excessive dietary intake or inadequate energy utilization, which causes a state of positive energy balance [3]. Several factors may predispose an individual to obesity including genetics, the amount of physical activity, and the energy content of the diet. The main medical concern of obesity relates to the many disease associations that accompany the adiposity. Studies have shown that obesity can have detrimental effects on the health and longevity of dogs and cats. The problems to which obese companion animals may be predisposed include orthopedic disease, diabetes mellitus, and abnormalities in circulating lipid profiles, cardiorespiratory disease, urinary disorders, reproductive disorders, neoplasia (mammary tumors, transitional cell carcinoma), dermatological diseases, and anesthetic complications [4]. The main therapeutic options for obesity in companion animals include dietary management and increasing physical activity. Although no pharmaceutical compounds are yet licensed for weight loss in dogs and cats, it is envisaged that such agents will be available in the future. Dietary therapy forms the cornerstone of weight management in dogs and cats, but increasing exercise and behavioral management form useful adjuncts [4]. Excessive body weight (overweight and obesity) is becoming a common medical problem in dogs [5], and is linked to both a shortened lifespan [1]; [6] and a host of secondary diseases [7]. A growing concern is the alarming

increase in prevalence of overweight dogs between 2006 (21%) and 2009 (35%), with almost half of all dogs in the UK currently being overweight [8]. Body weight does not take differences in body composition into account, but is reasonably well estimated using the body condition scoring (BCS) system. BCS is an established, inexpensive, and noninvasive technique for assessing body fat percentage and is widely used in veterinary practice [9]. A number of BCS charts are available, and provide a simplified index (typically a five-point or a nine-point scale) of the amount of muscle and degree of fatness of a particular animal. However, dogs deposit significant amounts of fat subcutaneously in the thoracic, lumbar, and coccygeal areas as well as intra-abdominally [3], making the typical palpation technique associated with BCS systems less accurate. In addition, BCS assignment is a subjective method, and although scoring systems using defined criteria can attempt to objectify the process, they cannot completely eliminate all subjectivity involved in assigning a score to a particular animal. In addition, body fat percentage calculated using morphometric measurements has been shown to produce results in agreement with dual-energy x-ray absorptiometry values when dogs with different genetic backgrounds and morphologic characteristics are used [10].

Combining body fat percentage with five-point BCS appears to increase the likelihood of validating overweight status in small medium sized dog breeds by detecting changes as a result of increasing adiposity. Correct estimation of body composition in dogs is important in veterinary practice and is a tool that the veterinarians can use to diagnose overweight status and provide owners with proper advice on feeding and weight management strategies. However, dual methods of assessing adiposity in dogs using BCS and BFP according to our literature search have not been reported in the study area; hence this study.

II. METHODOLOGY

Study area:

The study was conducted in Maiduguri, the Borno state capital, Nigeria. Maiduguri is located between latitude 11° and 50° north and longitude 13° and 36° east. The annual rainfall average 320 mm, rainy season begins in June and last till October and dry season begins in November and last till May. The rainfall is monsoonal, generally been heaviest in August. The annual temperature average 35.4°C, the climate of Maiduguri can be divided into six zones: Guinea zone, sunado-Guinea zone, sunado-sahelian zone, sahelo-sudanian, sudano-saharan zone and Saharan zone [11].

A. Experimental design:

The total of 30 dogs of both sexes were used for this study. All dogs were randomly selected in residential areas of Maiduguri Metropolis from group of hunters and individual dog owners. The brief clinical examinations of all the dogs were carried out to ascertain their health status as the main inclusion criterion for the dogs under study is good health (other than obesity). In addition, the medical histories of all the dogs were investigated in order to confirm their health status. One dog was excluded from the study because of obvious clinical signs of canine babesiosis, with 29 dogs finally participated in the study.

A well written informed consent were obtained from all the dog owners following a detailed explanation of the purpose and benefits of the study.

Each dog was assigned a body condition scoring on a previously five point scale by [3]. Using the amount of fat covering the rib area as judged by visual inspection and palpation. The five point system ranges from 1, very thin; 2, underweight; 3, ideal; 4, overweight to 5, obese. Also, the body fat percentage were calculated according to the formula developed by [9] as:

$$\text{Male body fat (\%)} = -1.4 (\text{HS}) + 0.77 (\text{PC}) + 4$$

$$\text{Female body fat (\%)} = -1.7 (\text{HS}) + 0.93 (\text{PC}) + 5$$

$$\text{Either gender body fat (\%)} = [-0.0034 (\text{HS}^2) + 0.0027(\text{PC}^2) - 1.9]/\text{body weight}$$

Using a measuring tape, anthropometric measurements were carried out in centimeters, measuring pelvic circumference (PC) and the length of right rear limb from the calcaneal tuber to the mid-patellar ligament (hock to stifle joints, HS). When performing measurements, each dog was made to stand looking straight forward with its head in a normal carriage position. In measuring pelvic circumference, the measuring tape was stretched and pulled tight until the dog's coat was compressed (though without excessive pressure) against its skin.

B. Statistical analysis:

The data generated in this study were analyzed using multivariate analysis (pairwise correlation and cluster analysis) with JMP version 11 software (SAS Institute Inc., Cary, NC). Analyses were considered significant at a P value of ($P < 0.05$).

III. RESULTS**Table 1: Physical characteristics of the dogs used in this study**

Breed	Spaying/ Neutering Status	Gender	Age ----- (Years)	Body weight (kg)	Body Condition Score (BSC out of 5)	Anthropometric Measurements		Body Fat% ----- (Bf %)
						PC (cm)	HS (cm)	
Boerboel	-	female	2	25	4	51	21.5	15.88
Boerboel	-	male	2	27	5	58	24	15.06
Cross	+	male	1	28	5	80	22	34.80
Caucasian	-	female	1	28	4	58	25	16.44
Mongrel	-	female	5	18	2	51	22	15.03
Mongrel	-	male	4	17	2	55	25	11.35
Alsatian	-	male	2	25	4	62	26	15.34
Caucasian	-	male	2	24	3	56	26	10.72
Caucasian	-	female	1	22	3	46	23	8.68
Lhasa apso	-	female	1	20	3	41	16	15.93
Labrador	-	male	2	25	3	46	22	8.62
Labrador	-	male	2	27	4	54	27	7.78
Labrador	-	male	3	24	3	52	23	11.84
Labrador	-	female	5	23	3	46	24	6.98
Caucasian	-	male	2	27	4	63	27	14.71
Mongrel	-	female	6	19	3	49	24	9.77
Labrador	-	female	3	22	3	38	17	11.44
Alsatian	-	male	2	23	2	61	28	11.77
Alsatian	-	female	2	25	3	55	29	6.85
Rottweiler	-	female	3	27	4	51	22	15.03
Terrier	-	female	2	26	3	53	23	15.19
Cross	-	male	4	25	3	61	26	14.57
Mongrel	-	male	7	20	3	54.5	24	12.37
Mongrel	-	male	5	19	3	59	26	13.03
Mongrel	-	male	4	19	3	42	21	6.94
Mongrel	-	male	6	17	3	40	22	4.00
Mongrel	-	male	10	14	1	43	26	2.11
Mongrel	-	female	14	11	1	37	21	3.79
Mongrel	-	male	5	22	4	48	21	11.56

Where BSC=Body condition scoring, PC=Pelvic circumference, BFP=Body fat percentage and HS= Hock to stifle

Table 2: Percentage of Breed of Dogs assigned to Body Condition Scoring (BCS)

BCS	BREEDS OF DOGS									% BCS
	AL	BO	CA	CR	LA	LH	MO	RO	TE	
1	0	0	0	0	0	0	2	0	0	2(6.9%)
2	0	0	0	0	0	0	2	0	0	2(6.9%)
3	2	0	3	1	3	1	5	0	1	16(55.2%)
4	1	1	1	0	2	0	1	1	0	7(24.1%)
5	0	1	0	1	0	0	0	0	0	2(6.9%)
	3(10.3%)	2(6.9%)	4(13.8%)	2(6.9%)	5(17.2%)	1(3.4%)	10(34.5%)	1(3.4%)	1(3.4%)	29

Where: AL= Alsatian, BO= Boarboel, CA= Caucasian, CR= Crossed, LA= Labrador, LH= Lhasa apso, MO= Mongrel, RO= Rotweiler and TE= Terrier.

Table 3: Body fat percentage reference ranges by morphometric measurements

	Normal	Overweight
Female (intact/spayed)	15%-25%	>25%
Male (intact/neutered)	15%-22%	>22%

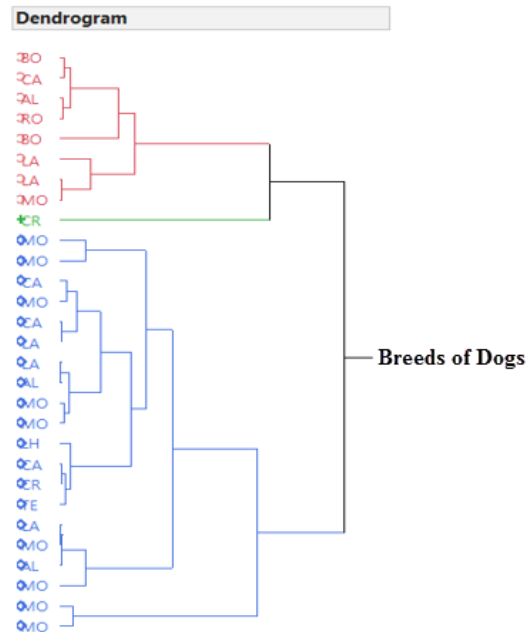


Figure 1: Three clusters of dogs based on the body conditions scores and body fat percentage

Pairwise Correlations						
Variable	by Variable	Correlation	Count	Lower 95%	Upper 95%	Signif Prob
BF	BCS	0.6153	29	0.3213	0.8011	0.0004*

There is strong positive and significant correlation between BSC and BFP in different breeds of dogs in Maiduguri.

IV. DISCUSSIONS

Assessment of obesity using body fat percentage in conjunction with five-point BCS appears to increase the likelihood of validating overweight status in dog in the present study which agrees with [3]. The result of the present study revealed that some of the dogs considered as overweight by the five-point body condition scoring were not detected by body fat percentage using gender specific formula. In a previous study by [2], none of the dogs was scored obese using Five-point body condition scoring in the same study area. Even though, they focused their study on hunting dogs only, as a results chances of obesity in hunting dogs are minimal as there is always adequate energy utilization because of their regular hunting exercise. The dogs were grouped into three clusters as revealed by the dendrogram, which suggest that there is close association among the dogs examined which cut across breed and gender. According to [12], obesity is having a positive mismatch between energy intake and energy expenditure. Therefore, either excessive dietary intake or inadequate energy utilization can lead to a state of positive energy balance; numerous factors may be involved, including genetics, the amount of physical activity, and the energy content of the diet [3].

Neutering is an important risk factor for obesity in dogs; many studies suggested that this is due to a decrease in metabolic rate after neutering [13]. It is in agreement with the present study, as the only neutered dog was found to be obese picked

by both five-point body condition scoring and body fat percentage. However, increased fat mass is usually present in neutered animals; when energy expenditure is expressed on a lean mass basis, no difference in metabolic rate is noted between neutered and entire individuals [14]. Alternative explanations for the effect of neutering on obesity is an alteration in feeding behavior leading to increased food intake [15], and decreased activity without a corresponding decrease in energy intake [12]. This also is in agreement with the present study as most of the dogs considered as obese were found among those kept for guarding purposes. These dogs are always locked in the kennels during the day and are only released in the night as a result, energy utilization may not adequate. Neutering is an important risk factor for obesity in both species; many studies suggested that this is due to a decrease in metabolic rate after neutering [16], [13]. However, increased fat mass is usually present in neutered animals; when energy expenditure is expressed on a lean mass basis, no difference in metabolic rate is noted between neutered and entire individuals [17]; [14]. Alternative explanations for the effect of neutering on obesity is an alteration in feeding behavior leading to increased food intake [15], and decreased activity without a corresponding decrease in energy intake. Gender itself is also a predisposing factor in some canine studies, with females overrepresented. Obesity is a major risk factor for orthopedic diseases in companion animals, especially dogs. An increased incidence of both traumatic and degenerative orthopedic disorders was reported [18]. One study reported body weight to be a predisposing factor in humeral condylar fractures, cranial cruciate ligament rupture, and intervertebral disc disease in cocker spaniels [19]. A recent study in boxers reported a link between neutering and hip dysplasia [20]; although the effect of obesity was not assessed directly in that study, this association was attributed to an increased incidence of obesity in neutered dogs. Further, a number of studies highlighted the association between obesity and the development of osteoarthritis [1], whereas weight reduction can lead to a substantial improvement in the degree of lameness in dogs with hip osteoarthritis [21].

V. CONCLUSION

Assessment of overweight and body fat percentage in dogs by using morphometric measurements cannot detect overweight and obesity in small breeds like Lhasa apso. This is because arthropometric measurements of pelvic circumference and the height of the right rear limb from the hock to stifle joint may present low data because of their small stature. In this case when those data are applied using gender specific formula may not present the true status of the animal. This is evident in this study as the 24% overweight detected by body condition scoring were presented as ideal body status by body fat percentage method. Therefore, body fat percentage should always be used in conjunction with other methods of estimating physical status of dogs like body condition scoring.

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