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Prevalence of Obesity Associated Disorders in Companion Dogs

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Abstract

This study was conducted in 142 clinically sick overweight/obese dogs presented with clinical signs and were diagnosed for various disorders. Seven comorbidities were identified in these dogs on the basis of history, clinical signs, hematobiochemical analysis, ultrasonography, electrocardiography, echocardiography, radiography, urinalysis, skin scrapping, fungal examination and fine needle aspiration cytology in required cases. Obesity is associated with various comorbidities; highest being dermatological (32%), followed by cardiac (18%), orthopaedic (15%), respiratory (12%), endocrine (12%), urinary (9%) and neoplastic disorders (2%).

Keywords: Body Condition Score, Disorders, Dogs, Obesity, Ultrasonography

Introduction

Obesity is a common nutritional disorder in dogs and has become a major health and welfare problem throughout the world. It is defined as an accumulation of excessive amounts of adipose tissue in the body which leads to harmful consequences to the health of an individual (Carreira *et al.*, 2016). Adipose tissue is now regarded as an active endocrine organ that communicates with the brain and peripheral tissues by secreting a wide range of hormones and protein factors, collectively termed adipokines (German *et al.*, 2010). Chronically dysfunctional adipokine production and secretion due to overweight and obesity may expedite inflammatory, metabolic, cardiovascular and malignant disorders (Fasshauer and Bluher, 2015).

Chandler *et al.* (2017) estimated the incidence of obesity in the dog population to be between 19.7 and 59.3% from various parts of the world. Obesity is usually the result of either sedentary lifestyle, especially inactivity causing energy imbalances, excessive dietary intake, inadequate energy utilization, which causes a state of positive energy balance. Obesity is linked to decreased quality of life and longevity and increased incidence of secondary diseases, including metabolic diseases, respiratory distress, hypertension, cardiac disease, renal diseases, neoplasia, orthopaedic and skin diseases (German, 2006).Information on obesity associated disorders is meager in Indian scientific literature so the present study was undertaken to document various disorders associated with natural obesity in companion dogs.

Materials and Methods

This study was conducted in142 sick adult dogs of different breeds that were presented with varied clinical signs at the Small Animal Clinics in the Department of Veterinary Medicine, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana. The patients were screened for obesity on 5-point scale of Body Condition Score (BCS) as designed by Laflamme, (1997) and graded as 1: thin, 2: underweight, 3: ideal, 4: overweight, 5: obese. Dogs presented with BCS 4 (overweight) and 5 (obese) were included in this study. Various obesity associated disorders were differentially diagnosed based on history, clinical, hematobiochemistry, urinalysis, X-ray, ultrasonography, echocardiography, skin scrapping and FNAC examinations.

Detailed information of feeding and exercise habits of all animals were obtained through a questionnaire. A detailed clinical examination of all sick overweight/obese dogs were done. Haematology of diseased dogs (N=142) of different breeds was done by standard methods. Serum biochemical analysis of diseased overweight/obese dogs (n=142) of different breeds was carried out using Vitros DT 350 Chemistry system (Ortho Clinical Diagnostics, Johnson& Johnson Company) for estimation of Renal Markers, Hepatic Markers, Minerals, Diabetic Marker, Lipid profile and Electrolytes. Thyroid Stimulating Hormone (TSH), Adiponectin and Leptin estimation was done using canine specific sandwich ELISA kit of Bioassay Technology Laboratory. Abdominal ultrasound was done using ultrasound scanner Logiq P5without any sedation or anaesthesia. As per need, lateral and ventrodorsal X-ray of chest, abdomen, spine and pelvis were taken to diagnose various disorders.

Echocardiography was done by standard methods as described by Boon (2011) using general electric ultrasound scanner Logiq P5 equipped with a multifrequency cardiac transducer 5S probe. Doppler blood pressure system (Vet-Dop2, Vmed Technology) was used for recording of blood pressure. Electrocardiogram was recorded in all dogs by standard methods described by Tilley, (1992) by using BPL cardiart 8108 six channel ECG machine. Microscopic examination of skin scrapping, fungal examination, urinalysis and fine needle aspiration cytology was done by standard methods.

Results and Discussion

History with regard to feeding and exercise status in overweight/obese dogs showed that majority of the dogs were fed only home-cooked food (n=78, 55%) followed by a combination of both home cooked and commercial diet (n=60, 42%) and only four dogs (3%) were being fed commercial dog food alone. Out of one hundred and forty-two dogs, forty-seven dogs (33%) had access to table scraps and leftover food whereas majority i.e. ninety-five dogs (67%) did not eat table scraps. Snacks and treats were provided by owners to 73% (n=103) dogs regularly whereas thirty-nine dogs (27%) were not provided treats. Only three dogs (2%) were fed once a day, seventy-eight dogs (55%) were fed meals twice, fifty-four dogs (38%) were fed thrice a day and seven overweight/obese dog (5%) was fed several times a day. Only twenty-seven dogs (19%) were being given nutritional supplements while rest one

hundred and fifteen dogs (81%) did not receive any nutritional supplementations. The number of dogs with a history of exercise was lower (n=64, 45%) than in comparison with dogs not taken for exercise (n=78, 55%). Fifty-five dogs (86%) were exercised for less than 0.5 hours, eight dogs (13%) for 0.5-1 hours and only one dog for more than one hour. Fifty-seven dogs were provided with walking (89%) and seven dogs (11%) were found to be involved with running (Table 1). In present study, reportedly high intake of snacks and treats by majority of dogs and sedentary life style; could be the possible reason for excessive weight gain in these dogs.

Table 1: History of feeding and exercise of overweight/obese dogs with various associated disorders

S. No.	Parameters	Variable	(n=142)
1	Type of food	Home cooked	78 (55%)
		Commercial	04 (3%)
		Both	60 (42%)
2	Table scraps	Yes	47 (33%)
		No	95 (67%)
3	Snacks and treats	Yes	103 (73%)
		No	39 (27%)
4	Feeding frequency	Once a day	03 (2%)
		Twice a day	78 (55%)
		Thrice a day	54 (38%)
		Several times a day	07 (5%)
5	Nutritional supplements	Yes	27 (19%)
		No	115 (81%)
6	Exercise status	Yes	64 (45%)
		No	78 (55%)
7	Duration of exercise (n=64)	<0.5hr	55 (86%)
		0.5-1hr	08 (13%)
		>1hr	01 (1%)
8	Type of exercise (n=64)	Walking only	57 (89%)
		Other exercise	07 (11%)

The observed associated disorders were dermatological (n=45, 32%), cardiovascular (n=25, 18%), orthopaedic (n=22, 15%), respiratory (n=17, 12%), endocrine (n=17, 12%), urinary (n=13, 9%) and neoplastic disorders (n=03, 2%).

Table 2: System-wise distribution of disorders associated with obesity

S. No.	Affected System	N=142
1	Dermatological disorders	45 (32%)
2	Cardiovascular disorders	25 (18%)
3	Orthopaedic disorders	22 (15%)
4	Respiratory disorders	17 (12%)
5	Endocrinology related disorders	17 (12%)
6	Urinary system related disorders	13 (9%)
7	Neoplasm related disorders	03 (2%)

The number of breeds involved in this study were Labrador (n=92, 65%), Pug (n=18, 13%), Beagle (n=08, 5%), Daschund (n=08, 5%), Spitz (n=06, 4%), Golden Retriever (n=02, 1%), German Shephard (n=02, 1%), Cocker Spaniel (n=01, 1%), American Bully (n=01, 1%), Rottweiler (n=01, 1%), English Bulldog (n=01, 1%), Chihuahua (n=01, 1%) and non-descript (n=01, 1%).

Table 3: Breed-wise distribution of overweight/obese dogs with associated disorders

S. No.	Breeds affected	N=142
1	Labrador	92 (65%)
2	Pug	18 (13%)
3	Beagle	08 (5%)
4	Daschund	08 (5%)
5	Spitz	06 (4%)
6	Golden Retriever	02 (1%)
7	German Shephard	02 (1%)
8	Cocker Spaniel	01 (1%)
9	American Bully	01 (1%)
10	Rottweiler	01 (1%)
11	English Bulldog	01 (1%)
12	Chihuahua	01 (1%)
13	Non-descript	01 (1%)

Male dogs (n=100, 70%) were observed to be more affected with obesity associated disorders as compared to female dogs (n=42, 30%).

Colliard *et al.* (2006) reported that Retriever breeds were 4.65-fold more obese than other breeds. Mao *et al.* (2013) reported that Pugs and Cocker Spaniels had highest predisposition to obesity as compared to other breeds. Preet (2018) reported that the highest prevalence of obesity was found in Labrador Retrievers followed by Pug, Beagle, Spitz, German Shepherd, Toy Pom, Boxer, Dachshund, Cocker Spaniel and mixed breed. Similar findings were observed in the present study.

Obesity Associated with Dermatological Disorders

Various studies in feline populations have found association between obesity and dermatological disorders (Lund *et al.*, 2005, Ohlund *et al.*, 2018, Teng *et al.*, 2018), but literature is lacking on dermatological disorders associated with obesity in dogs. In the present study, overweight/obese dogs with excessive fat accumulation could have struggled to self-groom certain anatomical areas, which may have become predisposed to dermatoses. Lyons *et al.* (2015) and Nino *et al.* (2012) suggested that obesity disrupts skin barrier function and increases transdermal water loss and may also increase the risk of atopic dermatitis *via* chronic low-grade systemic inflammation.

Obesity Associated with Cardiovascular Disorders

Obesity is a major risk factor for development of heart diseases, coronary heart disease, increasing heart rate and cardiac output, promoting cardiac hypertrophy, impairing systolic and diastolic functions, elevating blood pressure, increased morbidity and mortality throughout the world (Poirier and Eckel, 2002; Kotsis *et al.*,2010) that can cause marked changes in systemic hemodynamics as well as structural adaptations in blood vessels and in the heart. Coexistence of obesity along with hypertension exerts a double burden on the heart, resulting in distinct cardiac pathologic changes, which increases the risk for congestive heart failure and sudden cardiac death (Zhang and Reisin, 2000). Obesity induced by a high-fat diet can result in taurine depletion, which has been associated with dilated cardiomyopathy in dogs of certain breeds (Sanderson, 2006).

Obesity Associated with Orthopaedic Disorders

Excessive body weight and the associated increased stress on joints induce the transformation of passive hip joint laxity to functional hip joint laxity, thereby initiating osteoarthritis (Kapatkin *et al.*, 2002). Griffin *et al.* (2009) showed that leptin plays an important role in the development of osteoarthritis in obese mice and the findings suggest that increase in adipose tissue increases leptin concentration which plays a key role in the development of osteoarthritis. In the present study, increased mechanical burden on weight bearing joints and increased leptin concentrations might be the reason for orthopaedic disorders in overweight/obese dogs.

Obesity Associated with Respiratory Disorders

Biring *et al.* (1999) described that, thoracic restriction associated with obesity is usually mild and attributed to the mechanical effects of fat on the diaphragm and the chest wall: diaphragm excursion was impeded and thoracic compliance reduced. A recent study conducted by Pereira-Neto *et al.* (2018) reported that obesity causes decreased tidal volume and increased respiratory rate, which was characterized by a fast and low- amplitude respiratory pattern in dogs at rest without hyper or hypoventilation. In the present study, increased breathing efforts might be due to the reduction in chest wall compliance and respiratory muscle strength. Teng *et al*. (2018) and Ohlund *et al.* (2018) also reported obesity as a risk factor for respiratory diseases in obese cats.

Obesity Associated with Endocrine Disorders

Obesity directly or indirectly serves as a cause of various endocrine abnormalities contributing to metabolic disorders whereas obesity may also be developed secondary to endocrine disorders found in dogs and cats (Scott-Moncrieff, 2007). Hypothyroidism is a direct cause of obesity as it decreases basal energy expenditure (Fox *et al.*,2008). Obesity decreases insulin sensitivity in dogs and can therefore affect diabetic control, but as diabetes in dogs is generally due to a lack of insulin-producing pancreatic β cells, obesity does not cause diabetes mellitus (Pancier*aet al.*, 1990).Several studies have found positive associations between diabetes mellitus and increased body weight on BCS (Lund *et al.*, 2005, Prahl *et al.*, 2007, O'Neill *et al*., 2016, Ohlund *et al.*, 2018 and Teng *et al*., 2018).

Obesity Associated with Urinary Disorders

Obesity might increase the risk of UTIs through different mechanisms. Firstly, animals that are morbidly obese are more likely to suffer from arthritis and joint pain, withreduced mobility overall. This reluctance to move can cause animals to void their urine less often and give bacteria a better opportunity to adhere to the bladder mucosa (Marshall *et al.*, 2009). Secondly, as body fat accumulates, a change in the anatomy surrounding the urethral orifice may increase bacterial numbers and lead to dermatitis in the area. Obesity may cause a hooded vulva, which is an established cause of UTI recurrence in females (Morrison *et al.*, 2013 and Thengchaisri *et al.*, 2014). Animals that are morbidly obese are also more likely to have infections within the skin folds surrounding the tail base and perineal areas. Ascension of bacteria from the perineal, rectal, and genital areas are the most common sources of bacterial UTIs (Olin and Bartges, 2015).

Renal disease was reported to be common in the domestic cat population and Teng *et al.* (2018) observed that cats with BCS of 8 of 9 had comparatively high odds of showing upper urinary tract conditions. Obesity being a chronic low-grade systemic inflammation adipokines appears to expedite the progress of renal failure in both humans and animal models by the activation of renin-angiotensin aldosterone system (RAAS) (Abbate *et al*., 2006).

Obesity Associated with Neoplastic Disorders

Obese dogs have increased circulating levels of adipokines, such as insulin-like growth factor (IGF), TNFα and leptin (Gayet *et al.*, 2004). Leptin is an *in-vitro* promoter of mammary tumors (Chen *et al.*, 2006, Ressel *et al.*, 2012) and hepatocellular carcinomas in humans. Elevated levels of leptin can directly inhibit p53 expression in human mammary cancer cells in vitro (Chen *et al.*, 2006).

Obesity, a chronic low-grade inflammation causes increase in insulin resistance, changes in the concentrations of gonadal hormones and adipokine production (Dannenberg & Berger 2013, De Pergola andSilvestris 2013). Lund *et al.*, (2005) reported a positive correlation between neoplasm and obesity in their study.

Conclusion

Study concludes that obesity isassociated with comorbidities highest being dermatological followed by cardiac, orthopaedic, respiratory, endocrine, urinary and neoplastic disorders.

Conflict of Interests

There is no conflict of interest.

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