

## Validation of a modified 9-integer-unit body condition score system and a computer-based modelling tool to estimate body condition in pet dogs

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Body condition scoring (BCS) is the most widely accepted clinical method for estimating body fat mass in dogs. The 9-point system is preferred but, since visual characteristics are depicted with only 5 silhouette images from a single breed, assessment of visual characteristics of dogs of different size and body shape is challenging.

Two modifications to the original 9-point BCS system were developed with reference to an image archive of almost 3799 photographs from 155 dogs attending the Royal Canin Weight Management Clinic, University of Liverpool (Gant. BMC Veterinary Research 2016, 12:18). Body fat mass (measured by dual-energy X-ray absorptiometry [DEXA]) and BCS was known for all dogs, and owners gave written permission for use of these photographs (VREC50). The first modification was a paper-based system that used a set of 5 size-specific BCS charts, for small, medium, large, and giant breeds, respectively. The written descriptions for each category were identical, but different images were included for the different size categories. The second was a computer-based system whereby visual characteristics were modelled on-screen by altering body shape in 5 different zones (chest, abdomen, back, thigh, and pelvis), with the computer software then calculating the body condition score automatically using an algorithm.

Thirty dogs of a range of breeds were used to validate both systems, all of which had been referred for surgical treatment of cranial cruciate ligament disease at Small Animal Teaching Hospital, University of Liverpool. Owners had consented to their participation in a separate research study (VREC192), involving body fat measurement by DEXA (under the same anaesthetic used for diagnostic and therapeutic procedures). One author (WS) assessed the BCS for all dogs, under the supervision of a second author experienced in body condition scoring (AJG). The computer system was used first, followed by the paper-based system.

Median BCS was 6/9 (3/9-8/9) and median body fat was 35% (range 8-52%). There was a strong positive correlation between body fat measured by DEXA and BCS for both the paper- ( $R_s=0.74$ ,  $P<0.001$ ) and computer-based ( $R_s=0.80$ ,  $P<0.001$ ) systems. Both systems also correlated strongly with each other ( $R_s=0.97$ ,  $P<0.001$ ), and agreement was almost perfect (Cohen's kappa 0.89,  $P<0.001$ ).

These findings demonstrate that both the modified paper-based and computer-based BCS systems correlate with body fat mass measured by DEXA and can be considered for use with clinical cases.