The use of body condition scoring – Old-World nonhuman primates

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Introduction

Body condition scoring (BCS) is defined as a subjective semiquantitative method of assessing body fat and muscle [JAALA, 51(1) 83-93]. Used as a management tool designed to assess the physical state of an animal, its musculature, body reserves and fat accumulation, is useful to assess overall health, production and dietary management and can be a predictive factor in disease risk and outcome.

BCS and bodyweight are two common methods used to assess the health of Old-World nonhuman primates (NHPs). While both techniques provide valuable information, they differ in terms of their approach and the type of data they generate. Body condition takes into consideration the shape, size and body composition of an animal. This approach allows for a more holistic assessment of an animal's overall health and wellbeing. In contrast, bodyweights are quantitative and objective measurements that do not account for variations in shape, size or body composition. While bodyweights provide a straightforward numerical value, they may not accurately reflect an animal's true level of health. For example, body composition varies significantly between males and female, particularly concerning muscle mass. Rhesus macaques (Macaca mulatta) are moderately dimorphic in body mass. Males are ~44% larger than females (Kimock *et al.*, 2019), which can lead to noticeable differences in bodyweight. This disparity is not merely a reflection of physical strength or fitness but is rooted in biological differences such as hormonal influences and genetic predispositions. Consequently when assessing bodyweight alone, females may appear considerably smaller than their male counterparts. Despite these apparent size differences, it is essential to recognise that smaller bodyweight does not inherently equate to poor health or fitness levels among females. BCS serves as a valuable tool in evaluating overall health regardless of size or gender. BCS provides an objective measure that assesses fat coverage and distribution on an animal's body, allowing for a more nuanced understanding of health beyond mere weight metrics. In many cases, female bodies may exhibit lower muscle mass. However, with appropriate BCS evaluation it can be determined that they maintain good health status.

BCS involves a visual and hands-on assessment, with a numerical grading system using the BCS charts (Figures 1 and 2) based on Macaca mulatta as a model. It is reliant on visual observations and physical palpation to assess the overall body condition of the macaque. The hands-on approach allows for a more accurate evaluation compared to only relying on visual cues alone; additionally, the use of numerical grading system provides a standardised way to quantify to an animal's body condition, allowing for easy comparison between individuals.

Whilst Figure 1 primarily focusses on rhesus macaques (*Macaca mulatta*), it highlights the applicability of this scoring system to other species such as cynomolgus macaques (*Macaca fascicularis*). These two species share substantial anatomical and physiological similarities, making the BCS framework relevant beyond its original context (Clingerman & Summers, 2005). Both species belong to the same genus which naturally results in overlapping anatomical features and body composition. Although there are differences they could still be effectively assessed using the BCS system (macaques.nc3rs.org.uk, 2024). Figure 1 demonstrates significant potential for application to other macaque species.

Body Condition Scoring of Nonhuman Primates using *Macaca mulatta* as a model

1	**EMACIATED** – Very prominent hip bones (easily palpable and likely visible), prominent facial bones, spinous processes and ribs. Minimal to no muscle mass is palpable over ileum or ischium. Anus may be recessed between ischial callosities. Body is very angular, no subcutaneous fat layer to smooth out prominences.
1.5	**VERY THIN** – Hips, spinous processes, and ribs are prominent. Facial bones may be prominent. There is very little muscle present over the hips and back. Anus may be recessed between ischial callosities. Body is angular, no subcutaneous fat to smooth out prominences.
2	**THIN** – Very minimal fat reserves, prominent hip bones and spinous processes. Hips, spinous processes and ribs are easily palpable with only a small amount of muscle mass over hips and lumbar region.
2.5	**LEAN** – Overlying muscle gives hips and spine a more firm feel. Hip bones and spinous processes are readily palpable, but not prominent. Body is less angular because there is a thin layer of subcutaneous fat.
3	**OPTIMUM** – Hip bones, ribs and spinous processes are palpable with gentle pressure but generally not visible. Well developed muscle mas and subcutaneous fat layer gives spine and hips smooth but firm feel. No abdominal, axillary or inguinal fat pads.
3.5	**SLIGHTLY OVERWEIGHT** – Hip bones and spinous processes palpable with firm pressure but are not visible. Bony prominences smooth. Rib contours are smooth and only palpable with firm pressure. Small abdominal fat pad may be present.
4	**HEAVY** – Bony contours are smooth and less well defined. Hip bones, spinous processes and ribs may be difficult to palpate due to more abundant subcutaneous fat layer. May have fat deposits starting to accumulate in the axillary, inguinal or abdominal areas.
4.5	**OBESE** – This animal will often have prominent fat pads in the inguinal, axillary or abdominal region. Abdomen will be pendulous when animal sitting or ambulating. Hip bones and spinous processes difficult to palpate. Bony contours smooth and poorly defined.
5	**GROSSLY OBESE** – Obvious, large fat deposits in the abdominal, inguinal and axillary regions. Abdominal palpation is very difficult due to large amount of mesenteric fat. Pronounced fat deposits may alter posture/ambulation. Hip bones, rib contours and spinous processes only palpable with deep palpation.

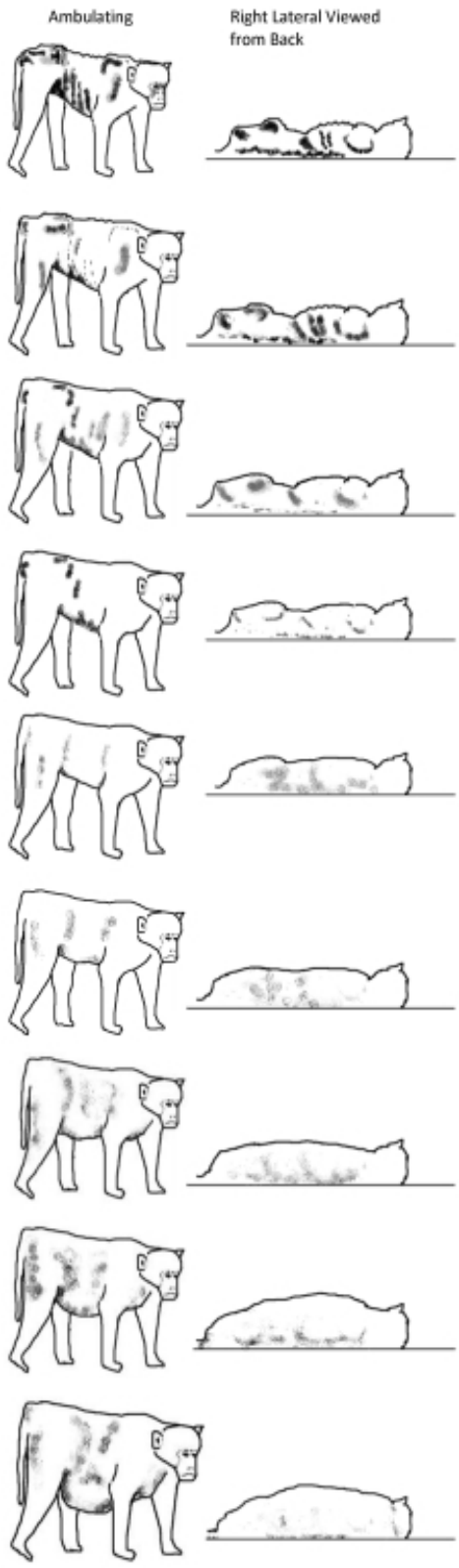

Figure 1. Body condition scoring system for nonhuman primates. Stylised drawings of ambulating animals and animals in right lateral recumbency attempt to visually depict bony prominences, muscle and fat that are palpated when scoring animals. Note that animals may not actually appear as drawn because of the presence of the haircoat. Clingerman KJ, Summers L. Development of a body condition scoring system for NHPs using *macaca mulatta* as a model. *Lab* Anim (NY). 2005 May;34(5):31-6. doi: 10.1038/laban0505-31. PMID: 15861156.

Method

Use of visual aids further enhances the practicality of BCS. Figure 2 was developed by the veterinary team at Labcorp as another aid to the BCS and to complement Figure 1 to help Animal Technicians reach a harmonised approach when scoring each animal. For example during a hands-on assessment, hip bones can indicate overall body fat levels. If they are easily felt it may suggest an animal is underweight or has insufficient body mass. In addition to that, during a visual assessment if an animal's body appears pronounced with fat deposits, without prominent spinous processes that cannot be easily seen, it could indicate that they fall closer to the grossly obese bracket.

Such tactile assessments with using both the hands-on and visual approach complement these evaluations and offer additional insights into an animal's condition. These approaches allow for subcutaneous fat and muscle mass covering boney prominences to be scored from 0 to 5 with half points in between. Half points are used when an animal shows one or more characteristics within two separate brackets.

The visual assessment should always be performed prior to the hands-on portion. Using Figures 1 and 2 as guides to score each animal, considerations should be made for the differences between juvenile and mature animals as well as male and female animals.

Visual assessment:

- Ribs – Are they visible? All of them? Just the end of rib cage?
- Spine – Are dorsal processes of vertebrae visible?
- Pelvic/hip bones – Are they visible?
- Waist/abdominal tuck – Can we see the waist? Is the abdomen tucked?

Hands-on assessment:

- Ribs – Are they palpable?
- Spine (especially lumbar region) – Are they palpable?
- Pelvic bones – Are they palpable? How much pressure needed?
- Body fat/muscle mass – How much coverage over ribs? How much coverage over sacrum, between hip bones? Any muscle wastage over spine, hindquarters, shoulders, legs, head?

This should then be recorded and monitored weekly. Any concerns should be raised with a named animal care and welfare officer (NACWO) and the veterinary team.

Case report

BCS is particularly valuable as it accounts for variations in body composition that may not be evident through bodyweight alone. For example, during periods of stress or illness it can reveal subtle changes in health that might not immediately affect weight but indicate deteriorating conditions. Typically bodyweights fluctuate more rapidly than BCS. For instance, a growing animal is expected to gain weight as it matures. However, if bodyweight remains stable while BCS decreases it may indicate underlying health issues or nutritional deficiencies. This discrepancy is particularly concerning when observed in NHPs, where a stable bodyweight accompanied by a declining BCS suggests negative physiological consequences.

	1	1.5	2	2.5	3	3.5	4	4.5	5
	Emaciated	Very Thin	Thin	Lean	Optimum	Slightly Overweight	Heavy	Obese	Grossly Obese
Facial bones	Prominent	Maybe prominent	---	---	---	---	---	---	
Spinous processes	Prominent	Prominent	Prominent/ easily palpable	Easily palpable/ not visible	Easily palpable with gentle pressure/ not visible	Easily palpable with firm pressure/ not visible	Difficult to palpate	Difficult to palpate	Very difficult to palpate (deep palpation only)
Ribs	Prominent	Prominent	Easily palpable	Easily palpable/ not visible	Easily palpable with gentle pressure/ not visible	Easily palpable with firm pressure/ not visible	Difficult to palpate	Difficult to palpate	Very difficult to palpate (deep palpation only)
Hip bones	Prominent	Prominent	Prominent/ easily palpable	Easily palpable/ not visible	Easily palpable with gentle pressure/ not visible	Easily palpable with firm pressure/ not visible	Difficult to palpate	Difficult to palpate	Very difficult to palpate (deep palpation only)
Anus	Recessed	Maybe recessed	---	---	---	---	---	---	
Muscle mass (ileum/ischium)	No/minimal	Very small amount	Small amount	Gives firm feel to hips and spine	Developed/gives smooth and firm feel	---	---	---	
Subcutaneous fat	No/minimal	No/minimal	Minimal	Thin layer	Developed/gives smooth and firm feel	Gives smooth bony contours	Gives smooth and less defined bony contours	Give smooth and poorly defined bony contours	Large fat deposits can alter posture/ ambulation
Abdomen	---	---	---	---	---	---		Pendulous	Difficult to palpate
Fat pads: abdominal, axillary, inguinal	---	---	---	---	---	Maybe small abdominal fat pad	Fat pads (all regions) start to accumulate	Prominent	Very prominent and large

Figure 2. BCS chart developed by the veterinary team. This serves as a supplementary tool for BCS of NHPs, complementing Figure 1, aiming to standardise the scoring process for Animal Technicians to ensure a unified approach when assessing their physical health. The importance of having a harmonised methodology cannot be overstated. Variability in scoring can lead to inconsistent assessments that may compromise Animal Welfare and research outcomes (Clingerman & Summers, 2012). By utilising visual aids technicians are better equipped to make accurate evaluations based on observable criteria.

Recent observations indicated a decline in BCS of a stock female primate, while her overall bodyweight remained relatively stable. This phenomenon raises important questions regarding the physiological implications of body composition changes that may not be immediately reflected in weight metrics alone. In this specific case, the involvement of veterinary professionals was prompted by the notable decrease in BCS, despite stable bodyweights (Figure 3). Vets found that the animal had liquid faecal matter residue over her tail, her eyes were sunken, as well as her skin tenting on her chest (indicators of dehydration). Her temperature was 39.7°C.

Following standard protocols, faecal samples were collected for analysis to ascertain potential underlying health concerns contributing to the observed condition. The results indicated the presence of Campylobacter spp. known to cause gastrointestinal distress and impact nutrient absorption. This diagnosis underscored the importance of comprehensive assessments that extend beyond mere bodyweight tracking and highlighted how subtle changes can signal significant health challenges. Consequently, appropriate veterinary intervention was initiated involving targeted medicinal treatment for Campylobacter infection, including supplements and rehydration fluids a well as a course of antibiotics.

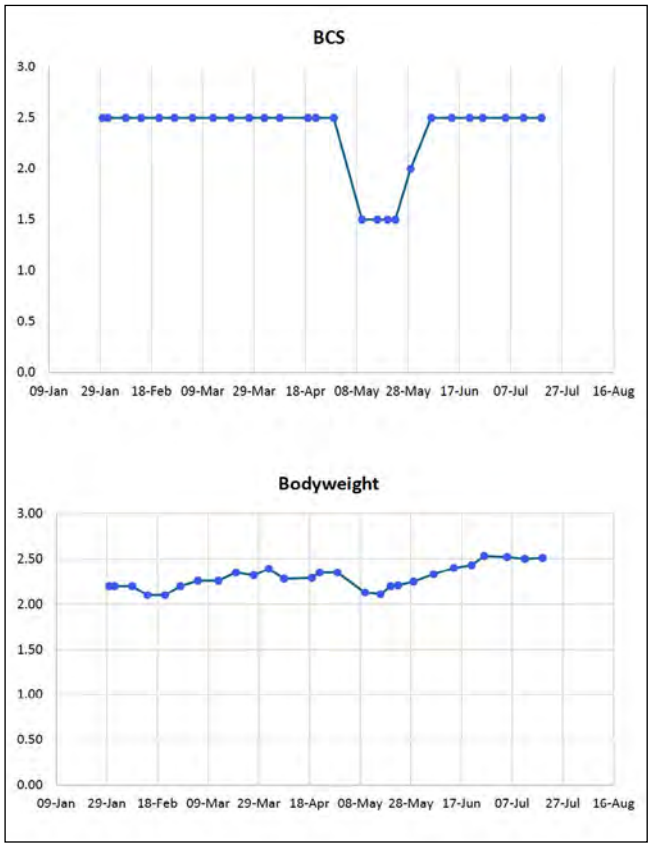

Figure 3. Body composition changes of a female stock NHP from Labcorp Huntingdon. Despite notable alterations in body composition, technicians proficient in BCS did not observe significant fluctuations in her bodyweight, alleviating concerns regarding her health status. This discrepancy emphasises the importance of comprehensive assessments beyond mere weight metrics.

Moreover, the integration of these assessments into routine care protocols and performed weekly can enhance overall Animal Welfare by guiding dietary adjustments and veterinary interventions. By utilising bodyweight monitoring alongside BCS evaluations, we can create individualised regimens tailored to each macaque's specific needs. This comprehensive approach not only supports the immediate health of macaques but also contributes to their long-term wellbeing by ensuring they remain within healthy physiological parameters, making for consistent scientific models.