



# Body Condition Scoring and other methods to estimate body composition in animals

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# Estimate body composition



WHY?



# Quantitative and semi-quantitative analyses of body composition

- Most precise: Chemical analysis of tissues of dead animals after desiccation
- Non-invasive quantitative methods
  - Bioelectrical impedance analysis (BIA)
  - Radioisotope total body water (TBW) analysis
  - Dual energy X-ray absorptiometry (DXA)
  - Morphometric measurements
  - BCS

# Bioelectrical impedance analysis (BIA)

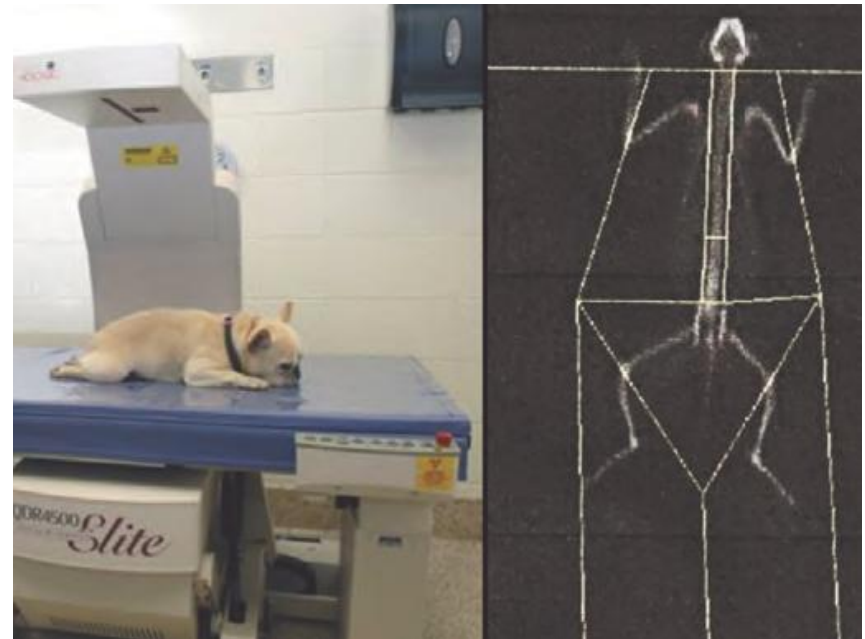
- Based on the concept that extra- and intracellular compartments in the body contain conducting ions
- Approach: High frequency (>50 Hz) current pass through fluid compartments to calculate TBW volume as a linear function of resistance
- Pro: is used to estimate % body fat (BF) in normal and overweight humans
- Contra: Increased adipose tissue accumulation require higher frequencies: 50 Hz doesn't penetrate all -> falsely lowered %BF, has not proven reliable in dogs & cats in most settings

# Radioisotope total body water (TBW) analysis

- Principle: Water is distributed in all parts of the body - except fat
- Measurement of total body water (TBW) by using stable isotopes like deuterium oxide
- Approach:
  1. Ingestion of known dose of isotopic
  2. Elapsing of time to allow equilibration within the body water
  3. Sample of blood, or urine, or saliva for analysis of the isotope concentration
  4. Calculation
    - Direct calculation of total body water
    - Indirect calculation of body fat (body weight – total body water)
- Pro: High correlation to carcass desiccation results
- Contra: Tends to overestimate TBW and is considered difficult and time-consuming -> is not a practical clinical tool

# Dual energy X-ray absorptiometry (DEXA)

- Method: X-rays at two levels are released as a beam and exhibit attenuation
- > X-rays of different energy levels are impeded differently by bone mineral, fat and lean tissue
  - > calculate the quantity of each tissue in each area scanned
  - > three compartments: bone mineral, fat tissue and lean tissue



# DEXA

- Requirements:
  - Expensive specialised equipment
  - Deep sedation/anaesthesia (no movement)
  - ~10-20 min/animal



# DEXA

- Pro: DEXA is useful for in vivo estimation of body composition in healthy dogs and cats
- Contra:
  - Possible inaccuracy
    - Obese subjects have increased tissue depth
    - High hydration level leads to overestimation of fat content
      - Since DEXA assumes also a set fat-free mass water content
  - Sedation
  - **Equipment!**



# Morphometric measurements in dogs and cats

- Measuring various areas of the body with a tape measure (non-invasive)
- Validated from the University of Tennessee, College of Veterinary Medicine in cooperation with Hill's
  - Assessment: Morphometric measurements (MM), BCS 5 –point, BFI, DEXA in dogs (20-65% BF) and cats (25-62% BF)
    - MM and BFI better than BCS
- Assesses accurately > 30% BF

# Morphometric Measurement Instructions

## CATS

### Circumferences

### Lengths



#### 1. Head circumference

Measure circumference by placing the tape equidistant between the eyes and ears at the widest part of the head.

\_\_\_\_\_ cm

Enter measurements in centimeters



#### 2. Thoracic circumference

Measure the girth at the level of the heart (~ 6th – 7th rib, just behind elbow).

\_\_\_\_\_ cm

Enter measurements in centimeters



#### 3. Front leg circumference

Measure circumference at the midpoint between the carpus and the elbow.

\_\_\_\_\_ cm

Enter measurements in centimeters



#### 4. Front leg length

Measure from the proximal edge of the central foot pad to the point of the elbow (olecranon process). Carpus must be straight.

\_\_\_\_\_ cm

Enter measurements in centimeters



#### 5. Hind leg length

Measure from the proximal edge of the central foot pad to the tip of the hock (dorsal tip of the calcaneal process). Tarsus must be straight.

\_\_\_\_\_ cm

Enter measurements in centimeters



#### 6. Body length

Starting from the base of the tail measure along the dorsal midline following the contours of the back, neck and head to the proximal edge of the nose pad.

\_\_\_\_\_ cm

Enter measurements in centimeters

# Morphometric Measurement Instructions

## DOGS

### Head



#### 1. Head length

Measure from the level of the medial canthus equidistant between the eyes to the external occipital protuberance.

\_\_\_\_\_cm

Enter measurements in centimeters



#### 2. Head circumference

Measure circumference by placing the tape equidistant between the eyes and ears at the widest part of the head.

\_\_\_\_\_cm

Enter measurements in centimeters

### Legs



#### 3. Front leg length

Measure from the proximal edge of the central foot pad to the point of the elbow (olecranon process). Carpus must be straight.

\_\_\_\_\_cm

Enter measurements in centimeters



#### 4. Hind leg length

Measure from the proximal edge of the central foot pad to the tip of the hock (dorsal tip of the calcaneal process). Tarsus must be straight.

\_\_\_\_\_cm

Enter measurements in centimeters

# Internet tool: Healthy Weight Protocol for dogs & cats

[www.hwp.hillsvet.com](http://www.hwp.hillsvet.com)

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## When words fail, numbers talk

INTRODUCING THE HILL'S HEALTHY WEIGHT PROTOCOL



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All it takes is the pet's weight and a few easy measurements to accurately determine each pet's ideal weight, body fat percentage and a customized feeding plan for lasting weight loss success.

Two simple steps. One easier conversation.

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Best viewed in Firefox, IE7 or IES

 Developed and validated in partnership with veterinarians at the University of Tennessee

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CLIENT: Rüdiger Schrottenhammer

FRANZ  
MALE 6 YRS.  
CURRENT WEIGHT: 35 KG



[PROFILE](#)

### HEALTHY WEIGHT CALCULATOR

MEASURE AN OVERWEIGHT PATIENT TO DETERMINE ITS HEALTHY TARGET WEIGHT

Weight (current)  lbs kg

Head Length  cm ☒


Head Circumference  cm ☒

Front Leg Length  cm ☒

Hind Leg Length  cm

[CALCULATE](#)

[SKIP THIS STEP](#)  
ESTIMATE BODY FAT INSTEAD



Use tailor's tape to measure from the external occipital protuberance to the point equidistant between the eyes.

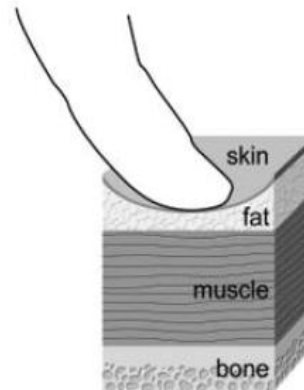
# Body Condition Scoring (BCS)

- Most common in small animal clinical practice
- Subjective, semi-quantitative method of evaluating body fat and muscle
- Developed for production (cattle, sheep, goats) and companion (dogs, cats, horses) animals

# Fat or Muscle?

## Muscle Condition Scoring

- Evaluation of muscle mass
  - Visual examination
  - Palpation
  - Of
    - Temporal bones
    - Scapulae
    - Ribs
    - Lumbar vertebrae
    - Pelvic bones



# Reliability of Body Condition Scoring

- The usefulness and reliability are dependent on 3 aspects:
  - Repeatability
    - Repeatability is the ability of an assessor to assign the same score for the same animal during repeated examinations, Repeatability is an assessment of within-assessor variability or within-assessor precision.
  - Reproducibility
    - Ability of 2 or more assessors
  - Predictability



Alberto Giacometti, „Le chien“ 1951




# **BODY CONDITION SCORES IN DOGS AND CATS**



# BCS in dogs and cats

- Multiple scales exist
  - Nine –point BCS validated by DEXA
  - Five-point system
- Problems:
  - No accurately prediction  $> 45\%$  BF
  - Differentiation fat - muscle
  - Growth (too heavy but not fat)

# 9-point BCS in dogs

TOO THIN	1	Ribs, lumbar vertebrae, pelvic bones and all bony prominences evident from a distance. No discernible body fat. Obvious loss of muscle mass.		1
	2	Ribs, lumbar vertebrae and pelvic bones easily visible. No palpable fat. Some evidence of other bony prominence. Minimal loss of muscle mass.		2
	3	Ribs easily palpated and may be visible with no palpable fat. Tops of lumbar vertebrae visible. Pelvic bones becoming prominent. Obvious waist and abdominal tuck.		3
IDEAL	4	Ribs easily palpable, with minimal fat covering. Waist easily noted, viewed from above. Abdominal tuck evident.		4
	5	Ribs palpable without excess fat covering. Waist observed behind ribs when viewed from above. Abdomen tucked up when viewed from side.		5
TOO HEAVY	6	Ribs palpable with slight excess fat covering. Waist is discernible viewed from above but is not prominent. Abdominal tuck apparent.		6
	7	Ribs palpable with difficulty; heavy fat cover. Noticeable fat deposits over lumbar area and base of tail. Waist absent or barely visible. Abdominal tuck may be present.		7
	8	Ribs not palpable under very heavy fat cover, or palpable only with significant pressure. Heavy fat deposits over lumbar area and base of tail. Waist absent. No abdominal tuck. Obvious abdominal distention may be present.		8
	9	Massive fat deposits over thorax, spine and base of tail. Waist and abdominal tuck absent. Fat deposits on neck and limbs. Obvious abdominal distention.		9

The BODY CONDITION SYSTEM was developed at the Nestlé Purina Pet Care Center and has been validated as documented in the following publications:

Mawby D, Barlges JV, Moyers T, et al. Comparison of body fat estimates by dual-energy x-ray absorptiometry and deuterium oxide dilution in client owned dogs. *Compendium* 2001; 23 (9A): 70

Laflamme DP. Development and Validation of a Body Condition Score System for Dogs. *Canine Practice* Feb./March 1997; 22:10-14.

5 ideal body weight

5 equates to 20-25% body fat






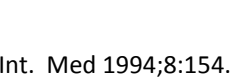
Each unit -> 10/15% + ideal body weight

Each unit -> 5% + body fat

7 equates to 20-30% overweight

9 equates to 40-45% body fat

# 9-point BCS in cats

TOO THIN	1	Ribs visible on shorthaired cats; no palpable fat; severe abdominal tuck; lumbar vertebrae and wings of ilia easily palpated.			1
	2	Ribs easily visible on shorthaired cats; lumbar vertebrae obvious with minimal muscle mass; pronounced abdominal tuck; no palpable fat.			2
	3	Ribs easily palpable with minimal fat covering; lumbar vertebrae obvious; obvious waist behind ribs; minimal abdominal fat.			3
	4	Ribs palpable with minimal fat covering; noticeable waist behind ribs; slight abdominal tuck; abdominal fat pad absent.			4
IDEAL	5	Well-proportioned; observe waist behind ribs; ribs palpable with slight fat covering; abdominal fat pad minimal.			5
TOO HEAVY	6	Ribs palpable with slight excess fat covering; waist and abdominal fat pad distinguishable but not obvious; abdominal tuck absent.			6
	7	Ribs not easily palpated with moderate fat covering; waist poorly discernible; obvious rounding of abdomen; moderate abdominal fat pad.			7
	8	Ribs not palpable with excess fat covering; waist absent; obvious rounding of abdomen with prominent abdominal fat pad; fat deposits present over lumbar area.			8
	9	Ribs not palpable under heavy fat cover; heavy fat deposits over lumbar area, face and limbs; distention of abdomen with no waist; extensive abdominal fat deposits.			9

5 ideal body weight

5 equates to 20-25% body fat

Each unit -> 10/15% + ideal body weight

Each unit -> 5% + body fat

7 equates to 20-30% overweight

9 equates to 40-45% body fat

# Traditional **BCS** only Validated for pets with **< 50% Body Fat**

5 Point BCS	% Body Fat	9 Point BCS	% Body Fat
3	16-25	5	23-27
4	25-35	6	28-32
5	36- <b>45</b>	7	33-37
		8	38-43
		9	<b>44-47</b>

# The Domino Effect of Starting with the **Wrong Ideal Weight**

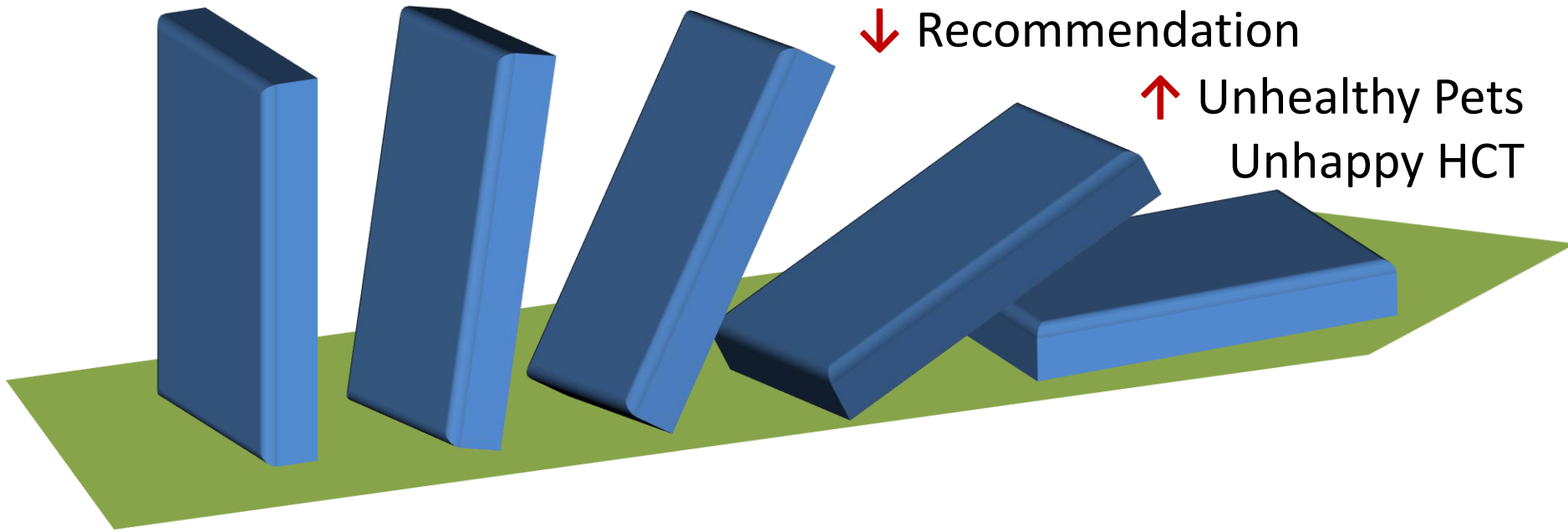
Inaccurate  
Starting  
Point

↓ Success

↑ Frustration

↓ Recommendation

↑ Unhealthy Pets  
Unhappy HCT





# Body Fat Index (BFI) versus BCS



## Body Fat Index (BFI): The next evolution of the BCS

- Ideal weight is an important measure of a pet's overall health. Determining a pet's ideal weight helps the pet owner understand the scope of the problem and gives them a clear goal to work toward
- The Body Fat Index (BFI) scale expands on the current Body Condition Score (BCS) scale for a more precise correlation between body fat percentage and the individual pet's ideal weight
- The BFI scale emphasizes body fat percentage to gauge the severity of a pet's weight problem



# 3 steps to determine ideal weight

Canine

- 1 Weigh the pet
- 2 Determine the pet's body fat percentage using images and descriptors on the reverse side.
- 3 Establish ideal weight using this chart.

Current Weight (kg)	Ideal Body Weight (kg)					
	20% Body Fat	30% Body Fat	40% Body Fat	50% Body Fat	60% Body Fat	70% Body Fat
4.5	4.5	4.0	3.4	2.9	2.3	1.7
5.0	5.0	4.4	3.8	3.1	2.5	1.9
5.4	5.4	4.8	4.1	3.4	2.7	2.0
5.9	5.9	5.2	4.4	3.7	2.9	2.2
6.4	6.4	5.6	4.8	4.0	3.2	2.4
6.8	6.8	5.9	5.1	4.3	3.4	2.5
9.1	9.1	7.9	6.8	5.7	4.5	3.4
11.3	11.3	9.9	8.5	7.1	5.7	4.3
13.6	13.6	11.9	10.2	8.5	6.8	5.1
15.9	15.9	13.9	11.9	9.9	7.9	5.9
18.1	18.1	15.9	13.6	11.3	9.1	6.8
20.4	20.4	17.9	15.3	12.7	10.2	7.7
22.7	22.7	19.9	17.0	14.2	11.3	8.5
24.9	24.9	21.8	18.7	15.6	12.5	9.3
27.2	27.2	23.8	20.4	17.0	13.6	10.2
29.5	29.5	25.8	22.1	18.4	14.7	11.1
31.8	31.8	27.8	23.8	19.9	15.9	11.9
34.0	34.0	29.8	25.5	21.3	17.0	12.7
36.3	36.3	31.8	27.2	22.7	18.1	13.6
38.6	38.6	33.7	28.9	24.1	19.3	14.5
40.8	40.8	35.7	30.6	25.5	20.4	15.3
43.1	43.1	37.7	32.3	26.9	21.5	16.1
45.4	45.4	39.7	34.0	28.3	22.7	17.0
47.6	47.6	41.7	35.7	29.8	23.8	17.9
49.9	49.9	43.7	37.4	31.2	24.9	18.7
52.2	52.2	45.6	39.1	32.6	26.1	19.5
54.4	54.4	47.6	40.8	34.0	27.2	20.4
59.0	59.0	51.6	44.2	36.9	29.5	22.1
63.5	63.5	55.6	47.6	39.7	31.8	23.8
68.0	68.0	59.6	51.0	42.5	34.0	25.5
72.6	72.6	63.5	54.4	45.4	36.3	27.2

Ideal body weights are calculated using current weight and Body Fat Index

# 3 Steps To Determine Ideal Weight

**Step 1**  
Weigh the pet.

34 kg

**Step 2**  
Determine the pet's  
Body Fat Percentage  
using images &  
descriptors below.

**Step 3**  
Establish ideal weight using  
chart on reverse side.

**20**

15-25% Body Fat

**30**

25-35% Body Fat

**40**

35-45% Body Fat

**50**

45-55% Body Fat

**60**

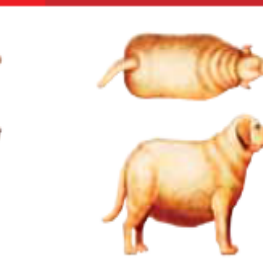
55-65% Body Fat

**70**

65-75% Body Fat



LOW RISK



HIGH RISK

## Ribs

Slightly prominent.  
Easily felt.  
Thin fat cover.

## Shape From Above

Well proportioned lumbar waist.

## Shape From the Side

Abdominal tuck present.

## Shape From Behind

Clear muscle definition,  
smooth contour.

## Tail Base Bones

Slightly prominent.  
Easily felt.

## Tail Base Fat

Thin fat cover.

## Ribs

Slightly to not prominent.  
Can be felt.  
Moderate fat cover.

## Shape From Above

Detectable lumbar waist.

## Shape From the Side

Slight abdominal tuck.

## Shape From Behind

Losing muscle definition,  
rounded appearance.

## Tail Base Bones

Slightly to not prominent.  
Can be felt.

## Tail Base Fat

Moderate fat cover.

## Ribs

Not prominent.  
Very difficult to feel.  
Thick fat cover.

## Shape From Above

Loss of lumbar waist, broadened  
back.

## Shape From the Side

Flat to bulging abdomen.

## Shape From Behind

Rounded to square appearance.

## Tail Base Bones

Not prominent.  
Very difficult to feel.

## Tail Base Fat

Thick fat cover.  
May have a small fat dimple.

## Ribs

Not prominent.  
Extremely difficult to feel.  
Very thick fat cover.

## Shape From Above

Markedly broadened back.

## Shape From the Side

Marked abdominal bulge.

## Shape From Behind

Square appearance.

## Tail Base Bones

Not prominent.  
Extremely difficult to feel.

## Tail Base Fat

Very thick fat cover.  
Fat dimple or fold present.

## Ribs

Not prominent.  
Impossible to feel.  
Extremely thick fat cover.

## Shape From Above

Extremely broadened back.

## Shape From the Side

Severe abdominal bulge.

## Shape From Behind

Square appearance.

## Tail Base Bones

Not prominent.  
Impossible to feel.

## Tail Base Fat

Extremely thick fat cover.  
Large fat dimple or fat fold.

## Ribs

Unidentifiable.  
Impossible to feel.  
Extremely thick fat cover.

## Shape From Above

Extremely broadened back,  
bulging mid-section.

## Shape From the Side

Very severe abdominal bulge.

## Shape From Behind

Irregular or upside down pear shape.

## Tail Base Bones

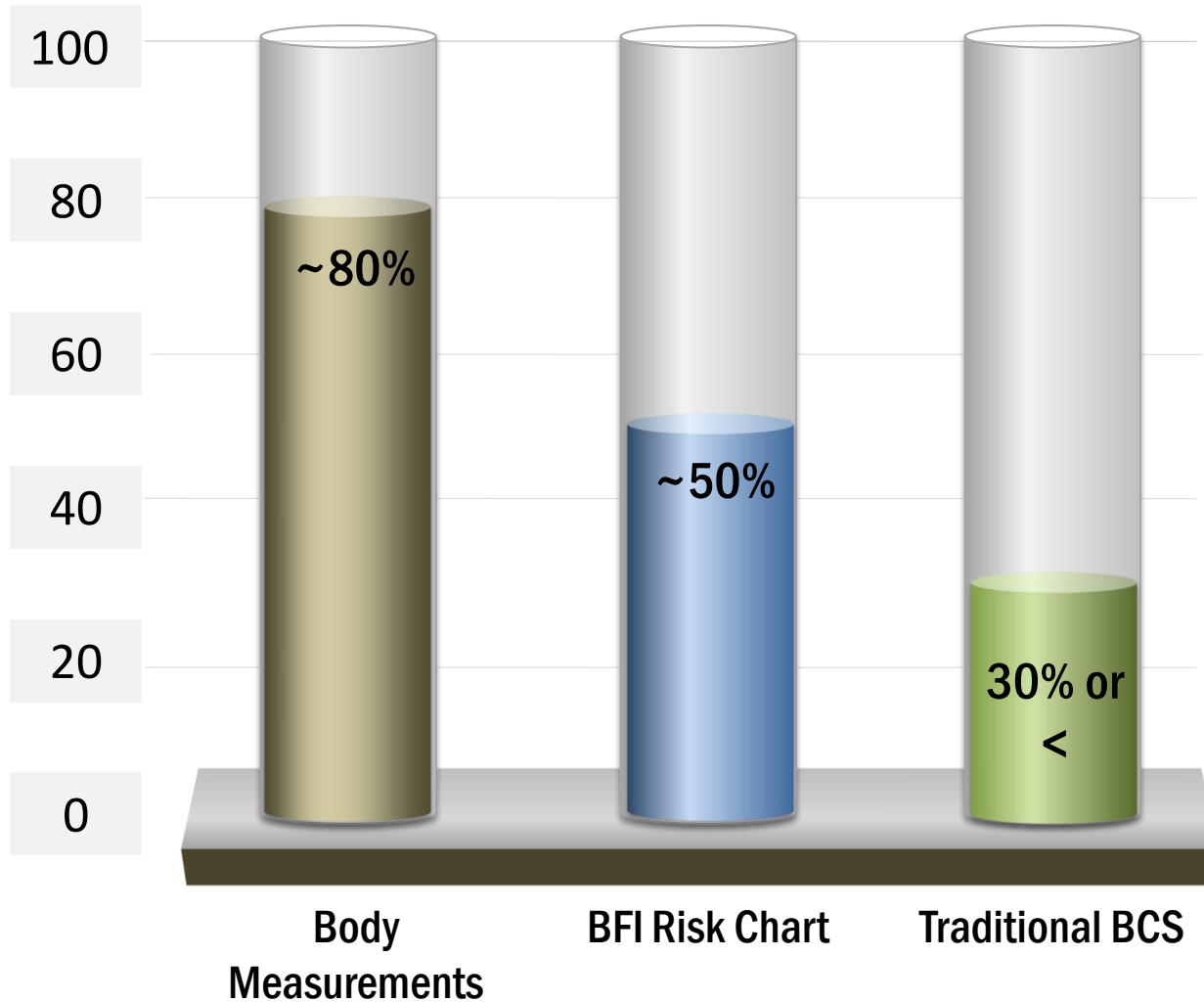
Unidentifiable.

## Tail Base Fat

Extremely thick fat cover.  
Large fat folds or pads.



# Relative Accuracy (+- 10% DEXA) of Predicting Ideal Weight



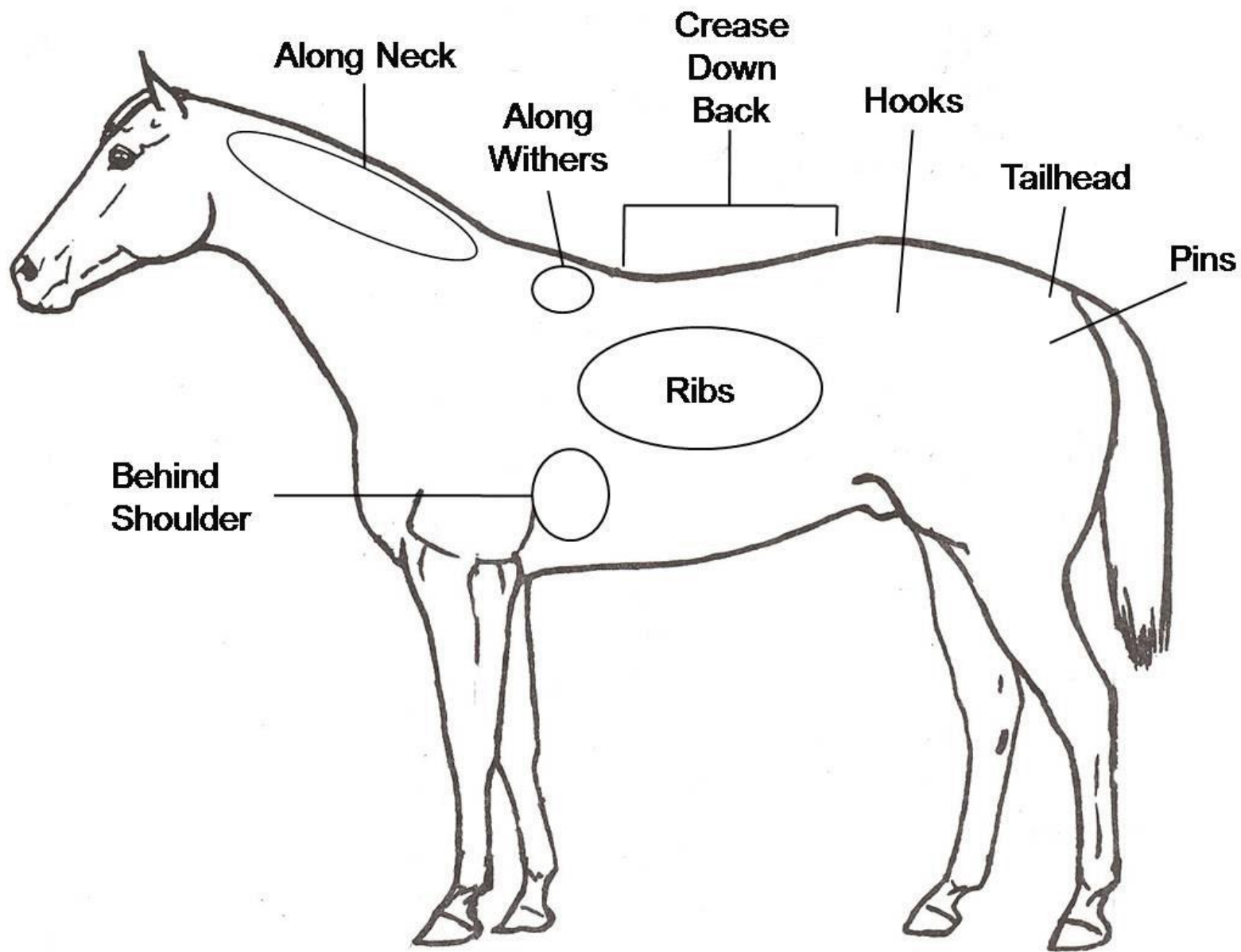
# **BODY CONDITION SCORE IN HORSES**

# BCS in horses



Often used standard system:  
HENNEKE et al. (1983)

- Evaluated on 20 adulten Quarterhorse mares
- The rating is based on palpation and visual assessments of fat deposits at several areas
- Scale of 1 to 9 for their fat/muscle content
  - 1 poor, 9 extremly fat



Areas checked in Henneke scoring system

## Score Condition

- |   |                   |  |
|---|-------------------|--|
| 1 | Poor              | Extremely emaciated; no fatty tissue; vertebrae, ribs, tail head, and bones of withers, shoulder, and neck are visible   |
| 2 | Very Thin         | Emaciated; slight tissue cover over bones; vertebrae, ribs, tail head, and bones of withers, shoulder, and neck are visible  |
| 3 | Thin              | Slight fat cover over body; individual vertebrae and ribs no longer visibly discernible; withers, shoulders, and neck do not appear overly thin                      |
| 4 | Moderately Thin   | Ridge of spine and outline of ribs are visible; tail head may or may not be visible depending on the breed; withers, shoulders, and neck do not appear overly thin   |
| 5 | Moderate          | Spine and ribs cannot be seen however ribs can be felt; tail head is spongy; withers, shoulders, and neck are rounded and smooth                                     |
| 6 | Moderately Fleshy | Slight crease down spine; ribs and tail head feel spongy; fat deposits along withers and neck and behind shoulders   |
| 7 | Fleshy            | Crease down spine; ribs have fat filling between them; tail head spongy; fat deposits along withers and neck and behind shoulders                                    |
| 8 | Fat               | Apparent crease down spine; ribs difficult to feel; soft fat surrounding tail head; fat deposits along withers, behind shoulders, and on inner thighs; neck is large |
| 9 | Extremely Fat     | Obvious crease down spine; patchy fat on ribs; bulging fat on tail head, withers, behind shoulders, and on neck; fat fills in flank and on inner thighs              |

# The ideal BCS - Henneke

Depend on the stage of production

- 4: horses in heavy race training
- 5: for growing and riding horses
- 6: mares going into the breeding season
- 7: Before foaling

Things to consider:

- Fed free-choice hay -> “hay belly”
- Not all horses are proportioned equally
- Growth and breeds

# Different breeds

**Quarter horse**



**Standard breed  
(Deutsches Warmblut)**





Mean BCS (Henneke) at individual areas in **standard breed horses**

$n = 40$ ,  $\mu = 5.9$ ,  $\sigma = 1.0$



# BCS 9



# BCS 1





# BCS 7



Same Horse (BCS 1) just 9 month later, with hay + oat in open stabling with free movement but no training

# Conclusion

One of the key elements of a successful feeding plan is to estimate the ideal body weight. The vets and their health care team should be aware of the most accurate and doable method they can use for their patients.



# Additional references

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# Thank you!

