International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(6): 749-754

Received: 22-09-2019
Accepted: 24-10-2019

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Body condition scoring of swine: A review

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Abstract
Body condition scoring (BCS) is a manage mental tool used by producer to optimize production, evaluate health and assess the nutritional status of pigs and is measured by subjective (manual body scoring) and objective methods (Sow caliper, Flank to flank & Renco Lean Meater) (Young & Aherne, 2005). The BCS score ranges from 1 – 5. BCS 1 indicate extreme emaciation, whereas, BCS 5 stands for extreme obesity while at BCS 3 the reproductive performance of sow is optimum. The BCS at weaning, farrowing and gestation affect the litter size at birth, birth weight, growth rate, survival-to-weaning and piglet mortality. Prolonged farrowing, stillbirth, secondary uterine inertia and higher preweaning mortality are observed at higher BCS in pigs. Whereas, in low BCS, shoulder injury and acyclic condition of ovaries are more common. While optimum BCS of pig increases the chances of healthy and viable piglet in the litter. BCS also influence the lameness which affects reproductive performance in pig. Moreover to this, it is also affected by the seasonal changes. Therefore, it can be concluded that maintenance of optimum BCS can improve the reproductive performance of swine besides increasing the life span of swine.

Keywords: Body condition score, subjective methods, objective methods, performances

Introduction
In global meat production, the contribution of pork is about 10%. The pig industry is well established with annual turnover of 394 million tones. Besidesthe significant achievements of pig industry, it also bears some economical losses such as heavy piglet mortality, reproductive disorders, shoulder injury and lameness. Most of these problems are associated with improper management. The improper management can be minimized by measuring the body condition score of pig at certain periods. Body condition scoring is an important managemental tool which is used by producers to enhance production, monitor health and nutritional status. This managemental practice helps to assess amount of fat & muscle as body reserves in sow. Maintenance of sow in proper body condition score throughout their life can lead to more consistent reproductive performance. The body condition of sows, determined mostly by fat and protein reserves, directly affects their performance throughout the entire production period [46].Sows with body condition score of 4-4.5 increases the chances of pre weaning mortality of piglets [8]. Sows with low body condition score suffers from reduced conception rates, increase of weaning to oestrus interval, increases the occurrence of shoulder lesion [3, 7, 39, 57] during nursing of her piglets. In case of improper BCS, difficult farrowing, poor rebreeding performance & high culling rates were observed. Optimum body condition of the sow at farrowing increases the chance to produce heavy and viable piglets [38]. Sows that are not in proper body condition were more likely to develop leg abnormality like hoof cracks and white line damage [25] that lead to lameness [3, 27] and reduced sow life span [26]. Pigs having BCS 5 suffered more from stillbirth due to the deposition of fat around the birth canal, this condition if stayed for long time lead to prolonged gestation [40] and secondary uterine inertia [16].

What is BCS?
It is defined as the amount of fatty material in respect to the amount of non-fatty matter in the body of living animals. BCS is associated with chemical fat in the body. The BCS can be evaluated by subjective and objective methodsof scoring [33].

Factors affecting the body condition scoring of pig
There are three major factors which must be considered while scoring body condition of an animal. They are:

Gut fill
The amount of feed and water present in gut and stages of pregnancy also affects the BCS of swine. Sow appears fatty at full gut & advance pregnancy can be confused with higher BCS. While fasting swine appears thin and can be confused with low BCS [34].

Amount of hair
The amount/quantity of hide, hair, or wool cover on swine also influences the BCS. The higher amount of hide, hair or wool on swine body makes it difficult to score the animal without manual palpation of those areas [34].

Amount of muscle
If pig becomes more round, it can develop confusion with smoothness due to fat deposition. Likewise, little muscled swine can be mistakenly viewed as thin. To observe the muscularity, the area through the center of the round (or hindquarter) is assessed as it is least affected by fat. Swine with heavier musculature tend to bulge more of whole body. In contrast, animals that are angular tend to be lighter muscled [34].

Recording of BCS
The BCS in pigs are recorded at following stages:

At farrowing
It is important for the litter size at birth, piglet birth weight, litter size at weaning, weaning weight of piglet, survival to weaning and pre-weaning mortality at optimum body condition scoring.

At weaning
It is essential for the sow's to produce sufficient amount of milk to nurse the piglets and reduce the piglet mortality at optimum BCS, whereas improper Body condition scoring lead to reduce milk production and increased piglet mortality [35]. Low BCS had adverse effect on the productivity and reproduction of sows [29].

At mid – gestation
It is done at 80 days of pregnancy to avoid embryo mortality in early gestation [10].

Methods to measure BCS in pig
It is done by two methods *viz*; subjective and objective methods. In subjective method, it is done manually by careful visual examination & palpation of pelvic bone, ribs, vertebrae and tail head of pig. Whereas, objective method includes 3 methods i.e. sow caliper method, lean meater and flank to flank measurement.

Subjective Method
It includes manual body condition scoring system.
In this method, BCS is measured by using finger or by applying hand pressure at ribs, pelvic bone, vertebrae & tail head.BCS is measured by careful visual examination as well as palpation of recommended body points of pigs. These points are included to measure BCS due to presence of fat tissue between skin and bone. BCS is subjective practice but is quite accurate when performed by trained evaluators. The points used on the sow body are those areas where only fat tissue between the skin and bones are present. The scale recommended to record BCS in subjective method varies from 1 to 5 points. In this procedure, the BCS can be increased by an increment of 0.5 [19]. The producers main aim is to have stable body condition score (3) of sow from mid-gestation to farrowing. The brief detail of body condition scoring ranging from1 to 5 is given in table.1.

Table 1: Overview of body condition scoring of swine [34]

Score	Vertebrae	Ribs	Pelvic bones	Tail head	External appearance
1	Prominent and sharp throughout the length of the backbone	Individual ribs very prominent	Veryprominent pelvic bones	Deep cavity around the tail head	Emaciated
2	Prominent vertebrae	Difficult to see individual ribs	Pelvic bones with slight cover	Cavity around tail head	Thin
3	Visible over the shoulder	Covered but can be felt	Pelvic bones covered	Tail head slightly cover	Ideal
4	Felt only with firm pressure	Very difficult to feel any ribs	Pelvic bones can only be felt with firm pressure	No cavity around tail	Fatty
5	Impossible to feel vertebrae	Not possible to feel ribsby palpation	Pelvic bones are impossible to feel	Root of tail sets deep in surrounding fat	Obese

Optimum body condition scoring of swine at different stages of production
In swine, body condition scoring varies with different stages of production. At farrowing the body condition score should range from 3.0 to 4.0 for optimum reproductive performances. Sow looses their body weight by mobilizing energy reserve during lactation [32] and reach the BCS of 2.5 to 3.5.Change in the BCS of sow during lactation is also influenced by litter size [50]. Likewise, at weaning, the BCS reaches to 2.5 – 3.0 [6].

Adjustment of feed intake according to body condition score
The amount or quantity of feed given to the sow to attain optimum weight for the targeted body condition score of 2.5 at mating should not be neglected. However, in case sow loose more body weight and lead to lower body condition score from the optimum (2.5) at weaning, then it is necessary to increase the amount of feed to achieve the optimum body condition for next farrowing. While, the sow is overweight or BCS > 3.0 at weaning, then it is recommended to reduce amount of feed given to attain optimum body condition. The main benefit in identifying these sows early in gestation is that ample time will be available to get them into proper condition. Feeding adjustment is not important in last one third of gestation. It can be used to adjust thedaily feed allowances of gestating sows based on their body condition score. Sow condition can be re-evaluated approximately after every two weeks and feeding levels are adjusted accordingly. Table 2 provides guidelines on feeding adjustments based on BCS [1].There are few limitations with this system of monitoring sow condition and are given below.

A. The body condition score and back-fat are poorly linked. Sows having a condition score of 3 have back-fat ranging from 8 to 31 mm [17, 55].
B. Body condition scoring of sows is influenced by overall condition of the herd. Moreover, different evaluators will assign different condition scores and feeding levels to the same sow [55].
C. There is no scientific concept for assignment of feeding levels to a particular condition score.

Table 2: Feeding adjustment based on body condition score (BCS)

BCS	Change in feed (grams/day)
1.0	+ 500
1.5	+ 400
2.0	+ 300
2.5	+ 200
3.0	0
3.5	- 200
4.0	- 300
4.5	- 400
5.0	- 500

Advantages and disadvantages of subjective methods

Advantages

The advantages of subjective methods are as:

1. No special instrument is required.
2. It is inexpensive method.
3. It can be used on large commercial scale.

Disadvantages

The disadvantages of subjective methods are as:

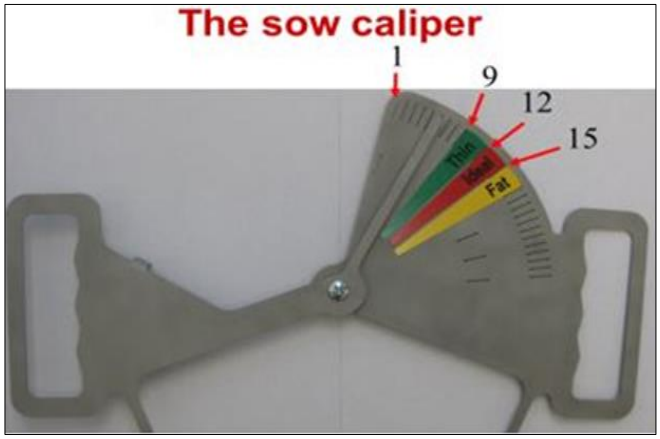
1. Thin sow possess high back-fat [31].
2. It is an inaccurate method that largely depend on scoring skill of person.
3. Less attention is paid to the evaluation when the visual scoring has to be performed in the same herd over time.
4. Difficulties of evaluation occur, when more than 2 breeds of pig will be present in herd due to variation in conformation among breeds [47].

Objective method

It is based on the facts and information and is precise method to measure the body condition scoring of pig. It includes 3 methods such as sow caliper method, lean meater and flank to flank measurement. These body condition scoring tools would enable producers to optimize feed costs and maximize sow well-being. The methods are discussed below:

Sow caliper method

The sow body condition caliper was invented by Knauer and Baitinger [28] on 2015 (Fig 1). The sow caliper method is based on sow loose fat & muscle. Sow with body condition score 1 will have more angular back while, a sow with body condition score of 5 will have more flatter and wide back. The caliper will be tested on three locations of the sows back i.e. behind the shoulder, middle of the back and at the last rib. Last ribs are more preferred location to measure BCS because a more consistent anatomical location will be available to locate the point of measurement. This method is fast and accurate to measure sow body condition. Sow caliper method reduces known BCS variations among individuals [4]. First the evaluator stands behind the sow and find the last rib carefully by palpation. Then apply two arms of the caliper line up with the last rib and rest softly on the edge of the loin of sow and take reading.



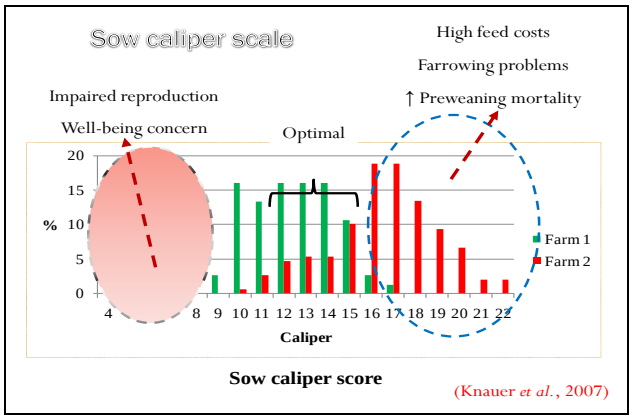


Fig 1: The sow calliper method [24]

Interpretation of sow caliper scale

The figure 1 shows that 12 to 15 sow caliper score is the best for optimum reproductive performance of sow and increases the chances of viable and healthy piglet. Whereas, score above 15 increases the feed wastage and such sows suffers from farrowing problems such as stillbirth, prolonged farrowing, secondary uterine inertia and increases the chances of pre-weaning mortality of piglets. In case of less than 12 sow caliper score, sow suffers from shoulder injury and acyclic ovaries condition.

The figure 2 shows that there is a relationship between piglet survival percentage and sow caliper score. At 12-15 sow caliper score, the piglet survival percentage is upto 90- 95 %, whereas score below and above this range will affect the piglet survival [24].

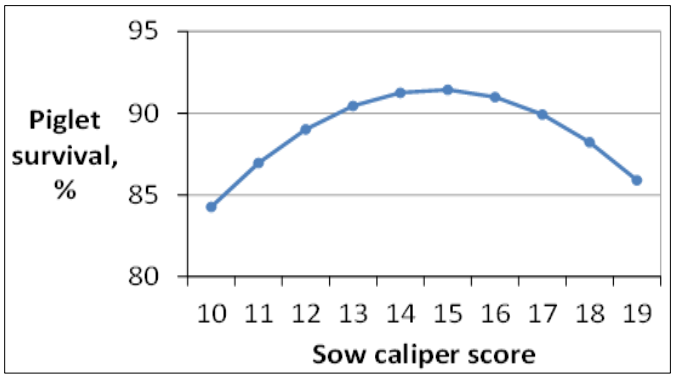


Fig 2: Relationship between sow caliper score and piglet survival [24]

Flank to flank measurement

It is easy & accurate method to estimate the body condition score. The BCS can be easily obtained with help of cloth tape into categories based on sow body weight [42]. In this method, the measurement is taken at the point where rear leg intersect with the body on one side of sow and same procedure is followed on the other side of sow. It is also important for calculating the energy requirement of sow during gestation for their maintenance and her foetal growth. Correlation of flank to flank measurement with BCS is given below in table 3.

Table 3: Correlation of flank to flank measurement with BCS [53]

Flank to flank (cm)	Weight category	Estimated weight (kg)	BCS
83 – 90	Very light	115 – 150	1
91 – 97	Light	150- 180	2
98 – 104	Medium	180-215	3
105 – 112	Heavy	215 -250	4
105- 112	Very heavy	250- 300	5

Renco lean meater

It is used to measure back-fat thickness which is directly related to body condition score. It is relatively expensive and durable machine for use in the sty. It works on the principles of the ultrasound. In this method an experienced person is required to measure the BCS. Lean meater consists of the probe & digital display. The probe is placed 7-9 cm away from the midline of last rib and measurement of back fat is taken carefully. Measurement displays on the digital display in inches or millimeter. The relationship between back-fat and BCS is tabulated in table 4.

Composition of Back-fat

In swine, it is subcutaneous fat that consists of water, collagen and lipid (triacylglycerol). The concentration of fatty acidsis also affected by the amount of feed intake & fat [49]. In addition, the quantity of fatty acids decides the cohesiveness & firmness of fatty tissue [48]. The nutritional quality of sow is determined by the concentration of fatty acidin back fat in the form of energy. The composition of water, collagen and lipid are influenced by thickness of subcutaneous fat, like lipid concentration will increase, when concentration of water and collagen will decrease. Composition of back fat in sow & boar is slightly different. The boar is composed of high water & collagen but less lipid as compared to sow [49].

Table 4: Relationship between back-fat and body condition score (BCS)

BCS	Back fat (in inches)	Back fat in millimeter (mm)
1	<0.6	< 15
2	0.6 – 0.7	15 – 18
3	0.7- 0.8	18 – 20
4	0.8- 0.9	20- 23
5	<0.9	>23
[12, 13, 24, 30, 41, 55]		

Sows with back-fat of 18 to 20 mm at farrowing with ad *libitum* feedingat lactationincreases the piglet growth rate in comparison to sows with a back-fat of less than 12 mm at farrowing that were restricted during lactation [51]. In agreement, Young and Aherne [53] reported that the sows with back-fat thickness of 19 mm at farrowing had shown slight loss of back fat during lactation due to loss of nutrients, as a result the 16 mm back fat at weaning will be achieved, which avoided the difficulty of rebreeding. While in case of sow having back fat more than 21 mm, there is decrease in feed intake during lactation and also affects the litter size and number of piglets born alive [54]. Likewise, the back fat of sow less than 16 mm lead to increase in the chances of stillborn as compared to the sow with back fat between 16 – 23mm [45]. To maximize the performances of sows, a back fat should be 19 – 20 mm at farrowing. The loss in body condition or back fat by 0.5 – 1.0 or 3-4 mm, respectively in lactation due to loss of nutrients result in loss of back fat at weaning which reaches to 13 -14 mm and is necessary for better reproductive performances [18, 43].10 – 15% of sow in total herd should be scanned at mid- gestation. The optimum back fat at mid – gestation of sow will be 13 mm. However, if sow does not reach optimum back fat at mid- gestation stage then feed the animal @ 0.5 kg/day and increase it to 1 kg/day after 100 days of gestation upto last 14 – 18 days of gestation.

There are three reasons to increase feeding level at mid-gestation:

1. To prevent sows from negative energy balance in late gestationaland to increase feed intake during this period that resultin extremely high catabolic state at farrowing.
2. Preparation of the upcoming lactation to increase feed intakeby stimulatingthe enzymes present in liver and intestines.
3. It allows prolactinrelease by increasing removal of progestrone at a faster rate and result in increased lactogenesis and reduced piglet mortality.

Effect of BCS onreproductive performance

The loss of BCS during lactation directly affects the reproductive performance of sow [44].There is slight loss of body weight or body condition during lactation which increases weaning to oestrous interval, while in case of heavy loss of BCS, there will be decrease in ovulation rate [56], conception rate [22, 23], second litter size [41] however, it increases the weaning to estrus interval [2, 20, 22, 23] and embryonic mortality.

Effect of BCS onacyclic ovary condition

Sows with BCS1suffer from acyclic ovaries condition more as compared to the sows with a BCS of 4. It is due to the body weight loss that tends to increase protein loss from these sows. The reduction in energy and protein consumption during lactation can disrupt or change the amount of signal from the hypothalamus of GnRH which affects the amount of release of LH and FSH and steriodogenesis of the ovary [5]. There will be limited follicular development and inability to complete recovery of reproductive organ of sow at weaning willfurther cause an increased piglet mortality in second parity. A low feed intake during lactation involves mobilization of body tissues and can lead to an excessive loss of body weight, decrement in sow longevity [15] as well as reproductive performances [37].

Effect of BCS on shoulder lesion

Sow with poor BCS will increases the chances of developing shoulder lesion. Sow having BCS less than 3 develop shoulder lesion more by 3.7 times as compared to sow with BCS more than 3. The exact reason lies in fewer amounts of cushion fat & muscle around tuber of spine of scapula. Likewise, pig with flank to flank measurement of less than 104 cm are more prone to develop shoulder lesion by 2.8 times as compared to sow having flank to flank measurement of 104.5 cm or more [3, 7, 24, 57].

Effect BCS on leg conformation

The BCS is directly related to feet & leg abnormality. Increase in the chances of rear & front heels lesion were observed with increase in the BCS of swine [24]. Similarly the hoof crack will increase with decrease in BCS, for which the exact reason is not known but it is due to the deficiency of biotin when the BCS is higher. On contemporary occurrence of white line damage in hoof & cracks in the wall of toe is more [9]. These abnormalities in leg & foot can increase the incidence of lameness [3] which reduces the reproductive performance as well as longevity [14].

Weather influences the body condition score

Weather also affects the body condition score of swine. Slightly higher body condition scores are observed during winter as the feed intake of pig will increases due to increase in the metabolic rate to cope from cold. Whereas, during summer the body condition score decreases due to increase in the temperature and relative humidity which leads to decrease in the feed intake of pigs [36].

Conclusion

Body condition scoring is an important tool to manage the sty. The optimum body condition score maintains and enhances the reproductive performances as well as increase the sow longevity. All systems describe the body reserves of animals i.e. the amount off at and muscle at key anatomical points. Even without knowing the intricacies of a specific system for a particular animal, one should be able to determine a thin animal, an over-conditioned animal or an animal that is near to optimum for body condition. It is important to adopt an efficient method to measure the BCS of swine for managing the sty.

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