

External Body Scores in Male Sakub Sheep Based on Different Physiological Age

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Abstract. This study aims to determine the external body score, including body condition score (BCS), body fat percentage (BFP), plumpness index (PI), and body conformation index (BCI), of male Sakub sheep at different physiological ages (lambs vs rams). The research was conducted from October to December 2023 in Pandansari Village, Paguyangan District, and Wanareja Village, Sirampog District, Brebes Regency, Central Java. The data were collected following purposive random sampling procedure and the Nomograph Harry King formula of which 118 male Sakub sheep (59 lambs and 59 rams) were sampled. The data were analyzed using the chi-square test to determine suitability or differences in each category and parameter. The results showed that the average values for lambs and rams are as follows: (1) body condition score of 3 ± 0.59 and 3.5 ± 0.50 , (2) body fat percentage of 13.72 ± 2.55 and 15.94 ± 2.22 , (3) plumpness index of 0.87 ± 0.02 and 0.88 ± 0.01 , and (4) body conformation index of 0.29 ± 0.02 and 0.30 ± 0.01 . It can be concluded that rams possess superior body condition and fat reserves, which may reflect their advanced physiological development and greater muscle mass relative to younger animals. This information is critical for optimizing management strategies in Sakub sheep production, particularly in breeding and selection programs aimed at enhancing productivity and carcass quality. Further research is warranted to explore the genetic and environmental factors influencing these traits.

Keywords: Male Sakub Sheep, External Body Score, Body Condition Score, Body Fat Percentage, Plumpness Index, Body Conformation Index.

Abstrak. Penelitian ini bertujuan untuk mengetahui *external body score* (*body condition score*, persentase lemak tubuh, indeks kebuguhan paha, dan indeks konformasi tubuh) domba Sakub jantan pada umur fisiologis yang berbeda (muda vs dewasa). Penelitian ini dilaksanakan pada bulan Oktober-Desember 2023 di Desa Pandansari, Kecamatan Paguyangan dan Desa Wanareja, Kecamatan Sirampog, Kabupaten Brebes, Jawa Tengah. Penelitian ini menggunakan *purposive random sampling* dan rumus Nomograf Harry King dengan jumlah domba Sakub jantan sebanyak 118 ekor (59 ekor domba Sakub muda dan 59 ekor domba Sakub dewasa). Data penelitian dianalisis menggunakan uji *chi square* untuk mengetahui kesesuaian atau perbedaan pada setiap kategori dan parameter. Hasil penelitian menunjukkan nilai rata-rata domba Sakub Jantan muda dan dewasa yakni *body condition score* $3 \pm 0,59$ dan $3,5 \pm 0,50$, persentase lemak tubuh $13,72 \pm 2,55$ dan $15,94 \pm 2,22$, indeks kebuguhan paha $0,87 \pm 0,02$ dan $0,88 \pm 0,01$, konformasi tubuh indeks adalah $0,29 \pm 0,02$ dan $0,30 \pm 0,01$. Dapat disimpulkan bahwa terdapat perbedaan yang signifikan pada penampilan *external body score* (*body condition score*, persentase lemak tubuh, indeks kebuguhan paha, dan indeks konformasi tubuh) pada domba Sakub Jantan muda dan dewasa. Domba Sakub jantan dewasa memiliki nilai *external body score* yang lebih besar dan tinggi daripada domba Sakub jantan muda.

Kata Kunci: Domba Sakub Jantan, *External Body Score*, *Body Condition Score*, Persentase Lemak Tubuh, Indeks Kebuguhan Paha, Indeks Konformasi Tubuh.

Introduction

The local sheep population in Indonesia is increasing alongside growing public awareness of the need for animal protein. Local sheep have significant production potential due to their adaptability to various climates, resistance to diseases and parasites, and their role as a genetic foundation for improving livestock quality and productivity (Utama et al., 2021).

The Sakub sheep is one of the local breeds officially recognized by the government through the Decree of the Minister of Agriculture of the Republic of Indonesia Number 882/KPTS/PK.010/M/12/2022 concerning the Determination of the Sakub Sheep Group. This breed results from crossbreeding Texel, Suffolk, Merino, and local sheep (Decree of the Indonesian Minister of Agriculture, 2022).

Table 1. Research data tabulation table

P	Lambs		Rams		T
	O	E	O	E	
P ₁	O ₁	E ₁	O ₁	E ₁	T ₁
P ₂	O ₂	E ₂	O ₂	E ₂	T ₂
P ₃	O ₃	E ₃	O ₃	E ₃	T ₃
Total (T)	59		59		118

Note: P = Parameters, T = Total, O = Observation Value, E = Expectation Value.

Sakub sheep in Brebes Regency, Central Java, have a large physique, giving them potential as a valuable genetic resource (Nurasih et al., 2022). As a local breed, Sakub sheep have not been extensively researched, particularly regarding their production performance. Production performance in livestock serves as a key predictor of productivity, especially for meat-producing animals. It can be assessed using External Body Scores, which include Body Condition Score (BCS), Body Fat Percentage (BFP), Plumpness Index (PI), and Body Conformation Index (BCI).

Increasing the physiological age of livestock (lambs and rams) is consistently accompanied by growth in external body dimensions, such as body length, shoulder height, chest girth, chest width, chest depth, and the length and width of the ears and tail. These dimensions are key factors in determining the external body score (Wattimena et al., 2014). Understanding the external body score is crucial in this research, as it not only contributes to scientific advancements but also serves as a predictor of Sakub sheep productivity. It can be used to estimate body weight, body fat percentage,

fatness levels, and body conformation. Therefore, studying the external body scores of male Sakub sheep at different physiological ages is essential.

Materials and Methods

The research used 118 male Sakub sheep, consisting of 59 lambs and 59 rams. The number of research samples was determined using the Harry King Nomograph formula. Lambs are 4–11 months old, and rams are more than 12 months old (Hutasoit et al., 2022). The research employed purposive random sampling from October to December 2023 in Pandansari Village, Paguyangan District, and Wanareja Village, Sirampog District, Brebes Regency, Central Java, Indonesia.

The research data were analyzed descriptively using the chi-square test to determine the suitability or differences in each category and its parameters (lambs and rams). Before testing, the data were tabulated according to the chi-square test provisions, as follows:

The parameters for each research variable in question are as follows:

Table 2. Body Condition Score (BCS) and Body Fat Percentage (BFP)

BCS Value	Body Fat Percentage (%)	Appearance
1	5.0	Very thin, the pelvic bones are very prominent, and there is no fat deposits.
1.5	7.2	Relatively the same as the appearance of BCS 1.
2	9.4	Looks thin and the pelvic bones protrude.
2.5	11.5	Relatively the same as the appearance of BCS 2.
3	13.7	Normally, the bones do not look thin, and fat begins to accumulate.
3.5	15.9	Relatively the same as the appearance of BCS 3.
4	18.1	Looks fat, bones do not stand out, fat accumulation tends to increase.
4.5	20.3	Relatively the same as the appearance of BCS 4.
5	22.5	Very fat, excess fat deposits.

Source: Meliana et al., (2022).

Table 3. Formula for calculating Plumpness Index (PI) and Body Conformation Index (BCI)

Plumpness Index	Body Conformation Index
$PI = \frac{\text{Loin Girth (cm)}}{\text{Loin Length (cm)}}$	$BCI = \frac{\text{Width of Chest (cm)}}{\text{Body Length (cm)}}$

Note: PI = Plumpness Index, BCI = Body Conformation Index.

Table 4. The range of values used each Plumpness Index (PI) and Body Conformation Index (BCI) parameters

Parameters	Plumpness Index		Body Conformation Index	
	Lambs	Rams	Lambs	Rams
Low	≤ 0.85	≤ 0.85	≤ 0.26	≤ 0.26
Medium	0.86-0.87	0.86-0.87	0.27-0.28	0.27-0.28
High	≥ 0.87	≥ 0.87	≥ 0.28	≥ 0.28

Source: Ramadhan et al. (2022).

1. Body Condition Score (BCS) and Body Fat Percentage (BFP)

Body Condition Score (BCS) reflects the physical condition of livestock, assessed both visually and through palpation. The scoring system ranges from 1 to 5 and is then estimated or adjusted to correspond with the body fat percentage based on the livestock's BCS value according to Meliana et al. (2022).

2. Plumpness Index (PI) and Body Conformation Index (BCI)

Plumpness index is one of the parameters for predicting livestock body size based on the size

of the loin. It is obtained from the ratio between loin girth and loin length. The body conformation index is another parameter for predicting livestock body size, based on chest dimensions. It is derived from the ratio between chest width and body length (Ramadhan et al., 2022).

Results and Discussion

Based on the research that has been carried out, the research results obtained are as follows:

1. General Condition

Table 5. Average of research variables in different villages

Research Variable	Lambs		Rams	
	Pandasari	Wanareja	Pandasari	Wanareja
BCS (1-5)	3 ± 0.56	3 ± 0.49	3.5 ± 0.51	3.5 ± 0.51
BFP (%)	13.70 ± 2.25	13.70 ± 2.25	15.90 ± 2.22	15.90 ± 2.22
PI	0.86 ± 0.02	0.88 ± 0.02	0.87 ± 0.01	0.89 ± 0.01
BCI	0.28 ± 0.02	0.30 ± 0.02	0.29 ± 0.01	0.31 ± 0.01

Note: BCS = Body Condition Score, BFP = Body Fat Percentage, PI = Plumpness Index, BCI = Body Conformation Index.

Table 6. Nutritional composition of feed ingredients

Village	WA (%)	DI (%)	DI (%)				
			CP	CFA	CF	Ash	EMWN
Pandansari	81.66	18.34	11.52	6.87	24.08	2.28	55.26
	81.36	18.64	12.66	6.85	25.42	2.69	52.37
Average	81.51	18.49	12.09	6.86	24.75	2.48	53.82
Wanareja	83.50	16.50	13.12	7.58	21.01	2.01	56.29
	83.90	16.10	13.04	7.52	22.86	2.14	54.44
Average	83.70	16.30	13.08	7.55	21.93	2.07	55.37

Note: WA = Water Content, DI = Dry Ingredients, CP = Crude Protein, CFA = Crude Fat, CF = Crude Fiber, EMWN = Extract Material Without Nitrogen.

2. Body Condition Score (BCS)

Table 7. BCS of male Sakub sheep in different categories and parameters

Parameters (BCS)	Lambs		Rams		Total
	OV (head)	EV (head)	OV (head)	EV (head)	
1	0	0	0	0	0
2	10	5	0	5	10
3	39	34	29	34	68
4	10	20	30	20	40
5	0	0	0	0	0
Total	59		59		118
Average	3		3.5		
SD	0.59		0.50		

Note: OV = Observation Value, EV = Expectation Value, SD = Standard Deviation.

Table 8. Chi square analysis on body condition score value

Degrees of Freedom	χ^2 Calculated	χ^2 Table	
		0.05	0.01
(5-1)(2-1) = 4	21.47	9.48	13.27

Lambs have a BCS of 3 ± 0.59 , while rams have a higher BCS of 3.5 ± 0.50 , indicating better body condition. This difference is attributed to physiological age, which impacts growth and development, as growth relates to physical size increase, and development to the maturation of body cells according to report by Sugiharto (2022). The BCS of both lambs and rams averages 3 or higher, indicating they are in ideal condition for fattening. BCS values of 3 and 4 are optimal for supporting production and reproduction needs.

The average BCS value in Wanareja Village is higher than in Pandansari Village (Table 5). This difference is due to variations in feed quality between the villages, particularly the protein content of the feed. The crude protein content in feed in Pandansari Village is 12.09 percent, while in Wanareja Village it is 13.08 percent (Table 6). This aligns with Hidayah (2016), higher feed protein content leads to greater daily body weight gain in livestock. This is because protein is a crucial nutrient that helps efficiently convert energy into muscle or meat.

3. Body Fat Percentage (BFP)

Table 9. Body Fat Percentage (BFP) of male Sakub sheep in different categories and parameters

Parameters (BFP - %)	Lambs		Rams		Total
	OV (head)	EV (head)	OV (head)	EV (head)	
5.0	0	0	0	0	0
9.4	10	5	0	5	10
13.7	39	34	29	34	68
18.1	10	20	30	20	40
22.5	0	0	0	0	0
Total	59		59		118
Average	13.70		15.90		
SD	2.55		2.22		

Note: BFP = Body Fat Percentage, OV = Observation Value, EV = Expectation Value, SD = Standard Deviation.

Table 10. Chi square analysis on Body Fat Percentage (BFP) value

Degrees of Freedom	χ^2 Calculated	χ^2 Table	
		0.05	0.01
(5-1)(2-1) = 4	21.47**	9.48	13.27

Lambs have an average body fat percentage of 13.70 ± 2.55 , while rams have an average value of 15.90 ± 2.22 . Based on these data, body fat percentage of rams is higher, indicating better body condition than lambs. This aligns with Meliana et al. (2022), the ideal or normal body fat percentage for livestock, based on BCS, is 13.70 percent at a BCS value of 3.

Some lambs do not have a BCS value of 3 (ideal) with a body fat percentage of 13.70 percent. This condition can hinder or reduce livestock productivity and performance. This aligns with Kurniawan et al. (2023), livestock with very thin bodies have insufficient fat reserves, leading to low reproductive rates. Fat serves as an energy reserve in the body, derived from nutrients in feed. A lack of adequate energy intake can result in delayed or stunted growth and reproduction in lambs.

The body fat percentage values at different physiological ages do not show large or significant differences. This is because the quality of the animal feed provided has a relatively similar nutritional composition (without concentrates), which corresponds to similar feed consumption or dry matter intake. Feed and dry matter consumption are linked to the growth of livestock body sizes and the daily increase in body weight. This aligns with Rostini and Zakir (2016), increased of the dry matter consumption is directly proportional to the

efficiency of feed use, including daily body weight gain, BCS, body fat percentage, feed digestibility, and the body's metabolic processes.

4. Plumpness Index (PI)

Lambs have an average plumpness index value of 0.87 ± 0.02 , while rams have an average plumpness index value of 0.88 ± 0.01 . Based on these data (Table 10), the plumpness index of rams is higher, indicating better body condition than lambs. A higher plumpness index indicates a larger or fatter loin. This aligns with Ramadhan et al. (2022), who stated that the plumpness index is influenced by loin length and loin girth. If the increase in loin girth exceeds that of loin length, the plumpness index value will be higher.

The plumpness index for lambs and rams shows different and varied values. This is because livestock have different loin girth and loin length measurements, which are influenced by physiological age and body weight. This aligns with Ramadhan et al. (2022), who stated that loin length and loin girth are determining factors for calculations in livestock, and these measurements increase at unequal ratios. Some livestock experience a significant increase in size, while others show only a small increase. This condition is influenced by livestock management, including factors such as the quality and quantity of feed (feed consumption).

Table 10. Plumpness Index (PI) of male Sakub sheep in different categories and parameters

Parameters (PI)	Lambs		Rams		Total
	OV (head)	EV (head)	OV (head)	EV (head)	
Low	8	5	2	5	10
Medium	33	18	3	18	36
High	18	36	54	36	72
Total	59		59		118
Average	0.87		0.88		
SD	0.02		0.01		

Note: PI = Plumpness Index, OV = Observation Value, EV = Expectation Value, SD = Standard Deviation.

Table 11. Chi square analysis on Plumpness Index (PI)

Degrees of Freedom	χ^2 Calculated	χ^2 Table	
		0.05	0.01
$(3-1)(2-1) = 2$	46.60**	5.99	9.21

The average plumpness index value of lambs and rams corresponds to their body weight. Livestock with a higher plumpness index value tend to have greater body weight. Lambs have an average plumpness index value of 0.87 ± 0.02 and an average body weight of 32.41 ± 11.59 kg, while rams have an average plumpness index value of 0.88 ± 0.01 and an average body weight of 55.69 ± 10.91 kg. This aligns with the findings of Satrio et al. (2019), who stated that the plumpness index is a useful indicator for predicting body weight, and that there is a strong relationship between the plumpness index and body weight in livestock.

5. Body Conformation Index (BCI)

Lambs have an average body conformation index value of 0.29 ± 0.02 , while rams have an average BCI value of 0.30 ± 0.01 . Based on the data, the body conformation index of rams is higher, indicating better body conformation compared to lambs. The higher the BCI value, the greater the body length and chest width, making the livestock appear wider or fatter. This aligns with Ramadhan et al. (2022), who stated that the body conformation index is a key parameter for predicting livestock body structure based on chest size. The body conformation index is calculated by comparing chest width to body length.

The body conformation index of lambs and rams shows different and varying values. This is

because the livestock have different body lengths and chest widths, which are influenced by physiological age and body weight. Rams have an average body length of 77.34 ± 6.35 cm and a chest width of 23.07 ± 2.15 cm, while lambs have an average body length of 65.02 ± 7.55 cm and a chest width of 18.86 ± 3.14 cm. This aligns with Ramadhan et al. (2022), who stated that the average value of the body conformation index in livestock varies based on body length and chest width, which are affected by age and feed consumption.

The average body conformation index value of male Sakub sheep at different physiological ages correlates with livestock body weight. Livestock with a higher body conformation index also tend to have greater body weight. Lambs have an average body conformation index value of 0.29 ± 0.02 and an average body weight of 32.41 ± 11.59 kg, while rams have an average body conformation index value of 0.30 ± 0.01 and an average body weight of 55.69 ± 10.91 kg. This aligns with Satrio et al. (2019), who stated that chest size has a significant relationship with livestock weight. Sodiq et al. (2011) also mentioned that local livestock typically have a body conformation suitable for meat production. Sakub sheep, as local livestock, are expected to become one of the optimal meat-producing breeds. Table 12. Body Conformation Index (BCI) of male Sakub sheep in different categories and parameters

Parameters (BCI)	Lambs		Rams		Total
	OV (head)	EV (head)	OV (head)	EV (head)	
Low	9	5	1	5	10
Medium	24	14	4	14	28
High	26	40	54	40	80
Total	59		59		118
Average	0.29		0.30		
SD	0.02		0.01		

Note: BCI = Body Conformation Index, OV = Observation Value, EV = Expectation Value, SD = Standard Deviation.

Table 13. Chi square analysis on Body Conformation Index (BCI)

Degrees of Freedom	χ^2 Calculated	χ^2 Table	
		0.05	0.01
$(3-1)(2-1) = 2$	30.49**	5.99	9.21

Conclusions

It can be concluded that rams possess superior body condition and fat reserves, which may reflect their advanced physiological development and greater muscle mass relative to younger animals. This information is critical for optimizing management strategies in Sakub sheep production, particularly in breeding and selection programs aimed at enhancing productivity and carcass quality. Further research is warranted to explore the genetic and environmental factors influencing these traits.

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