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Research Article

Association of Lamb Sex with Body Measurements in Single and Twin on the Awassi Ewes

Tahreer Mohammed Al-Thuwaini*, Ali Basim Abd Al-Hadi

Department of Animal Production, College of Agriculture, Al-Qasim Green University, Al-Qasim, Babil 51001, Iraq.

Abstract | Sheep litter size is the most crucial trait in terms of reproductive, and it is influenced by many factors, including ovulation rates, body scores, uterine capacity, and ewes' body condition. Productive traits of ewes are known to be affected by lamb sex and body measurement. Thus, this study aimed to investigate the association of lamb's sex with the ewes' body measurement in single and twin pregnancies in Awassi ewes. Within the current study, 232 sexually mature, healthy ewes (109 with twins and 123 with single pregnancies) between the ages of 3 and 4 years were evaluated. The body measurements and the live body weight of each animal were determined. This study revealed that lamb sex significantly ($P \leq 0.05$) influences the live body weight of Awassi ewes. Association analysis of lamb sex with body measurements of pregnant ewes, including singleton and twin, showed that male pregnant Awassi ewes had higher body dimensions than the female pregnant Awassi ewes. There was the highest correlation ($P \leq 0.05$) between lamb sex with live body weight and body dimensions of ewes with single and twin pregnancies. In conclusion, twin and single pregnancy ewes with heavier live body weights and higher body measurements have a significantly higher probability of having a male lamb than those have a female lamb. Using this variation, producers can discriminate between ewes carrying female births and those producing male births, thereby gaining more economic benefits.

Keywords | Body measurements, Lamb sex, Litter size, Pregnancy, Sheep

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***Correspondence** | Tahreer Mohammed Al-Thuwaini, Department of Animal Production, College of Agriculture, Al-Qasim Green University, Al-Qasim, Babil 51001, Iraq; **Email:** tahrearmohammed@agre.uoqasim.edu.iq, tahreeralthuwaini@yahoo.com
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INTRODUCTION

Awassi sheep are crucial economic resources due to their high performance in milk and lamb production (Al-Thuwaini, 2021a; Ajafar et al., 2022a). It is important to note that lamb production is the most beneficial trait in all sheep production systems and is highly important economically (Yavarifard et al., 2015). Sheep producers are heavily reliant on lamb production (Janssens et al., 2004; Al-Thuwaini, 2021b). Compared to the Finnsheep and Romanov sheep with triplet's birth (Ajafar et al., 2022b), the Awassi breed is mono-ovulatory (Iber and De Geyter, 2013) and exhibits very low rates of twins (Al-Sa'aidi et al., 2018; Kridli et al., 2018). In addition, sheep litter size varies according to breed; it ranges from a single birth for Texel and Suffolk to a twin birth for the Booroola Merino breed (Souza et al., 2001). Additionally, many factors, such as age, season, management, nutrition, genetics, body score, uterine capacity, ewe's body condition, and the environment affect sheep's productivity (Kumer et al., 2017; Sarvinda et al., 2022). Besides litter size, the gender of the lamb (or lambs) can affect the ewe's productivity (Ochoa et al., 2019; Al-Thuwaini, 2022). In part, this is because male embryos grow faster than females. Besides, a larger fetus-to-placenta weight ratio of twins may result in a greater nutritional insult than that of singletons (Cleal et al., 2007). During

pregnancy, males appear to have a faster growth rate than females (Gardner et al., 2007). This is because of the anabolic protein effect of androgens, and androgen hormones in male animals can stimulate growth, so male animals can be larger than females (Ibrahim et al., 2020). Several articles in the literature suggest that the sex of a lamb may affect its body dimensions (Cam et al., 2010; Caro-Petrović et al., 2013; Ibrahim et al., 2020; Sarvinda et al., 2022). The above considerations mean that no research on the relationship between lamb sex and ewe's body measurements has yet been conducted in single and twin pregnancies in Awassi ewes. Accordingly, the current studies investigated the association between sex lamb and body measurement in Awassi ewes with single and twin pregnancies.

RESULTS AND DISCUSSION

Association analysis of lamb sex with live body weight and body measurements of Awassi ewes

Based on a comparative analysis of lamb sex with body measurements in single pregnant ewes, the live body weight, body length, chest girth, width at shoulder, width at pelvic, abdomen girth, and a tail length of male pregnant Awassi ewes were higher than those of female pregnant Awassi ewes (Table 1). Accordingly, there was a significant difference in live body weight, head length, back height, pelvic width, forelimb length, hind limb length, abdomen width, and tail length for twin pregnant ewes with twin males compared with twin females and twin two sex (Table 2).

Table 1: Least square Mean ± SE of the body measurement for the litter size (single) and sex lamb of Awassi ewes.

Indices	Male	Female	*P* value
Live body weight (Kg)	48.47 ± 0.57[a]	46.80±0.58[b]	0.04
Body length (cm)	74.56 ± 3.13[a]	74.12±4.18[b]	0.05
Head length (cm)	22.98 ± 0.11[a]	22.90±0.19[a]	0.59
Chest girth (cm)	102.92 ± 6.34[a]	101.78±8.34[b]	0.02
Height at front (cm)	66.98 ± 2.58[a]	67.50±2.29[a]	0.44
Height at back (cm)	36.71 ± 0.40[a]	36.14±0.47[a]	0.35
Width at shoulder (cm)	24.52 ± 0.14[a]	23.96±0.16[b]	0.01
Width at pelvic (cm)	36.40 ± 0.34[a]	34.98±0.28[b]	0.05
Forelimb length (cm)	36.71 ± 0.40[a]	36.14±0.47[a]	0.33
Hind limb length (cm)	34.38 ± 0.44[a]	34.20±0.37[a]	0.75
Neck length (cm)	12.24 ± 0.32[a]	13.88±1.80[a]	0.34
Neck width (cm)	18.12 ± 0.37[a]	17.86±0.38[a]	0.62
Chest width (cm)	30.33 ± 0.43[a]	29.90±0.47[a]	0.50
Abdomen width (cm)	32.92 ± 0.30[a]	32.48±0.61[a]	0.49
Abdomen girth (cm)	105.33±6.38[a]	104.22±8.35[b]	0.04
Tail length (cm)	34.36 ± 0.31[a]	32.34±0.38[b]	0.05
Tail width (cm)	29.64 ± 0.27[a]	29.40±0.34[a]	0.57

SE, standard error. Different superscript in the same raw indicates significant differences (P≤0.05).

Live body weight has been reported to influence litter size in sheep (Akhtar et al., 2012). It is reported that the twinning ratio increases with ewe live body weight according to Aktas et al. (2015). In general, the litter size can be predicted by the live body weight of the ewes, with heavier ewes having a greater probability of producing more lambs than ewes that give birth to a single lamb (Pettigrew et al., 2019). The maternal weight of the dam influences lamb birth weight, as heavier dams are often well fed and tend to have male and heavier lambs (Torres et al., 2021). Male lambs receive a larger proportion of maternal resources, compared to female lambs at both pregnancy and birth (Ochoa et al., 2019). In pregnancy, nutrient partitioning is believed to favor the growth and weight gain of male lambs over female lambs, probably due to greater involvement of the somatotrophic axis in the development of male lambs (Gardner et al., 2007; Earle et al., 2017) compared to female lambs (Nieto et al., 2018). According to Gardner et al. (2007), males tend to grow faster than females in utero probably due to the presence of a Y-chromosome and the products of SRY gene activation, androgens, and mullerian inhibitors, which all have sex-specific effects on fetal development. This study included ewes in the fourth and fifth months of their pregnancy because this period represents affected periods that have the greatest impact on lamb growth. Kenyon et al. (2019), report that the last 50 days of pregnancy exhibit rapid fetal growth with distinct differences in feed demand among pregnancy ranks. Besides, Pesántez-Pacheco et al. (2019) revealed that the number of fetuses affects dam body weight during late pregnancy.

Furthermore, ewes' body dimensions offer insights into their reproductive traits. Abdullah and Tabbaa (2011) state that body length, chest circumference, shoulder, and hip lengths and widths, and hip height are the most important body measurements. These body measurements of ewes have been found to influence reproductive performance in the species (Corner-Thomas et al., 2015). Kenyon et al. (2012) note that ewes with higher body measurements may be better at managing multiple births than ewes with lower body measurements. The live body weight of ewes and body measurement traits could be used as functional indicators in production, as well as determining lamb sex and weight (Al-Thuwaini et al., 2020). The study of live body weight and body dimensions in pregnant stages is essential to determine the development and growth of the body by examining the positive association between dam body weight and lamb sex. These variations could be used to predict the sex and weight of the lamb and discriminate between multiple-born goats and single-born goats, allowing this sort of discrimination to lead to higher economic benefits (Pan et al., 2015; Abdel-Lattif and Al-Muhja, 2021).

Table 2: Association of sex lamb with body measurement in twin pregnancies Awassi ewes.

Indices	Least square Mean ± SE			P value
	Male and female	Twin male	Twin female	
Live body weight (Kg)	49.88 ± 4.12 [b]	53.00 ± 4.83 [a]	47.22 ± 3.07 [c]	0.04
Body length (cm)	75.94 ± 3.15 [a]	76.14 ± 2.31 [a]	75.88 ± 4.20 [a]	0.76
Head length (cm)	23.74 ± 0.12 [b]	23.98 ± 0.19 [a]	23.11 ± 0.17 [c]	0.01
Chest girth (cm)	104.74 ± 6.48 [a]	105.07 ± 7.65 [a]	104.74 ± 9.58 [a]	0.94
Height at front (cm)	68.27 ± 0.23 [a]	68.00 ± 0.48 [a]	67.59 ± 0.35 [a]	0.26
Height at back (cm)	64.15 ± 0.27 [b]	65.57 ± 0.81 [a]	63.96 ± 0.43 [c]	0.04
Width at shoulder (cm)	29.76 ± 0.73 [a]	28.00 ± 1.34 [a]	28.22 ± 1.01 [a]	0.33
Width at pelvic (cm)	36.17 ± 0.21 [b]	37.42 ± 0.65 [a]	35.77 ± 0.44 [c]	0.03
Forelimb length (cm)	38.15 ± 0.31 [ab]	38.07 ± 0.42 [a]	36.92 ± 0.41 [b]	0.05
Hind limb length (cm)	35.94 ± 0.25 [b]	36.35 ± 0.35 [a]	35.03 ± 0.36 [b]	0.04
Neck length (cm)	12.17 ± 0.27 [a]	12.28 ± 0.52 [a]	11.81 ± 0.39 [a]	0.68
Neck width (cm)	18.76 ± 0.31 [a]	19.28 ± 0.62 [a]	18.22 ± 0.40 [a]	0.32
Chest width (cm)	30.09 ± 0.31 [a]	31.14 ± 0.40 [a]	30.37 ± 0.61 [a]	0.38
Abdomen width (cm)	34.21 ± 0.32 [b]	35.57 ± 0.71 [a]	33.03 ± 0.52 [c]	0.01
Abdomen girth (cm)	112.92 ± 8.58 [a]	112.14 ± 8.24 [a]	111.55 ± 10.99 [a]	0.44
Tail length (cm)	33.76 ± 0.26 [ab]	33.94 ± 0.61 [a]	32.70 ± 0.42 [b]	0.05
Tail width (cm)	29.35 ± 0.57 [a]	30.42 ± 0.41 [a]	29.40 ± 0.92 [a]	0.53

SE, standard error. Different superscript in the same raw indicates significant differences (P≤0.05).

Correlation analysis of lamb sex with other variables in single and twin pregnancies Awassi ewes

The correlation coefficient between lamb sex and phenotypic characteristics of Awassi ewes is presented in Table 3. The highest and strongly positive correlation (P ≤ 0.05) was recorded between single pregnant ewes with live body weight (r=0.39, P=0.04), body length (r=0.48, P=0.05), chest girth (r=0.22, P=0.02), width at shoulder (r=0.44, P=0.01), width at pelvic (r=0.29, P=0.05), and abdomen girth (r=0.53, P=0.04). According to the ewes pregnant with twin, the highest and mightily positive connection (P ≤ 0.05) was listed between twin pregnant ewes with live body weight (r=0.51, P=0.03), head length (r=0.30, P=0.003), forelimb length (r=0.24, P=0.02), hind limb length (r=0.19, P=0.05), abdomen width (r=0.16, P=0.01), abdomen girth (r=0.13, P=0.02), and tail length (r=0.21, P=0.03).

In single and twin pregnancies, there was a positive and statistically significant correlation (P ≤ 0.05) between lamb sex with live body weight and body measurements. The results of this study are in agreement with the study by Pan et al. (2015) found that the phenotypic variations (heart girth, body weight, punch girth, and other measurements) are significantly different in goats giving birth multiple times compared to goats giving birth once. Another study has shown a correlation between the maternal body condition score and reproductive traits of Corriedale ewes (r = 0.37, p < 0.05) (Moraes et al., 2016).

Table 3: Correlation between lamb sex and other variables in Awassi ewes

Variables	Lamb sex in single pregnant ewes		Lamb sex in twin pregnant ewes	
	r	P-value	r	P-value
Live body weight (Kg)	0.39	0.04	0.51	0.03
Body length (cm)	0.48	0.05	0.31	0.32
Head length (cm)	0.35	0.07	0.30	0.003
Chest girth (cm)	0.22	0.02	0.14	0.06
Height at front (cm)	0.27	0.44	0.17	0.10
Height at back (cm)	0.39	0.33	0.26	0.52
Width at shoulder (cm)	0.44	0.01	0.13	0.18
Width at pelvic (cm)	0.29	0.05	0.24	0.06
Forelimb length (cm)	0.49	0.09	0.24	0.02
Hind limb length (cm)	0.33	0.07	0.19	0.05
Neck length (cm)	0.19	0.34	0.07	0.48
Neck width (cm)	0.84	0.62	0.19	0.37
Chest width (cm)	0.06	0.50	0.11	0.53
Abdomen width (cm)	0.13	0.08	0.16	0.01
Abdomen girth (cm)	0.53	0.04	0.13	0.02
Tail length (cm)	0.27	0.07	0.21	0.03
Tail width (cm)	0.16	0.57	0.22	0.83

P ≤ 0.05: Significant, P ≥ 0.05: Not significant.

MATERIALS AND METHODS

Animals and body measurements

According to international guidelines of animal care and

use (Agri, No. 015, 7, 20), a study on Awassi ewes was conducted at Al-Qasim Green University from July 2021 to April 2022. The study involved 232 mature, sexually mature ewes between the ages of 3 and 4 years. Ewes from two sheep raising stations (Babylon and Karbala) were collected at random, including (123 ewes with a single pregnancy and 109 ewes with twin pregnancies) that were classified at parturition, with weights ranging from 40-60 kg. Ewes in the fourth and fifth months of their pregnancy participated in the study. Animals received concentrates based on 2.5% of their weight. Feed 59% barley bran, 40% bran, 1% salt, 3 kg of green alfalfa, and 1 kg of straw were provided for each animal. All animals were provided with drinking water at all times. The live weight of Awassi ewes was measured using a suspended spring balance before each animal started grazing. According to Abd-Allah et al. (2019), the measurement of body length and head length was performed with measuring tape calibrated in centimeters (cm), as well as measurements of height, width at the shoulder, width at the pelvis, and the lengths of forelimbs and hind limbs, as well as measurements of abdomen, chest, tail length and tail width.

Statistical analysis

Statistical analysis of data was performed with SPSS v23.0 (IBM, NY, USA). To compare the two groups, a student's t-test was used, and a one-way ANOVA was used to identify differences in the measured characteristics for twin pregnancies. A Tukey-Kramer test was used to compare main factors pairwise. Significance was determined by a 0.05 P-value. The Kolmogorov-Smirnov test was used to determine normality. For correlation analysis, a Pearson correlation coefficient was computed at 0.05 significance levels.

CONCLUSION AND RECOMMENDATIONS

There was an association between lamb sex of pregnant Awassi ewes and other phenotypic traits. Pregnancies ewes that have higher live body weights and body measurements bear male lambs when compared to those with female births, both in single pregnancies and twin pregnancies. With this variation, it is possible for the breeder to discriminate between the ewes that give male births and the ewes that give female births, and therefore to gain better economic benefits from this discrimination.

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NOVELTY STATEMENT

This study is the first one to reveal the relationship between lamb sex and ewe's body measurements in single and twin pregnancies in Awassi ewes.

AUTHOR'S CONTRIBUTION

All authors contributed equally.

Conflict of interest

The authors have declared no conflict of interest.

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