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Renuka Hada
Ph.D. Scholar, Department of Animal Genetics and Breeding, PGIVER, RAJUVAS, Jaipur, Rajasthan, India

Rohit Sharma
Ph.D., Department of Animal Genetics and Breeding, LUVAS, Hisar, Haryana, India

RK Nagda
CVAS, RAJUVAS, Department of Animal Genetics and Breeding, Navania, Udaipur, Rajasthan, India

Vishnu Kumar
CVAS, RAJUVAS, Department of Animal Genetics and Breeding, Navania, Udaipur, Rajasthan, India

Gaurav Kumar Bansal
CVAS, RAJUVAS, Department of Animal Genetics and Breeding, Navania, Udaipur, Rajasthan, India

Corresponding Author:
Rohit Sharma
Ph.D., Department of Animal Genetics and Breeding, LUVAS, Hisar, Haryana, India

Influence of non-genetic variables on the body weight of Sonadi sheep

Renuka Hada, Rohit Sharma, RK Nagda, Vishnu Kumar and Gaurav Kumar Bansal

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Abstract
The present study was conducted to assess the effect of non-genetic factors on body weight of Sonadi sheep of different age. In this study data on 1396 Sonadi sheep maintained over the period of 2012-2019 under the Mega Sheep Seed Project, College of Veterinary and Animal Science, Navania, Vallabhnagar, Rajasthan were analysed to assess the effect of non-genetic factors (Year of birth, season of birth, sex, type of birth,) on body weight at birth, 3, 6, 9 and 12 months age . The overall least-squares mean along with standard error for of body weight were observed as 2.82±0.03, 10.06±0.27, 14.62±0.38, 17.41±0.43, 21.96±0.55 kg at birth, 3, 6, 9 and 12 months of age respectively. Year of birth had highly significant ($p \leq 0.01$) effect on all age. Effect of season of birth on body weight was also highly significant ($p \leq 0.01$) effect on all age. Sex of lamb showed s highly significant ($p \leq 0.01$) effect on all age whereas effect of type of lamb on body weight was found to be highly significant at birth, 3, 9 and significant at 6 and non-significant at 12 month of age.

Keywords: Body weight, least square mean, non-genetic factors, significant, Sonadi

Introduction
Sheep with its multi-faceted value for fleece, meat, milk, skin and compost form a significant segment of rustic economy, especially in dry, semi-dry and hilly zones of the nation where atmosphere stays unfavourable. Sheep husbandry play an important role in the livelihood of rural masses and a crucial function in the financial upliftment of a large portion of the under privileged communities and ranchers. They contribute greatly to the agrarian economy, especially in areas where crop and dairy farming are not economical. India ranks 8th in the world in terms of total meat production; out of India's total meat produced during 2022-23 about 10.51% was contributed by sheep along with 33.61 million kg wool (DAHD, 2024). As per NBAGR (2024), Rajasthan which is also the 4th biggest sheep rearing state of India has 8 well defined breeds out of total 44 enlisted breeds.
Sonadi breed of sheep is reared for mutton purpose because towards mutton there is no prejudice by any community in India. Meat is a nutritious food that has a significant part in human balanced diet. Accordingly, there is an interest to increase the rate of meat production and utilization all through the world. Consequently, an expansion in small ruminant production could add to the achievement of food self-sufficiency in the nation especially because of protein necessity for the increasing human population and improve the export of mutton. Attributes identified with growth are of intricate qualities. They reflect the impacts of an intricate net of gene actions affected by the climate. Accordingly, to improve the growth performance of animals, improvement in both their hereditary structure and the climate they are encircled by is required. Growth profile attributes are acceptable markers of versatility of an animal to the current ecological conditions. In this manner, better growth is fundamental for suitable proliferation, creation and survivability in sheep

Materials and Methods
The data on growth of 1396 animals (Sonadi sheep) spread over period of 8 years from 2012-2019 were taken from mega sheep seed project coordinating Sonadi sheep unit, Vallabhnagar,

Udaipur (Rajasthan) where they are maintained under semi-intensive system of management. Sex of lamb was classified according to male (K_1) and female (K_2) while type of birth according to single (L_1) and twin (L_2).

To estimate the effect of various non-genetic factors on growth efficiency was estimated through the following model:

$$Y_{ijk} = \mu + A_i + B_j + e_{ijk}$$

Where,

Y_{ijklm} = Growth records of the k^{th} progeny belonging to j^{th} type of birth and i^{th} sex

μ = Population mean

A_i = Fixed effect of i^{th} sex of birth (i = 1, 2)

B_j = Fixed effect of j^{th} type of birth (j = 1, 2)

e_{ijk} = Residual error, NID (0, σ^2)

Duncan's Multiple Range Test (DMRT) was used to make pair wise comparison among the least squares means.

Results and Discussion

Sex of lamb

Effect of Sex of lamb had highly significant ($p \leq 0.01$) effect on all age group body weight (Table and Figure 1).

Female lambs (2.77±0.03 kg) had significantly ($p \leq 0.01$) lower body weight than male lambs (2.86±0.03 kg) on birth. Similar findings had been reported by Sharma *et al.* (2003) [26] in Marwari x Nali sheep, Kumar *et al.* (2003) [16] in Malpura x Kheri sheep, Sharma *et al.* (2003) [26] in Malpura lamb, Poonia (2004) [21] in Munjal sheep, Reddy *et al.* (2009) [23] in Nellore lambs, Gowane and Arora (2009) in Malpura x Kheri sheep, Singh *et al.* (2013) [27] in Marwari sheep, Joshi *et al.* (2013) [15] in Magra sheep, Mane *et al.* (2014) [17] in Deccani sheep, Gowane *et al.* (2015) [13] in Malpura x Kheri sheep, Meena *et al.* (2019) [18] and Sharma *et al.* (2019) [25] in Sonadi sheep birth weight. While significant effect of sex on birth weight were also observed by Waghmode *et al.* (2008) [33] in Madgyal sheep and Chikurdekar *et al.* (2012) [8] in Deccani sheep. Whereas in contrast to our findings, Sivakumar *et al.* (2009) [28] in Madras red lamb observed non-significant effect of sex on birth weight.

Male lambs (10.42±0.28 kg) on 3months age had significantly ($p \leq 0.01$) higher body weight than female sheep (9.69±0.28 kg). Similar findings had been reported by Sharma *et al.* (2003) [26] in Marwari x Nali sheep, Sharma *et al.* (2003) [26] in Malpura sheep, Poonia (2004) [21] in Munjal sheep, Waghmode *et al.* (2008) [33] in Madgyal sheep, Reddy *et al.* (2009) [23] in Nellore sheep, Gowane and Arora (2009) in Malpura x Kheri sheep, Singh *et al.* (2013) [27] in Marwari sheep, Joshi *et al.* (2013) [15] in Magra sheep, Mane *et al.* (2014) [17] in Deccani sheep, Meena *et al.* (2019) [18] and Sharma *et al.* (2019) [25] in Sonadi sheep at 3month body weight. While significant effect of sex on 3month body weight was also observed by Rao *et al.* (2004) [22] in Nellore sheep and Chikurdekar *et al.* (2012) [8] in Deccani sheep. Whereas in contrast to our findings, Kumar *et al.* (2003) [16] in Malpura x Kheri sheep, Sivakumar *et al.* (2009) in Madras Red sheep and Gowane *et al.* (2015) [13] in Malpura x Kheri sheep observed non-significant effect of sex on 3 month body weight.

Male lambs (15.36±0.40 kg) on 6months age had significantly ($p \leq 0.01$) higher body weight than female sheep (13.87±0.40 kg). Similar findings had been reported by Sharma *et al.* (2003) [26] in Marwari x Nali sheep, Kumar *et al.* (2003) [16] in Malpura x Kheri sheep, Sharma *et al.* (2003) [26] in Malpura sheep, Poonia (2004) in Munjal sheep, Waghmode *et al.* (2008) in Madgyal sheep, Reddy *et al.* (2009) in Nellore sheep, Gowane and Arora (2009) in Malpura x Kheri sheep, Joshi *et al.* (2013) [15] in Magra sheep, Mane *et al.* (2014) [17] in Deccani sheep, Meena *et al.* (2019) [18] and Sharma *et al.* (2019) [25] in Sonadi sheep at 6month body weight. While significant effect of sex on 6month body weight was also observed by Rao *et al.* (2004) [22] in Nellore sheep and Chikurdekar *et al.* (2012) [8] in Deccani sheep. Whereas in contrary to our findings, Sivakumar *et al.* (2009) [28] in Madras Red sheep and Gowane *et al.* (2015) [13] in Malpura x Kheri sheep observed non-significant effect of sex on 6month body weight.

Male lambs (18.60±0.45 kg) had significantly ($p \leq 0.01$) higher body weight than female sheep (16.22±0.44 kg) on 9month of age. Similar findings had been reported by Sharma *et al.* (2003) [26] in Marwari x Nali sheep, Kumar *et al.* (2003) [16] in Malpura x Kheri sheep, Sharma *et al.* (2003) [26] in Malpura sheep, Waghmode *et al.* (2008) [33] in Madgyal sheep, Reddy *et al.* (2009) [23] in Nellore sheep, Gowane and Arora (2009) in Malpura x Kheri sheep, Joshi *et al.* (2013) [15] in Magra sheep, Mane *et al.* (2014) [17] in Deccani sheep, Meena *et al.* (2019) [18] and Sharma *et al.* (2019) [25] in Sonadi sheep at 9month body weight. While significant effect of sex on 9month body weight was also observed by Chikurdekar *et al.* (2012) [8] in Deccani sheep and Gowane *et al.* (2015) [13] in Malpura x Kheri sheep. Whereas in contrary to our findings, Sivakumar *et al.* (2009) [28] in Madras Red sheep observed non-significant effect of sex on 9month body weight.

Male lambs (23.50±0.58 kg) had significantly ($p \leq 0.01$) higher body weight than female sheep (20.41±0.56 kg) on 12month of age. Similar findings had been reported by Sharma *et al.* (2003) [26] in Marwari x Nali sheep, Kumar *et al.* (2003) in Malpura x Kheri sheep, Sharma *et al.* (2003) [26] in Malpura sheep, Waghmode *et al.* (2008) [33] in Madgyal sheep, Reddy *et al.* (2009) [23] in Nellore sheep, Gowane and Arora (2009) in Malpura x Kheri sheep, Joshi *et al.* (2013) [15] in Magra sheep, Mane *et al.* (2014) [17] in Deccani sheep, Gowane *et al.* (2015) [13] in Malpura x Kheri sheep, Meena *et al.* (2019) [18] and Sharma *et al.* (2019) [26] in Sonadi sheep at 12 month body weight. While significant effect of sex on 12 month body weight was also observed by Chikurdekar *et al.* (2012) [8] in Deccani sheep and Umeel *et al.* (2018) [31] in Munjal sheep. Whereas in contrary to our findings, Sivakumar *et al.* (2009) [28] in Madras Red sheep observed non-significant effect of sex on 12 month body weight.

The difference between both the sexes can be due to the hormonal differences in their endocrinological and physiological functions. In females, estrogen hormone restricts growth of long bones, whereas testosterone had positive impact on growth rate in males. Testosterone hormone makes the males aggressive for suckling and feeding, which may have resulted in higher intake of nutrients and consequently higher body weight.

Type of birth

Type of birth showed highly significant ($p \leq 0.01$) effect on all age groups of body weight except 12 month age group (Table and Figure 2).

Single born (2.98±0.12 kg) lamb had significantly ($p \leq 0.01$) higher body weight than twin (2.66±0.06 kg) at birth. Similar findings had been reported by Poonia (2004) [21] for Munjal sheep, Dixit *et al.* (2001) [10] in Bharat Merino sheep, Mishra *et al.* (2008) [19] in Garole x Malpura sheep and Abbas *et al.* (2010) [3] in Rahmani and Chios sheep. However, non-significant effect of type of birth on body weight was reported by Bahreini *et al.* (2007) [6] in Kermani sheep.

Twin born (9.14±0.52 kg) lamb had significantly ($p \leq 0.01$) lower body weight than single (10.98±0.10 kg) at 3month of age.

Similar findings had been reported by Poonia (2004) [21] for Munjal sheep, Dixit *et al.* (2001) [10] in Bharat Merino sheep, Mishra *et al.* (2008) [19] in Garole x Malpura sheep and Abbas *et al.* (2010) [3] in Rahmani and Chios sheep. However, non-significant effect of type of birth on body weight was reported by Anamika *et al.* (2019) [5] in Rambouillet sheep.

Single born (15.56±0.14 kg) lamb had significantly ($p \leq 0.01$) higher body weight than twin (13.67±0.74 kg) lambs at 6month of age. Similar findings had been reported by Poonia (2004) [21] for Munjal sheep, Dixit *et al.* (2001) [10] in Bharat Merino sheep, Mishra *et al.* (2008) [19] in Garole x Malpura sheep and Abbas *et al.* (2010) [3] in Rahmani and Chios sheep. However, non-significant effect of type of birth on body weight was reported by Anamika *et al.* (2019) [5] in Rambouillet sheep and Bahreini *et al.* (2007) [6] in Kermani sheep.

Single born (18.85±0.17 kg) lamb had significantly ($p \leq 0.01$) higher body weight than twin (15.97±0.83 kg) lambs at 9month of age. Similar findings had been reported by Dixit *et al.* (2001) [10] in Bharat Merino sheep and significant effect was reported by Abbas *et al.* (2010) [3] in Rahmani and Chios sheep. However, non-significant effect of type of birth on body weight was reported by Anamika *et al.* (2019) [5] in Rambouillet sheep.

Twin born (20.96±1.04 kg) lambs had significantly ($p \leq 0.01$) lower body weight than single (22.95±0.22 kg) at 12 month of age. Similar findings had been reported by Anamika *et al.* (2019) [5] in Rambouillet sheep. Whereas in contrast to our findings for effect of type of birth on 12 month body weight, Dixit *et al.* (2001) [10] in Bharat Merino sheep and Mishra *et al.* (2008) [19] in Garole x Malpura reported highly significant effect. Single lambs had higher body weight than twin lambs may be because of compete feeding of mother milk in twin lambs during pre-weaning age. Single born lambs with higher birth weight grew faster due to better nutrient supply during prenatal as well as pre-weaning period.

Table 1: Least square mean and standard error of body weight (kg) trait of Sonadi sheep on different sex of lambs

Effect	BWT	3MWT	6MWT	9MWT	12MWT
Sex	**	**	**	**	**
Male	2.86^{b}±0.03 (683)	10.42^{b}±0.28 (513)	15.36^{b}±0.40 (414)	18.60^{b}±0.45 (316)	23.50^{b}±0.58 (269)
Female	2.77^{a}±0.03 (713)	9.69^{a}±0.28 (553)	13.87^{a}±0.40 (443)	16.22^{a}±0.44 (380)	20.41^{a}±0.56 (320)

Table 2: Least square mean and standard error of body weight (kg) trait of Sonadi sheep across different type of births

Effect	BWT	3MWT	6MWT	9MWT	12MWT
TOB	**	**	*	**	NS
Single	2.98^{b}±0.12 (1356)	10.98^{b}±0.10 (1037)	15.56^{b}±0.14 (836)	18.85^{b}±0.17 (679)	22.95±0.22 (576)
Twin	2.66^{a}±0.06 (40)	9.14^{a}±0.52 (29)	13.67^{a}±0.74 (21)	15.97^{a}±0.83 (17)	20.96±1.04 (13)

**=Highly significant ($p \leq 0.01$), *=Significant ($p \leq 0.05$), NS= Non-significant ($p > 0.05$) Figures in parentheses are the number of observations

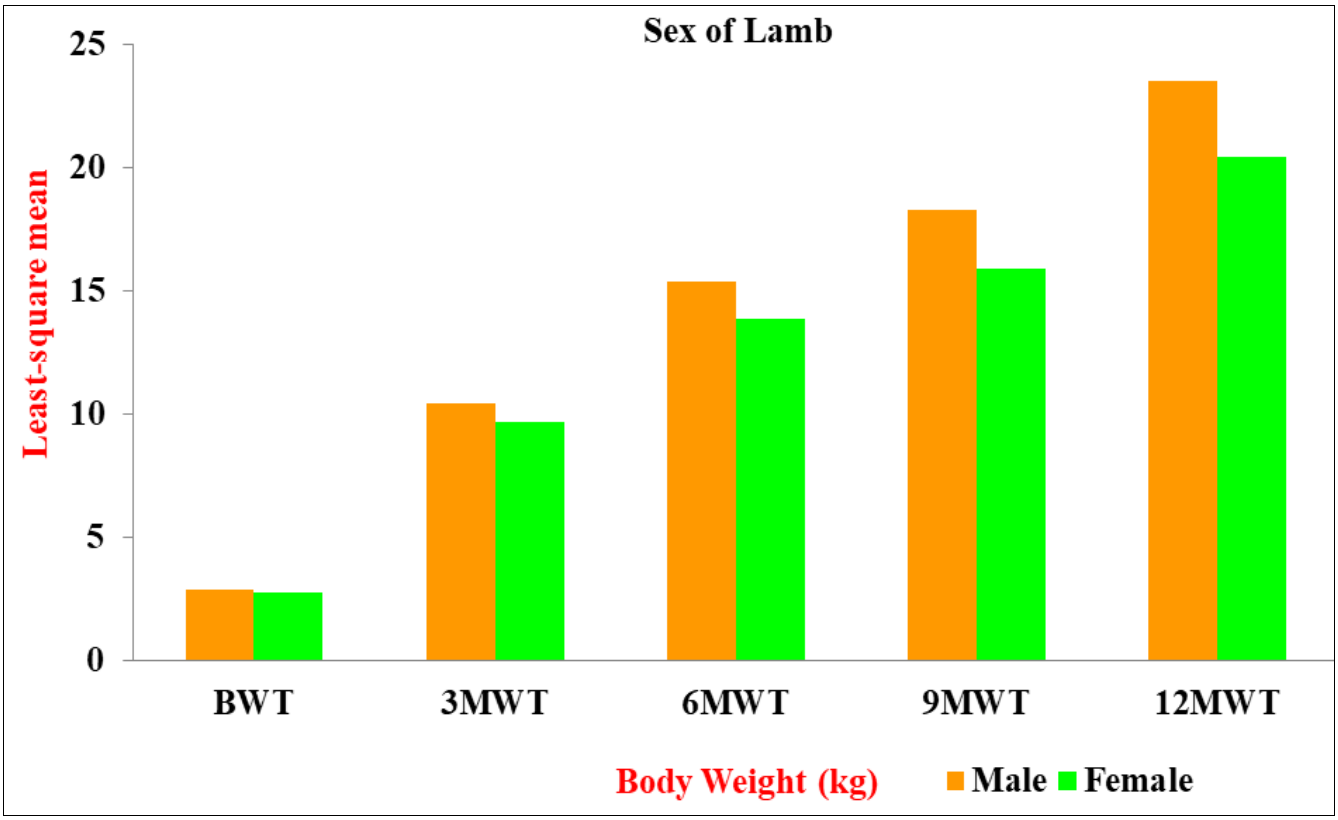

Fig 1: Least square mean and standard error of body weight (kg) trait of Sonadi sheep on different sex of lambs

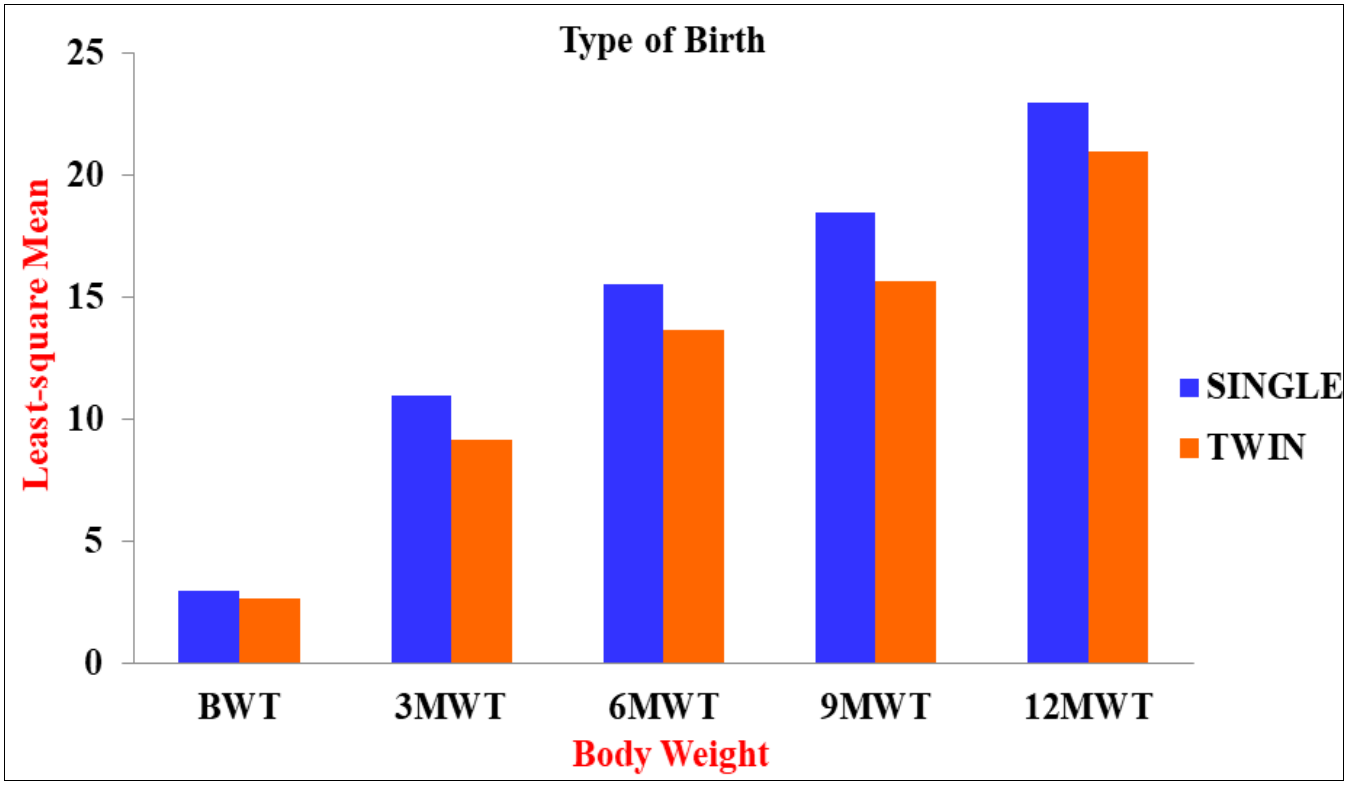

Fig 2: Least square mean and standard error of body weight (kg) trait of Sonadi sheep across different type of births

Conclusion

The current study demonstrates that the sex and type of birth factors influence the body weight of Sonadi sheep, specifically the sex of the lamb. The effect of sex of lamb had highly significant effect on all age group body weight also female lambs had significantly lower body weight than male lambs on birth. Type of birth showed that single lambs had higher body weight than twin lambs. Hence, to formulate effective breeding programme for improvement of growth performance of Sonadi sheep assessment of non-genetic factors plays a vital role and measures should be taken for standardizing the management of the flock for sustainable production.

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