Original Research Article

Factors Influencing Birth Weight and Pre-weaning Weight Gain of Piglets Reared in Different Farrowing Facilities

ABSTRACT

Aim: This study aims at analysing the relationship among birth weight, size of litter, parity on the growth performance and subsequently the pre weaning weight gain. To improve production and welfare in farrowing systems, it is especially important to improve breeding aims by integrating the process of selection for the survival of the piglet which is directly related to the weight at birth and pre weaning weight gain in piglets. Low weight at birth shortens the productive lives of piglets till slaughter and increases pre-weaning mortality. Thus, this study was done to understand the factors that influence the birth weight and pre-weaning weight gain in piglets.

Place and Duration of Study: Department of Livestock Production & Management and Piggery Unit of Livestock Farm Complex, Tamil Nadu Veterinary and Animal Sciences University, Chennai, 600 007, India. The study was carried out for a period of twelve months from October 2021 to September 2022.

Methodology: In this study, the Large White Yorkshire breedable females were housed in conventional sties in groups of four after mating. Out of the eighteen breedable sows, six sows were placed in each of the farrowing facility as they are near parturition. Five days before the expected farrowing date, each sow was moved randomly from the conventional sty to the farrowing unit in one of the three farrowing facilities/crate models on the basis of farrowing stage, viz. Conventional farrowing crate and Guard rail model.

Results: Litter size, season of farrowing, number of still birth and parity affected birth weight significantly ($p < 0.01$). It was seen that each increase in the number of litter size reduces birth and weaning weight. However, parity did not affect the weaning weight ($p > 0.05$). The type of farrowing facility ($p > 0.05$) viz., conventional farrowing crate and guard rail model had no significance on the birth weight.

Conclusion: The results of the present study reveal that mean birth weight and weaning weight were not influenced by the type of farrowing system they were reared in. However, season of farrowing affected the birth weight which could affect the pre weaning survival.

KEY WORDS*: Birth weight, farrowing crate, guard rail, pigs, preweaning weight gain.*

INTRODUCTION

Pig productivity is influenced by birth weight and litter size. The productivity of the sow depends on the entire litter, as well as the weight distribution at birth within the litter (mean weight at birth and variability within the litter). In recent times, selection strategy for including sows with enhanced prolificacy in pigs has resulted in a significant increase in litter size at birth and weaning. Panzardi *et al*. (2013) indicated that environments during pregnancy and labour, litter size, birth weight, and liveliness at birth all have an impact on piglet mortality and pre weaning performance. Instead of the genetic makeup of the individual piglet, the factors impacting the litter a piglet was born into were the most significant factors for predicting the birthweight of individual piglets (Harper and Bunter, 2023).

Surek *et al*. (2019) found that the average weight of piglets at birth was 1.43 Kg, with a range of 0.60 to 2.30 Kg. Weaning age was between 18 to 25 days, with an average of about 21.3 days and weaning weights ranging from 4.51 ± 0.53 to 6.75 ± 0.45 Kg. There was no link between weight at birth and average daily weight gain during suckling, which the researchers assumed was due to litter birth weight equalisation. Larger litters at birth are known to have more within-litter birth weight variation and a higher percentage of low-viability piglets. This means that, despite the larger number of piglets born, they are more likely to be small, underdeveloped and having higher risk of mortality. Number of piglets born is very weakly correlated to the piglet mortality and weight at birth factors and these correlations are different (antagonistic) within each year (Knap *et al.,* 2023).

Yun *et al*. (2018) found that sows kept under open farrowing crate system with a large litter of an average 19 piglets have 17.9% of piglet mortality during the first day of lactation. Piglets with low weight at birth had higher preweaning mortality rates, however in both the U.S. data set and the European data set, preweaning mortality rates decreased and plateaued when birth weights rose beyond 1 Kg and 1.2 Kg, respectively. They discovered a curvilinear association between birth weight and preweaning mortality, with 1.11 Kg serving as the cut-off point or threshold (Feldpausch *et al*., 2019). Also, Surek *et al*. (2014) found that piglets born with lower birth weight had a lower weaning weight but the same daily weight gain as heavier piglets during the pre-weaning phase. Within-litter variation in birth weight was favourably correlated with litter size, but the mean birth weight was inversely correlated with litter size (Nam and Sukon, 2022).

Colostrum consumption and birth weight were found to be substantially correlated with weaning weight and robustness at weaning, respectively. In the future, management measures aimed at enhancing the unique traits of piglets at birth may be advantageous for enhancing the piglets' general robustness prior to weaning, which will enhance the piglets' resistance to diseases in the early post-weaning (Vodolazska *et al.*,2023)

Sows that farrowed during rainy season had smaller litters at birth. During gestation, higher relative humidity, high temperature, and high THI dramatically decreased the total piglet number born per litter. The effect of the climatic conditions on litter size at birth was more pronounced in gilts than in sows (Tummaruk *et al.,* 2010).

This study aims at understanding the influence of factors that influence and also to determine the trend of various traits that affect the birth and weight at weaning of piglets when reared in two farrowing systems viz., conventional type of farrowing crate and guard rail model pen.

MATERIALS AND METHODS

The study was conducted in Piggery Unit of Livestock Farm Complex, Tamil Nadu Veterinary and Animal Sciences University, Madhavaram, Chennai. Twelve number of Large White Yorkshire sows of different parities were selected for this study. Breedable females were housed in conventional sty in groups of four after mating. During the observation period, five days before the expected farrowing date, each sow were moved randomly from the conventional sty to the farrowing unit in one of the two farrowing facilities/crate models on the basis of farrowing stage. Thus, out of the eighteen breedable females, ten females were placed in Conventional farrowing crate (Figure 1) and eight were placed in Guard rail model farrowing facility (Figure 2). Weaning of piglets were done at 42 days of age. Subsequent to weaning, the piglets were placed in the weaner shed. Piglets that were less than 6 Kg were retained for another week.

Figure 1: Conventional farrowing Crate

Figure 2: Guard Rail Model

Individual body weight of piglets was measured at birth and on the day of weaning. In addition to recording birth weight, litter size, parity, season of farrowing and weaning weight, piglet management were done according to normal farm practices. Pre weaning growth performance of piglets were determined as the rate of daily gain in weight (gm day^{-1}) from the date of birth to date of weaning. ANOVA was used to evaluate data with a normal distribution. The Tukey's test was used to compare means at a 5% significance level.

RESULTS

The average birth weight of the 164 piglets was 1.32 Kg, ranging between 0.54 and 1.95 Kg. When weaning was done on the 42nd day, of the total number of piglets, 43 piglets were below the average weaning weight of 6 Kg with an average weaning weight of 6.94 Kg. Regarding the birth weight and weaning weight of piglets, the effects of factors such as farrowing facility, parity, litter size, number of still birth, sex of piglet and average daily weight gain (ADG) are shown in Table 1.

The statistical significance of litter size, season of farrowing, number of still birth (p=0.00**) and parity (p=0.001*) was very high for birth weight demonstrated by Uni ANOVA. There was no significance of treatment (p>0.05) i.e., farrowing facility viz., conventional farrowing crate and guard rail model on the birth weight. The birth weight means gradually decreased with an increase in the litter size. It especially reduced for litter size more than 10 except for litter size of 13 wherein there was a slight increase. The birth weight was inversely proportional to the number of still births. There is a decrease in the birth weight with the increase in the number of still births of piglets. The gender of piglets has influence on the birth weight wherein the males weighed higher than the females at birth and weaning. Likewise, depending on the season of farrowing, birth weight was found to be more especially during July to October months. A Tukey HSD post hoc test showed statistically no significant difference between litter size and birth weight subsets. (p=0. 638).

Effect of farrowing facility and parity on weaning weight was insignificant (*p*>0.05) whereas litter size, season of farrowing and average daily weight gain of piglet was highly significant (*p*<0.01) and sex of the piglet was found to have significant (*p*<0.05) effects on weaning weight (Table 2). A slight decrease in weaning weight was seen in sows that had parity less than 3 (Table 3). With the increase in litter size especially after 10, there is a decrease in weaning weight.

Table 1: Factors influencing birth weight of piglets

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	49952.274[a]	15	3330.152	7.071	0.00	0.417
Intercept	624084.993	1	624084.993	1.325E3	0.00	0.900
Treatment	1111.707	1	1111.707	2.361	0.127	0.016
Parity	5194.497	1	5194.497	11.030	0.001**	0.069
Litter size	19371.791	7	2767.399	5.876	0.00**	0.217
Sex of piglet	3772.485	1	3772.485	8.011	0.005*	0.051
Season	16638.716	2	8319.358	17.666	0.00**	0.193
Still birth	9848.100	3	3282.700	6.971	0.00**	0.124
Error	69698.507	148	470.936			
Total	2957158.000	164				
Corrected Total	119650.780	163				

a. R Squared = 0.417 (Adjusted R Squared = 0.358)

Table 2. Factors influencing weaning weight of piglets

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared

Corrected Model	3.787E6[a]	88	43031.723	337.169	0.00	0.999
Intercept	1.289E7	1	1.289E7	1.010E5	0.00	1.000
Farrowing facility	358.174	1	358.174	2.806	00.101	0.064
Parity	303.701	1	303.701	2.380	.131	0.055
Litter size	7497.017	7	1071.002	8.392	0.00**	0.589
Sex of piglet	961.808	1	961.808	7.536	00.009*	0.155
Season	5092.340	2	2546.170	19.950	.000**	0.493
ADG	2517130.788	76	33120.142	259.508	0.00**	0.998
Error	5232.686	41	127.626			
Total	6.647E7	130				
Corrected Total	3792024.277	129				

a. R Squared = 0.999 (Adjusted R Squared = 0.996)

Table 3. Effect of farrowing facility, parity, litter size and sex on birth weight and weaning weight of piglets.

	Birth Weight			Weaning weight		
Farrowing Facility	**Mean ± S.E.**	**95% Confidence Interval**		**Mean ± S.E.**	**95% Confidence Interval**	
		Lower Bound	**Upper Bound**		**Lower Bound**	**Upper Bound**
CFC Model	1.46 ± 4.25	1.38	1.55	6.94 ± 2.58	6.88	6.99
GR Model	1.56 ± 5.98	1.44	1.68	7.02 ± 3.97	6.94	7.10
Parity	**Mean ± S.E.**	**95% Confidence Interval**		**Mean ± S.E.**	**95% Confidence Interval**	
		Lower Bound	**Upper Bound**		**Lower Bound**	**Upper Bound**
Less than 3	1.39 ± 4.61	1.30	1.48	6.94 ± 3.37	6.87	7.01
More than 3	1.63 ± 6.25	1.51	1.75	7.02 ± 3.44	6.95	7.09
Litter Size	**Mean ± S.E.**	**95% Confidence Interval**		**Mean ± S.E.**	**95% Confidence Interval**	
		Lower	**Upper Bound**		**Lower**	**Upper**

		Bound			Bound	Bound
6	1.90 ± 1.30	1.64	2.16	7.22 ± 8.14	7.05	7.38
7	1.80 ± 1.61	1.56	2.39	7.20 ±7.77	7.01	7.39
8	1.52 ± 9.28	1.34	1.71	6.84 ±7.63	6.69	6.99
9	1.33 ± 4.41	1.24	1.42	6.84 ± 4.17	6.77	6.93
10	1.31 ± 7.54	1.21	1.55	6.82 ± 5.48	6.81	7.12
11	1.25 ± 5.47	1.14	1.36	6.80 ± 4.98	6.73	6.93
13	1.15 ± 7.38	1.01	1.30	6.77 ± 5.91	6.65	6.89
14	1.46 ± 7.32	1.31	1.60	7.08 ± 8.04	6.92	7.24
SEX	**Mean ± S.E.**	**95% Confidence Interval**		**Mean ± S.E.**	**95% Confidence Interval**	
		Lower Bound	**Upper Bound**		**Lower Bound**	**Upper Bound**
Male	1.56 ± 4.43	1.47	1.65	7.03 ± 2.29	6.99	6.99
Female	1.46 ± 4.59	1.37	1.55	6.93 ± 3.34	6.86	7.08
SEASON	**Mean ± S.E.**	**95% Confidence Interval**		**Mean ± S.E.**	**95% Confidence Interval**	
		Lower Bound	**Upper Bound**		**Lower Bound**	**Upper Bound**
March-June	1.49 ± 3.42	1.43	1.56	6.99 ± 2.89	6.94	7.06
July- Oct	1.83 ± 9.79	1.64	2.02	7.23 ± 5.37	7.12	7.34
Nov-Feb	1.21 ± 5.18	1.11	1.31	6.71 ± 5.01	6.61	6.81

Effect of still birth on birth weight of piglets			
No. Of Still births	**Mean ± S.E.**	**95% Confidence Interval**	
		Lower Bound	**Upper Bound**
0	1.22 ± 4.71	1.13	1.31
1	1.53 ± 6.20	1.41	1.65
2	1.80 ± 6.26	1.60	2.01
3	1.49 ± 7.86	1.34	1.65

DISCUSSION

The results of the present study revealed significant influence of parity on birth weight of piglets. Sows that had farrowed more than 3 times had higher birth weight and subsequently higher weaning weight than sows that delivered 3 or less times (Table 3). This was contrary to the reports of Milligan *et al*. (2002) wherein he had observed that the piglets farrowed at first parity had a higher birth weight than those farrowed at the second parity and after the second parity the mean birth weight declined as the parity number increased. Silva *et al*. (2013) discovered that as parity increased, the overall number of pigs born tended to rise. The total number of piglets born, the average birthweight, and the proportion of live births were all quadratically affected by parity. Suriyasomboon *et al*. (2006) demonstrated that the average birth weight was lowest in parity 1 and reached a plateau in parities 2 and 3; thereafter, it decreased significantly as parity number increased. However, parity did not affect weaning weight whereas the litter size effect was highly significant (p<0.01) which was similar to the findings of Akdag *et al*. (2009).

Birth weight of the piglets was affected by litter size. Higher litter size has a negative impact on birth weight, resulting in a significant reduction. It is similar to the findings of Damgaard *et al*. (2003). Even though the farrowing facility has no significant effect on birth weight and weaning weight, the birth weight was found to be higher for guard rail model pen than conventional farrowing crate. This was similar to the findings of Oostindjer *et al*. (2010) who stated that the weaning weight was higher for piglets reared in the guard rail model pen and that there is influence of the farrowing environment on the performance of piglets before and after weaning. The piglets kept in a pen grew faster than those reared in a crate between 15 days after birth and weaning. It may be contributed to the fact that piglets' solid feed consumption increases throughout the later half of the lactation period, which may be stimulated more in piglets kept in farrowing pens which was easily accessible. However, Vande Pol *et al*. (2021) observed that there is no effect on piglet performance from expanding the width of farrowing pens. Weaning weight was unaffected by the size of the farrowing pen. ADG was also highly significant (p=0.00**) for weaning weight. Cabrera *et al*. (2010) found a linear relationship ($P < 0.05$) between weaning weight and ADG in piglets.

Season of farrowing highly influenced birth weight as well as weaning weight in piglets, it was highest in the months from July to October. This was similar to the findings of Zindove *et al*. (2014) who also found that the heaviest litters were born in September and October ($P < 0.05$), while the lightest litters were recorded during the dry months (May to August) (P< 0.05).

CONCLUSION

It was evident from the study that no significant effect was found on mean birth weight and weaning weight from rearing piglets in different farrowing systems. Higher litter size has been demonstrated to reduce mean piglet birth weight. Mean birth weight was affected by the parity of the sow, however weaning weight was not affected by this trait. Season of farrowing greatly influenced birth weight but more studies need to be done to find the influence of temperature and humidity.

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