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

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Authors' contributions

This work was carried out in collaboration among all authors. Author RR involved in conducting the study, data analysis, prepared original draft. Author PTG engaged in supervision. Author SMS conceptualized the study and edited the final draft. Authors TTV, LR and BSMR proof read the manuscript. Author VR involved in statistical analyses. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study aims at analysing the influence of variables such as farrowing facilities, parity, litter size and sex on the birth weight and pre-weaning weight of piglets.

Place and Duration of Study: The study was conducted in the 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: The study comprised of eighteen Large White Yorkshire breed sows of different parities with 177 piglets that were reared in three types of farrowing systems which included Conventional farrowing crate, Guard rail model & modified farrowing facility.

Results: Litter size, season of farrowing, number of stillbirth 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 had no statistically significant effect on the weaning weight ($p > 0.05$). Likewise, the type of farrowing facility ($p > 0.05$) also had no statistical 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.

Keywords: Birth weight; preweaning weight gain; farrowing crate; guard rail; piglets.

1. INTRODUCTION

The pig industry has grown quickly in response to the recent surge in consumer demand for pork [1]. However, in the swine industry, piglet survivability is a significant issue, especially in light of the notable rise in prolificity in recent years [2]. 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) [3]. Pig productivity is influenced by birth weight and litter size. 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. The environments during pregnancy and labour, litter size, birth weight, and liveliness at birth all have an impact on piglet mortality and pre-weaning performance [4]. 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. However, the most important criteria for predicting a piglet's birthweight were those affecting the litter into which it was born, rather than the piglet's genetic composition [5].

On an average, the weight of piglets at birth is 1.43 Kg, with a range of 0.60 to 2.30 Kg wherein the weaning is done between 18 to 25 days, with an average of about 21.3 days and weaning weights range from 4.51 ± 0.53 to 6.75 ± 0.45 Kg. There is no link between weight at birth and average daily weight gain during suckling, which the researchers assumed was due to litter birth weight equalisation [6]. 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 higher 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 [7]. Sows that are 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 [8]. 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 [9]. 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 [10]. Within-litter variation in birth weight was favourably correlated with litter size, but the mean birth weight was inversely correlated with litter size [11]. Colostrum consumption and birth weight were found to be substantially correlated with weaning weight and robustness at weaning, respectively [12]. 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 [13]. 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 [14]. Hence, sows that farrowed during rainy season had smaller litters at birth. This study therefore aims at understanding the factors influencing birth weight and preweaning weight of piglets in different farrowing facilities. It determined the trend of various traits that affect the birth weight and weight at weaning of piglets when reared in two farrowing systems; conventional farrowing crate and guard rail model pen.

2. MATERIALS AND METHODS

The study was conducted in Piggery Unit of Livestock Farm Complex, Tamil Nadu Veterinary and Animal Sciences University, Madhavaram, Chennai for a duration of twelve months. Eighteen 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 three farrowing facilities/crate models on the basis of farrowing stage. Thus, out of the eighteen breedable females, six females were placed in Conventional farrowing crate (Fig. 1), six sows were placed in Guard rail model farrowing facility (Fig. 2) and six sows were placed in a modified farrowing facility (Fig. 3). The modified farrowing facility was specially designed with elevated slatted floor, hinged sides, nest box for the piglets and swivelling rods to allow short-term restraining which slows down the movement of sows. 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.

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 livestock management 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.

Fig. 1. Conventional farrowing crate

Fig. 2. Guard rail model

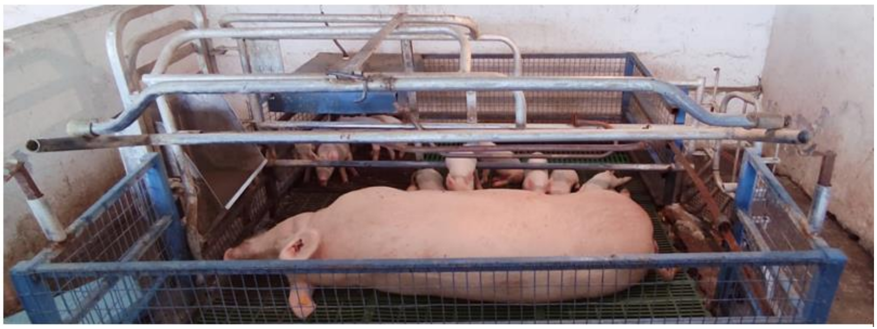

Fig. 3. Modified farrowing crate

2.1 Statistical Analysis

The collected data was subjected to statistical analysis using SPSS 16 in order to arrive at a meaningful interpretation. The differences between the parity order, the average number of live born piglets among groups was evaluated using the ANOVA procedure. The Tukey's test was used to compare means at a 5% significance level. To compare the differences in piglet weight at birth and weaning among the two groups of farrowing facilities, a Chi-square test was performed.

3. RESULTS

Of the three farrowing facilities, the average litter size in the conventional farrowing facility was 8.8 ± 0.21, guard rail model had a litter size of 11.33 ± 0.54 and the average litter size observed in the modified farrowing facility was 10.5 ± 0.33. (Table 1). The average birth weight of the 177 piglets born in the three farrowing systems was 1.36 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 stillbirths, 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 stillbirth (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) that is, farrowing facility; conventional farrowing crate, guard rail model or modified farrowing facility 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 stillbirths. There is a decrease in the birth weight with the increase in the number of stillbirths 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 (Table 3). A Tukey HSD post hoc test showed statistically no significant difference between litter size and birth weight subsets. (*p*=0. 638).

Table 1. Factors influencing birth weight of piglets

Factors	df	F	Sig.	Partial Eta Squared
Farrowing facility	1	2.361	0.127	0.016
Parity	1	11.030	0.001**	0.069
Litter size	7	5.876	0.00**	0.217
Sex of piglet	1	8.011	0.005*	0.051
Season	2	17.666	0.00**	0.193
Stillbirth	3	6.971	0.00**	0.124

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

Table 2. Factors influencing weaning weight of piglets

Factors	df	F	Sig.	Partial Eta Squared
Farrowing facility	1	2.806	00.101	0.064
Parity	1	2.380	0.131	0.055
Litter size	7	8.392	0.00**	0.589
Sex of piglet	1	7.536	00.009*	0.155
Season	2	19.950	0.000**	0.493
ADG	76	259.508	0.00**	0.998
Error	41			
Total	**130**			

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 Bound	**Upper Bound**		**Lower Bound**	**Upper 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

	Birth Weight			Weaning Weight		
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	7.56
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 stillbirth on birth weight of piglets						
No. Of Stillbirths	**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			

Effect of farrowing facility and parity on weaning weight was statistically not significant ($p>0.05$) 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). The average weaning weight of piglets from sow that had farrowed more than three times was 7.02 ± 3.44 kg whereas on an average, the weaning weight of piglets born to sows that farrowed less than three times was 6.94 ± 3.37 kg. Thus, 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.

4. DISCUSSION

The results 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. This was similar to the reports of Adi et al. [15], wherein they had observed primiparous sows had lower piglet birth weights compared to pluriparous sows. This is probably due to the effect of sow parity on ADG of the piglets wherein the higher volume of milk produced by older sows [16] may explain the higher ADG. Factors related to parity also include the ones affecting gastrointestinal morphology [17] and muscle fibre development [18] of piglets. Silva et al. [18] 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. [19] 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. [20].

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. [21].

Even though the farrowing facility has no significant effect on birth weight and weaning weight, the birth weight was found to be higher for piglets reared in modified farrowing facility than in guard rail model pen or conventional farrowing crate whereas weaning weight was found to be more in piglets reared in guard rail model of farrowing facility. Oostindjer et al. [22] 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 latter 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. [23] 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. [24] found a linear relationship ($P < 0.05$) between weaning weight and ADG in piglets. Likewise, 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. [25] 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) ($P< 0.05$).

5. CONCLUSION

Piglet birthweight was influenced by sow parity wherein average daily weight gain of and sex of the piglet influenced the weaning weight of the piglets. All the factors had an impact on the piglet post-natal development, mainly during early life. It is evident that a larger litter size results in a lower mean birth weight and a higher percentage of light piglets. However, the type of farrowing facility was found to have no significant effect on mean birth weight and weaning weight of the piglets. Season of farrowing and the litter size greatly influenced birth weight and weaning weight of the piglets but more studies need to be done to find the influence of temperature and humidity. To maintain productivity, further studies need to also focus on various other factors influencing birth weight & weaning weight of piglets which is very significant because of how it affects viability. Piglets born weighing less than 1 kg have lower chance of surviving till weaning. Furthermore, if they make it through lactation, their performance is inferior to that of the larger piglets, which has an impact on their post-weaning growth performance.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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