



Effect of different parities on reproductive performance, birth intervals, and tail behavior in sows

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Abstract

A goal for swine farming is the improvement in the number of live-born and weaned piglets per sow. Hence, the effect of parities should consider the correlation between the component traits of reproductive performance, weaning, and duration. Sows were housed in farrowing pens (W 2.2 × D 1.8 × H 1.2 m) on a partially slatted plastic floor. Twenty sows used in this study were between the first and sixth parity in gilts (P1), parity 2–5 (P3), and parity 6–9 (P6). Data collection by parity was classified into three categories: (1) reproduction performance (gestation length, total number of piglets born, number of piglets live born, number of piglets stillborn, total piglet birth weight); (2) weaning traits (weaning period, number of piglets weaning, total piglets weaning weight); (3) duration traits (farrowing duration, placenta expulsion duration, time from last piglet to first placenta, average birth interval, and tail wagging behavior). Gestation length was higher in P6 than P1 and P3 of different parity sows. The maximum value in P1 and P3 was 117 days, but the median value in P6 was 117 days ($p < 0.05$). The total number of piglets born ($p = 0.113$), number of piglets live born ($p = 0.118$), number of still piglets born ($p = 0.151$), and total piglet birth weight ($p = 0.117$) were not affected by parity. The number of live piglets was higher than the other parities by an average of 15.6 ± 2.1 in P1. The duration of farrowing was the lowest at 22.2 min in P6, but the maximum value was 42.2 min more than other parities ($p = 0.355$). Weaning traits of sows also did not differ significantly ($p > 0.05$), but the weaning period from P1 was lower than that of the other parities ($p = 0.170$). The number of piglets weaned was 10 heads on average in P1, P3, and P6 ($p < 0.05$). However, the mean values of the total piglet weaning weight ($p = 0.377$) of P6 (62.0 10.4 kg) were higher than those of P1 (54.9 10.2 kg) and P3 (58.4 13.6 kg). The placenta expulsion duration was higher in P6 than that in P1 and P3 ($p = 0.447$). The time from the last piglet to first placenta was lower in P3 than that of the other parities ($p = 0.206$). The average birth interval was higher in P3 than that of the other parities ($p = 0.156$). Tail wagging (count) behavior was higher in P6 than in the other parities ($p = 0.065$). The data showed that the reproduction performance, total piglets born, and weight were higher in the gilts group, and higher in the weaning trait than that in the P6 group. This study examined the relationship between reproductive performance, birth interval and tail motion according to sow parity. Regarding duration, farrowing duration was lower in P6 than that in the other parities, but placenta expulsion and tail wagging were higher in P6 than in the other parities. Therefore, it is possible that the results from these sows could be used as basic data for effective farm management.

Keywords: Birth intervals, Farrowing, Parity, Sows, Tail wagging

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Background

Farrowing of sows in swine farms is closely related to economic efficiency. In addition to gilt, sows of different parity are required to have special help during farrowing from managers [1]. Further, the process of birth is a stressful event for the sow as well as for the piglets [2]. Good maternal ability in sows is characterized by high piglet growth rate and no piglet mortality [3]. The number of live-born piglets and birth weight in sows are major reproductive and economic traits. For piglets, the birth process can be a struggle for life and death [2]. The majority of piglets die within the first 2–4 days of life [4]. Approximately 75% of stillborn piglets die during parturition [3]. Several reports on the duration of farrowing (and/or on birth intervals) have been published [2,3,5,6]. However, most of these reported results have suggested farrowing duration is related to the duration of farrowing parity, litter size, genotype management system. In addition, studies on the interval of piglets in gilts have been carried out [7,8], but there has been no study on the interval of piglets in sows according to various parities.

Recently, animal welfare research has been conducted on live-stock emotions [9,10]. Regarding pigs, various indexes of emotions such as tails, ears and facial expressions have been studied in various ways [11]. It has been suggested that tail movements in general could be a new potential behavioral indicator of positive emotions in gilts. However, reports about tail movement behavior relative to farrowing are limited. Sows are very limited in their behavior in farrowing crates, and the degree of stress varies with individuals [12]. When farrowing, gilts have been reported to exhibit abnormal behavior in farrowing crates [13]. These abnormal behaviors of sows may vary according to parity, but are more frequent in sows with higher parity than gilts [14]. Although studies on farrowing related to sow management (such as changes in posture, nursing, lying down behavior, etc.) have been steadily progressing, studies on the frequent occurrence of tail movements every time a piglet is born have not yet been studied [15–18].

The overall objective of this study was to examine the effect of parity on farrowing and weaning traits for sows. Hence, this study was conducted to investigate the relationship between farrowing traits, and birth interval and tail movement according to sow breeding, and to utilize the basic data obtained in sow farm management.

Materials and Methods

Animals and housing animal

The experimental period was from May 2017 to May 2018 at a farm in Hadong Country. Twenty Yorkshire × Landrace F2 cross-bred sows were used. The sows used in this study were between

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the first and sixth parity in gilt (P1), parity 2–5 (P3), and parity 6–9 (P6), respectively, representing gilt, middle parity, and last parity (parity that is culled from most farms). Sows were housed in individual farrowing pens (W 220 × D 180 × H 120 cm) on a partially slatted plastic floor. To observe behavior, the cameras were installed at 4 sides located 2 m from the farrowing pens. The pens were equipped with a nipple drinker, feed trough, and lamp heater. The sows were fed twice a day with a standard concentrated diet (3.0 kg of a diet with 13.2 MJ digestible energy and 131 g crude protein (16% or less)/kg). Water was freely available from a drinker within the feed trough. The sows house temperature averaged 20.5 ± 2.1°C.

Observation, data collection during farrowing

Data collection by parity was classified into three categories:

- (1) Reproductive performance (gestation length days, total number of piglets born, number of live born piglets, number of still born piglets, total piglet birth weight);
- (2) Weaning traits (weaning period days, number of piglets weaning, total piglet weaning weight, and duration traits);
- (3) The duration traits examined were: farrowing duration (the time interval between the birth of the first and last piglets), placenta expulsion duration (the time interval between the first placenta being visible and the last placenta being expelled), time from last piglet to first placenta (the time of appearance of first placenta relative to the last piglet), average birth interval (the first born piglet was assumed to have a reference point of 0 min), and tail wagging behavior (rapid swinging of the tail from side to side and a few seconds before piglet birth tail movement).

Data of reproduction performance and weaning traits were obtained from computerized records, and software programs (PIG PLAN, Ezfarm, Inc., Korea) were used for the management of breeding stock on the experimental farm. The tail wagging behavior of the sows was recorded during farrowing from the first to the last piglet. Whenever movement, was observed, the frequency was analyzed.

In principle, no attempts were made to interfere with the natural farrowing of the sows. Furthermore, there was no human intervention to control aggression towards the newborns and no assistance of the piglets to find a teat. No savagers behavior occurred in the sows observed in the experiment (gilts that displayed offspring-directed aggression, i.e., attacked, bit, or even killed offspring) [2].

Statistical analysis

All data were analyzed with R package (R version 3.31, R Foundation for Statistical Computing, Tokyo, Japan). Effect of parity on reproduction performance, weaning traits, and duration traits were

analyzed using ANOVA. The data for farrowing traits and weaning traits were investigated of mean and standard deviation. The data for duration traits of frequency and minute was not normally distributed, based on the Shapiro-Wilk test. For the calculation of significant differences between the days of observation, the Kruskal-Wallis test was used. A p -value of < 0.05 was considered significant. To analyze the relationship between variables in the birth intervals and tail wagging, a Pearson correlation was conducted.

Results and Discussion

Gestation length was higher in P6 than P1 and P3 in different parity sows (Table 1). The maximum value in P1 and P3 was 117 days, but the median value in P6 was 117 days ($p < 0.05$) [12]. Studies have shown that stress during pregnancy is more prevalent in gilts than in other sows owing to limited behavior during gestation, but P6 had the longest gestation length in the present study. This means that the higher the parity, the greater the physical impact of sows than the effect of stress on reproductive performance. It also supports previous research on sows, indicating that stress may delay farrowing and recurrent estrus periods [19].

The total number of piglets born ($p = 0.113$), number of live piglets born ($p = 0.118$), number of still born piglets ($p = 0.151$), and total piglet birth weight ($p = 0.117$) were not affected by parity. The number of live piglets in P1 was higher than that in the other parities by an average of 15.6 ± 2.1 . In contrast, the average number of weaning piglets was 10 heads. This indicates that gilts lacked maternal behavior, and weak piglets were likely to starve to death owing to competition [20,21].

In addition, the influence of sow behavior on piglets mortality due to crushing reported [15] found that piglets are most vulnerable to crushing during the first 24 h of life, when they are spending much of their time near the udder and have relatively poor mobility. Furthermore, there are reported the piglets born to older sows have reliable thermoregulation [27].

It is well recognize that in the sow most stillbirths occur intrapartum as a result of dystocia and the delayed expulsion of the litter [28]. There are substantial data on stillbirth rates in sows [29,30]. The results of this experiment suggest that the number of stillborn is less than 1 in most parities and it is difficult to regard them as dystocia.

Weaning traits of sows also did not significantly differ ($p > 0.05$), but the weaning period from P1 was lower than that in other parities ($p = 0.170$). The results indicated that the gilts reflect piglet relationships, which was consistent with a theoretically predicted model of weaning conflict.

This is similar to previous studies in which there is a difference in the degree of stress and maternal at the farrowing, and a longer weaning period in sows of higher parities than gilts [22].

The number of piglets weaning was 10 on average in both P1, P3, and P6 ($p < 0.05$). However, the mean the total piglet weaning weight ($p = 0.377$) in P6 (62.0 ± 10.4 kg) was higher than that in P1 (54.9 ± 10.2 kg) and P3 (58.4 ± 13.6 kg). This indicated that the number of piglets weaning was the same, but the different parities of the sow and her piglets could influence their interactions with one another [23].

The farrowing duration was the lowest at 22.2 min in P6 and, but the max value was 42.2 min more than the other parities ($p = 0.355$). The placenta expulsion duration was higher in P6 than in P1 and P3 ($p = 0.447$). The time from last piglet to first placenta was lower in P3 than that in the other parities ($p = 0.206$). The average birth interval was be higher in P3 than that in the other parities ($p = 0.156$).

The tail wagging (count) behavior was higher in P6 than that in the other parities ($p = 0.065$). There were no significant differences between parities on the placenta expulsion duration, time from last piglet to first placenta, birth intervals, as well as tail wagging ($p > 0.05$). Fig. 1 shows of the birth interval of piglets compared to parity. There was no significant difference ($p > 0.05$), but the distributions of graphs were larger in P1 and P3 than that in P6. This was supported by the fact that P1 was a gilts group with a large distribution, whereas in P3 the maximum number of stillborns was 4 heads (Table 1). [4] reported that the averages decreased with birth interval with an increase in birth order. However, in a study of gilts, the average of birth interval decreased with an increase of birth order, which was inconsistent with the results from the present experiment [2].

Fig. 2 shows a comparison between the frequency of tail wagging behavior and parities of sows. P1, P3, and P6 showed an increase in tail wagging with the first-born piglet, but this decreased considerably when the last piglet was born ($p > 0.05$). Table 2 shows the correlation between the birth interval of the piglets and tail wagging behavior of sows. This showed the same negative correlation in all parities. In P6, the slope was -0.832 , indicating a significantly negative correlation ($p < 0.001$). In the present experiment, the frequency of tail movement in sow behavior was active, and the piglets born last were healthy and were not still born. Research reported that the active movement of the tail of pigs was previously studied as an indicator of positive emotions, but the results from the present study were contradictory [11]. We suggested that tail wagging is one of the more important parts of sow pain. In the case of piglets that tail wagging increased significantly in a food frustration situation [24]. Increased amounts of tail wagging were also found after surgical procedures like tail docking [25] and castration [26]. These results are in agreement with suggested that skin irritation (which is likely for pigs with tail damage) would induce tail wagging.

Table 1. Descriptive statistics of the Yorkshire × Landrace F2 crossbred P1, P3, and P6

	Parity	Avg SD	Med	Min	Max	p-value
Sows traits						
Gestation length (days)	P1	115.4 ± 1.3	116	114	117	<0.05
	P3	115.5 ± 1.2	115	114	117	
	P6	116.7 ± 0.9	117	115	118	
Total number of piglets born (heads)	P1	16.8 ± 1.8	17	14	19	0.113
	P3	15.5 ± 3.1	15	12	21	
	P6	12.4 ± 3.2	12	7	17	
Number of piglets born live (heads)	P1	15.6 ± 2.1	16	13	18	0.118
	P3	14.0 ± 3.2	13	10	19	
	P6	11.0 ± 3.4	11	6	16	
Number of piglets still born (heads)	P1	0.2 ± 0.5	0	0	1	0.151
	P3	1.3 ± 1.5	1	0	4	
	P6	1.1 ± 0.3	0	0	1	
Total piglet birth weight (kg)	P1	16.8 ± 2.1	16	14	20	0.117
	P3	14.7 ± 3.2	14	10	19	
	P6	12.4 ± 3.5	12	7	18	
Weaning traits						
Weaning period (days)	P1	23.0 ± 7.8	24	13	34	0.170
	P3	20.7 ± 2.7	19	18	24	
	P6	20.2 ± 4.8	19	16	32	
Weaning piglets (heads)	P1	10.4 ± 1.5	11	8	12	<0.05
	P3	10.0 ± 0.6	10	9	11	
	P6	10.4 ± 1.7	11	8	12	
Total piglets weaning weight (kg)	P1	54.9 ± 10.2	56	38	66	0.377
	P3	58.4 ± 13.6	59	43	77	
	P6	62.0 ± 10.4	58	54	81	
Durations traits						
Duration of farrowing (min)	P1	25.9 ± 6.1	26	18	33	0.355
	P3	29.5 ± 3.8	29	25	33	
	P6	22.2 ± 13.3	21	5	42	
Duration of placenta expulsion (min)	P1	141.0 ± 263.0	15	0	536	0.447
	P3	192.0 ± 423.0	17	0	1,056	
	P6	663.0 ± 1,802.0	23	0	5464	
Time from last piglet to first placenta (min)	P1	74.0 ± 117.0	25	0	248	0.206
	P3	34.0 ± 37.0	31	0	80	
	P6	87.0 ± 79.0	83	1	248	
Average birth interval (min)	P1	125.6 ± 94.8	114	0	357	0.156
	P3	229.3 ± 125.0	229	0	455	
	P6	167.1 ± 92.0	189	0	340	
Behavior of tail wagging (count)	P1	5.3 ± 4.3	4	1	16	0.065
	P3	5.6 ± 2.3	4	2	9	
	P6	7.8 ± 6.7	5	0	24	

Twenty sows used in this study were between the first and sixth parity in gilts (P1), parity 2–5 (P3), and parity 6–9 (P6).

Avg, average; SD, standard deviation; Med, median; Min, minimum; Max, maximum.

In conclusion, the data showed that the reproduction performance, total number of piglets born and piglet weight were higher in the gilts than others groups, and the weaning trait was highest in the P6 group. This study examined the relationship between reproductive performance, birth interval and tail motion according to sow parity. Regarding the duration trait, farrowing duration was lower in P6 than other parities, but placenta expulsion duration and tail wagging were higher in P6 than that in the other parities. In contrast the gilts housing environment changes, they might be stressful and became more anxious and uneasy, resulting in increased standing behavior. Based on the results of this study, we believed that effect of different parties on reproductive performance and tail behavior in sow. This can help producers to take ap-

Table 2. Correlation between the birth interval of the piglets and the tail wagging behavior of sows

Parity	Birth interval: tail wagging correlation	p-value
P1	-0.441	0.087
P3	-0.428	0.097
P6	-0.832	0.001

Twenty sows used in this study were between the first and sixth parity in gilts (P1), parity 2–5 (P3), and parity 6–9 (P6).

appropriate measures to prevent further of the problem as basic data in sow farm management. Through further experiments involving correlations between dystocia and tail movement of sows, a behavioral study of different parties to dystocia is also needed.

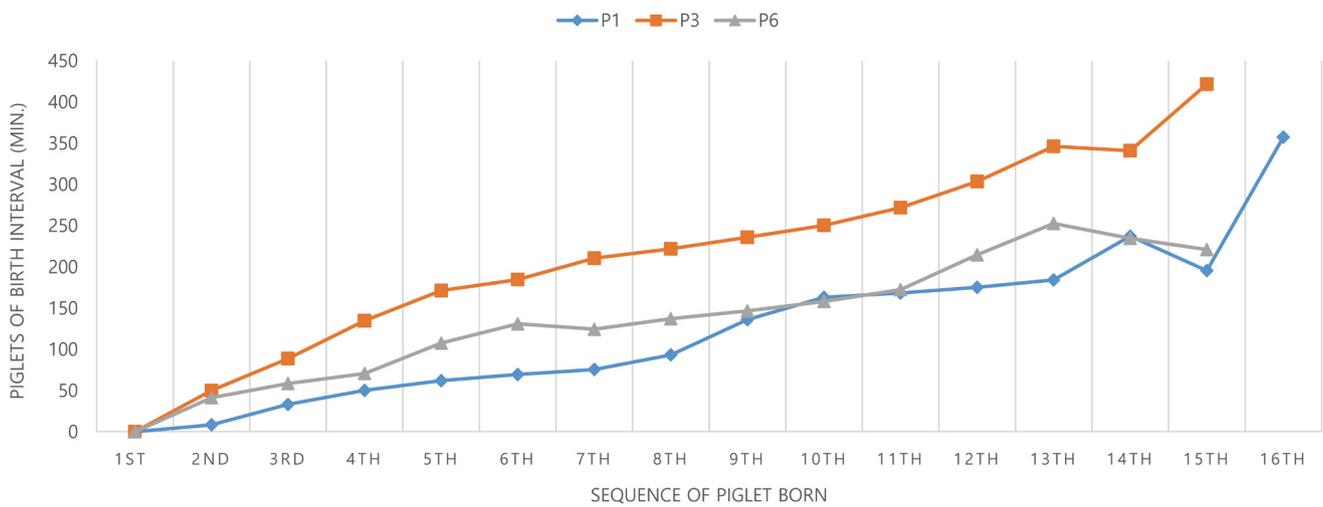


Fig. 1. Comparison of the intervals of birth in piglets. Twenty sows used in this study were between the first and sixth parity in gilts (P1), parity 2–5 (P3), and parity 6–9 (P6).

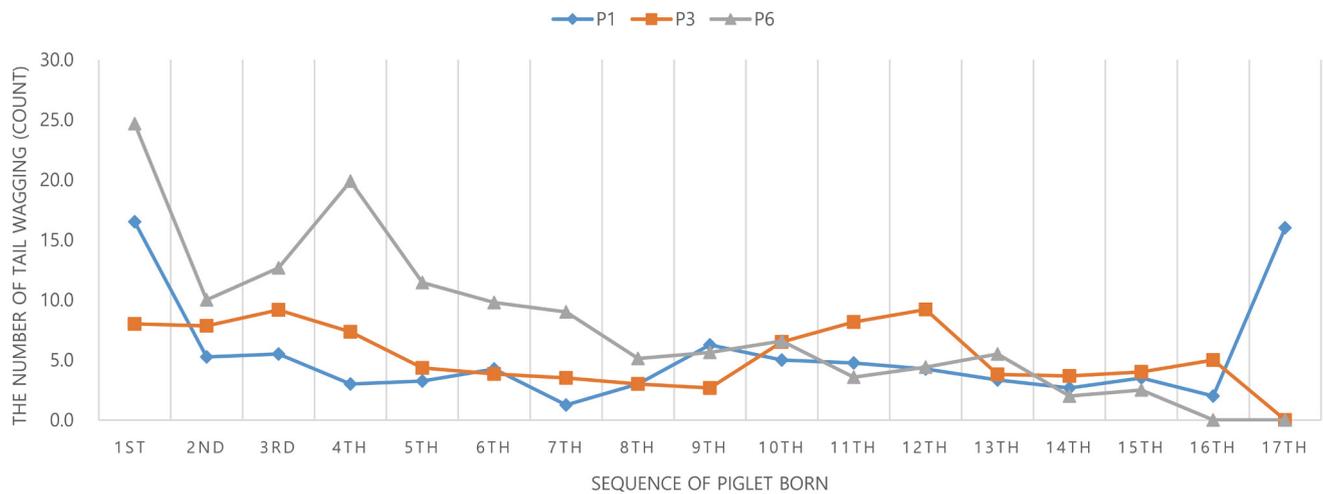


Fig. 2. Comparison of the frequency of tail wagging behavior effect to the parity of sows. Twenty sows used in this study were between the first and sixth parity in gilts (P1), parity 2–5 (P3), and parity 6–9 (P6).

Competing interests

No potential conflict of interest relevant to this article was reported.

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Availability of data and material

Upon reasonable request, the datasets of this study can be available from the corresponding author.

Authors' contributions

Conceptualization: Lee JY.

Data curation: Yang KY.

Formal analysis: Jeon JH.

Methodology: Yang KY, Jeon JH.

Software: Kim JB, Kwon KS.

Validation: Choi HC.

Investigation: Lee JY.

Writing-original draft: Yang KY.

Writing-review & editing: Lee JY, Choi HC, Jeon JH.

Ethics approval and consent to participate

Protocols involving the use of experimental animals were conducted in accordance the ethical and scientific guidelines of the animal Experiment Ethics Committee of RDA (No: NIAS-2017064).

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