EFFECTS OF MULTI-SUCKLING ON PIGLET WELFARE AND PERFORMANCE PRE- AND POST-WEANING

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Executive Summary

Group farrowing systems have been developed with increasing focus being placed on the welfare of sows confined within conventional farrowing crates. However, the effects of grouping sows during lactation on the welfare and performance of piglets have been studied to a much lesser extent. The aim of this experiment was to compare the mortality, performance and welfare of piglets pre- and post-weaning and to elucidate the stress response of piglets in a conventional farrowing crate and those socialized piglets in an alternative multi-suckling system.

196 Large white x Landrace primiparous sows were randomly allocated to either a traditional farrowing crate (Control; n=49 sows; 49 reps) or were mixed into groups of three (multi-sucked) with litters from day 13 prior to weaning (Grouped; n=147 sows; 49 reps). Piglets were assessed for growth performance, removals and mortality, creep consumption and welfare using an injury scoring system pre- and post-weaning. Sows were assessed for general lactation traits and welfare using an injury scoring systems pre-weaning. Subsequent reproductive traits were observed post-weaning.

No difference was seen in the lactation performance of grouped sow's other than they weaned smaller litters (0.33 fewer pigs). Similarly, there was no effect of grouping in lactation on the subsequent reproductive performance of these sows. Mixing in lactation had negative effects of the welfare of grouped sows. They had increased head, body and rump injuries at all points measured post mixing. Grouped sows also tended to have increased udder injuries.

Grouping in lactation had no effect on piglet mortality, however did increase the incidence of removals, primarily due to ill thrift (0.10 vs 0.33 pigs per litter of control and grouped litters respectively). The day prior to weaning grouped pigs were 560g lighter than control piglets (P<0.0001) and 770g lighter on day 30 post-weaning but was not significant (P=0.3071). Variance in piglet weight was greater on all days post-mixing at day -13 in grouped piglets. Injuries were greatest around mixing. In grouped piglets, these were greatest on days -12 and -1 relative to weaning. For control piglets, injuries were greatest 7 days post weaning.

The key message from this experiment is that any mixing event result in a reduction in welfare; for the sow and piglet when grouped in lactation, and the piglet at weaning in individually housed sows and litters. However mixing litters at weaning, as seen in a traditional weaning event is less likely to result in a long-term reduction in piglet growth performance.

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1. Introduction

Group farrowing systems have been developed with increasing focus being placed on the welfare of sows confined to conventional farrowing crates. However, the effects of grouping sows during lactation on the welfare and performance of piglets have been studied to a much lesser extent (Li et al. 2012), with most results to date coming from relatively small-scale experiments.

Weaning is a stressful period for piglets, resulting from the nutritional, environmental and social changes, which has implications for subsequent post-weaning growth. Weight gain immediately post-weaning may influence the growth performance of the pig throughout the grower-finisher period (Pluske et al. 2003), and therefore, is possibly the most crucial period for the pig in pig production. Focus should be placed on reducing stress at weaning to ensure optimal feed intakes and growth in the subsequent few days (Brooks and Tsourgiannis, 2003).

Hessel et al. (2006) indicated that multi-suckling pens did not have any negative effects on the behavior and performance of piglets pre-weaning, although, multi-suckled piglets had improved post-weaning behaviors and performance through a reduced weaning growth-check. Li et al. (2012) also indicated that this positive performance extended into the grow-finish period with improved weight gains, reduced feed intakes and improved fed conversions. Whilst the post-weaning performance and welfare of piglets from multi-sucked systems seems elucidated, the pre-weaning effects are less obvious. Pre-weaning mortalities due to crushing by the sow appear to increase in multi-suckling scenarios whilst weaning weights decrease (reviewed by Wattanakul et al. (1997)). However, most of these trials were relatively small in scale and these concepts deserve investigation in a more commercial environment.

The aim of this experiment was to compare the mortality, performance and welfare of piglets pre- and post-weaning and to elucidate the stress response of piglets in a conventional farrowing crate and those socialized piglets in an alternative multi-suckling system.

2. Methodology

This experiment was conducted on a large commercial piggery in South Australia. All animal procedures were conducted with animal ethics approval under the PIRSA Animal Ethics Committee (# 05/15), in accordance with the *Animal Welfare Act* 1985 and Regulations, and with the *Australian Code of Practice for the care and use of animals for scientific purposes 8th edition 2013*.

Treatments

In total, 196 large white x landrace primiparous sows were randomly allocated to one of two treatments. Control sows (n=49 sows; 49 reps) were housed in traditional farrowing crates for the duration of lactation Grouped sows (n=147 sows; 49 reps) were housed in traditional farrowing crates unit 13 days prior to weaning (which occurred at ~28 days), at which point they were mixed into groups of three (multi-sucked) with litters until weaning.

Only primiparous sows were used as they had no prior experience with farrowing crates or lactation and therefore removed any possible behavioral effects due to prior experiences. The experiment was conducted over eight farrowing batches with 12 replicates from each batch. Replicates consisted of one sow for control and three sows in multi-suckling treatments. All sows and piglets were managed as part of the normal farm practices of the commercial piggery.

Housing

Both treatments were housed in the same farrowing room. Farrowing buildings were naturally ventilated curtain sided sheds enabling temperature control. A water dripper was located over each sow for cooling in farrowing crates and misters over grouped pens. Farrowing crates were fully slatted and 1,750mm wide by 2,350mm long and contained a piglet cubby heated by an overhead lamp. Creep feeders were not supplied to piglets in crates. The fully slatted multi-suckling pens compromised 3 sows and their litters in a pen of $21m^2$, with a creep area for piglet protection of $5.25m^2$ (Figures 1 and 2), containing a heat lamp, creep feeder and piglet waterer. The sow area of the grouped pen had three feeders and three water sources to reduce competition for resources.

Housing treatments

The same stock people managed all animals. Sows entered the farrowing house at least 3 days prior to the anticipated farrowing date. After farrowing, piglets were fostered within 24 hours and within the experiment if possible, such that all piglets on trial were the progeny of primiparous sows. Piglets were fostered to functional teat capacity, excluding the last two teats. Additional piglets needed to standardize fostering to teat capacity came from sows that had farrowed on the same day. After farrowing sows were fed a commercial lactation diet *ad libitum* containing 14.3 MJ DE/Kg, 18.8% crude protein and 1.06% Lysine. Sows and litters in the “Grouped” treatment were moved from the farrowing crate to the group lactation pens (Figure 1) 13 days prior to weaning (approximately 15.2 ± 2.2 days of age). Pigs in the grouped treatment were offered creep feed from grouping, however, the control litters were not offered creep feed until weaning, which is standard practice on the farm where the experiment took place. Piglets were weaned at an average of 28.0 ± 2.1 days of age. At weaning, sows were moved into groups of 15-20 and received boar exposure from weaning until insemination.

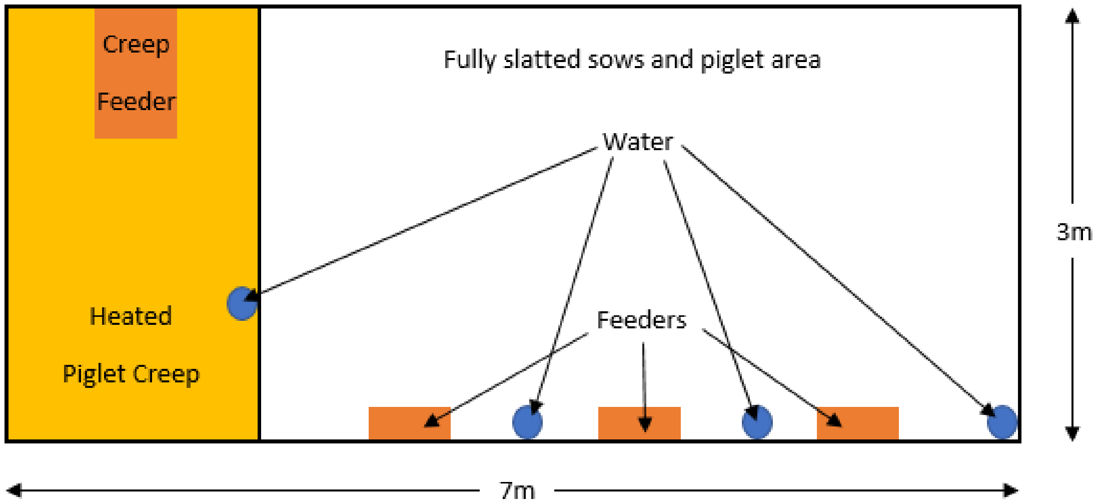

Figure 1: Floorplan of the group lactation pen for sows and piglets

Figure 2: Group lactation pen for sows and piglets

Measurements

At farrowing house entry, sows were weighed and allocated to treatment based on entry weight. With the exception of sow entry weight, all sow and piglet experimental measurements were made on days relative to weaning, beginning on the day prior to mixing (day -14).

Pre-weaning piglet measures

Mortalities were recorded for the active duration of the experiment i.e. day -14 to weaning. Piglet removals were recorded from day -14 to weaning. Reasons for removal included ill thrift and meningitis. Most piglet removals were for ill thrift. Piglets were weighed individually on days -14, -12 and -1 relative to weaning. Piglet weight gain was calculated from inference during each of these periods.

Piglet injury scores were assessed on all piglets prior to mixing (day -14) the day after mixing (day -12) and the day prior to weaning (day -1), where weaning represented day 0. Piglet injury scores were based on a modified procedure as described by Widowski et al (2003). The procedure consisted of scratches, redness and facial wounds (Table 1). Scratches were graded from 0-3 (based on the number and length of the scratches), redness graded 0-3 (based on detectable redness and loss of hair). The recording of facial wounds (eczema) was based on whether they were present or not.

Table 1: Injury scoring procedure using scratches and redness adapted from Widowski et al. (2003).

Score:	0	1 (Mild)	2 (Moderate)	3 (Severe)
Redness	No redness, swelling, or hair loss is evident	Reddening, swelling, or hair loss is barely detectable	Swelling, redness, or hair loss is obvious	Irritation easily observed as darker reddening, swelling, and patches of hair loss
Scratches	No scratches or skin loss were evident on face and body	One to three small (≤ 2 cm) scratches or areas of abraded skin is evident, or scratches on face only or back only	One to three larger (>2 cm) scratches or areas of abraded skin is observed on back and/or face	More than three scratches (usually >2 cm) or larger areas of superficial skin loss. Scratches on both face and back

Creep feed consumption was recorded for focus piglets. Four focus piglets were selected (tagged) per litter (2 males and 2 females of average weight) on day -14, the day before the grouped litters were mixed. Pelleted starter feed was dyed with brilliant blue (5g per 1kg feed) and piglets received a rectal swab to assess consumption of creep feed. The same focus piglets were used for the assessment for creep feed consumption throughout the experiment. Piglet injury scores and creep feed assessment was performed on all piglets individually pre wean but only on focus piglets post wean.

Post-weaning piglet measures

Mortalities were recorded throughout the weaner phase i.e. day 0 to 30. Piglets were mixed at weaning within their treatments and grouped according to size (n=17 pigs per pen). Piglets were weighed as groups on days 1, 7, 14 and 30 relative to weaning, in addition to individual weights at day 1 and 7 post-weaning. Piglet weight gain was calculated from inference during each of the periods.

Piglet injury scores (Table 1) were assessed on all focus piglets post-weaning mixing on days 1, 2, 7, and 30 (where weaning represents day 0). Feed consumption was recorded for focus piglets until all focus piglets were confirmed to be eating.

Sow measures

All sows were individually weighed at farrowing house entry and at weaning. Weight loss was calculated by inference. Lactational estrus was measured by the presence or absence of sow sexual behavior each day from mixing by an experienced stockperson.

Sow injury scores were assessed on all sows at days -14, -12 and day -1 relative to weaning. The sow injury scoring assessment used is described in Table 2. The sow's body was divided into three areas for injury scoring (head and neck, body and rump). On each measurement point the following were recorded for each body section: fresh injuries, the presence or absence of cuts, abscess, or ulcers, shoulder ulcers and vulva bites. The udder was evaluated for injuries, redness, damaged teats and mastitis. The number and type of injuries were recorded on all sows on each observation day.

Subsequent sow reproductive performance was recorded: weaning to estrus interval, conception rate, farrowing rate, and subsequent litter size (total born, born alive, born dead and mummified)

Table 2: Sow injury scoring assessment used to evaluate injuries on days -14, -12 and -1 relative to weaning.

Score:	0	1 (mild)	2 (moderate)	3 (severe)
Head and Neck	No injuries	0-5 fresh abrasive injuries	6-10 fresh abrasive injuries	>11 fresh abrasive injuries
Body	No injuries	0-5 fresh abrasive injuries	6-10 fresh abrasive injuries	>11 fresh abrasive injuries
Rump	No injuries	0-5 fresh abrasive injuries	6-10 fresh abrasive injuries	>11 fresh abrasive injuries
Udder injury	No injuries	Mild abrasive injuries	Moderate abrasive injuries	Severe abrasive injuries
Udder Redness	No redness or swelling	Reddening or swelling is barely detectable	Swelling or redness is obvious	Irritation easily observed as darker reddening and swelling
Damaged teats	Presence or absence of damaged teats (number)			
Mastitis	Incidence of mastitis (yes/no)			
Cuts	Presence or absence of cuts (number)			
Abscess	Presence or absence of abscesses (number)			
Ulcers	Presence or absence of ulcers (number)			
Shoulder Ulcers	Presence or absence of shoulder ulcers (left right or both)			
Vulva Bites	Presence or absence of fresh vulva biting (yes/no)			

Statistical Analysis

Before analysis, data were checked for normality and logistic transformations were applied as necessary.

Pre-weaning traits were analyzed with a generalized linear mixed model (Proc MIXED; SAS 9.3), with pen considered the unit of replication and sow fitted as a random effect. Fixed effects where appropriate included block, pen, sex, litter size, after adjustment for birth weight. Pen, the unit of replication had 49 reps for control sows (n=49 sows) and 49 reps for grouped sows (n=147 sows). Binary traits (e.g. survival) were analyzed with a linear logistic regression using a logistic transformation (Proc LOGISTIC; SAS 9.3).

Sow traits were analyzed with a generalized linear mixed model (Proc MIXED; SAS 9.3), with pen considered the unit of replication. Fixed effects where appropriate included treatment, block, pen. Binary and ordinal traits (e.g. some injury data) were analyzed using a linear logistic regression using a logistic transformation (Proc LOGISTIC; SAS 9.3).

Post-weaning fixed effects included block, pen, replicate and sex after adjustment for initial pen weight.

Where transformations occurred, back-transformed means are presented. Data are expressed as least squares means ± SEM and a difference at P < 0.05 was deemed significant.

3. Outcomes

Sow Outcomes

No sows were removed from the experiment during the pre-weaning (days -14 to weaning). There was no difference between housing treatments in the pre-farrow weight of sows at farrowing house entry (Table 3). Weaning weight and weight change during lactation were not significantly different between housing treatments.

Table 3: Sow weight and weight change in control and grouped lactation housing treatments LSM±SEM.

	Control	Grouped	Prob>t
Pre-Farrow Weight† (kg)	214.9 ± 2.4	211.2 ± 1.5	0.2036
Weaning Weight (kg)	177.4 ± 2.0	175.1 ± 1.2	0.3271
Weight Change (kg)	-38.1 ± 2.8	-36.9 ± 1.7	0.7022

†Sow weight at farrowing house entry and therefore includes gravid uterus weight.

There was no significant difference between housing treatments in farrowed litter characteristics (Table 4), or in post-fostered litter size. Weaned litter size tended to be greater in control sows than grouped sows (P=0.0634). Lactation estrus was only observed in two sows in the grouped treatment. This is consistent with expectations from non-stimulated first parity sows.

Table 4: Reproductive characteristics of sows allocated to control and grouped lactation-housing treatments LSM±SEM.

	Control	Grouped	Prob>t
Total Born	11.17 ± 0.51	11.36 ± 0.22	0.5624
Born Alive	10.31 ± 0.52	10.77 ± 0.21	0.2658
Born Dead	0.85 ± 0.16	0.58 ± 0.07	0.3987
Mummified fetuses	0.04 ± 0.03	0.04 ± 0.02	0.6159
Post-fostered litter size	12.02 ± 0.13	11.98 ± 0.11	0.3326
Day -14 litter size	10.82 ± 0.17	10.78 ± 0.15	0.3497
Weaned litter size	10.11 ± 0.15	9.78 ± 0.09	0.0634
Average piglet weaning weight (kg; day -1)	7.17 ± 0.08	6.61 ± 0.05	<0.0001

Injury scores were, in general, significantly different between housing treatments at all-time points and all areas of sows, except for body injuries on the day prior to mixing (day -14; Figure 3). Rump injuries tended to be different between housing treatments on day -14 (P=0.0722). Injury scores from sows in grouped housing treatments increased after mixing on day -13 prior to weaning (P<0.0001). Incident of shoulder ulcers were greater of day -14 in crated sows (0.36 vs. 0.15; P=0.0097), and were not different at other time points. Udder injuries (scratches) for grouped sows tended to be greatest on the day prior to weaning (0.87 vs 0.63; P=0.0719). All other injury types were of very low incidence and were not significantly different between housing treatments.

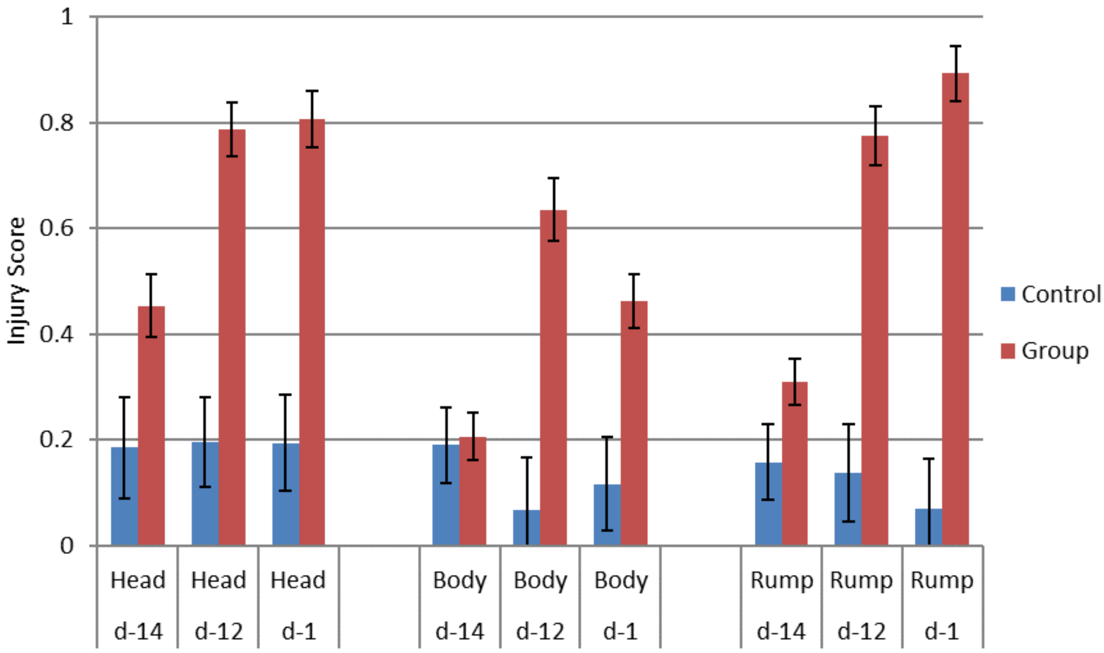

Figure 3: Injury scores head and neck, body and rump of sows measured on days -14, 12 and -1 prior to weaning. Mixing of grouped sows occurred on day -13.

Table 5: Subsequent Reproductive characteristics of weaned sows that had been allocated to control and grouped lactation-housing treatments during lactation LSM±SEM.

	Control	Grouped	Prob>t
Wean to Oestrus (Days)	5.4 ± 0.4	5.6 ± 0.3	0.6791
Conception Rate	97.10%	92.30%	0.2721
Farrowing Rate	89.90%	87.00%	0.6207
Total born	12.97 ± 0.23	12.59 ± 0.25	0.6035
Born alive	11.91 ± 0.19	11.60 ± 0.18	0.6794
Still born	0.83 ± 0.08	0.79 ± 0.08	0.5468
Mummified fetuses	0.23 ± 0.03	0.20 ± 0.03	0.9112

Piglet outcomes

Prior to mixing from day -13 relative to day weaning, mortalities, removals and the total mortalities and removals were not different between housing treatments (Table 6). Piglet mortality was not different between housing treatments post mixing, however removals were different between treatments (P=0.0199). The predominant cause of removals post mixing in grouped piglets was for ill thrift (93%) which was similar in control piglets (85%). The large difference in removals and the smaller difference in mortalities in grouped piglets vs control piglets impacted the total reduction in litter size (0.34 pigs/litter; P=0.0199) of grouped piglets and resulted in the reduction in pigs weaned of grouped litters.

Table 6: Piglet mortality and removals from litters of sows housed individually, through lactation or mixed into groups from 13 days prior to weaning.

	Control	Grouped	Prob>t
Pre-mixing Mortality	0.71 ± 0.3	0.57 ± 0.12	0.7279
Post-mixing Mortality	0.38 ± 0.12	0.50 ± 0.07	0.3792
Pre-mixing Removal	0.32 ± 0.23	0.37 ± 0.09	0.8688
Post-mixing Removal	0.10 ± 0.08	0.31 ± 0.05	0.0199
Pre-mixing Mortality + Removal	1.03 ± 0.12	0.94 ± 0.07	1.5967
Post-mixing Mortality + Removal	0.48 ± 0.08	0.81 ± 0.05	0.0199

Piglet weights were not different between housing treatments prior to mixing on day -14 (Figure 4; Table 7). The day post mixing the difference in piglet weights between housing treatments was 175g (P<0.0001), with grouped piglets being lighter. The day prior to weaning the difference had increased to 560g (P<0.0001). One week post weaning the difference still equated to 418g (P=0.0006). By 30 days, post mixing grouped piglets were 770g lighter than control piglets. At this time, this was not significant due to the increases in variance within the groups (P=0.3071). Growth rate between time points was not affected by housing treatment.

Table 7: Pre-weaning and post-weaning weight of piglets from sows housed individually or in groups from 13 days prior to weaning LSM±SEM.

Day	Control	Grouped	Prob>t
-14	4.23 ± 0.08	4.23 ± 0.06	0.9999
-12	4.74 ± 0.02	4.56 ± 0.01	<0.0001
-1	7.17 ± 0.08	6.61 ± 0.05	<0.0001
1	7.28 ± 0.09	6.78 ± 0.06	<0.0001
7	8.29 ± 0.11	7.88 ± 0.07	0.0006
14	10.2 ± 0.39	9.89 ± 0.21	0.3785
30	18.57 ± 0.55	17.8 ± 0.31	0.3071

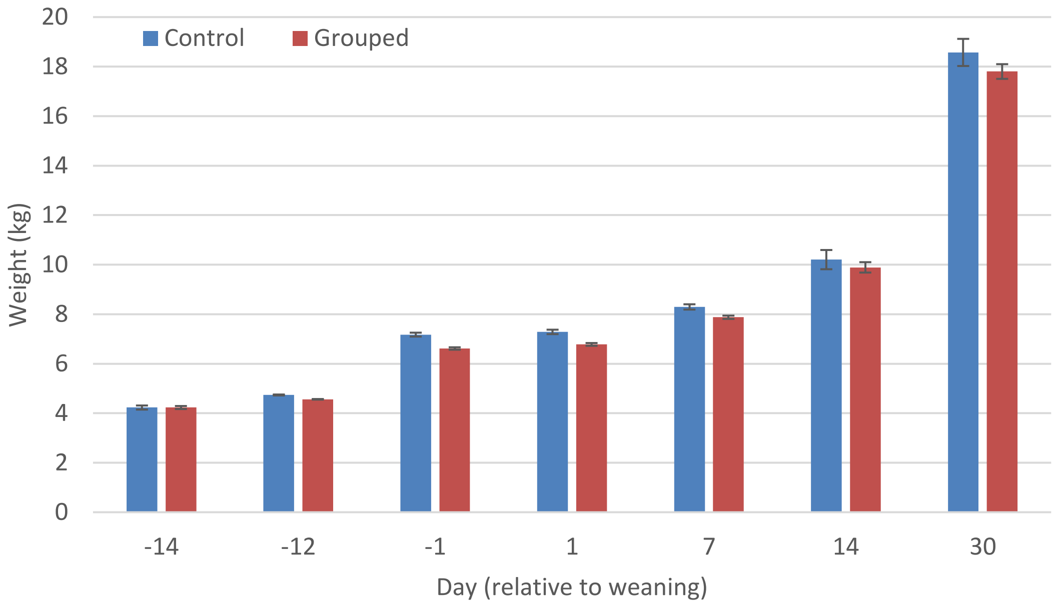

Figure 4: Pre-weaning and post-weaning weight of piglets from sows housed individually or in groups from 13 days prior to weaning LSM±SEM.

Variance (as calculated by the squared standard deviation) in piglet weight was greater in grouped piglets than control piglets (Table 8).

Table 8: Variance (standard deviation^2) in weight between control and grouped piglets on weigh days relative to weaning.

	Day relative to Mixing							
	-14	-12	-1	1	3	7	14	30
Control	0.96	0.98	2.09	1.18	1.40	2.63	3.48	4.34
Grouped	0.88	1.13	2.29	1.89	2.28	3.42	3.88	6.66

Feed consumption data was confounded with housing treatment, as creep feed was not offered to control piglets prior to mixing due to the limitations of the commercial farm where the experiment took place. Therefore, the day prior to weaning no piglets in the control group were consuming solid feed whereas in the grouped treatment over 60% of piglets were (Figure 5). By day 7 post weaning all piglets were consuming starter feed.

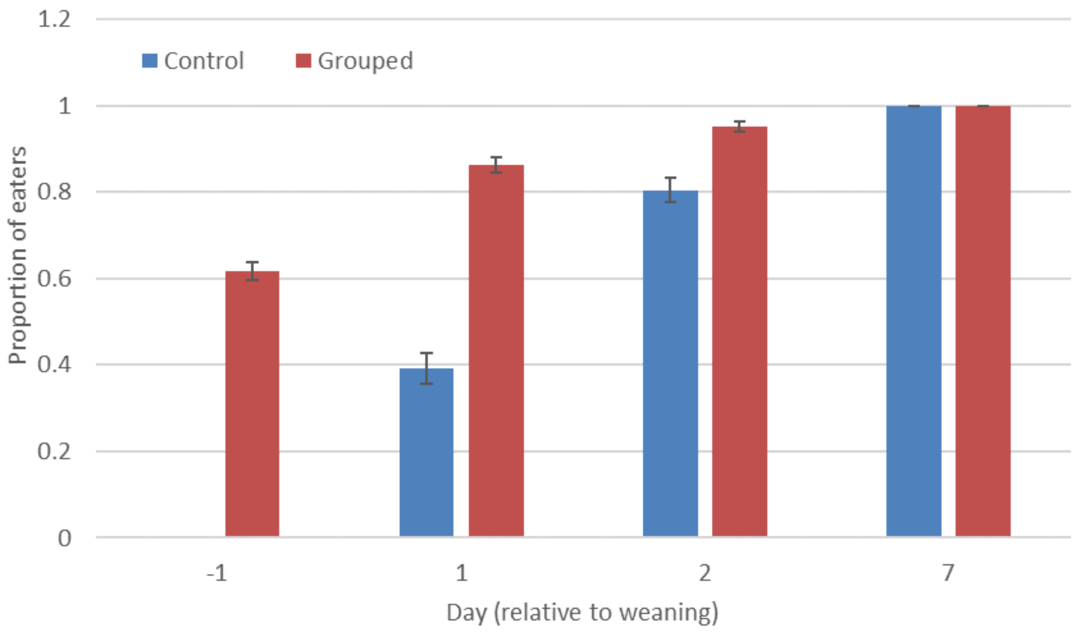

Figure 5: Effects of sow housing in lactation on proportion of piglets consuming solid feed

Piglet injury scores were not different between housing treatments prior to mixing on day -14 (Figure 6). The day after mixing piglet injury scores in grouped piglets was half a score greater that control piglets ($P<0.0001$) and decreased closer to weaning. The days following weaning (day 1 and 2) injury scores were not different between control and grouped piglets, however, injury scores on day 7 post weaning in control piglets was 0.27 injury scores greater than grouped piglets. By day 30 post, weaning there was no difference between treatments. Redness was not different between treatments at any time point measured.

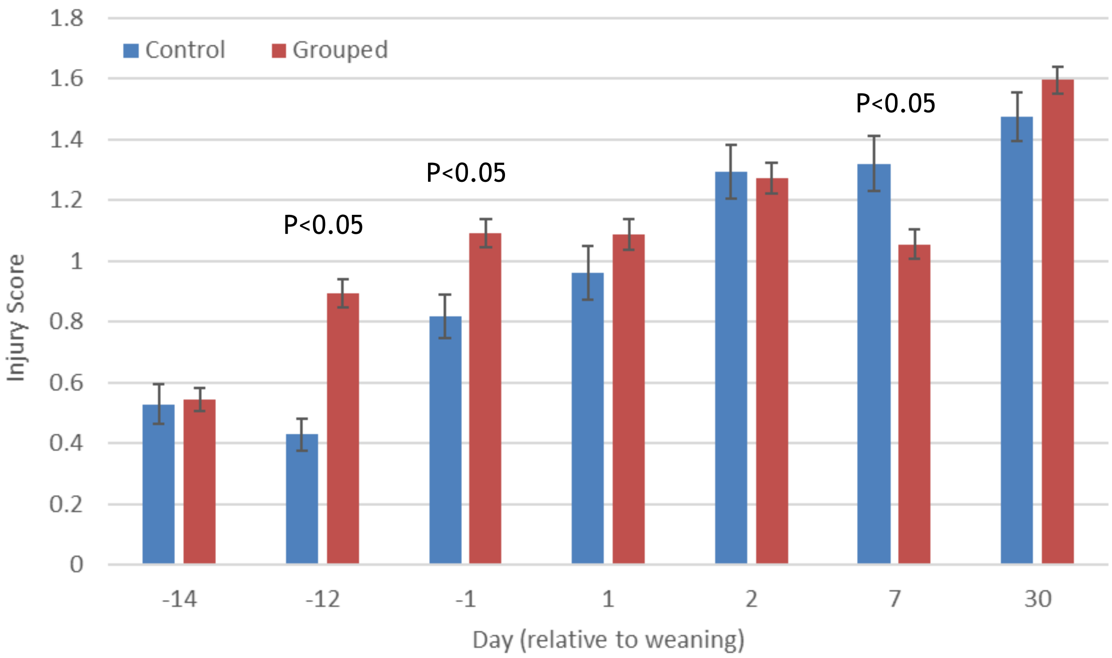

Figure 6: Injury scores of piglets of sows housed individually or in groups from 13 days prior to weaning.

4. Application of Research

From the data, it is clear that there were minimal effects on sow performance from either housing treatment. Sows confined in traditional farrowing crates tended to perform slightly better in that they weaned larger litters. Crated sows that do not undergo a mixing event in lactation would appear to have improved welfare, as the mixing event (in grouped sows) was associated with increased aggression (measured via injury score) that would not be apparent otherwise when individually housed. Whilst the stress response or the welfare implications for grouped sows cannot be ascertained from the experiment here, the report of Morrison *et al*. (2015) also showed increasing injuries in grouped sows (at day 13 of lactation) over individually housed sows in lactation. Plush *et al*. (2016) showed almost no aggression in sows grouped later in lactation at day 21. It is probable that the welfare of sows in groups in lactation is compromised, however mixing sows later in lactation (>21days) may improve this.

There were however larger effects on the piglets from grouped housing. Mixing during lactation resulted in increased injury scores around the mixing event in lactation, and a significant reduction in weaning weight in the order of over half a kilogram per piglet on the day prior to weaning. Grouping in lactation also increased removals and mortality post-mixing (0.34 pigs/litter). Most of the removals were due to ill thrift piglets. It could be argued that this increase in injuries, reduction in growth, and increased likelihood of removal impaired the welfare of piglets housed in group lactation. Whilst some argue that pre-socialisation, that can be facilitated by a group lactation pen, results in a better adaptation to post-weaning stressors, we propose that the stress is simply shifted from weaning to lactation.

The reduction in weaning weight exhibited by group-housed piglet in lactation was not compensated for over the 8^{+}-week duration of the experiment. Additionally, grouping of piglets in lactation-increased variance in growth. This disproportionately favors larger piglets within a group and disadvantages smaller piglets, hence increasing variance in growth pre-and post-weaning. This increase in variance is surely a concern for the remaining grower/finisher phase and is likely to impact on cost of production during this period.

The key message from this experiment is that any mixing events result in a reduction in welfare; for the sow and piglet in a grouped lactation, and the piglet at weaning in individually housed sows and litters. However mixing litters at weaning as seen in a traditional weaning event is less likely to result in a long-term reduction in piglet growth performance.

5. Conclusion

The welfare of sows and piglets is compromised by a mixing event as is evident by:

- Sows at mixing in grouped lactation,
- Piglets at mixing in grouped lactation,
- and piglets mixed at weaning from more traditional crated systems

The performance of the piglet grouped in lactation is compromised as was apparent by

- lighter weaning weights (0.56kg lighter the day prior to weaning) which are not compensated for by the end of the weaner phase,
- The variance in piglet growth being increased,
- The increase in removals and mortalities of piglets pre-weaning.

The key message from this experiment is that during a piglet-mixing event (either in lactation or at weaning) the welfare of the piglet suffers. However, for piglets mixed at weaning, there is less implication on performance losses.

6. Limitations/Risks

There were no limitations or risks identified to the application of the research findings other than that these data were derived deliberately from primiparous sows, as they had no previous lactation experience. Piglet feed consumption was confounded by treatments due to the limitations of the commercial piggery on which the study took place.

7. Recommendations

As a result of the outcomes in this study the following recommendations have been made:

1. Group lactation is not an effective way to ameliorate mixing aggression for the sow or piglet.
2. Group lactation should be avoided to reduce performance losses of the piglet.
3. The mixing of litters during a traditional weaning event is likely to balance the needs of the piglet and the sow more adequately than during lactation.

8. References

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