Factors associated with prolonged weaning-to-mating interval among sows on farms that wean pigs early

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Objective—To determine factors associated with weaning-to-mating interval among sows on commercial farms that wean pigs early.

Design—Cohort study.

Animals—11,861 farrowing sows.

Procedure—Production, farrowing, and feed intake records were reviewed for sows on 16 farms for which mean duration of lactation was between 14.3 and 18.9 days.

Results—Among sows with high feed intake during lactation (≥ 5.6 kg/d [12.3 lb/d]), lactation duration was not associated with weaning-to-mating interval, but among sows with low feed intake during lactation (< 5.6 kg/d), weaning-to-mating interval increased as lactation duration decreased. Furthermore, among sows with the lowest feed intake during lactation (< 4.2 kg/d [9.2 lb/d]), those that had heavier litter weights at weaning (≥ 54 kg [119 lb]) had a longer weaning-to-mating interval than did those that had lighter litter weights at weaning. Sows with low feed intake and high litter weight at weaning accounted for 5 to 20% of sows on each farm. In general, weaning-to-mating interval increased as parity decreased, but the change in weaning-to-mating interval associated with a particular change in lactation duration varied with parity.

Clinical Implications—When feed intake during lactation is maximized (≥ 5.6 kg/d), lactation duration is not significantly associated with weaning-to-mating interval. Producers should consider fostering or partially weaning litters when sows with high litter weights are not consuming sufficient feed. (J Am Vet Med Assoc 1997;211:894–898)

There is an ongoing trend in the swine industry in North America toward early weaning of pigs. Early weaning has been associated with improvements in health, growth rate, and feed conversion rate and with increases in the number of litters/sow/year and efficiency of facility use. Variations within the swine industry, including development of nursery diets, facilities, and management practices specifically designed for pigs that have been weaned early, have made early weaning of pigs economical and practical on commercial farms, and in some instances, pigs are weaned as early as 12 days after birth.

However, early weaning is not without problems. Early weaning is typically associated with reductions in at least some measures of reproductive performance among breeding herds. For example, reducing lactation duration to < 3 weeks has been associated with prolongation of the interval between weaning and mating. Weaning-to-mating interval has a major influence on breeding efficiency of female pigs, because it is the single greatest contributor to nonproductive days on most farms.

Insufficient feed intake during lactation, low parity, and summer season have also been associated with suboptimal reproductive performance in sows. Furthermore, high milk production may affect reproductive performance in sows as it does in dairy cows. If it does, then heavy litter weight and large litter size would be expected to indirectly affect reproductive performance through their effects on milk production.

Although we have some information about the independent associations between these various factors and weaning-to-mating interval, these factors and their interactions have not been thoroughly investigated together. The purpose of the study reported here was to determine factors associated with weaning-to-mating interval among sows on commercial farms that wean pigs early.

Materials and Methods

Data—The study was conducted using data collected from 16 commercial swine farms in Minnesota and Iowa. Farms were selected only if they were willing to keep records of production events and feed intake during lactation and had a mean lactation duration < 19 days. Mean lactation duration < 19 days was chosen as an inclusion criterion, because it was less than the 10th percentile for lactation duration among 642 farms in North America during 1990.

The study consisted of a 1-year period (1991). Data collected included daily feed intake during lactation and breeding, farrowing, and weaning records. Any change in management practices, facilities, health status, or diet was recorded. Parity 1 sows from 1 farm that used the skip breeding technique were excluded from analyses. This technique involves not mating sows until 17 days after weaning. Sows with lactation duration < 7 days were also excluded, because such sows were likely removed as

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a result of poor performance during the early part of the lactation period. Sows with lactation duration > 28 days were excluded, because such sows might have been used as nurse sows for ≥ 2 litters. Records of sows with weaning-to-mating interval > 114 days (n = 7) and records of sows with litter weight at weaning > 100 kg (220 lb; n = 6) were excluded.

To determine feed intake, farm workers were trained to use a scoop to measure 0.9, 1.8, and 2.7 kg (2, 4, and 6 lb) of feed during an initial visit to each farm prior to the start of the study. Each farm was visited at quarterly intervals during the study to determine the accuracy of feed intake determinations. Workers were asked to scoop 0.9, 1.8, and 2.7 kg of feed into pails, and pails were then weighed. Mean measurement errors (%) for scooping 0.9, 1.8, and 2.7 kg of feed were +4.5, -1.8, and -4.4%, respectively.

Statistical analysis—Data were analyzed by means of ANOVA, performed with standard software. The dependent variable was weaning-to-mating interval; independent variables were mean daily feed intake during lactation, parity, lactation duration, farrowing season, litter weight at weaning, and farm. The Kolmogorov-Smirnov test was performed, and degrees of kurtosis and skewness were examined to evaluate normality of the residuals from the models. Farms were treated as blocks to adjust for farm-to-farm variation.

Each factor was grouped, and the resulting categorical variables were analyzed by use of Fisher’s protected least significant difference test, using the least squares means. Mean feed intake was grouped as ≤ 4.2 kg/d (9.2 lb/d), > 4.2 but ≤ 5.6 kg/d (12.3 lb/d), and > 5.6 kg/d. Parity was grouped as 1, 2, 3 through 6, and ≥ 7. Lactation duration was grouped as 8 to 10, 11 to 13, 14 to 16, 17 to 19, 20 to 22, and 23 to 28 days. Farrowing season was grouped according to typical farrowing room temperature (uniformly low, increasing, uniformly high, decreasing). Farrowing seasons were winter (December through March), spring (April through May), summer (June through August), and fall (September through November). Litter weight at weaning was grouped as ≤ 36 kg (79 lb), > 36 but ≤ 54 kg (119 lb), and > 54 kg. All possible two- and three-way interactions were included in the model, but insignificant interactions (P > 0.10) were removed from the final model. Litter weight was replaced with litter size in a separate model, because these 2 variables were collinear.

Results
Mean lactation duration for the individual farms ranged from 14.9 to 18.9 days. Overall mean lactation duration was 17.3 days (Table 1). Records on daily feed intake during lactation were available for 10,450 sows; breeding, farrowing, and weaning records were available for 11,861 sows.

Lactation duration, parity, feed intake, and farrowing season were significantly (P < 0.05) associated with weaning-to-mating interval, as were two-way interaction terms for parity × lactation duration, feed intake × lactation duration, and litter weight at weaning × feed intake. Litter size at weaning and interactions between litter size and other factors were not significantly associated with weaning-to-mating interval.

Weaning-to-mating interval increased as lactation duration decreased (Table 2). In general, weaning-to-mating interval also increased as parity decreased (Table 3), but the change in weaning-to-mating interval associated with a particular change in lactation duration varied with parity. For instance, among parity 1 sows, mean weaning-to-mating interval increased from 6.9 to 14.9 days as lactation duration decreased from 22 through 28 to 8 through 10 days. However, among parity 3 through 6 sows, mean weaning-to-mating interval increased from 5.62 to only 7.50 days as lactation duration decreased from 22 through 28 to 8 through 10 days.

Among sows with mean feed intake ≥ 5.6 kg/d (12.3 lb/d), lactation duration was not significantly associated with weaning-to-mating interval (Table 4). However, among sows with mean feed intake < 5.6 kg/d, mean weaning-to-mating interval increased as lactation duration decreased. Sows with low mean feed intake (< 4.2 kg/d [9.2 lb/d]) for which litter weight at weaning was > 36 kg (79 lb) had a longer mean weaning-to-mating interval than did sows with low mean feed intake for which litter weight at weaning was ≤ 36 kg (Table 5). However, when mean feed intake was > 4.2 kg/d, litter weight at weaning was not associated with weaning-to-mating interval. Between 5 and 20% of the sows on each farm had mean feed intake < 4.2 kg/d and litter weight at weaning > 36 kg.

Sows farrowing during the summer had a longer mean weaning-to-mating interval than did sows farrowing during other seasons (Table 6).
Table 3—Mean ± SE weaning-to-mating interval as a function of lactation duration and parity among sows on 16 commercial farms

<table>
<thead>
<tr>
<th>Lactation duration (d)</th>
<th>1</th>
<th>2</th>
<th>3-6</th>
<th>≥7</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of sows</td>
<td>Interval (d)</td>
<td>No. of sows</td>
<td>Interval (d)</td>
<td>No. of sows</td>
</tr>
<tr>
<td>8-10</td>
<td>61</td>
<td>14.99 ± 1.29 ± A</td>
<td>26</td>
<td>7.40 ± 1.70 ± B</td>
</tr>
<tr>
<td>11-13</td>
<td>83</td>
<td>11.19 ± 3.49 ± A</td>
<td>224</td>
<td>7.67 ± 0.58 ± B</td>
</tr>
<tr>
<td>14-16</td>
<td>1,085</td>
<td>10.78 ± 3.28 ± A</td>
<td>663</td>
<td>7.55 ± 0.35 ± B</td>
</tr>
<tr>
<td>17-19</td>
<td>825</td>
<td>8.76 ± 0.32 ± A</td>
<td>554</td>
<td>7.31 ± 0.40 ± B</td>
</tr>
<tr>
<td>20-22</td>
<td>544</td>
<td>10.51 ± 0.48 ± A</td>
<td>431</td>
<td>7.09 ± 0.44 ± B</td>
</tr>
<tr>
<td>23-28</td>
<td>224</td>
<td>6.94 ± 0.86 ± B</td>
<td>180</td>
<td>5.58 ± 0.82 ± B</td>
</tr>
<tr>
<td>Overall</td>
<td>3,704</td>
<td>11.12 ± 0.30 ± A</td>
<td>2,058</td>
<td>5.91 ± 0.35 ± B</td>
</tr>
</tbody>
</table>

Within each column, values lacking a common superscript letter are significantly (P < 0.05) different. Values without superscript letters are not significantly different from other values in that column. **Within each row, values lacking a common superscript letter are significantly (P < 0.05) different. Values without superscript letters are not significantly different from other values in that row.**

Table 4—Mean ± SE weaning-to-mating interval as a function of lactation duration and daily feed intake among sows on 16 commercial farms

<table>
<thead>
<tr>
<th>Mean feed intake during lactation</th>
<th>≤ 4.2 kg/d (8.9 lb/d)</th>
<th>4.2-5.6 kg/d</th>
<th>≥ 5.6 kg/d (12.3 lb/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactation duration (d)</td>
<td>No. of sows</td>
<td>Interval (d)</td>
<td>No. of sows</td>
</tr>
<tr>
<td>8-10</td>
<td>108</td>
<td>12.45 ± 0.54 ± A</td>
<td>49</td>
</tr>
<tr>
<td>11-13</td>
<td>417</td>
<td>8.76 ± 0.47 ± A</td>
<td>494</td>
</tr>
<tr>
<td>14-16</td>
<td>1,303</td>
<td>8.37 ± 0.30 ± A</td>
<td>1,555</td>
</tr>
<tr>
<td>17-19</td>
<td>789</td>
<td>7.05 ± 0.38 ± B</td>
<td>1,297</td>
</tr>
<tr>
<td>20-22</td>
<td>390</td>
<td>7.09 ± 0.51 ± C</td>
<td>894</td>
</tr>
<tr>
<td>23-28</td>
<td>151</td>
<td>5.87 ± 0.84 ± D</td>
<td>272</td>
</tr>
</tbody>
</table>

See Table 3 for key.

Table 6—Mean ± SE weaning-to-mating interval as a function of litter weight at weaning and feed intake during lactation for sows on 16 commercial farms

<table>
<thead>
<tr>
<th>Mean feed intake during lactation</th>
<th>≤ 4.2 kg/d (8.9 lb/d)</th>
<th>4.2-5.6 kg/d</th>
<th>≥ 5.6 kg/d (12.3 lb/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litter weight at weaning</td>
<td>No. of sows</td>
<td>Interval (d)</td>
<td>No. of sows</td>
</tr>
<tr>
<td>≤ 38 kg (79 lb)</td>
<td>1,192</td>
<td>7.69 ± 0.94 ± A</td>
<td>986</td>
</tr>
<tr>
<td>39-54 kg</td>
<td>1,461</td>
<td>6.54 ± 0.47 ± A</td>
<td>2,111</td>
</tr>
<tr>
<td>≥ 54 kg (119 lb)</td>
<td>438</td>
<td>8.70 ± 0.31 ± A</td>
<td>1,212</td>
</tr>
<tr>
<td>Overall</td>
<td>3,091</td>
<td>8.31 ± 0.20 ± A</td>
<td>4,309</td>
</tr>
</tbody>
</table>

See Table 3 for key.

**Discussion**

Reducing farrowing-to-mating interval decreases the mean number of nonproductive days/sow, which is one of the best predictors of the number of pigs weaned/sow/year and early weaning of pigs has been associated with a shorter farrowing-to-mating interval, fewer nonproductive days, more litters/sow/year, and more pigs weaned/sow/year. Fewer nonproductive days and more litters/sow/year are 2 of the key benefits of successful early weaning systems in breeding herds. Reducing farrowing-to-mating interval, rather than decreasing lactation duration (i.e., farrowing-to-weaning interval) or weaning-to-mating interval alone, is logically a better way to decrease nonproductive days and to optimize breeding productivity of swine herds.

Although some commercial producers are weaning pigs as early as ≤ 10 days after birth, results of the present study suggest that this may not be a beneficial practice, because lactation duration of 8 to 10 days was associated with a prolonged weaning-to-mating interval. Our results further indicate that weaning-to-mating interval will be prolonged regardless of feed intake, parity, or season when lactation duration is decreased that much.
We did not detect differences in weaning-to-mating intervals for multiparous sows when lactation duration varied from 11 to 19 days. This suggests that piglets born to parity 2 through 6 sows can be weaned as early as 11 days after birth without adversely affecting weaning-to-mating interval. However, weaning piglets born to primiparous sows < 17 days after birth may result in a prolonged weaning-to-mating interval. Feed intake of primiparous sows is low during lactation,11 and this may be why weaning-to-mating interval is prolonged in primiparous sows. Older sows (parity ≥ 7) with lactation duration of 8 to 10 days had the longest weaning-to-mating interval, possibly because of slower uterus involution.12 Our results indicate a clear difference in weaning-to-mating interval between primiparous and multiparous sows; therefore, commercial swine farms should maintain an appropriate parity distribution among sows and should provide separate nutrition programs for sows of different parities.

In this study, lactation duration was not associated with weaning-to-mating interval among sows that consumed a large amount of feed but was among sows that consumed a low or moderate amount of feed. This suggests that producers that wean piglets early might minimize the risk of prolonged weaning-to-mating intervals by increasing feed intake during lactation.

The finding that weaning-to-mating interval was prolonged during the summer, even after we adjusted for feed intake, parity, lactation duration, and litter weight at weaning, was consistent with results of previous studies.13 However, spring has not previously been reported to be associated with a short weaning-to-mating interval. We do not have a biological explanation for when spring should be associated with a short weaning-to-mating interval, and this finding was probably associated with alterations in management factors that we did not measure.

The fact that the interaction term litter weight at weaning × feed intake was significantly associated with weaning-to-mating interval suggests that the associations between litter weight, milk production, and reproductive performance are complicated. In previous studies, litter size was not associated with weaning-to-mating interval when sows were fed 5.4 kg of feed/d (11.9 lb/d)10 or ad libitum.14 However, when feed intake during lactation was restricted (3 kg/d [6.6 lb/d]), sows with high milk production (determined on the basis of suckling intensity) had low luteinizing hormone secretion.15 Because luteinizing hormone secretion plays a key role in duration of the interval between weaning and estrus,16 it seems likely that when feed intake is low and reserves of protein and fat are drained to produce milk, luteinizing hormone secretion is decreased and the weaning-to-mating interval is prolonged. However, when feed intake is adequate, luteinizing hormone secretion and, thus, weaning-to-mating interval will be normal.

The proportion of sows with low feed intake and high litter weight suggests that production of milk deficient in some nutrients is not rare. In this study, between 5 and 20% of the sows on each farm had a low daily feed intake and high litter weight. To minimize the impact of these sows on overall herd performance, we recommend that producers monitor daily feed intake of individual sows during lactation and consider fostering or partially weaning litters when sows with high litter weights are not consuming sufficient feed (< 4.2 kg/d [9.2 lb/d]). It is possible that some high-producing sows will no: consume enough feed because of lameness, subclinical gastric ulceration,4 or decubital ulcers.6 Monitoring individual feed intake will help identify these sows.

Genetic background has been associated with weaning-to-mating interval17 and feed intake.11 In the present study, however, we did not determine the genetic background of individual sows.

A major limitation of this study is that farms were not randomly selected; therefore, these findings may not apply to all swine herds in North America. Furthermore, the relationships found in this study between various factors and weaning-to-mating interval should be interpreted as associations, not as evidence of causality, because this was an observational study. Finally, in instances when we did not detect significant differences between group means, the low number of observations may have reduced our power to detect a difference even if one truly existed. Even with these limitations, we believe that this study provides valuable information on factors associated with weaning-to-mating interval.

References


From My Armchair: W. W. Armistead

Herriot revisited

In the 1970s, Scottish veterinarian James Herriot wrote a series of runaway best-selling books about his practice experiences in the Yorkshire Dales of northern England. Herriot’s tales began in the 1930s, at about the same time I entered general practice in Dallas County, Tex. In those days, veterinary practice still was more art than science. Few reliable vaccines or diagnostic tests existed, and no antibiotics were available. Diagnosis was mostly intuitive; treatment was mainly symptomatic. Practitioners relied heavily on nursing care, with the support of those sterling healers—Mother Nature, Father Time, and Lady Luck.

Still, Herriot’s books won the hearts and stirred the imaginations of millions of readers. The books helped to elevate public esteem for our profession and inspired many young people to choose veterinary medicine as a career. The books did this not by recounting technical miracles, but rather by dramatizing the humility, dedication, honesty, resourcefulness, and compassion of an admirable rural veterinarian. Herriot’s love of animals and his warm friendship with his clients shone from almost every page.

Veterinary medicine today is far different from the profession of the 1930s. Advances in electronic instrumentation and explosions of knowledge in biochemistry, microbiology, and immunology have made diagnoses more accurate and therapeutics far more effective. But, as developments in human medicine have shown, increasing scientific sophistication can bring new hazards.

In just this century, public perception of the typical physician has changed from that of a caring family friend to a remote medical magnate. This is partly attributable to the enormous increase in the cost of health care and greatly increased expectations by patients. But a major culprit is the growing impersonality brought about by changes in the health care delivery system. House calls by physicians are a thing of the past. Family practice now is organized in an assembly-line mode. Patients wait in separate examining rooms, in various states of undress, while the doctor hurries from one to the other, conducting quick examinations, then turning the patients over to nurses or technologists to carry out instructions. Patients with serious illnesses are referred to specialists who are too busy to establish personal relationships with patients who are soon to be returned to their regular physicians. Patients in sudden distress are sent to hospital emergency rooms where, amid stark drama and confusion, they are treated by harried, often sleep-deprived, strangers.

Ironically, even though human medicine has become more scientific and far more effective than it was early in this century, today’s physicians are accused more often of being greedy and unsympathetic. Impersonality sabotages trust and fosters malpractice litigation. It is much easier to sue a remote medical magnate than a caring family friend.

The lesson for veterinary medicine seems obvious. We must take every effort to preserve our priceless reputation for compassion for our patients and genuine personal interest in our clients—qualities that, along with scientific competence, have made veterinary medicine one of the world’s most trusted and admired professions.

W. W. Armistead