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EFFECT OF EQUINE CHORIONIC GONADOTROPIN ON WEANING-TO-FIRST SERVICE INTERVAL AND LITTER SIZE OF FEMALE SWINE

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ABSTRACT

We evaluated the effect of PMSG on the weaning-to-first service interval, total litter size and born alive litter size in swine. Four doses of PMSG (0, 500, 750 and 1,000 IU) were administered intramuscularly after weaning to sows at 3 different farms, grouped by parities (1, 2 and 3 or higher) and 2 distinct time periods. The associations among main effects and response variables were assessed by analysis of variance. Polynomial orthogonal terms were used to adjust the estimates of weaning-to-first service interval, total litter size and born alive litter size for the interaction effect of parity and PMSG treatment. The weaning-to-first service interval did not differ across periods and farms (P>0.05), although the interval was shorter (P<0.05) for Parity 3+ sows (4.97 d) than for Parity 1 sows (5.29 d), with no other differences in intervals observed across parities (P>0.05). Time period did not influence litter size (P>0.05), but there were differences in litter size across farms (P<0.05). Both litter size traits were lower for Parity 1 sows than for higher parity sows (P<0.05), but there were no differences in litter size between Parity 2 and 3+ sows (P>0.05). Litter size increased with PMSG dose in both Parities 1 and 2 (P<0.05), but not in Parity 3+ (P>0.05). A significant quadratic effect (P<0.05) of PMSG treatment in weaning-to-first service interval was observed for both Parity 1 and 2 sows, with the shortest intervals occurring with the 750 IU dose for Parity 1 sows. Administration of PMSG after weaning was associated with a shortened weaning-to-first service interval in Parity 1 sows and increased litter size in Parity 1 and 2 sows.

Key words: PMSG, weaning-to-first service interval, litter size, parity, sow

INTRODUCTION

The number of pigs weaned per female per year is the most common parameter used to evaluate reproductive efficiency of female swine. This parameter is highly influenced by traits

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related to litter size and by accumulation of nonproductive days, such as the weaning-to-first service interval (6, 15, 22). Parity also has a strong effect on the weaning-to-first service interval and litter traits.

Use of equine chorionic gonadotropin (PMSG) after weaning, either alone or in combination with human chorionic gonadotropin (hCG), effectively induces estrus in anestrous females (2) and increases litter size in sows (9, 16). However, an optimal dosage has not been established yet. While some authors (9) have recommended a dose of 1,000 IU PMSG, others (16) reported better results using 800 IU, and still other study (3) have obtained normal follicle development using 600 IU.

In this study, we evaluated the effects of administering different doses of PMSG post-weaning on the weaning-to first service interval, total litter size and born alive litter size in weaned sows of different parities.

MATERIALS AND METHODS

The experimental procedures were conducted at 3 farms located in the Rio Grande do Sul State (Southern Brazil) and having similar management. The farms had average breeding herd inventories of 310, 443 and 447 females each. In most cases, these were crossbred F1 females, although some purebred females were also included. These sows were allocated to 3 groups according to parity: Parity 1, Parity 2 and Parity 3+. One day after weaning, PMSG was administered intramuscularly at 4 different doses (0, 500, 750, 1000 IU). The PMSG was purchased in Brazil (Cientistas Associados Produtos Biológicos Ltda, Pelotas, RS, Brazil). The procedures used to purify this product have been described elsewhere (1). The study was conducted over two different time periods: July to October 1993, and January to September 1994. During the first period, 125 Parity 1, 92 Parity 2 and 139 Parity 3+ sows were treated (n = 356). During the second period, 176 Parity 1, 184 Parity 2 and 183 Parity 3+ sows were treated (n = 543). The distribution of sows by parity and by PMSG treatment is shown in Table 1.

Table 1. Allocation of PMSG treatment by parity

Parity	PMSG dose (IU)				
	0	500	750	1000	Total
1	77	77	77	70	301
2	72	72	68	64	276
3+	86	81	77	78	322
Total	235	230	222	212	899

Data for sows that did not farrow after treatment were not analyzed for litter size, no matter the reason related to their failure to farrow. Data for sows that remained in anestrus for more than 20 d after treatment were also not analyzed. Therefore, of the 899 sows that were initially treated, data on the weaning-to-first service interval and litter size were analyzed for 849 and 700 sows, respectively. In both treatment periods, weaned sows were housed in breeding (pre-gestation) facilities and randomly selected to receive PMSG treatments. After completion of treatment, estrus detection was conducted twice daily. Once estrus was detected, the sows were mated following procedures already in place on the farms prior to the beginning of this study. Individual female identification was checked through the PigCHAMP® system (14).

We used a randomized 4x3x3x2 factorial design, including combinations of PMSG dose, parity, farm and time period, respectively. In this study, the outcome variables selected for analysis of variance were weaning-to-first service interval, total litter size and born alive litter size. The main effects included PMSG treatment, parity, farm, time period, and the interaction between PMSG treatment and parity. Interactions between farm and time period, and between these 2 factors with PMSG and parity were tested in a series of preliminary analyses, but excluded from the final model due to lack of statistical significance. Least-squares means for the different factors were compared using the Fischer's protected least significant differences test. Variation in weaning-to-first service interval and total litter size and born alive litter size attributed to PMSG treatment was grouped in orthogonal polynomial terms, while polynomial curves were adjusted up to the second level as indicated by tests of significance. All analyses were conducted using SAS procedures (17).

RESULTS

The weaning-to-first service interval was influenced by parity ($P<0.05$), PMSG treatment and their interaction (both $P<0.01$), whereas the effects of farm and time period were not statistically significant ($P>0.05$). Farm, PMSG treatment (both $P<0.05$) and parity ($P<0.01$) influenced total litter size and born alive litter size, but no effect of time period or interaction between PMSG and parity was observed ($P>0.05$). There were no differences ($P>0.05$) in weaning-to-first service interval across farms (Table 2). Total litter size was larger for Farm 2 than for Farm 3 ($P<0.05$), but total litter size for Farm 1 did not differ from any other farm ($P > 0.05$). However, born alive litter size was larger for Farm 2 than for Farms 1 and 3 ($P<0.05$).

Table 2. Least-squares means for weaning-to-first service interval (WSI), total litter size (TLS) and born alive litter size (BA) by farm

Farm	WSI	TLS	BA
	n (mean ± SEM)	n (mean ± SEM)	(mean ± SEM)
1	254 (5.1 ± 0.10)^{a}	216 (11.4 ± 0.21)^{bc}	216 (10.6 ± 0.20)^{d}
2	282 (5.1 ± 0.09)^{a}	239 (11.9 ± 0.20)^{c}	239 (11.1 ± 0.19)^{e}
3	313 (5.3 ± 0.09)^{a}	245 (11.2 ± 0.20)^{b}	245 (10.5 ± 0.19)^{d}

^{a,b,c,d,e}Means lacking a common superscript within a column differ by at least $P<0.05$

The weaning-to-first service interval did not differ (P>0.05) for Parity 1 and 2 sows (Table 3). Sows in Parity 3 and higher had shorter weaning-to-first service interval than Parity 1 sows (P<0.05), but their interval did not differ from that of Parity 2 sows (P>0.05). Both total litter size and born alive litter size were lowest across parities for first-parity sows (P<0.05), but no differences were observed among sows having Parity 2 and 3 (P>0.05).

Table 3. Least-squares means for weaning-to-first service interval (WSI), total litter size (TLS) and born alive litter size (BA) by parity

Parity	WSI	TLS	BA
	n (mean ± SE)	n (mean ± SE)	(mean ± SE)
1	271 (5.3 ± 0.10)[a]	213 (10.9 ± 0.21)[c]	213 (10.4 ± 0.20)[e]
2	265 (5.2 ± 0.10)[ab]	225 (11.7 ± 0.21)[d]	225 (11.0 ± 0.19)[f]
3+	313 (5.0 ± 0.09)[b]	262 (11.9 ± 0.19)[d]	262 (10.8 ± 0.18)[f]

[a,b,c,d,e,f]Means lacking a common superscript within a column differ by at least P<0.05

Since there was a significant effect of the interaction between PMSG treatment and parity on the weaning-to-first service interval (P<0.05), polynomial curves were adjusted to express the relationship between PMSG treatment and weaning-to-first service interval within each parity group. A significant quadratic effect (P<0.05) of PMSG treatment on weaning-to-first service interval was identified for Parities 1 and 2, but not (P>0.05) for Parity 3 or higher (Table 4). The weaning-to-first service interval was generally reduced in PMSG treated Parity 1 sows, with the shortest interval occurring with 750 IU PMSG (Figure 1).

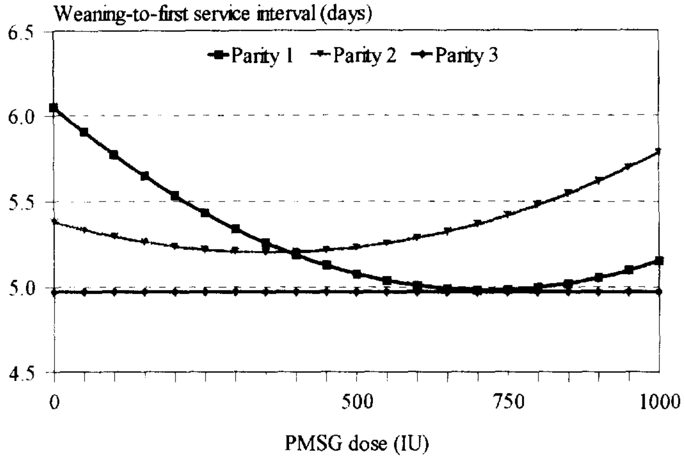

Figure 1. Effect of PMSG dose in the weaning-to-first service interval by parity

Table 4. Estimates from polynomial regression analyses for the effects of PMSG treatment in weaning-to-first service interval stratified by parity

Parity	Weaning-to-first service interval			
	Intercept	Linear	Quadratic	r^2
1	6.05	-0.003	0.0000021	0.93
2	5.38	-0.001	0.0000014	0.33
3+	4.97	-	-	-

Despite the lack of a significant effect of the PMSG by parity interaction on litter size, polynomial regression was adjusted to express the association among litter traits and PMSG treatment across parities. There was a trend for a significant effect of PMSG on both total litter size and born alive litter size for Parity 1 and 2 sows, but no effect for sows in Parity 3 or higher (Table 5). Total litter size tended to increase with higher PMSG dose for Parity 1 and 2 sows, but there was no effect on Parity 3+ sows (Figure 2).

Table 5. Estimates from linear regression analysis for the effect of PMSG treatment in total litter size (TLS) and born alive litter size (BA) stratified by parity

Parity	TLS			BA		
	Intercept	Linear	r^2	Intercept	Linear	r^2
1	10.03	0.002	0.92	9.61	0.001	0.96
2	11.01	0.001	0.98	10.56	0.001	0.93
3+	11.88	-	-	10.79	-	-

DISCUSSION

Administration of PMSG in Parity 1 and 2 sows influenced the weaning-to-first service interval, but no effect was observed in sows of Parity 3 and higher. Shortened intervals contribute to improved reproductive efficiency and the accumulation of fewer nonproductive days, thus potentially leading to higher numbers of litters weaned and pigs weaned per female per year (6, 15, 18, 22). An additional contribution of a reduced weaning-to-first service interval for reproductive efficiency would also be reflected by an increase in subsequent litter size (19, 21). The shortest weaning-to-first service interval across treatments was obtained with 750 IU PMSG for Parity 1 sows. Compared with the control group, Parity 1 sows treated with 750 IU had a decrease in the weaning-to-first service interval by more than 1 d (6.05 and 4.98, respectively). This is a relevant finding, since the mean weaning-to-first service interval on the farms analyzed in our study was superior to industry standards (6, 15, 22). However, a characteristic reduction in the weaning-to-first service interval following PMSG treatment was not observed in Parity 2 sows in comparison with sows in the control group. In a previous study (8), treatment with PMSG at doses of 750 and 1000 IU appeared to be more efficient than higher doses (between 2600 to 3400 IU). However, some studies (5, 7, 20) have reported that concentrations of 1200 IU were effective in improving weaning-to-first service interval. The results of the present study indicate that PMSG treatment is a feasible tool to minimize farrowing intervals in Parity 1 sows, and that doses higher than 750 IU are not needed

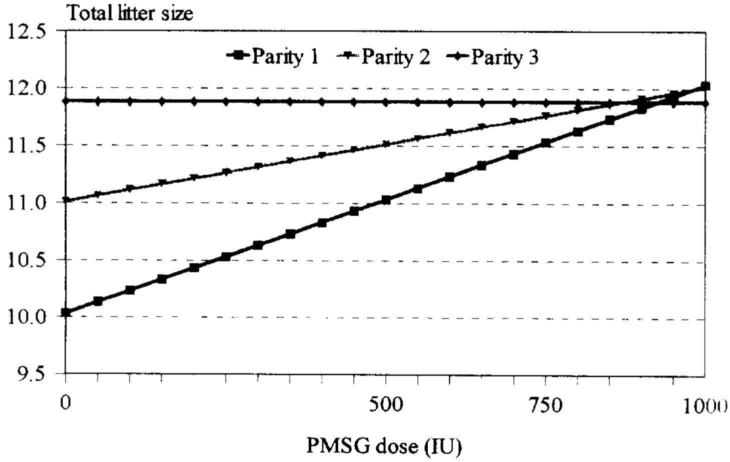

Figure 2. Influence of PMSG dose in total litter size by parity

Litter size increased in Parity 1 and 2 sows as PMSG dose increased, which is consistent with previous findings of higher prolificacy following PMSG treatment (10). However, the difference in total litter size between Parity 1 and 2 sows was reduced with higher PMSG doses. In fact, total litter size was similar for Parity 1 and 2 sows treated with 1000 IU PMSG. Nonetheless, the number of ovulations and of embryos at Days 6 and 24 of gestation have been reported to be increased with PMSG concentrations of 600 to 1200 IU (7). Although PMSG can also have a direct effect on embryo loss (4, 11), sows treated with PMSG can farrow up to 2 extra piglets per litter compared with control sows, possibly as a consequence of the higher number of ovulations. In our study, administration of 1000 IU PMSG yielded 2 additional piglets born per litter for Parity 1 sows and at least 1 additional piglet born per litter for Parity 2 sows in comparison with the control group, which is a substantial advantage. Thus, although improvement in weaning-to-first service interval would be achieved with 750 IU PMSG only for first parity sows, the potential benefits in litter size may justify the use of higher doses in both Parities 1 and 2.

In an early study, the weaning-to-first service interval was reported to be longer for first-parity sows and tended to decrease for sows at higher parities (6). In our study, the weaning-to-first service interval for Parity 1 sows was shorter than those reported in other studies (12, 18, 19), being in the range described as ideal by Tubbs (19), which was less than 6 d. Therefore, the parity effect on the weaning-to-first service interval was less characteristic in our study, since the weaning-to-first service interval did not differ across parities. The coefficient of determination (r^2) obtained by polynomial regression analysis was higher for Parity 1 sows than for Parity 2 sows (0.93 and 0.33, respectively), which indicates that the effect of PMSG on interval reduction would be stronger and more predictable in primiparous sows than in second-parity sows. Despite the lack of effect on the weaning-to-first service interval, parity influenced both total litter size and born alive litter size, which were lower for Parity 1 sows than for sows of 2 and 3 parities, as previously reported (6, 13). The lack of difference in litter size between second- and third-parity sows may reflect the good body condition of the experimental animals at early parities and which then influenced similar litter sizes in Parities 2 and 3. Estimates of both total litter size and born alive litter size in our study were higher than those reported elsewhere (18, 22). The results in our study were obtained from highly productive herds, but in herds with low productivity, especially in sows farrowing below-average litter size, these results could be even more dramatic.

In conclusion, administration of PMSG after weaning was associated with short weaning-to-first service intervals in Parity 1 sows and increased subsequent total litter size and born alive litter size for both Parity 1 and 2 sows. Such a protocol could effectively improve sow reproductive efficiency by maximizing the number of litters weaned per female per year (by reducing the nonproductive days) and the number of pigs weaned per litter. A practical use a PMSG regimen in the field would require that different doses be administered to sows at different parities, thereby balancing the cost with potential benefits, as expressed by the number of pigs weaned per sow per year.

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