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Influence of day of postpartum breeding on pregnancy rate, pregnancy loss rate, and foaling rate in Thoroughbred mares

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Abstract

Records (years 2005–2007) were analyzed from a Thoroughbred stud farm in central Kentucky. Data from all breeding cycles of foaling mares were tabulated (3184 cycles of 2003 foaling mares bred between 7 and 163 days postpartum). A multiple logistic regression model employing Bayesian statistics was used to adjust for factors that significantly affected outcome; odds ratios (ORs) for pregnancy rate, pregnancy loss rate, and foaling rate were determined to examine the influence of day of postpartum breeding on these parameters. Mares bred before Day 22 (Day 0 = day of foaling) postpartum had a decreased OR for becoming pregnant ($P < 0.05$); the median OR for becoming pregnant (1.00) was not reached until Day 46 postpartum. Mares bred before Day 13 postpartum had an increased OR for pregnancy loss ($P < 0.05$). The median OR for pregnancy loss did not decline below 1.00 until Day 78 postpartum. Mares bred before Day 20 postpartum had a decreased OR for producing a foal ($P < 0.05$). The median OR for producing a foal (1.00) was not reached until Day 75 postpartum. We concluded that fertility (in terms of a higher OR for becoming pregnant and a lower OR for pregnancy loss, resulting in a higher OR for producing a foal) continued to improve in Thoroughbred mares for approximately 2.5 mo postpartum. These findings are of importance to management strategies directed at early postpartum breeding, and explain some of the reported drift in subsequent foaling dates of Thoroughbred mares, despite management practices that employ early postpartum breeding.

Keywords: Horse; Thoroughbred; Postpartum; Pregnancy rate; Pregnancy loss rate

1. Introduction

Rossdale and Ricketts [1] reported mean gestational length (breeding to birth) for Thoroughbred mares to be 338 to 340 days (range, 310–374). Failure to become pregnant relatively early in the postpartum period results in gradual drift to later foaling dates in subsequent years; due to the seasonal pattern of breeding (mid-February through early July), eventually a skipped year of foal production results. A recent study of Thoroughbred mares from Kentucky revealed this gradual drift (13 ± 23 days) in consecutive foaling dates resulted in failure to produce a yearly foal after an average of only 3.4 yr of breeding for almost two-thirds of the mares [2]. In that study, a stochastic model was used to describe delayed profitability on the average brood mare investment (being purchased in November as a maiden for breeding the following year) until beyond 7 yr of ownership.

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The postpartum mare returns rapidly to a condition compatible with fertility [3,4]. The first postpartum estrus (foal heat) begins 5 to 12 days after foaling, with most mares ovulating within 20 days postpartum [5–7]. Although the first postpartum estrus is recognized as fertile [6], controversy exists regarding relative fertility achieved by breeding the early postpartum mare. In general, a lower (perhaps averaging 20%) pregnancy rate is often achieved for mares bred on foal heat (first postpartum estrus) as compared with mares bred on later postpartum estrous periods [5,6,8–12]. Greater potential for pregnancy losses may or may not occur with foal heat compared with later postpartum estrus breeding [6,7,13–15]. Progestogen or prostaglandin $F_2\alpha$ ($PGF_2\alpha$) therapy to delay breeding until later in the postpartum period [9,16–19] has been advocated to improve pregnancy rates in the early postpartum period. Use of progestogen or $PGF_2\alpha$ therapy for this purpose could result in a more even distribution of breedings (i.e., over a broader range of days) than that obtained when mares are only bred on spontaneous estrus (i.e., first or second postpartum estrus), and thus might allow better characterization of the influence of day of postpartum breeding on fertility outcomes.

Because of the emphasis on early postpartum breeding in the mare, fertility achieved by breeding beyond the second spontaneous postpartum estrus (i.e., approximately 30 days postpartum) has seldom been characterized. Additionally, whereas Loy [5] reported breeding mares that ovulated before Day 10 postpartum resulted in lower foal heat pregnancy rates, outcomes from breeding on specific days postpartum have not been reported. The objective of this investigation was to examine the relationship between the day of postpartum breeding to fertility outcomes (pregnancy rate, pregnancy loss rate, and foaling rate) in mares bred on one Thoroughbred stud farm in central Kentucky.

2. Methods

Records (years 2005–2007) were evaluated from a Thoroughbred stud farm in central Kentucky, and entries for all foaling mare breedings were retrieved. Data tabulated for analysis included mare identification, mare age, boarding farm for the mare, date of breeding, cycle of breeding for the year, day postpartum at each breeding (Day 0 = day of foaling), stallion used for breeding, whether the mare was given a tranquilizer prior to breeding, whether the mare was reinforcement bred (i.e., dismount semen sample infused into the uterus of the mare immediately after the mare was bred), and pregnancy outcomes (whether the mare became pregnant, whether the pregnancy was lost, and whether the mare produced a foal) from each breeding. Data on factors affecting fertility of stallions used in this study has been reported [12].

2.1. Data analysis

To quantify the impact of factors influencing pregnancy rate, pregnancy loss rate, and foaling rate, the statistical model used to adjust for potential confounding variables was relatively complex and employed recently developed estimation methods. Briefly, the model used Bayesian inference, with vague prior beliefs and a Markov Chain Monte Carlo (MCMC) implementation [20]. The Markov Chain Monte Carlo implementation was performed with OpenBUGS version 3.2.1 (Boston, MA, USA). The initial 1000 iterations were discarded to allow for convergence and the next 100 000 iterations were sampled for the posterior distribution. Odds ratios (ORs) for becoming pregnant, pregnancy loss, and producing a foal were determined to examine influence of day of postpartum breeding on these parameters of fertility. Pregnancy and foaling rates achieved from all foaling mare cycles of breeding, and pregnancy loss rate experienced in all foaling mare cycles of breeding that resulted in pregnancy, were used as baseline risk for establishing OR for the appropriate outcome. For the purpose of reporting P values, P was reported as < 0.05 when the 95% Bayesian credibility interval for the OR excluded one. The priors were as follows: vague normal priors were used for the overall intercept, each cycle, reinforced breeding, and tranquilization. Stallion, farm, and mare effects were modeled as random from a normal distribution with a zero mean and vague precision. Random walk priors were used for variables with autoregressive correlation [21] including 'season' (which was estimated for each of 876 days of the three breeding seasons from the beginning to end of the study), age of mare, and for the effect of postpartum day of breeding.

3. Results

Breeding results from 3184 estrous cycles for 2003 foaling mares (aged 3–24 yr) bred to 1 of 15 stallions from 7 to 163 days postpartum were available. Mares were maintained on 471 boarding farms. The proportion of total variability in the model due to boarding farm, mare, and stallion on pregnancy outcomes are shown (Table 1). The greatest contribution to variation in pregnancy outcomes (becoming pregnant, pregnancy