

How conditions during conception and pregnancy can influence horses later in life

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Each year thousands of sport horse foals are conceived with the goal of producing the next top horse. With respect to horses bred for show jumping, only a small proportion of these horses will go on to reach the Grand Prix level, and the odds of having a horse win a medal at a major championship are similar to buying a winning lottery ticket.

To improve the likelihood of producing a top horse, breeders will methodically choose bloodlines to acquire 'optimal' genetics for their horse. Further, once the foal is born, top breeders will put the young horse in the best possible environment, ensuring high-level training, an outstanding and safe living environment, proper nutrition, top veterinary care, and so on. With this approach, breeders attempt to optimize both nature (genetics) and nurture (the environment).

Despite this thorough planning and the best efforts of everyone involved, the horse may still not reach the pinnacle of the sport. Interestingly, recent scientific evidence has linked the environment of the mare at both conception and during pregnancy as an important factor that can have lifelong implications for the foal. It is possible that these factors, which are typically not given much thought when the mare is carrying the foal, may be contributing more to the health and performance potential of the foal than originally thought.

Termed 'Developmental Origins of Health and Disease', the conditions the foal is exposed to from conception through pregnancy and to the neonatal period can modify the expression of genes (while the DNA remains unchanged). Examples of factors that can influence the developing foal in dams include elevated stress and improper nutrition. Thus, a dam exposed to suboptimal conditions in one of these factors can produce negative changes to the in utero environment for the foal, and consequently changing how the developing horse expresses certain genes.

For example, two recent studies^{1,2} have linked the development of Osteochondritis Dissecans (OD) in young horses to the nutrition their dams received during pregnancy. OD is defined as a disease in which the cartilage at the ends of bones, especially long bones, fails to develop properly – leading to a lesion in the cartilage that may or may not dislodge. The disease presents in young horses, and arthroscopic surgery is the current standard of care to return horses to work. Researchers have found that pregnant mares fed diets high in concentrate produce foals with OD at a higher rate than dams fed forage only diets.

Does this mean that all pregnant mares should be on forage only diets? The answer is: No. Understanding how developmental conditions influence horses is an incredibly complex area that is multifactorial and dynamic. Although OD is linked to a lower prevalence in pregnant mares fed only forage, other studies have found that a forage only diet produced foals with thinner canon bones (potentially indicative of weaker bone) and foals predisposed to issues regulating blood glucose³. So as you can see, diets of both extremes (forage only vs high in concentrate) can be linked to issues,

and a proper diet will be a happy medium. That said, each dam is an individual and will have slightly different needs, but determining those needs accurately remains a challenge.

The future:

To help answer the question of ‘what nutrition is best for a dam?’ or ‘how to ensure a comfortable environment’, advancements in our understanding of ‘Developmental Origins of Health and Disease’ will begin to play a larger role in how pregnant dams are cared for. Using the knowledge researchers produce, it is likely that each dam will eventually have a custom nutrition plan based on a quick test. The test could be a simple blood test, whereby certain markers in the blood determine exactly what feed is needed to optimize in utero conditions for the developing foal. Further, the same blood test could detect markers of chronic stress, and again actions could be taken to remove the stress before it has harmful effects on the developing foal. Armed with this information, we will eventually be able to increase the likelihood of producing horses with better health.

References:

- 1) Peugot et al., PLoS One 10:e0122596
- 2) Vander Heyden et al., Veterinary Record 172:68
- 3) Robles et al. PLoS One 12:e0169295