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Association of growth, feeding practices and exercise conditions with the prevalence of Developmental Orthopaedic Disease in limbs of French foals at weaning

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ABSTRACT

Developmental Orthopaedic Disease (DOD) in limb joints of horses is frequent and is a common cause of pain and lameness. DOD is a multifactorial disease involving genetics, growth, feeding practices and exercise conditions leading to joint injuries. However, there is no clear understanding of the contribution of each factor. The aim of this cohort study was to assess the adjusted effects of breed and gender, growth, feeding practices and exercise conditions on the prevalence of DOD in the limbs of foals at weaning and on the prevalence restricted to osteochondrosis (OC).

Twenty-one farms in Normandy, France, were convenience sampled and enrolled in a cohort study. The study sample consisted of 401 foals from 3 breeds, followed from the 8th month of pregnancy of the mares until weaning period at approximately 6 months of age of the foals. Stud farms were regularly visited to collect growth, feeding practices and exercise conditions data. The carpus, the front and hind digits, the hock and the stifle of the foals were X-rayed at the end of follow-up. Foals were categorised as affected or unaffected by DOD or by OC. Two mixed-effects logistic regression models were used to determine risk factors for DOD or OC, adjusting for clustering by farm.

Of the 378 foals with complete data, 47% (95% CI: 42–52) were affected by DOD and 36% (95% CI: 31–41) by OC. Risk was significantly increased for DOD and for OC in Warmblood foals compared to Thoroughbreds (OR 2.8; 95% CI: 1.2–6.5 for DOD, OR 2.9; 95% CI: 1.1–7.5 for OC), in foals with a high wither height at 30 days of age, and in foals with a rapid increase of wither height (for DOD only). Exercise conditions such as large area of pasture, some irregular exercise, or some batch changes were also significant risk factors for DOD or OC. No association was found with quantitative feeding practices; it was likely due to the limited variability of horse regimens and to the partial inclusion of nutritional effects in other factors such as breed and growth. In order to reduce the prevalence of DOD or OC in foals, following the growth and reducing nutritional supply in subjects growing fast, limiting the pasture areas offered and providing a regular exercise to foals seems appropriate. To our knowledge, to date the assessment of adjusted effects of potential risk factors for DOD has never been proposed.

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1. Introduction

Developmental Orthopaedic Disease (DOD) is the accepted term to designate all orthopaedic disorders observed in the growing horse (McIlwraith, 2004). DOD can affect all limb joints (van Weeren, 2006) of young horses. The radiological signs can be first detected before 3 months of age (Hoppe, 1984; Carlsten et al., 1993) then throughout the whole life. DOD lesions are often attributed to dyschondroplasia (Jeffcott, 1991) resulting from a failure in endochondral ossification in growth cartilage (Olsson and Reiland, 1978). However, they can also be due to other mechanisms (McIlwraith, 2004). Depending on the joint, on the location in the joint, or on the severity of the endochondral ossification defect, DOD results in different entities (Jeffcott, 1991; McIlwraith, 2004). The term DOD was first defined in 1986 and included five entities (McIlwraith, 1986), but controversy exists over the classification of DOD (Pool, 1993; Hurtig and Pool, 1996) and most of the published studies were limited to osteochondrosis (OC) or osteochondritis dissecans (OCD) (Sandgren et al., 1993a; Grondahl and Engeland, 1995; Jorgensen et al., 1997; Stock et al., 2006; Wittwer et al., 2006).

These diseases are a common cause of pain and lameness for horses in sports, which limit their performance (Hoppe, 1984; Kane et al., 2003). Prevalence estimates, based on X-ray examinations, vary among studies depending on which and how many anatomical locations are examined, on the entities considered, or on the breed (Alvarado et al., 1989; Sandgren et al., 1993a; Grondahl and Engeland, 1995; Pagan and Jackson, 1996; Jorgensen et al., 1997; Stock et al., 2006; Wittwer et al., 2006). However, it is internationally recognised that DOD incidence and prevalence are high (Jeffcott, 1993; van Weeren and Barneveld, 1999). Therefore, DOD is considered a major cause of considerable economic losses in the horse breeding industry (Schougaard et al., 1990; Jeffcott, 1996).

In order to propose recommendations to breeders to prevent DOD occurrence in growing horses, detailed knowledge on its aetiology is required. However, the causes of the initial lesion in the growth cartilage are still unknown (Jeffcott, 1991, 2005; van Weeren, 2006). The aetiopathogenesis of DOD and OC lesions has been debated in the literature for more than 20 years, but little information and consequently no consensus has been reached on the uniqueness (or not) of the initial lesion appearing during endochondral ossification and of its various ensuing manifestations (Jeffcott, 1991; McIlwraith, 2004).

Epidemiological studies (including observational and experimental designs) cannot fully answer these questions, but can give a few keys to explain DOD prevalence. DOD manifestations appear to have a multifactorial origin (Jeffcott, 1991; Hurtig and Pool, 1996). Genetic predispositions (Schougaard et al., 1990; Grondahl and Dolvik, 1993; Philipsson et al., 1993; Stock and Distl, 2005), body size and growth rate (Sandgren et al., 1993b; Pagan and Jackson, 1996; van Weeren et al., 1999; Donabedian et al., 2006; Stock et al., 2006), nutritional excesses (Glade and Belling, 1984; Savage et al., 1993a) or imbalances (Bridges and Harris, 1988; Knight et al., 1990; Savage et al., 1993b; Pearce et al., 1998) are the most studied factors. Conversely, exercise conditions are often mentioned (Watkins, 1992; Jeffcott, 1993; Martin-Rosset, 2001; McIlwraith, 2004) but have been less extensively studied (Caure et al., 1998; van Weeren and Barneveld, 1999; Wilke et al., 2003; Rogers et al., 2008b). Among these epidemiological studies, a lot of experimental ones have assessed the impact of one of the potential risk factors of DOD or OC occurrence; the corresponding study designs implemented have not allowed for the assessment of the relative contribution of each potential risk factor of DOD or OC. On the contrary, observational studies at large scale are appropriately designed for this purpose and some have been performed (Alvarado et al., 1989; Sandgren et al., 1993a; Jelan et al., 1996; Vervuert et al., 2005; Stock et al., 2006), but none of them has considered all the risk factors of DOD in assessing adjusted effects of genetic, growth, feeding practices, and exercise conditions. Moreover, most of these observational studies classified horses as DOD-affected or not on a basis of only one or two joints examined, mainly the hock and fetlock, and limited their DOD assessment to one entity, usually OC.

The objective of this study was to assess the adjusted effects of breed and gender, growth, feeding practices and exercise conditions on the prevalence of DOD and on the prevalence restricted to OC lesions on the other hand, in the limbs of foals at weaning.

2. Materials and methods

2.1. Study sample

A prospective cohort study of foals born between 2002 and 2004 involved 21 stud farms from Normandy, the main horse breeding area in France. The three main sport and racehorse breeds were included: French Warmblood, French Trotter Standardbred and Thoroughbred. Due to repeated implementation of observations, body measurements and radiographic sessions during 3 years, only convenience sampling of the farms and of the foals was deemed feasible. Out of the 21 stud farms, 401 foals were included based on the availability of the mare-foal couples during all the season; mares due to leave the farms for breeding purpose or foals supposed to be sold at weaning were not included. For practical and financial reasons, and taking into account the follow-up of the foal, the staff of the study could not follow-up more than approximately 150 foals during the first and the last year of the study and no more than 100 foals during the second year. Broodmares were chosen in autumn when pregnancy was confirmed. In small farms, all the pregnant mares were included in the study. In large farms, the number of mares was limited to 16 per year for practical reasons and to avoid the predominance of one herd on the others. Foals were followed from the 8th month of the mare's pregnancy up to the X-ray examination.

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