Horse–Environment Interaction: The Relationship Between Environmental Particulate Matter and Airway Inflammation in Thoroughbred Racehorses

Melissa L. Millerick-May, MS, PhD; Wilfried Karmaus, MD, Dr. Med, MPH; Frederik J. Derksen, DVM, PhD, Diplomate ACVIM; Brett Berthold, DVM; Susan J. Holcombe, VMD, MS, PhD, Diplomate ACVS, ACVECC; and N. Edward Robinson, BVetMed, MRCVS, PhD

Ambient particulate matter, <10 and 2.5 μm in diameter, is associated with the presence of tracheal mucus in racehorses. Authors’ addresses: Department of Large Animal Clinical Sciences, Michigan State University, East Lansing, MI 48824 (Millerick-May, Derksen, Holcombe, Robinson); Cleveland Equine Clinics, Ravenna, OH 44266 (Berthold); and Arnold School of Public Health, University of South Carolina, Columbia, SC 29208 (Karmaus); e-mail: millerick@cvm.msu.edu. © 2008 AAEP.

1. Introduction
Inflammatory airway disease (IAD) is characterized by excess tracheobronchial mucus, which has been associated with poor racing performance. We hypothesized that the presence of tracheal mucus and elevated inflammatory cells would be associated with airborne particulate concentrations (PMs).

2. Materials and Methods
We studied 107 racehorses from three stables for 3 mo each. After horses were endoscopically examined and assigned a mucus score, a tracheal lavage was performed. Bivariate procedures, general estimating equations (GEE), and mixed models determined the association between PMs measured in each stall/stable, the presence of mucus, and the number of inflammatory cells.

3. Results
Month, stable, and PM were significantly associated with the presence of tracheal mucus, which had an overall prevalence of 67%. GEE models confirmed the association with PM <10 μm in diameter (PM10; odds ratio [OR] = 5.8, 95% CI = 1.64–20.56, p < 0.0064) and PM 2.5 μm in diameter (PM2.5; OR = 4.5, CI = 1.35–14.90, p < 0.0151). The prevalence of tracheal mucus was highest in the stables and months with highest overall PM. The prevalence of tracheal mucus was least in the open-sided stable with low PM and after a period of wet weather when PM was low. Sixty-eight percent of tracheal-wash samples contained >20% neutrophils, and there was a significant association between PM2.5 and inflammatory cells.

4. Discussion
Airborne PM affects the presence of tracheal mucus. Further study is warranted to investigate associa-
tions between PM and severity of mucus, and recommendations need to be developed on how to reduce overall prevalence. Neutrophil numbers of >20% in 80% of horses without visible mucus underscores the need to reevaluate the use of inflammatory cells in the definition of IAD. Tracheal-mucus score rather than number of inflammatory cells should be used as the gold standard for diagnosis.