Letters to the Editor

Inverse relationship of osteoarthritis to weight: The bird lesson

Sirs,

Osteoarthritis is the most common form of arthritis in humans (1). Weight has been presumed to be a major factor in its development (2, 3). Prior studies (e.g., 1, 2), however, have not been sufficiently controlled for confounding factors, especially clinically significant joint instability. Rarity of osteoarthritis in free-ranging mammals and different joints affected in captive (versus free-ranging) animals compromises attributions (4-6).

Given the lack of or inverse relationship of osteoarthritis to weight in dinosaurs (4), their purported relationship to birds, the high frequency of osteoarthritis in wild-caught birds and observations previously reported in woodpeckers (7), there is a unique opportunity to critically examine the effects of weight. Hawks, falcons, and pigeons were selected to assess effects of weight within families with very different lifestyles, predator and prey.

The articular skeletons of adult hawks, falcons, and pigeons were examined from the following collections: Academy of Natural Sciences of Philadelphia; American Museum of Natural History, New York City; Carnegie Museum, Pittsburgh; Cleveland Museum of Natural History; Field Museum of Natural History, Chicago, Ill.; Los Angeles County Museum; Michigan State Museum, East Lansing; Musee d'archeologie de Neuchatel Laboratoire d'Archezoologie, Neuchatel, Switzerland; Natural History of Bern, Switzerland; Royal Ontario Museum, Toronto; Science Museum of Minnesota, Minneapolis, United States National Museum, Washington, D.C.; University of California at Berkeley; University of Manitoba, University of Michigan, Ann Arbor, University of Winnepeg, and Yale Peabody Museum, New Haven. All animals were categorized as either free-ranging (80% of those studied) or captive (tamed or aviary). Detefleshed skeletons were surveyed for visible evidence of articular and periarticular joint and spine pathology. Osteoarthritis was identified on the basis of synovial-lined joint remodeling with spur (osteophyte) formation (4, 8). The validity of diarthrodial joint osteoarthritis for recognition of osteoarthritis has been documented across vertebrate orders (4, 5) including dinosaurs (4), which some view as bird ancestors, and so is equally as applicable to birds as to humans. Chi square analysis was performed to determine significance of variation among two bird families, hawks (Falconiidae including Falco and Buteo), and herons (Ardeidae). As bird growth and weight accrue cease at time of epiphyseal closure and are inde-

pendent of subsequent aging, body mass measurements are directly comparable, as derived from Dunning and Dei Hoyo's groups have documented (9, 10). Regression analysis was performed to determine the relationship of body mass to frequency of osteoarthritis.

Osteoarthritis was common among examined pigeons and hawks, limited in distribution to tibiotarsal joints (ankles). No evidence of osteoarthritis was found in any other joints of the examined species. Osteoarthritis was more common in pigeons than in birds of prey (Chi square = 56.314, p < 0.0001). Figure 1 reveals the frequency of osteoarthritis as a function of typical species body mass (10 kg) for 2061 hawks and 2747 pigeons (Fig. 1). An inverse relationship is documented.

The morphology of the tibiotarsal joint in birds is analogous to the knee in humans. Given the prominence of the knee as a target of osteoarthritis in humans (1, 2, 4), it is perhaps not surprising that when osteoarthritis occurs in birds, it affects this joint. Limitation to the ankle suggests the likelihood of biomechanical derivation of the phenomenon.

Recognition of an inverse relationship between weight and frequency of osteoarthritis certainly negates any major role for weight and stimulates a more complex analysis of what factors are really pertinent. Curiously, inverse relationship to weight also infers inverse relationship to longevity, as smaller animals (especially birds) do not live as long as larger ones. Osteoarthritis appears to be dependent upon how they live.

Higher frequency of osteoarthritis in pigeons than in birds of prey suggests trauma (e.g., strikes on prey) is not the significant factor in development of osteoarthritis in birds. Perhaps ground time is more important? Hereditary factors (e.g., collagen defects) may account for 1% of osteoarthritis in humans, as does abnormal joint structure (e.g., dysplasia). Such subjects are required for future study, to assess if they account for any more significant contribution to avian osteoarthritis than the limited epidemiological impact documented in mammals. Future advances in understanding of osteoarthritis may be "pinned" on what else we can learn from analysis of osteoarthritis in birds.

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