Review

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Adipose energy stores, physical work, and the metabolic syndrome: lessons from hummingbirds

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Abstract

Hummingbirds and other nectar-feeding, migratory birds possess unusual adaptive traits that offer important lessons concerning obesity, diabetes and the metabolic syndrome. Hummingbirds consume a high sugar diet and have fasting glucose levels that would be severely hyperglycemic in humans, yet these nectar-fed birds recover most glucose that is filtered into the urine. Hummingbirds accumulate over 40% body fat shortly before migrations in the spring and autumn. Despite hyperglycemia and seasonally elevated body fat, the birds are not known to become diabetic in the sense of developing polyuria (glucosuria), polydipsia and polyphagia. The tiny (3–4 g) Ruby-throated hummingbird has among the highest mass-specific metabolic rates known, and loses most of its stored fat in 20 h by flying up to 600 miles across the Gulf of Mexico. During the breeding season, it becomes lean and maintains an extremely accurate energy balance. In addition, hummingbirds can quickly enter torpor and reduce resting metabolic rates by 10-fold. Thus, hummingbirds are wonderful examples of the adaptive nature of fat tissue, and may offer lessons concerning prevention of metabolic syndrome in humans.

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