Using Spitzer IRAC data and pre-main-sequence (PMS) star rotation periods from the literature in NGC 2264 and the Orion Nebula Cluster, we present the first unambiguous correlation between rotation period and the presence of a circumstellar disk across the entire period range represented in the samples. Observed period distributions of stars with and without a disk not only clearly confirm the claim that star-disk interaction regulates the angular momentum of PMS stars; they also allow us for the first time to quantitatively analyze the star-disk interaction history in these clusters. We present results from robust Monte Carlo simulations used to study which critical disk parameters are allowed by current observational results.