

Yin and Yang of reciprocally scale-free biological networks between disease genes and death genes

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Abstract

Biological networks often show a scale-free power-law distribution. Furthermore, lethal genes tend to form functional hubs whereas non-lethal disease genes are located at the periphery. Uni-dimensional analyses, however, are flawed. Here we report two distinct scale-free networks; a protein-protein interaction (PPI) and a perturbation-sensitivity (PSN) network. Hubs of both networks demonstrate a low molecular evolutionary rate and a high codon adaptation index, indicating that both hubs have been shaped under high evolutionary selective pressure. Moreover, the topologies of PPI and PSN are inversely proportional: hubs of PPI tend to be located at the periphery of PSN and vice versa. PPI hubs are highly enriched with lethal genes whereas PSN hubs with disease genes and drug targets. PPI network hubs are enriched with essential cellular processes whereas PSN hubs with environmental interactions like TATA boxes and transcription factor binding sites. It is concluded that biological systems may balance internal growth signaling and external stress signaling by unifying the two opposite scale-free networks that are reciprocal to each other but work in concert between death and disease.

Biography

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