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Synucleins form oligomers and induce oligomerization of other proteins

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Statement of the problem: Synucleins belong to a family of small naturally unfolded or intrinsically unstructured proteins consisting of three members: alpha-, beta and gamma-synuclein. Aggregation of alpha-synuclein is associated with Parkinson's disease and other neurodegenerative disorders. The susceptibility to the formation of protein aggregates depends on cooperative conformational changes which may contribute to the kinetic control of fibrillization with transitions between alpha-helical and beta-sheet secondary structure. The protein aggregates which may be formed under *in vitro* and *in vivo* conditions exhibit significant variations in their structure and function. Interaction of synucleins with other proteins promotes their oligomerization and affect their dynamics.

Findings: Alpha-synuclein binds to microtubules and tubulin tetramer inducing microtubule nucleation and growth rate thus affecting microtubule dynamics. Alpha-synuclein also affect superoxide dismutase 1 and Tau oligomerization and actin dynamics. Gamma-synuclein can affect microtubule properties and act as a functional microtubule associated protein. We found that gamma-synuclein after oxidation of Met-38 acts as anti-chaperone, which is able to enhance alpha-synuclein aggregation and form heterologous complexes containing both proteins. We identified specific post-translational modifications altering synuclein's susceptibility to aggregation. We also found that γ-synuclein affects the formation of actin–cofilin rods 11.2 ± 1.4 μm in length.

Significance: Such cross-seeding effects of intrinsically unstructured proteins play an important role in the pathogenesis of neurodegenerative diseases.

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