

Impact of PS-NPs on Cell Viability and Cell Death in PC12 Cells and Meta-Analytic Evidence on Oxidative Stress and Neuroinflammation

Yashoda Wanigasekara P.W.S.M.P

School of Life Sciences, Tiangong University, Tianjin, China

Xiuping Fu

School of Life Sciences, Tiangong University, Tianjin, China

Abstract:

Polystyrene nanoplastics (PS-NPs) are emerging environmental pollutants that have become a particular concern because they can be readily taken up by cells and may be neurotoxic. This paper examined the neurotoxicity of PS-NPs in differentiated PC12 cells using both experimental and meta-analytic approaches. In the experimental part, PC12 cells were exposed to PS-NPs with sizes of 100, 300, and 500 nm at exposure volumes of 10, 20, and 30 mL for 1, 3, and 6 hours. The final nominal concentration of the added stock suspension varied depending on the volume of culture medium in each well. The MTT assay and FDA/PI dual staining were used to assess cell viability and cell death, respectively. The findings revealed that the PS-NPs had a significant effect on cell viability, depending on particle size and time, with smaller particles being more toxic. After 6 hours of exposure, cell viability declined to 47.48%, 45.98%, and 52.07% for the 100, 300, and 500 nm groups, respectively. In the 100 nm group at 10 μ L, viability dropped from 83.32% at 1 hour to 63.64% at 3 hours, and then to 47.47% at 6 hours. FDA/PI staining revealed a high level of cell death, reaching up to 83.68% in the 100 nm group. These results were supported by the meta-analysis that included 25 studies and 1,426 observations and demonstrated significant associations between PS-NP exposure and oxidative stress and neuroinflammation, especially at higher concentrations and smaller particle sizes. In general, the results indicate that PS-NPs exhibit potent neurotoxicity in PC12 cells and provide a comprehensive toxicological model that correlates with decreases in viability, cell death, oxidative stress, and neuroinflammation.

Keywords:

Polystyrene nanoplastics (PS-NPs), PC12 cells, neurotoxicity, cell viability, Cell Death, oxidative stress, neuroinflammation, meta-analysis.