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Comparative analysis of the toxicity profile of eleven consumer-relevant nanomaterials in human intestinal and placental barrier cells

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Abstract

Background: The growing number of items incorporating nanomaterials (NM) has prompted considerable concerns about human health and safety [1]. Metal nanoparticles, inorganic non-metallic, and carbon-based NM are among the types with the highest market volume [2]. **Objective:** The purpose of this study was to determine the effect of chemical composition [Ag, Au, TiO_2, SiO_2, and graphene oxide (nano_GO)], primary size (10, 30 and 60 nm AgNP and AuNP), crystal structure (TiO_2NP rutile/anatase and anatase), and surface coating (citrate and PEGylated AuNP) on potential toxicity to human intestinal (Caco-2) and placental (BeWo b30) epithelial cells. **Methods:** Changes in cell morphology, metabolic activity, plasma membrane integrity, intracellular ROS and ATP levels, and DNA integrity were assessed to investigate their potential toxicity at 24 h after exposure. **Results:** In both barrier models, the toxicity profile was similar, however placental were more sensitive than intestinal epithelial cells. Overall, NM may be ranked for cytotoxicity as AgNP > nano_GO > AuNP ~ TiO_2NP ~ SiO_2NP, with the effects becoming more evident at greater concentrations. The influence of size was more pronounced for AgNP than for AuNP, with the smaller nanoparticles producing higher cytotoxic effects. The cytotoxicity of AuNP was prevented by PEG capping. AgNP and nano_GO exposure markedly raised the levels of ROS, indicating that oxidative stress may play a role in their cytotoxicity. Except for 10 nm AuNP, every NM tested markedly increased intracellular ATP levels. One interesting finding was that a higher cytotoxic potential did not necessarily equate to a higher genotoxic potential, since only AgNP (classified as positive) and anatase TiO_2NP (classified as equivocal) caused DNA damage. **Conclusions:** Our findings alert to the potential risks associated with human barriers exposure to NM, where the physicochemical properties are important determinants of their toxicity. Additional research is needed for a deeper understanding of NM impact on human barriers.

Keywords: nanomaterials; *in vitro* toxicity; Caco-2 cells; BeWo b30 cells

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