

Nano-TiO₂ Inhalation Early in Gestation Impairs Maternal Vascular Reactivity and Fetal Development

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Engineered nanoparticles are used in products at an increasing rate and nano-sized titanium dioxide (TiO₂) is in many domestic products. Nanomaterial exposure has been shown in rodents to have negative health effects on the cardiovascular system that can impair fetal growth and cause future health problems for the offspring. The effect of timing of exposure during gestation and the mechanism by which engineered nanomaterials affect the cardiovascular system are not known. This study investigated the effects of nanomaterial exposure at different time points during gestation to better understand the mechanisms by which nanomaterials can impact the cardiovascular system and the health of the mother, developing litter, and fetus. Timed pregnant Sprague Dawley rats 8-12 weeks of age at gestational day (GD) 4, 12 or 17 were placed in one of three groups: nano-TiO₂ exposure [10.1±0.1 mg/m³, 4 hours, median particle size 317±37 nm (SMPS)], filtered air, or naïve as control. At GD 20, pups and placenta were harvested and weighed. Microvascular reactivity was assessed via wire myography (DMT 620). Vascular (maternal aorta, uterine artery, umbilical vein, fetal aorta) reactivity was evaluated in response to chemical stimuli to assess endothelium-dependent [acetylcholine (10⁻⁹-10⁻⁴ M)], -independent [spermine-NONOate (10⁻⁹-10⁻⁴ M)], and vascular smooth muscle [phenylephrine (10⁻⁹-10⁻⁴ M)] function. Preliminary results indicate hyper-reactivity in the uterine smooth muscle vasculature of the GD 4 exposed animals. This finding suggests blood flow may be limited to the developing pups when animals are exposed to nano-TiO₂ early in gestation. The GD 4 exposed litters also have more reabsorption sites of the embryos; however there were no significant differences to litter size or pup weight. These results indicate that a single exposure to nano-TiO₂ early in gestation may impact maternal and fetal health, while later in gestation had no apparent negative effect.

