Gestational Exposure to Inhaled Nano-sized Titanium Dioxide Impairs Maternal Nutrition and Fetal Health

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Due to the persistent use and development of engineered nanomaterials (ENM), there is a growing need to understand their effects on human health, especially in understudied populations. Exposure to ENM during pregnancy has the potential to affect both the mother and fetus through the development of a hostile gestational environment. In rodents, chronic maternal exposure to inhaled ENM early in gestation induces low offspring weights at birth and throughout critical stages of development. However, the reason for these low birth weights is not fully known. As gestational ENM exposure has also been found to severely impair uterine vascular reactivity, fetal growth restriction may be due to limited blood flow and transfer of nutrients to the developing pups. To investigate nutritional impairments associated with ENM exposure, pregnant Sprague-Dawley rats were exposed to nano-sized titanium dioxide aerosols beginning at gestation day 4 (9.35 ± 0.15 mg/m3, 11 days, 5 hours/day, mean particle size 162 ± 7.67 nm) and maternal and fetal plasma glucose and ω-3 unsaturated fatty acid (3-UFA) levels were measured at gestation day 20. Although no differences in pup weight or number of reabsorption sites were seen in this cohort, ENM exposed animals had smaller litter sizes, placental weights, and maternal weights. With respect to nutritional transfer, the exposed dams had a lower fed glucose status than their control counterparts, which trended towards significance ($p = 0.09$). There were no differences in glucose levels in the fetal cohort or with respect to 3-UFA. These results indicate that exposure to titanium dioxide aerosols may affect maternal nutrition, leading to a lower dam weight and blood glucose levels. Interestingly, these reduced glucose levels were not seen in their fetal pups. Although 3-UFA levels and transport do not appear to be influenced in this cohort, transfer of other fatty acids may be impaired. Further, these results were derived from a fed state while fasted animals may show different results. Overall, gestational exposure to ENM influenced maternal nutrition and litter and fetal health. Supported by ASPET SURF and NIH R25ES020721, P30ES005022, and R00ES024783.