A mother's salt intake could be key to prenatal kidney development

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A new animal study from Europe has drawn an association between pregnant mothers' sodium intake and their newborn's kidney development. Among the most significant aspects of the study's findings is that either too much or too little salt during pregnancy had an adverse effect on the prenatal development of the offspring's kidneys. The consequence of such disruption can lead to high blood pressure in later years.

These are the conclusions reached in the study, "Both High and Low Maternal Salt Intake in Pregnancy Alters Kidney Development in the Offspring," conducted by Nadezda Koleganova, Grzegorz Piecha, Annett Müller, Monika Weckbach, Peter Schirmacher, and Marie-Luise Gross-Weissmann, Eberhard Ritz and Luis Eduardo Becker, all with the University of Heidelberg in Heidelberg, DE; and Jens Randel Nyengaard of the University of Aarhus, Aarhus, DK. Their study is published in the online edition of the *American Journal of Physiology--Renal Physiology*.

Background

This research builds upon past studies that recognize that excessive salt intake causes secretion of endogenous cardiotonic steroids such as marinobufagenin (MBG). For the pregnant female, this can be harmful since high concentrations of MBG are correlated to low birth-weight and higher blood pressure in the offspring.

Previous research has also linked high blood pressure with a low nephron number, critical because the nephron is the basic structural and functional unit of the kidney. The nephron eliminates wastes from the body, regulates blood volume and blood pressure, controls levels of electrolytes and metabolites, and regulates blood pH. Its functions are vital to life and are regulated by the endocrine system.

Methodology

Sprague-Dawley rats were fed low, intermediate or high sodium diets during pregnancy and lactation. The litters were standardized to identical size at birth with 1:1 male to female ratio. The offspring were separated from their mothers at four weeks of age and subsequently received the intermediate sodium diet. The animals had free access to water and food and their body weight, food and water consumption were monitored weekly.

The kidney structure was assessed at postnatal weeks 1 and 12, and the expression of proteins known to be involved in kidney development were examined at birth and 1 week of age. Blood pressure was measured by telemetry in male offspring between the ages of two and nine months.

Results

The researchers found that the number of glomeruli (the main structural unit of the kidney) during weeks 1-12 were significantly lower, and the measured blood pressure for males after the fifth month was higher in offspring of mothers on high- or low- compared with intermediate-sodium diet. High salt diet was paralleled by higher concentrations of marinobufagenin in the amniotic fluid and an increase in the expression of both GDNF and its inhibitor, sprouty-1 in the offspring's kidney. The expression of FGF-10, a genetic signal responsible for kidney

development, was lower in offspring of mothers on low-sodium diet and the expression of Pax-2 and FGF-2, tissue-specific genes that determine cell lineages, tissue patterning, and cellular proliferation was lower in offspring of mothers on high-sodium diet.

Importance of the Findings

Taken together the above findings indicate that both too low and too high maternal salt intakes retard development of new glomeruli, resulting in a nephron deficit. If the findings in the animals in this study can be extrapolated to humans, both too low and too high salt intake during pregnancy would be a risk factor for hypertension and renal damage in the offspring.

In women, each mother-to-be has specific health issues and conditions that require guidance from a health provider. This study sheds light on the issue of salt intake during pregnancy and draws attention to the possible consequences of consuming too much or too little salt during pregnancy and the impact it may have on the kidney development of an offspring.

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