Study suggests a much earlier onset for bone problems

April 25 2010

We all know that eating a calcium-rich diet is important for keeping our bones healthy and strong. This concept is clearly on display in any elementary school cafeteria where the walls are decorated with colorful posters with celebrity icons encouraging children to make sure they drink milk every day. However, emerging research suggests that urging school-aged children to pay attention to their dairy intake might actually be too late to optimize their bone health. Indeed, the idea that long-term bone health may be "programmed" or established during infancy or even earlier is gaining significant scientific support as nutrition researchers continue to study the genesis of chronic diseases such as osteoporosis.

In a presentation concerning early nutritional programming and long-term skeletal health to be presented on April 27 at the Experimental Biology 2010 meeting in Anaheim, researchers from North Carolina State University and the US Army Research Institute of Environmental Medicine will present evidence that very early calcium nutrition may have more impact than we previously thought. This presentation is part of the scientific program of the American Society for Nutrition, home of the world's leading nutrition researchers.

The research is led by Dr. Chad Stahl, an Associate Professor in the Department of Animal Science at North Carolina State University, who studies the nutritional regulation of growth and development and utilizes the neonatal pig as a surrogate for the human infant. Stahl and his colleagues have a long-standing interest in understanding how much calcium babies need in order to optimize bone density and strength when

they get older. Not only is this a worthy academic question, but it has special relevance to the infant food industry which currently fortifies most baby formulas with calcium at levels substantially above those found in breastmilk - considered the "gold standard" for infant nutrition. This differential level of fortification has been based largely on older studies suggesting that breastmilk's calcium is substantially more usable than that in baby formulas. However, more recent research has challenged this dogma, and Dr. Stahl and his group are committed to helping determine what is best in this regard.

To test their hypotheses, the scientists bottle-fed 12 piglets a calcium-rich diet and another 12 piglets a calcium-deficient diet during the first 18 days of life. Throughout the study, blood samples were drawn frequently from the piglets, and they were weighed daily. At the end of the study, the researchers collected samples from the animals' bone marrow, livers, kidneys, and small intestines. They also tested their hind legs for bone density and strength.

Their results were both surprising and intriguing. For instance, there were no differences between groups in terms of blood markers of calcium status and growth. These data support the previously suggested concept that, unlike what happens in adults, calcium absorption in newborns is not dependent on vitamin D. They also documented marked differences in bone density and strength such that the calcium-deficient piglets were compromised. When they looked at the bone marrow tissue which contains all the material (known as mesenchymal stem cells) that will eventually become bone-forming cells, they discovered that many of the calcium-deficient piglets' cells appeared to have already been programmed to become fat cells instead of bone-forming osteoblast cells. Fewer osteoblasts in early life may translate to a diminished ability for bones to grow and repair themselves throughout the remainder of life. Thus, it appeared as if calcium deficiency had predisposed the animals to having bones that contained more fat and less mineral.

Dr. Stahl concluded that "While the importance of calcium nutrition throughout childhood and adolescence is well recognized, our work suggests that calcium nutrition of the neonate may be of greater importance to life-long bone health due to its programming effects on mesenchymal stem cells. It also points to a potential paradigm shift in which health professionals might want to begin thinking about osteoporosis not so much as a disease of the elderly, but instead as a pediatric disease with later onset."

Provided by Federation of American Societies for Experimental Biology