Vitamin D deficiency alters lung growth and decreases lung function

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Previously linked to the severity of asthma and chronic obstructive pulmonary disease (COPD) in humans, vitamin D deficiency has now been shown to alter lung structure and function in young mice. The new study, conducted by researchers in Australia, offers the first concrete evidence linking vitamin D deficiency with deficits in lung function and altered lung structure.

The findings were published online ahead of the print edition of the American Thoracic Society's American Journal of Respiratory and Critical Care Medicine.

"The results of this study clearly demonstrate that vitamin D deficiency alters lung growth, resulting in lower lung volume and decrements in lung function," said Graeme Zosky, PhD, a research fellow at the Telethon Institute for Child Health Research in Subiaco, Australia. "This is the first direct mechanistic evidence showing that vitamin D deficiency alters lung development, which may explain the association between obstructive lung disease and levels of vitamin D."

To conduct their study, the researchers used a mouse model of vitamin D deficiency and evaluated lung responses of two-week-old mice, comparing them to control mice without vitamin D deficiency to determine what, if any, effects the deficiency may have caused in the growth, structure or function of the lungs.

Lung volume and lung function were evaluated using a plethysmograph,

an instrument used to measure the amount of air in the lung, and via forced oscillation, a technique used to measure the resistance to air flow in the lungs. Microscopic lung tissue samples were also evaluated to assess changes in lung structure.

"The aim of this study was to determine if vitamin D deficiency results in altered lung function and/or structure as a potential explanation for the association between vitamin D and chronic respiratory disease," said Dr. Zosky, who is also an adjunct senior lecturer at the University of Western Australia's Centre for Child Health Research. "Specifically, we aimed to determine if vitamin D deficiency has an influence on lung growth as indicated by a decrease in lung volume. We also wanted to determine if the deficiency alters the mechanical properties of the lung tissue due to changes in the structure of the lung."

The researchers found that airway resistance was significantly higher while lung volume was significantly lower in vitamin D-deficient mice compared to control mice. Examinations of specific tissue responses revealed model mice had reduced lung function. Lungs were also smaller in model mice, which Dr. Zosky said could have been caused by the deficiencies of the mother or of the offspring.

"Due to the nature of this study, we were not able to determine whether the differences in lung size and function we observed in the deficient offspring were the result of their own deficient status or as a consequence of developmental deficits that occurred in utero due to the mother's deficiency," he said.

Dr. Zosky noted that although recent studies suggest that vitamin D deficiency is associated with reduced lung function, causal data confirming a relationship between vitamin D and lung function have been lacking.

"For the first time, we have demonstrated a direct role for vitamin D in causing decreased lung function in the absence of known confounders such as physical inactivity, confirming the assertion by epidemiological studies that there is a relationship between vitamin D deficiency and lung function," Dr. Zosky said. "The differences we observed in lung volume and lung mechanics, which were substantial and physiologically relevant, raise serious concerns regarding the increased prevalence of vitamin D deficiency in communities around the world. The results also raise concerns about the potential this deficiency may have on lung health, and in particular, the potential impact deficiency may have on the susceptibility to obstructive lung disease."

Dr. Zosky said the study results have important implications for prevention of lung diseases in populations where vitamin D deficiencies are common. Future studies need to be conducted to determine whether vitamin D deficiency-induced alterations in lung growth increase the severity of obstructive lung disease and to identify susceptible populations whose use of dietary vitamin D supplementation could be used to improve lung health outcomes, he added.

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