Vitamin D deficiency may impair muscle function

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Vitamin D deficiency may impair muscle function due to a reduction in energy production in the muscles, according to a mouse study published in the *Journal of Endocrinology*. Vitamin D deficient mice were found to

have impaired muscle mitochondrial function, which may have implications for muscle function, performance and recovery. This may suggest that preventing vitamin D deficiency in older adults could help maintain better muscle strength and function and reduce age related muscle deterioration, but further studies are needed to confirm this.

Vitamin D is a hormone well known to be important for maintaining bone health and preventing rickets and osteoporosis. In recent years, vitamin D deficiency has been reported to be as prevalent as 40% in European populations and linked to increased risk for several conditions, including COVID-19, cancer and diabetes. Although these studies report association rather than causation, the benefits of vitamin D supplementation are now a major subject of health debate. Multiple studies have also linked low vitamin D levels to poor muscle strength, particularly in older people. Skeletal muscle enables us to move voluntarily and perform everyday activities. It is essential that they have enough energy to power these movements. Specialised organs in cells, called mitochondria, convert nutrients in to energy to meet this demand. Previous studies indicate that impaired muscle strength in people with vitamin D deficiency may be linked to impaired muscle mitochondrial function. Determining the role of vitamin D in muscle performance of older people is also difficult, as they may suffer from a number of pre-existing health conditions that can also affect their vitamin D status. Therefore, previous studies have been unable to determine how vitamin D may directly affect muscle performance.

Dr. Andrew Philp and his team at the Garvan Institute of Medical Research in Australia, and collaborating universities, used a mouse model to determine the effects of diet-induced vitamin D deficiency on skeletal muscle mitochondrial function in young, male mice. Mice were either fed a diet with normal quantities of vitamin D, or with no vitamin D to induce deficiency, for a period of 3 months. A typical vitamin D level for humans is 40-50 $nmol.L^{-1}$, and acute vitamin D deficiency is

diagnosed when levels drop below 12 nmol.L^{-1}. On average, the mice in this study had vitamin D levels of 30 nmol.L^{-1}, with diet-induced vitamin D deficiency leading to levels of just 3 nmol.L^{-1}. Although this level was more extreme than typically observed in people, it is still within the clinically-recognised range. Tissue and blood samples were collected monthly to quantify vitamin D and calcium concentrations and to assess markers of muscle mitochondrial function and number. After 3 months of diet-induced vitamin D deficiency skeletal muscle mitochondrial function was found to be impaired by up to 37%. This was not due to a reduced number of mitochondria or a reduction in muscle mass.

"Our results show there is a clear link between vitamin D deficiency and oxidative capacity in skeletal muscle. They suggest that vitamin D deficiency decreases mitochondrial function, as opposed to reducing the number of mitochondria in skeletal muscle." Dr. Philp comments. "We are particularly interested to examine whether this reduction in mitochondrial function may be a cause of age related loss in skeletal muscle mass and function."

These findings suggest that vitamin D deficiency may impair mitochondrial function and reduce the amount of energy produced in the muscles, which may lead to poor muscle function. Therefore, preventing vitamin D deficiency in older people may help maintain muscle performance and reduce the risk of muscle related diseases, such as sarcopenia. However, further studies that investigate the direct effect of vitamin D deficiency on muscle function and strength are necessary to confirm this.

Whilst this study indicates that vitamin D deficiency can alter mitochondrial function in skeletal muscle, Dr. Philp and his team were unable to determine precisely how this process occurred. Therefore, their future work aims to establish how vitamin D deficiency alters mitochondrial control and function in skeletal muscle.

The study "Diet-Induced Vitamin D Deficiency Reduces Skeletal Muscle Mitochondrial Respiration" will be published in the *Journal of Endocrinology* on 16 April 2021.

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