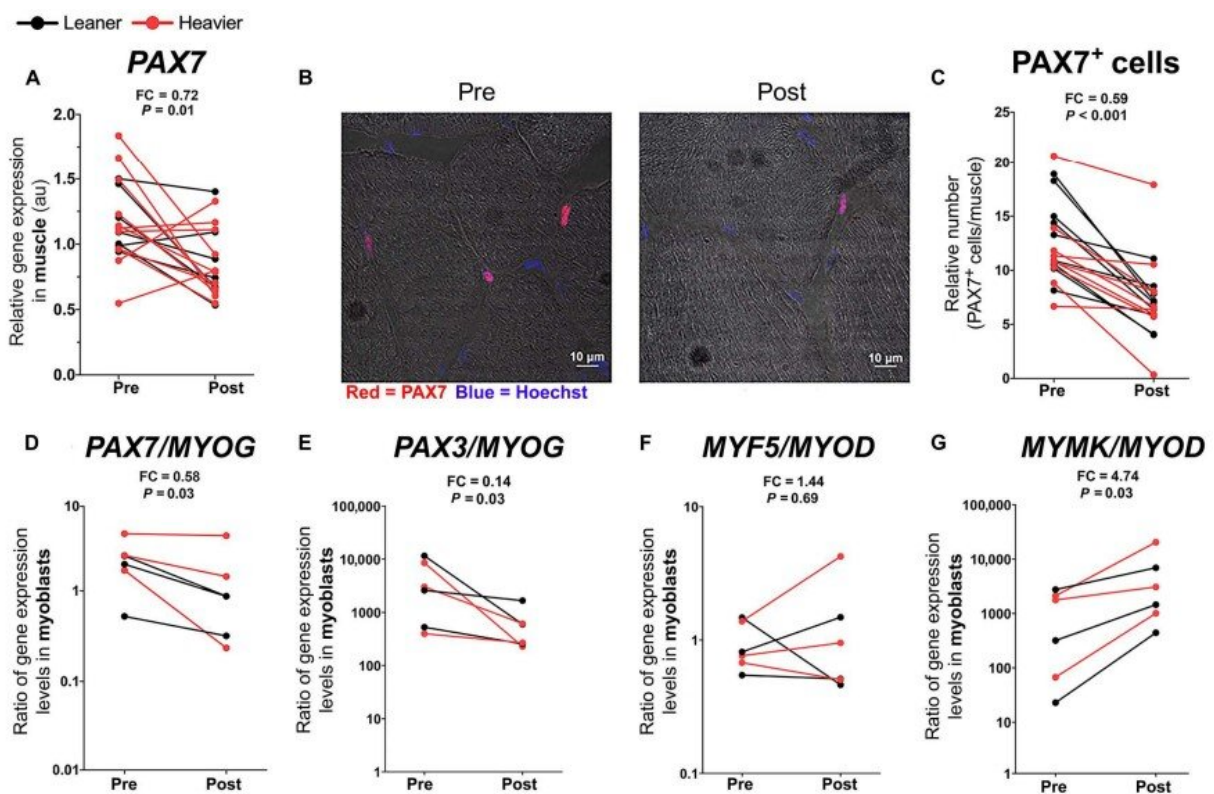


Vitamin B3 nicotinamide riboside improves muscle mitochondria and gut microbiota composition

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NR promotes muscle satellite cell differentiation in the twins from the BMI-discordant pairs. (A) Muscle gene expression level of satellite cell marker PAX7 before versus after NR (n = 9 twin pairs/18 individuals). (B) Immunostaining of PAX7⁺ satellite cells in muscle cryosections before versus after NR in one representative study participant. PAX7 (red, satellite cells); Hoechst (blue, nuclei). Scale bars, 10 μm. (C) Muscle PAX7⁺ satellite cell quantification before versus after NR (n = 10 twin pairs/ 20 individuals). (D to G) Ratios of

PAX7/MYOG (D), PAX3/MYOG (E), MYF5/MYOD (F), and MYMK/MYOD (G) mRNA expression in myoblasts before versus after NR (n = 3 twin pairs/6 individuals). Y axis is on a logarithmic scale. PAX3, paired box 3; MYF5, myogenic factor 5. Lines connect the pre- and post-values of each individual, with black denoting the leaner and red denoting the heavier cotwins. Fold change indicates the mean of the post-NR value divided by the pre-NR value. P values were calculated using paired Wilcoxon signed-rank test. Credit: *Science Advances* (2023). DOI: 10.1126/sciadv.add5163

The newest vitamin B3 family member, nicotinamide riboside (NR) has been found to have beneficial effects on mitochondria in the human muscle. Currently, mitochondrial dysfunction cannot be treated. Recent findings from the University of Helsinki encourages further investigation of whether this vitamin B3 form could serve as a potential therapeutic option for mitochondrial dysfunction.

In a recent twin study at the University of Helsinki, it was found that nicotinamide riboside (NR) increased the number of mitochondria in the muscle after long-term administration. In addition, NR improved the gut bacterial composition and increased the blood NAD⁺ concentrations.

Different forms of vitamin B3, such as niacin, nicotinamide and NR, boost cellular energy metabolism, as they serve as precursors for the important molecule for mitochondria, NAD⁺.

"NAD⁺ precursors are currently the focus of active research world-wide, as NR has been found to improve mitochondrial function as well as to alleviate [metabolic syndrome](#) and obesity in rodents," Associate Professor Eija Pirinen says.

However, it has been unclear whether NR has beneficial effects on mitochondria and metabolic health in humans.

"Our study demonstrated the beneficial effects of long-term supplementation of NR on NAD⁺ metabolism, and particularly on muscle mitochondria and [gut microbiota](#) in humans for the first time," Pirinen says.

Blood, lipid, muscle and [stool samples](#) were collected before and after NR supplementation from the [identical twins](#) who participated in the study. The samples were analyzed, among other methods, by measuring NAD⁺ metabolites in the blood, investigating the amount of mitochondria in tissues and determining the microbiota composition of the stool samples.

The beneficial effects of NR were observed in both leaner and heavier co-twins. In other words, NR supplementation is likely to benefit all individuals regardless of their weight.

A future drug for treating mitochondrial and gut microbiota imbalance?

NR was also found to affect several muscle tissue functions. It increased the differentiation of muscle stem cells and modified [gene expression](#) by modulating DNA methylation, i.e., an incorporation of methyl groups to DNA.

Based on the findings, NR supplementation appears to be a promising therapeutic option to be studied in diseases characterized by gut microbiota imbalance and/or muscle [mitochondrial dysfunction](#), such as sarcopenia, which is age-related muscle loss. According to the authors of this study, long-term administration of NR should be investigated further in [clinical trials](#), although in carefully selected patients, as NR was found to impair insulin sensitivity.

"This is a significant step forward in the development of vitamin B3 forms for the therapeutic use. Since NR supplementation has been used in the short term only in prior studies, this study has increased our understanding of the long-term effects of NR," Professor Kirsi Pietiläinen from the University of Helsinki notes.

More information: Helena A. K. Lapatto et al, Nicotinamide riboside improves muscle mitochondrial biogenesis, satellite cell differentiation, and gut microbiota in a twin study, *Science Advances* (2023). [DOI: 10.1126/sciadv.add5163](https://doi.org/10.1126/sciadv.add5163). www.science.org/doi/10.1126/sciadv.add5163

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