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Customized vitamins a fix for genetic flaws?

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(06-05) 20:01 PDT -- UC Berkeley scientists are exploring whether high-speed gene-reading machines - like those used to decode the human genome - will be able to find subtle genetic flaws that can harm health and can be cured by treatments as simple as vitamins.

Eventually, they hope, these scans will help nutritionists customize a course of vitamins to match the strengths and weaknesses of every individual. "Think of it as a metabolic tuneup," said Berkeley researcher Nicholas Marini.

Marini and a team of researchers reported this week that they had found, in DNA samples from over 500 people, four types of genetic mutations that were treatable with folate, a well-known member of the vitamin B family. One of the four had already been identified as a relatively common genetic defect that responded to the vitamin. The three others were new.

Although the research is years away from practical tests on humans, the study published Monday in the journal Proceedings of the National Academy of Sciences is a first step showing that such tuneups might be possible.

Marini cautioned that there is much about the interaction of genes and nutrition that is still unknown. "The reality is, we don't know how to interpret a lot of this information," he said.

Raising ethical questions

The study was partially funded by the Department of Defense, which saw the potential to improve human performance on the battlefield. Medical ethicists are now pondering what it will mean for those seeking to enhance performance in sports, in schools or on the job.

"There is no doubt that athletes will try to take advantage of DNA markers," said Steven Ungerleider, a research psychologist in Eugene, Ore., and author of "Faust's Gold," the story of the East German Olympic doping scandal. "The flip side of this wonderful medical technology is that it will be abused."

Arthur Caplan, director of the University of Pennsylvania Center for Bioethics, said the issues surrounding the use of genetic information to enhance performance are complex. "The idea that we are going to modify diet, modify sleep, modify exercise is well established in sports," he said. "On the one hand, we don't like steroids, we don't want blood doping. On the other hand, most top-flight athletes have a dietician and nutritionist watching every calorie."

Caplan believes that if the technology is shown to be effective, such testing might be required in the

workplace, particularly among those competing for elite positions. For example, he asked, would such testing be required for astronauts or even by ordinary businesses looking for a competitive edge?

People commonly take vitamins in the hope of filling gaps in their diet or improving their daily health, but UC's Marini pointed out that most of the recommended daily allowances established for supplements are derived from nutrition studies conducted in the 1940s. "They are based on the assumption that, biochemically, we are all the same," he said.

In fact, studies like this one are affirming that a wide variety of genetic mutations occur among humans. Every person is likely to have a mix of defective genes, and many of the less apparent, minor variants might have a cumulative negative effect on health.

The Berkeley team noted that humans produce about 600 different enzymes that need vitamins and minerals to carry out their work. They estimate that each person can carry five different defective enzyme genes that are repairable with a higher dose of the related vitamin.

Researcher Jasper Rine, a co-author of the study, said gene scans such as those used in the experiment are expensive and not even available to consumers, but there is a push to develop a test that can be run for less than $1,000.

Genetically engineered yeast

The scientists carried out their experiment using sophisticated computers, cutting-edge DNA sequencers and genetically engineered yeast. They screened DNA samples from 564 people who donated specimens to an international gene bank. They studied just one gene, which serves as a blueprint for the production of an enzyme that requires folate to work properly.

A total of 14 mutations of the same gene were collected from the group - some appeared rarely, less than 1 percent of the time - while others were more common, with as many as 1 in 3 samples carrying the defect.

The studies were not carried out in people. Instead, the defective genes were transplanted into yeast cells, which were then tested to see whether folate could restore the function of the flawed enzymes. In four out of five cases, increased levels of folate compensated for the most heavily damaged genes. People carrying those genes would be likely to benefit from higher dosages of folate in their diet, or by taking vitamin supplements.

Rine said studies are now under way to explore other vitamin-gene relationships. In collaboration with Children's Hospital Oakland Research Institute, the scientists are scanning genes for every enzyme known to interact with folate. Eventually, he believes researchers will have a catalog of mutations affecting all 600 enzymes that require a vitamin or mineral to function properly.

If the suppositions of the researchers are correct, every person is likely to carry a handful of genetic defects that can be remedied by higher consumption of specific vitamins. One strategy, long used by consumers, is simply to down high doses of all vitamins. Rine believes that it simply makes more sense to match vitamin consumption to each individual's genetically determined vitamin requirements. It avoids waste of vitamins and potential health problems caused by toxic levels of some supplements.

People are also more likely to take a higher dose of a specific vitamin regularly if they know for certain that they need it and also know what pills they don't have to take. "Try to swallow 10 Centrums," said Rine. "That is a lot of swallowing."

Path to improved health?

What: UC Berkeley researchers are searching for genetic flaws that can be fixed by simply taking vitamin and mineral supplements.

How: By knowing which genes are defective, people will know which vitamins they need.

Goal: Eventually, a person's entire genome may be scanned for flaws, and a set of vitamins could be prescribed for optimum health.

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