We are all unique and wonderful creatures! You may have heard that before, but I'm not sure that most of you realize just how unique we are. The sequencing of the human genome showed just how alike we all are - our DNA sequences are more than 99.5% alike. But that 0.5% makes all the difference. In the study I will be talking about below, there were over 58,000 genetic variations between individuals.

Some of them are common mutations that are easily linked to diseases. However, there are other genetics variations that increase the risk of certain diseases, but are so rare that they can be linked to diseases only by the most sophisticated genetic analyses.

Welcome to the amazing science of nutrigenomics. The vitamin D story is a perfect example of what I mean.

You may remember from my previous "Tips From The Professor Series" that we now know that many people with adequate dietary intakes of vitamin D have low levels of the active form of vitamin D in their bloodstream. That is why I recommend that everyone get their blood levels of 25-hydroxy vitamin D tested and, if their blood levels are low, consider taking greater than RDA levels of vitamin D until they reach optimum 25-hydroxy vitamin D levels in the bloodstream.

You may also remember that I alerted you to studies showing that **inadequate sun exposure and/or vitamin D intake during early childhood increased the risk of developing multiple sclerosis** latter in life. But, not everyone with low sun exposure or vitamin D intake develops MS.

At present we don't understand why some people with adequate vitamin D intake (according to RDA standards) have inadequate blood levels of the active form of vitamin D in their bloodstream. Nor do we understand why only some people with low vitamin D exposure develop MS.

That's why a recent paper ("Rare Variants in the CYP27B1 Gene Associated with Multiple Sclerosis" by S. V. Ramagopolan et al., Annals of Neurology, doi: 10.1002/ana.22678) caught my eye.

The CYP27B1 gene codes for the enzyme that catalyzes the final step in the conversion of vitamin D to its most active form. A complete loss of activity of this gene causes a disease called **vitamin D dependent rickets** that can only be corrected by the active form of vitamin D or extremely high levels of vitamin D.

However, these rare genetic variants of CYP27B1 only caused a partial loss of enzyme activity. People with these rare variants have low blood levels of active vitamin D but do not necessarily develop rickets.

This was a very robust study. The research team initially looked at 43 individuals from families where four or more people had developed MS (ie families that were genetically highly prone to develop MS). They found a very high correlation between a particular variant of the CYP27B1 gene and MS.

They then looked at 1,000 families in which the parents were unaffected but at least one of the children developed MS. They found 35 cases in which one of the parents had a single copy of this variant of the CYP27B1 gene. In all 35 cases the child with MS had inherited the same genetic variant.

These results clearly show that defects in vitamin D metabolism can lead to MS. If the CYP27B1 gene variant were unrelated to MS, the probability of inheriting the variant from one parent would be 50:50. Or put another way - if the CYP27B1 gene variant were unrelated to MS, the probability of every child with MS inheriting the same variant would be a billion to one!

Finally, the research team genotyped 12,579 people with MS and identified four other variants of the CYP27B1 gene in those individuals.

Let me put this study in perspective for you.

Scientists like me find this kind of study fascinating. We know that gene by gene we will unveil the mysteries of vitamin metabolism and diseases like MS.

However, it is very important for you to understand the limitations of this study.

1) This is not classical genetics. A defect in this gene does not cause MS by itself. Remember that at least one of the parents had the same gene variant as their child with MS, but the parents never developed MS. hether someone actually develops a disease such as MS is a complex interplay between genetic background, environment and diet.

- For example, this was a Canadian study. Perhaps the **parents grew up in a sunnier location but moved to Canada** and raised their children there.

- Our diet has also changed dramatically over the past twenty years. For example, we now consume more sodas and less vitamin D-fortified milk than previous generations. Perhaps the parents had a diet that provided significantly more vitamin D than their children were getting.

2) **Defects in this gene only explain a small percentage of MS cases. When this research team genotyped MS patients, defects in the CYP27B1 gene were found in only 0.81% of MS patients. Obviously we scientists have a lot of work to do!**

3) While everyone with this gene variant has low blood levels of the most active form of vitamin D, defects in this gene only account for a small percentage of people with low blood levels of active vitamin D. There are many more genetic variants affecting vitamin D metabolism that are yet to be discovered.

So What DOES this kind of research mean for you?

1) This study confirms earlier research showing that low blood levels of vitamin D are strongly associated with increased risk of developing MS.

2) This is just the tip of the iceberg. There are hundreds, if not thousands, of genetic variants that affect the metabolism of vitamins, minerals, phytonutrients, and macronutrients (fat, protein and carbohydrate) and just as many genetic variants that affect how these nutrients relate to disease.

As I said earlier we are all unique and wonderful creatures.

We all have genetic variants that predispose us to certain nutritional deficiencies and to certain diseases. And, it is impossible using today's technology to predict how much of each nutrient we need to prevent disease.

So we should make every effort to assure that our diet provides optimal intake of all of the essential nutrients - and in today's world that includes both good food choices and supplementation.

3) Vitamin D is unique in that we have a simple blood test (25-hydroxy vitamin D levels) that will identify most cases in which either our intake or metabolism of vitamin D are inadequate.

Hence my recommendation that everyone get their blood levels of 25-hydroxy vitamin D tested and modify their vitamin D intake accordingly.

Unfortunately, defects in this particular variant of vitamin D metabolism would not be identified in the 25- hydroxyvitamin D test. However, this variant is extremely rare and the 25-hydroxyvitamin D test is still the best overall measure for vitamin D adequacy.

Simple blood tests of vitamin sufficiency don't exist for all of the other essential nutrients, and I don't recommend many of the blood tests that do exist.

Once again, your best assurance of meeting your unique nutritional needs is good diet and supplementation.

To Your Health!
Dr. Stephen G Chaney