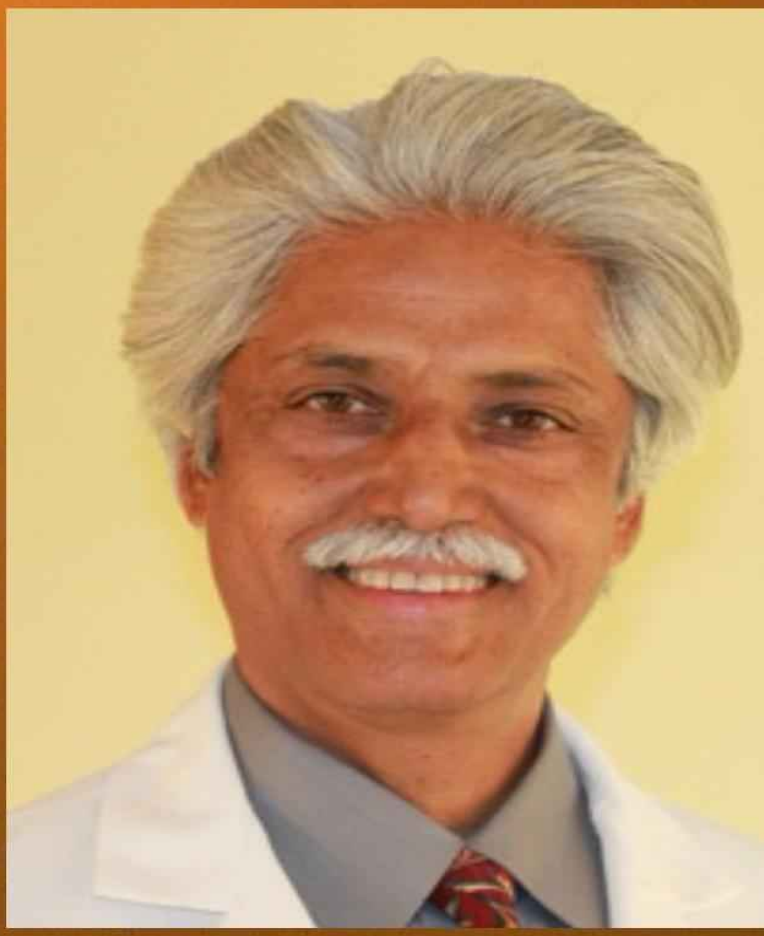
POWER OF VITAMIN D

The Most Scientific, Useful and Practical Information About Vitamin D - Hormone D



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Preface

Since its first publication in 2010, “Power Of Vitamin D” has reached out to more than 100,000 people around the world. At the time of this writing, the book has earned 149 reviews by the readers at Amazon.com, out of which 139 (93%) are excellent reviews (4 and 5 stars). It has been translated into Polish and Romanian languages.

Nothing can be more rewarding for me than to see thousands of people getting in-depth, scientific yet practical knowledge about vitamin D or rather Hormone D, and taking charge of their Hormone D needs. Through the power of knowledge, we can turn around the seemingly insurmountable tide of the pandemic of Hormone D Deficiency - HDD.

In my own clinical practice at the Jamila Diabetes and Endocrine Medical Center in California, patients continue to reap the health benefits of vitamin/hormone D. Every day I hear comments like: “Doc, I don’t get colds and the flu any more like I used to.” Or” I don’t have body aches and pains any more.” Or “I have so much energy now.” I see an improvement in their clinical parameters as well. From diabetes to Hashimoto’s thyroiditis, from asthma to osteoporosis, and so many other diseases, I see a clear-cut clinical improvement.

Researchers from every corner of the world continue to provide compelling scientific evidence about the incredible health benefits as well as safety of vitamin/hormone D. Their findings are in line with my own clinical experience.

In the 3rd edition of “Power Of Vitamin D,” I have included more of these excellent scientific studies in addition to sharing my own clinical observations. I have also added three new chapters:

Chapter 27: Vitamin D Supplementation In Special Situations (especially Kidney Stones)

Chapter 29: Vitamin D, Calcium and Magnesium

Chapter 30: Vitamin D and Vitamin K2

I am truly excited to present to you the 3rd edition of “Power Of Vitamin D.”

Sarfraz Zaidi, MD

Introduction

For years, Evelyn suffered from body aches and pains as well as lack of energy. She consulted several physicians. One specialist gave her the diagnosis of Fibromyalgia. Another physician told her she had Chronic Fatigue Syndrome. Someone else told her, “It’s all in your head.” She was told to just live with it.

This advice didn’t satisfy Evelyn. “There has to be a better answer,” she said to one of her coworkers, who happened to be my patient and had been on the same dreadful road herself until she consulted me. She told Evelyn that her body aches, pains and chronic fatigue had vanished after she finally got the right diagnosis and treatment. Evelyn immediately made an appointment to see me.

“You’re my last hope, Doc,” Evelyn said during her visit. I could sense utter frustration in her voice. I tested her vitamin D level which turned out to be very low. With proper treatment of vitamin D deficiency, Evelyn was relieved of her symptoms in just three months.

I see patients like Evelyn every day in my practice. What amazes me is that physicians run numerous expensive and complicated tests, but don’t think to order the one simple test that could clinch the diagnosis. Sad!

Here’s the plain truth. Most physicians don’t have adequate knowledge about vitamin D deficiency and its serious consequences. What little they do know about vitamin D deficiency is based on outdated and inaccurate data.

My own journey to “enlightenment about vitamin D” started about ten years ago. I vividly remember the day at a medical conference in the Boston area when an old professor gave an amazing talk about vitamin D deficiency. Not only are humans affected, he brilliantly explained, but even animals can develop vitamin D deficiency and its awful complications. For example, in nature, iguanas spend most of the day sun bathing. In captivity however, they can develop severe deficiency of vitamin D and consequently, their back bones melt away.

This lecture definitely left a mark on me. Like most other doctors, I was taught that vitamin D deficiency occurs primarily in older folks, people living in cold, northern areas and patients on kidney dialysis. However, the professor made it very clear that it is quite prevalent in young active people, as well.

On my flight home, I kept thinking about it. I wondered, “What about people living in warm, sunny places like my hometown in southern California? Are they low in vitamin D?” I was taught that people living in sunny places like California and Florida don’t develop vitamin D deficiency. Like a true scientist, I wanted to figure it out myself.

I decided to start checking vitamin D levels in my patients. Was I in for a big surprise! Almost 90% of my patients were low in vitamin D. Most of my patients are active people. They are often involved in all sorts of outdoor activities over the weekends. They are proactive in taking care of their health. They take multivitamins, calcium and vitamin D. They are not elderly shut-ins or kidney dialysis patients. And they live in weather charmed, sunny Southern California.

I started to give my vitamin D deficient patients a dose of vitamin D higher than the recommended dose, while closely monitoring them for vitamin D toxicity. I checked their vitamin D level periodically and adjusted the dose of vitamin D accordingly. I was surprised to find that most people required about five to ten times the recommended dose to achieve a good level of vitamin D.

With proper replacement of vitamin D, I started seeing some amazing results in my patients. Body aches and pains simply disappeared. People who were tired all the time and didn’t want to do much made a U-turn. Now they had plenty of energy to participate in their favorite activities. Women with osteoporosis did very well. Their bone density got better and fractures were rare. Diabetics achieved excellent control of their blood sugars. Diabetics are at particularly high risk for heart disease, stroke and cancer, but in my patients, these medical catastrophes were rare occurrences. Patients with thyroid disease felt much better.

I’m not attributing all these great results simply to vitamin D replacement because I have developed my own effective strategies in treating diabetes and thyroid diseases. However, proper vitamin D replacement has been a significant factor in achieving these great results.

In the last few years, many researchers have done excellent work in the field of vitamin D and their findings are in line with my own clinical experience. The relationship of vitamin D deficiency to bone pains, osteoporosis, immune disorders, heart disease, high blood pressure, depression and cancer is well established now. There is also strong evidence to support that vitamin D deficiency may play a significant role in the development of diabetes.

Over the last ten years, my patients have benefited from my strategy of diagnosing and treating vitamin D deficiency. It’s time to spread this important knowledge. That’s why I decided to write this book.

Chapter **1**

Why Is Vitamin D Important?

In the last 20 years, there has been tremendous research in the field of vitamin D. The findings are astounding! We now know that vitamin D affects almost every organ system in the body.

We now know that:

1. Vitamin D plays a vital role in the health of *muscles and bones*. It not only helps in the absorption of calcium and phosphorus from the intestines, but it also exerts a direct effect on the muscles and bones. Therefore, vitamin D can prevent as well as treat muscle aches, bone pains, chronic fatigue and osteoporosis.

2. Vitamin D plays a vital role in the normal functioning of the *immune system.* Therefore, vitamin D can prevent as well as treat immune disorders such as asthma, rheumatoid arthritis, Type 1 diabetes, Hashimoto's thyroiditis, Graves' disease, Crohn's disease and Multiple Sclerosis (MS). By boosting the immune system, Vitamin D can prevent as well as treat common colds, flu and other infections.

3. Vitamin D controls the growth of normal as well as *cancerous cells*. Hence, vitamin D can play an important role in the prevention as well as treatment of various cancers especially cancer of the colon, prostate, pancreas and breast.

4. Vitamin D stimulates the production of *insulin* from insulin - producing cells in the pancreas. It also reduces *insulin resistance*. Therefore, vitamin D can help in the prevention as well as treatment of Type 2 diabetes.

5. Vitamin D inhibits the Renin Angiotensin Aldosterone System (RAAS). Renin is a chemical normally produced in the body. It leads to the production of another chemical, called Angiotensin which is responsible for maintaining your blood pressure. Angiotensin also causes release of another chemical called Aldosterone, which is also involved in maintaining your blood pressure. Together, this system of inter-related chemicals is called Renin Angiotensin Aldosterone System (RAAS). If RAAS becomes overactive, it causes high blood pressure (hypertension), kidney disease and heart failure. Now consider

this: *Vitamin D inhibits RAAS*, and therefore, it can prevent *hypertension, kidney disease and heart failure*.

6. Vitamin D can prevent *coronary heart disease* through a number of mechanisms which include inhibition of RAAS, reduction in insulin resistance and reduction of inflammation in the blood vessel wall.

7. Vitamin D affects the normal function of the skin and therefore, can be helpful in the treatment of skin disorders such as *Psoriasis.*

8. Vitamin D affects the health of the teeth and therefore, can play an important role in preventing many dental problems.

9. Vitamin D affects one's mood and therefore, can play an important role in the prevention and treatment of mood disorders such as *depression.*

10. Vitamin D is important for the normal development and functioning of the brain. Therefore, vitamin D may play a role in the prevention as well as treatment of neurologic disorders such as Multiple Sclerosis (M.S.), Alzheimer's disease, Parkinson's disease and Autism.

Isn't it obvious that vitamin D plays a crucial role in maintaining our health?

It's a breakthrough discovery! Now we can truly prevent and treat a number of diseases through proper vitamin D supplementation.

In the following chapters, you'll find detailed information on:

A. The remarkable benefits of vitamin D

B. The symptoms and diseases you may have if you are low in vitamin D

C. How to accurately diagnose vitamin D deficiency

D. How to properly treat vitamin D deficiency without the risk of its toxicity.

Chapter **2**

What Is Vitamin D?

Most people, including most doctors, don't really understand what vitamin D truly is. Why do we have such a limited understanding about vitamin D? In order to answer this question, we need to trace the historic background of our understanding of vitamin D.

The Long Journey To Understanding Vitamin D

Let me take you back to post-Industrial Revolution Europe in the late nineteenth century, when physicians began to notice a *new* disease among children living in big industrial cities such as London and Warsaw. These children had stunted growth, muscle wasting and deformed legs. Physicians named this new disease ***rickets***, but no one understood the cause of this crippling disease.

Now we look back and realize that these children had little exposure to sunshine. They lived in inner cities in over-crowded congested houses with narrow alleys. Prolonged winters as well as pollution from burning coal and wood further decreased sunrays from reaching the surface of Earth. Consequently, severe deficiency of vitamin D developed. Children were particularly affected as their developing bones suffered severely from the consequences of vitamin D deficiency. Moving like a shadow across the land, rickets erupted in the Northeastern U.S. as big industrial cities popped up in this country. By 1900, approximately 80% of children living in Boston suffered from rickets.

By the 1930's, the link between rickets and vitamin D deficiency was well established. This remarkable discovery led to the fortification of milk with vitamin D. In the countries which adopted this practice of vitamin D fortification, rickets was mostly eradicated.

With the elimination of rickets, medical science mostly *forgot* about vitamin D until a few decades ago when it was discovered that <u>vitamin D is really not a vitamin, but a hormone</u>.

What is a hormone? A hormone is a substance that is produced in one part of the body, enters the blood stream and exerts its effects at sites distant from the original site of its production. For example, thyroid hormone is produced in the thyroid gland. It then travels through the blood stream and exerts its actions on the heart, muscle, brain and almost

every other organ in the body.

Vitamin D: A Hormone

Vitamin D is, in fact a hormone. It is produced in the skin from 7-dehydrocholesterol (pro-vitamin D3) which is derived from cholesterol. Here is evidence that cholesterol is not all that bad, contrary to what most people think these days. The fact is that cholesterol is a precursor for most hormones in your body.

Type B Ultraviolet rays (UVB) from the sun act on pro-vitamin D3 and convert it into pre-vitamin D3, which is then converted into vitamin D3. Medically speaking, we call it cholecalciferol. Vitamin D3 then leaves the skin and gets into the blood stream where it is carried on a special protein called a vitamin D-binding protein (VDBP).

Through blood circulation, vitamin D3 reaches various organs in the body. In the liver, vitamin D3 undergoes a slight change in its chemical structure, under the influence of an enzyme called 25 hydroxylase. At that point, it is called 25-hydroxy cholecalciferol or 25-(OH)-D3 (or calcifediol). It is then carried through the blood stream on vitamin D-binding protein (VDBP) to the kidneys where it goes through another change in its chemical structure, under the influence of an enzyme called, 1-alpha hydroxylase. At that point, vitamin D is called 1,25- dihydroxy cholecalciferol or 1,25-$(OH)_2$-D3 (or calcitriol). This is the *active* form of vitamin D. It gets in the blood stream and goes to various parts of the body and exerts its actions.

In addition, 25-hydroxy cholecalciferol can convert into an *inactive* form, called 24,25-dihydroxyvitamin D_3. This action takes place through the action of an enzyme called 24 hydroxylase, located in the kidneys.

With the discovery that vitamin D is a hormone, scientists found the main effect of vitamin D was on calcium and phosphorus absorption from the intestines.

It was also realized that people with kidney failure cannot convert 25 (OH) vitamin D into 1,25-$(OH)_2$ - vitamin D. Therefore, people with chronic kidney failure on dialysis were placed on a synthetic supplements of 1,25-$(OH)_2$-D which is also called calcitriol. Drug companies saw an opportunity and started manufacturing calcitriol (brand name Rocaltrol). Soon, it became a standard of medical practice to prescribe calcitriol to every patient on chronic kidney dialysis.

In the last 20 years, our understanding about vitamin D has gone through revolutionary changes. For example, now we know that conversion of 25-(OH)-D into 1,25-$(OH)_2$-D takes

place *not* only in the kidneys, but also in a number of other tissues such as lymph nodes, skin and lungs. Now we know that vitamin D is *not* only involved in the absorption of calcium and phosphorus from the intestines, but also plays an important role in the normal functioning of *every system* in the body, such as regulation of cell growth, differentiation of cells into specialized cells and eventually cell death, regulation of immune, cardiovascular and musculoskeletal systems, and insulin metabolism.

Like other hormones, vitamin D exerts its biologic effects through a specific chemical structure inside the cell, called Vitamin D receptor (VDR), which has been found in almost every tissue in the body. VDR is present inside the nucleus of a cell. After vitamin D binds to its receptor, it can affect various genes. Breakthrough research (1) from McGill University, Canada has revealed that vitamin D can affect more than 900 genes, directly or indirectly. In this way, vitamin D regulates a vast range of physiological processes inside the cell.

Hormone D Deficiency or HDD

Scientists also discovered that vitamin D deficiency is much more prevalent than was previously thought. In fact, it has reached pandemic proportions around the world. This may partly explain the pandemics of chronic fatigue, osteoporosis, heart disease, hypertension, diabetes, cancer, asthma and other immunologic diseases. Proper vitamin D supplementation can help to prevent as well as treat most of these medical diseases. Unfortunately most physicians are *not* taking vitamin D seriously. Why? One reason is that it is mistakenly called a vitamin. And physicians are trained not to take vitamins seriously. Calling a hormone a vitamin is a serious medical mistake, which unfortunately continues in this day and age. Amazing!

It's time we correct this biggest *misnomer* in recent medical history. I am calling vitamin D deficiency as **Hormone D Deficiency or HDD**. Please join me in spreading this accurate terminology. In an attempt to educate my fellow physicians, I wrote an article in the July-August *2010* issue of *Endocrine Practice*, official journal of the American Association of Clinical Endocrinologists (2).

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1. Wang TT, Tavera-Mendoza LE, Laperriere D, Libby E, MacLeod NB, Nagai Y, Bourdeau V, Konstorum A, Lallemant B, Zhang R, Mader S, White JH. Large-scale in silico and microarray-based identification of direct 1,25-dihydroxyvitamin D3 target genes. *Mol Endocrinol*. 2005 Nov;19(11):2685-95.

Chapter **3**

Misconceptions About Vitamin D

There are a lot of misconceptions about vitamin D. Here are some common ones I've heard:

- "I drink milk, so I can't be low in vitamin D."
- "I take a multivitamin and a calcium supplement every day, so my vitamin D should be okay."
- "I eat healthy, so my vitamin D should be fine."
- "I play tennis outdoors twice a week. How can I be low in vitamin D?"
- "I don't want to take vitamin D because I read about vitamin D toxicity. It's quite scary."
- "I'm outdoors at least 15 minutes a day. My vitamin D should be fine."
- "I live in a sunny place. How can I be low in Vitamin D?"
- "But a study did not find any benefits of vitamin D."

When people make these comments, I simply advise them to have their vitamin D level checked. They're often surprised at the results. Most people turn out to be low in Vitamin D.

Contrary to common belief, milk is a poor source of vitamin D. In the USA, one cup of milk contains 100 I.U. of vitamin D. Now imagine trying to drink about 20-40 cups of milk a day to get a good level of vitamin D! The usual cup of milk added to your cereal provides you with just a *miniscule* amount of vitamin D.

People who take multivitamins and calcium supplements are under the impression they get enough vitamin D. Not true! I check vitamin D level in my patients who are on multivitamins and calcium supplements. Almost all of them turn out to be low in vitamin D. Why?

At the root of the problem is the recommended daily dose of vitamin D, which is old and

outdated. Currently, the recommended daily dose of Vitamin D is 400 - 600 I.U. (International Units). This dose of vitamin D was developed to prevent rickets, a bone disease in children.

In the last decade, scientific studies have shown that vitamin D is not only important for the health of bones, but is also vital for the health of virtually every cell in the body. However, you need a much higher dose of vitamin D than 400 - 600 I.U. a day to achieve these results.

In contrast, multivitamins and calcium supplements continue to follow the recommended daily dose. So when you read the label of a multivitamin or a calcium supplement, which claims that it meets 100% of the daily requirement for vitamin D, you obviously assume you take the right amounts of vitamin D. However, if you have your vitamin D level checked, you'll be in for a big surprise. Your vitamin D level will likely be low.

Sunshine is an excellent source of vitamin D. However, playing tennis or golf a couple of times a week is not enough. Neither is taking a walk 3 times a week or spending some weekends outdoors. I am amazed to see articles on vitamin D deficiency in newspapers and magazines which recommend that outdoor sun exposure for 15 minutes a day is enough to take care of your vitamin D requirement. How inaccurate!

For the last 13 years, I have checked vitamin D levels in all of my patients. Many of these people are active - outdoors about 30 to 60 minutes a day, playing golf or other sports two to three times a week and walking three times a week. They take multivitamins and calcium supplements containing vitamin D and yet they are still quite low in vitamin D. This is reality!

Occasionally, you may read or hear about a study that did not find any benefits of vitamin D. If you look at the study carefully, you will find that the researchers employed the recommended dose of vitamin D -400-600 IU per day- a dose which will prevent rickets and that's all. Whenever you look at a study on vitamin D, make sure that the researchers measured vitamin D levels and these levels were between 50-100 ng/ml, (which is equal to 125-250 nmol/L, units often used outside the USA.)

So why do people have these misconceptions about vitamin D? To answer this question, you have to answer another question. Where do people get their medical information? Usually from newspapers, magazines, TV and the internet. Unfortunately, many articles are written by people who have no real medical experience. Most of these professional writers simply gather information on vitamin D from previously published articles. In this way, inaccurate information in those previous articles simply gets recycled.

Chapter **4**

Natural Sources Of Vitamin D

Where do we get our vitamin D? A lot of people recognize that we get vitamin D from the sun: Vitamin D is the “sunshine” vitamin. But are we getting enough vitamin D from the sun?

Sun

The Sun is the major source of vitamin D. How much vitamin D you get from the sun varies from person to person. There are a number of factors that determine the amount of vitamin D you can get from the sun.

1. Geographic Location.

Where you live determines how much vitamin D you *can* get from the sun. The farther North you live from the equator, the less is the intensity of sun rays reaching the earth. Therefore, your skin forms less vitamin D if you live in northern climates such as the North Eastern U.S., Canada and northern European countries.

2. Season and time of the day.

Your skin *can* form more vitamin D during summer, but less during winter. This is because fewer sun rays reach the surface of Earth during winter. Similarly, the best time for the synthesis of vitamin D is between 10 am and 3 pm.

3. Sun Screens, Pollution, Shade, Glass Windows, Clothing

Sunscreens, pollution, shade, glass windows and clothing all decrease the amount of UVB rays entering your skin and therefore, reduce the normal production of vitamin D by the skin. A sunscreen with a Sun Protection Factor (SPF) of 8 or more reduces the ability of the skin to form vitamin D by more than 95%. Complete cloud cover, shade and severe pollution reduce solar UVB energy by 50%.

4. Age

Compared to a young person, the skin of an elderly person contains much less 7-dehydrocholesterol. Therefore, the skin of an elderly person typically manufactures only about 25% of vitamin D3 as compared to the skin of a young person.

5. Color of skin

The color of your skin comes from a pigment in the skin called *melanin*. The more melanin you have, the darker your skin color. Melanin serves as a natural sun screen and blocks sunrays from getting into deeper layers of skin. Therefore, darker skin is *less* efficient in synthesizing vitamin D from the sun as compared to fair skin. For example, an African American person may need 6-10 fold the time in the sun as compared to a white person in order to produce the same amount of vitamin D. However, people with darker skin are less likely to get skin cancer due to the protective effects of melanin. Nature is such an equalizer!

DIET

Diet is not a major source of vitamin D. Some food items that naturally contain small amounts of vitamin D include oily fish such as salmon, mackerel and blue fish. The amount of vitamin D in fish remains unchanged if it is baked, but decreases about 50% if fish is fried. Also, farm raised salmon has only about 25% of vitamin D compared to wild salmon.

Vitamin D is also present in small quantities in vegetables, meat and egg yolks. Natural milk does *not* contain any vitamin D, but most milk in the USA (and some other countries) is fortified with vitamin D and therefore, contains small amounts of vitamin D. Vitamin D is also added in small amounts in dairy products such as cheese and some yogurts.

Most cereals in the USA are also fortified with small amounts of vitamin D. Orange juice is also fortified with a small amount of vitamin D.

The following food items are supposed to contain the indicated amount of vitamin D:

Cod Liver Oil, 1 Tablespoon = 1360, I.U.	Swordfish, cooked, 3 ounces = 566, I.U.	Salmon, cooked (3.5 ounces) = 360, I.U.
Mackerel, cooked (3.5 ounces) = 345, I.U.	Canned Tuna (3.0 ounces) = 200, I.U.	Sardines canned in oil, drained (1.75 ounces) = 250, I.U.
Raw Shiitake	Fortified Milk, one cup (8	Yogurt, from fortified milk,

Mushrooms (10 ounces) = 76, I.U.	ounces or 240 ml) = 100, I.U.	6 ounces = 80, I.U.
Margarine, fortified,1 Tablespoon = 60, I.U.	Fortified Orange Juice, one cup (8 ounces or 240 ml) = 100, I.U.	Fortified Cereal 40-80 I.U. per serving.
Egg, 1 whole (vitamin D is found in the yolk) 20, I.U.	Liver of beef, cooked (3.5 ounces) = 15, I.U.	Swiss cheese (1 ounce) = 12, I.U.

* I.U. = International Units

A word of caution! You can't rely on the stated quantities of vitamin D on food labels. In one study (1) researchers from Boston University School of Medicine, USA, found that 62 % of the milk samples they tested, contained less than 80% of the stated amount of vitamin D on the label. In addition, no vitamin D was detected in 3 of the 14 samples of skim milk tested. The vitamin D content of fish is also highly variable.

Vitamin D3 Versus Vitamin D2

Natural vitamin D comes in two forms: vitamin D3 and vitamin D2. The proper chemical name for vitamin D3 is cholecalciferol and vitamin D2 is ergocalciferol. Vitamin D from the sun and fatty fish is vitamin D3 (cholecalciferol) and the one from vegetables is Vitamin D2 (ergocalciferol).

Over the counter vitamin supplements are mostly vitamin D3. A prescription form of vitamin D is vitamin D2 which comes in a large dose of 50,000 I.U. Recently, vitamin D3 has also become available in a high dose of 50,000 I.U.

In an excellent study (2) from Creighton University in Omaha, USA, researchers compared the blood levels of vitamin D level after administering a single dose of 50,000 IU of vitamin D2 or D3 in healthy volunteers. They concluded that vitamin D2 potency is less than one third that of vitamin D3. Certainly vitamin D3 is more physiological, as we humans synthesize Vitamin D3, and not D2, in our skin. For this reason, I primarily use vitamin D3 in my clinical practice.

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1. Holick MF, Shao Q, Liu WW, et al. The vitamin D content of fortified milk and infant

Chapter **5**

A Pandemic Of Vitamin D Deficiency

Believe it or not, we are facing a *pandemic* of vitamin D deficiency! Fifteen years ago, I started investigating vitamin D levels in my patients. To my surprise, the vast majority turned out to be low in vitamin D. My experience is in line with other researchers. For example, a study (1) from the National Institutes of Health, USA, analyzed the data on vitamin D status in the U.S. adult population from 2000-2004, which showed that 50-78% of Americans were low in vitamin D. What's alarming is that the situation is getting worse. In a study (2) from the University of Colorado, USA, researchers found that vitamin D levels in Americans were lower during the 2000-2004 period compared to the 1988-1994 period. Clearly vitamin D deficiency is rapidly getting worse.

Not only Americans, but people all around the world are suffering from vitamin D deficiency. For example, according to a publication (3) from The Medical Research Council Human Nutrition Research, United Kingdom, 90% of adults in the United Kingdom were found to be low in vitamin D. In a study (4) from Sri Venkateswara Institute of Medical Sciences, India, researchers concluded that 82% of individuals in India had varying degrees of low vitamin D levels. In a study (5) from The Chinese University of Hong Kong, researchers assessed vitamin D levels in women in Beijing and Hong Kong. Over 90% of women in both cities were low in vitamin D. In another study (6), from the University of Tokyo, Japan, investigators found that 82% of Japanese men and women were low in vitamin D. In a study (7) from Qassim University, Saudi Arabia, all participants were low in vitamin D. In a study (8) from the University of São Paulo, Brazil, 100% of men and women were found to be low in vitamin D.

Vitamin D deficiency is the true pandemic of our times. It is perhaps more common than any other medical condition at the present time.

It Spares No Age

Infants, children, adults and elderly are all low in Vitamin D. In my extensive clinical experience, it's rare to find someone who has a good level of vitamin D. In my practice, the age of patients range from 15 to 95. I find an overwhelming majority of these patients to be low in vitamin D. Several studies have clearly demonstrated that vitamin D deficiency spans across all age groups.

It Spares No Geographic Location

According to an old paradigm, vitamin D deficiency exists only in northern areas with severe prolonged winters such as Canada, the Northeastern U.S., the U.K. and other northern European countries. However, in reality, vitamin D deficiency is highly prevalent even in sunny, warm places such as the Middle East, India, Pakistan, Brazil, Mexico, New Zealand and Australia. In my own extensive clinical experience in southern California, I have found that most of my patients are low in vitamin D. Vitamin D deficiency is a global phenomenon.

If you live in northern climates, you are more prone to vitamin D deficiency because you can't get enough vitamin D during winter months. In places above 42 degrees North latitude (approximately a line drawn between the northern border of California and Boston), there isn't sufficient solar UVB (Ultra Violet B) energy to form vitamin D in the skin during winter time (from November through February). In far northern latitudes, this decrease in solar energy may last up to 6 months.

In areas below 34 degrees North latitude (approximately a line drawn between Los Angeles and Columbia, North Carolina), there's enough solar UVB energy for skin synthesis of vitamin D throughout the year. *But even in these areas, the sun can't give you vitamin D if you avoid it by using clothing, sun screen lotions or by simply staying out of it.* Therefore, you may live in a sunny place south of 34 degrees latitude, but still be low in vitamin D.

Several clinical studies have shown that vitamin D deficiency is extremely common in the sunny Middle East, primarily because the skin doesn't get enough sun exposure. Due to cultural habits, people avoid the sun and cover most of their body with clothes. This is particularly true in the case of women living in these countries.

It Spares No Race

Although fair skin is more efficient in synthesizing vitamin D from sun exposure as compared to dark skin, people with fair skin avoid the sun more than people with dark skin for fear of skin cancer. Even when they go out, they often apply a layer of sunscreen, which prevents vitamin D synthesis. In my extensive clinical experience, I've found people from various racial and ethnic groups to be low in vitamin D.

What Are The Causes For The Pandemic Of Vitamin D Deficiency?

1. Modern Life-Style

Let's take a historic look on vitamin D. It appears that humans started their journey on planet Earth in Africa where there was plenty of sunshine. These early humans covered little, if any, parts of their body. With slow migration northwards over thousands of years, the skin gradually adapted to colder northern climates by reducing the content of its natural sun screen (melanin) and consequently, skin became lighter in color. People with light skin were then able to synthesize enough vitamin D in brief exposures to sunshine.

Vitamin D deficiency is a relatively new phenomenon. Scientists first recognized it in the seventeenth century in the U.K. and other Northern European countries. Interestingly, it coincided with the period of the *Industrial Revolution* when people flocked to big industrial cities and lived in multistoried buildings with narrow, dark alleys. Pollution from coal burning factories created a thick layer of smog. These factors significantly reduced the amount of sun rays reaching Earth in these regions which already had marginal sunshine during long winter periods.

The phenomenon of the Industrial Revolution continued in the newly discovered lands of America and Canada. In addition, native Africans were enslaved and transported in ships to America over a period of months. Compare this *rapid* migration to the thousands of years it took for early Africans to migrate to Europe, allowing for their skin to adapt to less sunshine. In contrast, this recent migration was extraordinarily rapid, allowing no time for the skin to adapt to conditions of less sunshine. For this reason, African-Americans as a group are particularly low in vitamin D. In recent years, worldwide migration happens at an even faster pace. In a matter of hours, you can migrate from one region of the world to another. That's why people from various parts of Asia and Africa who migrate to the U.K and North America are particularly low in vitamin D.

Now consider another interesting phenomenon. As a result of the *Industrial Revolution*, people with fair skin were able to rapidly migrate to Southern regions with plenty of sunshine. Their skin didn't have time to adapt to these new sunny environments. Therefore, these fair skinned people started developing skin cancer from excessive sun exposure. This led to the development of sunscreen lotions and the drum beat of "avoid the sun!" Even people with dark skin started applying sunscreen lotions under the impression that "it's a healthy habit."

The main reason we're facing an epidemic of vitamin D deficiency is our modern life-style, which minimizes our exposure to the sun. Our technological revolution has dramatically changed lifestyles around the globe. Most people work indoors. They leave their homes early in the morning and return home around sunset or even after dark (especially during winter time). Even at lunch, most people drive to a restaurant or stay

inside to eat. Many people spend their lunch break in their office. Over the weekend, we watch TV or surf the internet for entertainment. Teenagers usually stay indoors hooked to a computer, smart phone or other electronic gadgets rather than going outdoors and playing real sports. While shopping, people are mostly indoors thanks to huge grocery stores and shopping malls. Many of the elderly live in assisted living facilities or nursing homes and don't get any sun exposure. Just observe yourself. How often do you, your family and friends stay indoors while carrying out usual activities of daily living?

2. Sun Phobia

Over the last 30 years or so, sun avoidance has been successfully drilled into the minds of the general public. People are simply scared of the *so-called* ill-effects of the sun including skin cancer, wrinkles and aging spots. Due to sun phobia, people avoid sun exposure at all costs. When we go outside for even a little while, we make sure to apply sun screen. Parents compulsively apply sunscreen before they allow their children to go outdoors. Many people don't realize that sunscreen also prevents vitamin D synthesis in the skin.

3. Obesity

Vitamin D is fat soluble. Therefore, it gets stored in the fat in your body. In obese individuals, there is excessive storage of vitamin D in fat. Consequently, the circulating level of vitamin D is low in these individuals. Obesity has reached epidemic proportions in the USA and the rest of the world is also catching up in this regard. The epidemic of obesity is contributing to the epidemic of vitamin D deficiency. It's interesting to note that in most cases, obesity is a product of our modern life-style as well.

In a study (9) from City University of New York, USA, researchers looked at the levels of vitamin D in 12,927 adults 18 years and older living in the USA. They found that overweight and obese individuals were 24% and 55%, respectively, less likely to have an adequate level of vitamin D compared with their normal-weight counterparts.

In one study (10) from Columbia University Medical Center, USA, researchers assessed vitamin D status in 56 obese men and women. Vitamin D was low in all individuals. It was inversely associated with BMI (Body Mass Index). In other words, the more obese you are, the lower your vitamin D level.

4. Medical Illnesses

Malabsorption:

Because vitamin D is fat soluble, vitamin D deficiency can develop in medical conditions that cause malabsorption of fat, such as surgical resection of the small intestine and stomach, chronic pancreatitis, pancreatic surgery, celiac sprue, Crohn's colitis and cystic fibrosis.

Liver and Kidney Diseases:

Vitamin D from the blood is taken up by the liver where it is transformed into 25 (OH) Vitamin D which in the kidneys is further transformed into 1,25 $(OH)_2$ Vitamin D. Therefore, vitamin D deficiency develops in chronic liver disease such as cirrhosis and in chronic kidney disease.

5. Medications

Some medications can further decrease vitamin D level. These medications include: Phenytoin (brand name Dilantin), Phenobarbital, Rifampin, Orlistat (brand names Xenical and Alli), Cholestyramine (brand names Questran, LoCholest and Prevalite) and Steroids

I often see patients who have been on these drugs for a long time, yet they're completely unaware these drugs can rob them of vitamin D. They react with disbelief when I inform them about the relationship between these medications and vitamin D deficiency. "Why didn't my other doctor tell me about it?" is their usual question. Of course, it's your doctor's responsibility to inform you about the side-effects of medicines. Unfortunately, the reality is that some do and some don't.

So educate yourself and be a partner in taking charge of your health. That's why you're reading this book. Nothing can be more rewarding for me than providing you with the information you need to help take care of your vitamin D needs in collaboration with your health care provider.

6. Current Recommendations on Vitamin D Intake are Inadequate

Many people taking vitamins assume that their vitamin D level is okay because the label on their vitamin bottle says it meets 100% of the daily requirements. This misconception is one of the major reasons for vitamin D deficiency among those people who are proactive in taking care of their health.

Vitamin manufacturers follow government guidelines for the daily recommended amounts of various vitamins and minerals. As of 2015, the recommended daily allowance of vitamin D in the USA is: 400 I.U. (International Units) from birth to age 1, then 600 I.U. from age 1 until age 70, and 800 I.U. if you are older than 70.

In various parts of the world, vitamin D dose is also expressed in microgram (mcg) in stead of I.U. Therefore, you need to convert I.U. into micrograms.

Here is the table to convert from I.U. to mcg.

400 I.U.	10 mcg.
600 I.U.	15 mcg.
800 I.U.	20 mcg.

Based on my vast clinical experience, most people need a much higher dose of vitamin D to obtain an optimal level of vitamin D. In addition, how much vitamin D a person needs is dependent on a number of factors, as you will learn in this book. Therefore, the optimal dose of vitamin D varies from person to person, and in the same person from summer to winter. Hence, the one-size-fits-all approach is not very scientific.

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Chapter **6**

Vitamin D Deficiency and Body Aches, Pains And Chronic Fatigue Syndrome

Body aches, pains and chronic fatigue are the most common complaints that doctors hear from their patients. While there are many reasons why people develop body aches, pains and fatigue, one *common and easily treatable* cause is vitamin D deficiency. Unfortunately, it often remains undiagnosed and untreated. Consequently, people continue to suffer from chronic pains and fatigue for many years.

The Link Between Vitamin D Deficiency And Body Aches, Pains and Chronic Fatigue

Vitamin D has a close relationship with another hormone known as Parathyroid Hormone (PTH) which is produced by the parathyroid glands, four tiny structures lying low in the neck behind the thyroid gland.

Under normal conditions, PTH is important in maintaining a normal level of calcium in the blood, which is important for the normal functioning of each and every cell in the body, particularly muscle cells and heart cells. PTH maintains a normal level of calcium in the blood by acting on the kidneys, bones and intestines. By acting on the kidneys, it prevents excessive loss of calcium in the urine. It also helps the kidneys convert 25 (OH) vitamin D into 1,25 $(OH)_2$ vitamin D, which then acts on the intestines and helps in the absorption of calcium and phosphorus into the blood stream. By acting on the bones, PTH dissolves their calcium and brings that calcium into the blood stream.

In people with vitamin D deficiency, the parathyroid glands start to produce more than the normal amount of PTH. Large amounts of PTH then cause excessive dissolving of calcium from the bones. Consequently, bones become weak. These people then start to experience bone aches and pains, which are diffuse and deep. People often can't describe them precisely, but say things like:

“Doc, my whole body hurts.”

“It hurts all over.”

“My body just aches. I feel like someone pulled the plug.”

But sometimes, patients can describe these pains with precision: “Doc, this pain feels deep, as if my bones are aching.”

As a result of generalized aches and pains, you also feel tired and fatigued. You may feel like taking a nap in the afternoon. Typically, you visit your family physician who puts you on pain medications and runs a bunch of expensive tests, which often turn out to be normal. You are then referred to a number of specialists who order more special diagnostic tests. Results of all these tests are often normal as well. Meanwhile, no one orders a test for vitamin D and PTH and therefore, your true diagnosis remains elusive. Some specialist may give you the diagnosis of Fibromyalgia, Chronic Pain Syndrome or Chronic Fatigue Syndrome. This simply describes your symptoms in fancy medical terminology, but obviously doesn’t get to the root of your problem.

You and your physician are perplexed. What’s really causing these pains? “It must be in your head.” Your doctor suggests an anti-anxiety/anti-depression medication. You may actually be anxious and/or depressed because of your frustration. After all, you’ve undergone extensive testing and yet no one really knows what’s wrong with you. You start thinking the worst: “Maybe it’s some cancer they haven’t diagnosed yet.” It’s understandable if you’re anxious or depressed.

By this time, you’re willing to accept any diagnosis. So you buy into any explanation your physician offers. I have heard all kinds of interesting explanations given to patients by their physicians. Here are some examples:

“Your aches and pains are due to anxiety and depression.”

“It’s just from getting old!”

“You have fibromyalgia.”

“You have Chronic Fatigue Syndrome”

“You’re suffering from frailty.”

So your physician puts you on anti-anxiety/anti-depression medications in addition to the pain killers you’re already taking. Each drug may cause some side-effects. Often you

develop new symptoms for which you're given a new medication and then you experience their side-effects. A vicious cycle sets in.

Before you know it, you're on a long list of medications and still having a lot of symptoms, including generalized aches and pains. Because these medications give temporary relief of your symptoms, you get attached to them. You start to think you can't live without them. You go from physician to physician looking for pain and anti-anxiety medications, which sooner or later, they refuse to refill. Eventually, you may be referred to a pain specialist. Now you are in for some heavy duty pain medications and sometimes, your pain specialist recommends complicated procedures aimed at treating your Chronic Pain Syndrome. These pain medications are often narcotics with potential for addiction and many other serious side-effects. Over the years, I have seen many such unfortunate messed up cases.

In medical literature, there are several studies which clearly demonstrate that patients with chronic muscles aches and pains continue to suffer simply because their physicians fail to diagnose vitamin D deficiency as the root cause of their symptoms. In one such study (1), researchers investigated vitamin D level in patients with chronic muscle aches and pains at a university-affiliated clinic in Minneapolis, Minnesota, USA. They were amazed to find out that nearly all of their patients were low in vitamin D. Many had *severe* deficiency of vitamin D. Some had been seeing doctors for years and vitamin D deficiency was not even considered as a cause of their disabling symptoms.

Perhaps now, you realize how frequently physicians miss the diagnosis of vitamin D deficiency as the root cause of chronic muscle aches and pains. Therefore, you have to be proactive in taking charge of your health. Get your vitamin D level tested and get on the proper dose of Vitamin D! (See Chapters 25 and 26 on Diagnosis and Treatment of Vitamin D Deficiency) I have many patients in my practice whose body aches and pains simply disappeared after proper replacement of vitamin D.

Secondary Hyperparathyroidism

When vitamin D deficiency goes undiagnosed and untreated, PTH level in the blood becomes elevated. In medical terms, we call it *secondary hyperparathyroidism*. Your blood calcium level is normal at this stage of your disease of chronic vitamin D deficiency. Physicians generally don't order a PTH test when your calcium level is normal. That's what they were taught in medical schools! Therefore, secondary hyperparathyroidism often remains undiagnosed.

Unfortunately, this high level of PTH comes with a price. It erodes your bones, causing

them to ache. Medically speaking, we call it *osteomalacia*. In plain language, your bones are weak, they ache and they can also easily fracture.

Therefore, if you have bone pains, muscle aches, or chronic fatigue, make sure you get a 25 (OH) vitamin D blood test and a PTH blood test, even if your ***blood calcium level is normal.***

Treatment Of Secondary Hyperparathyroidism

Secondary hyperparathyroidism is due to vitamin D deficiency. Obviously, you treat this condition with vitamin D supplementation. Surprisingly, I have seen patients whose parathyroid glands were *inappropriately* surgically removed to treat their secondary hyperparathyroidism.

In a study (2) from Helsinki University Central Hospital, Finland, researchers performed a statistical analysis of 52 published clinical trials, including 72 intervention groups and 6290 patients. They found an *inverse* relationship between vitamin D level and PTH level. In other words, the lower the vitamin D level, the higher the PTH level. They also found that PTH level decreases in a *linear* fashion during vitamin D supplementation. In other words, as vitamin D level goes up, PTH level comes down proportionately.

I have similar experience at the Jamila Diabetes and Endocrine Medical Center. Here is a case study to illustrate these points:

Case Study

A 61 year old Caucasian female consulted me for Hyperparathyroidism and Osteoporosis. Her primary care physician had put her on Actonel, without ever checking her vitamin D level. She stopped taking Actonel after she read its potential horrendous side-effects.

She had a history of breast cancer, diagnosed 5 years ago, for which she underwent breast surgery and radiation. She had seen several physicians, and none of them mentioned anything about vitamin D. After reading my book, “Power of Vitamin D,” she became aware of the benefits of vitamin D and started to take 1000 IU of Vitamin D3 per day. When she consulted me, she was having fatigue, and generalized body aches and pains. I checked her blood levels of vitamin D. PTH and Calcium, which were as follows:

25 OH Vitamin D = 32 ng/ml (Normal range: 30-100)

PTH intact = 101 pg/ml (Normal range: 14-72)

Blood Calcium = 10.3 mg/dl (Normal range: 8.6-10.4)

I diagnosed her with Secondary Hyperparathyroidism due to vitamin D deficiency. Even though vitamin D at a daily dose of 1000 IU had brought her vitamin D level at the low normal range, it was still low for her, which caused an elevation in her PTH level. Secondary Hyperparathyroidism was the main reason for her osteoporosis.

Over the next two years, I gradually increased her dose of Vitamin D to 20,000 IU per day. Her PTH level has come down into the normal range as her vitamin D level rose into high normal range.

Here are her Progress Notes:

	Baseline	**1 year**	**2 year**
25 OH Vitamin D Normal range: 30-100 ng/ml	32	48	93
PTH, intact Normal range: 14-72 pg/ml	101	78	50
Calcium Normal range: 8.6-10.4 mg/dl	10.3	10.0	10.3
Daily Dose of Vitamin D3	1000 IU	15,000 IU	20,000 IU

As you can see, her PTH and blood calcium levels have stayed in the normal range on high doses of vitamin D. She feels great. No kidney stones. No aches or pains. No bone fractures.

Her primary care physician, on his own, decided to order a parathyroid scan, which turned out to be normal. There was no tumor of the parathyroid gland.

Tertiary Hyperparathyroidism / Primary Hyperparathyroidism

If vitamin D deficiency and resulting secondary hyperparathyroidism is not properly

treated, eventually, one or more of your parathyroid glands may get enlarged from all the overwork they have to do. At this stage of chronic vitamin D deficiency, your *blood calcium level also becomes elevated*. I call this advanced stage of chronic vitamin D deficiency *tertiary hyperparathyroidism*. Tertiary means that your disease has progressed from secondary hyperparathyroidism to a more advanced stage. However, traditionally, it is called *primary hyperparathyroidism*.

Typically, a physician is trained to order a blood level of PTH in a patient with elevated calcium level in the blood. If PTH turns out to be high, the patient is diagnosed with primary hyperparathyroidism. As a knee jerk reflex, the patient is then sent for parathyroid surgery.

I have a problem with this terminology of primary hyperparathyroidism, because it implies that your PTH level became elevated for some *unknown* reason. With this mind set, physicians, even at this advanced stage of the disease, don't order a vitamin D level. This terminology of primary hyperparathyroidism comes from the era when we did not test our patients for vitamin D deficiency as we do now. Unfortunately, most physicians remain stuck in their old way of thinking.

My belief is that most cases of primary hyperparathyroidism are actually tertiary hyperparathyroidism, the result of years and years of untreated vitamin D deficiency. With early diagnosis and treatment of vitamin D deficiency, we should be able to prevent a large number of these cases of so called primary hyperparathyroidism.

Rarely, blood level of calcium and PTH are elevated despite an optimal level of vitamin D. These are the true cases of primary hyperparathyroidism. What is an optimal level of vitamin D? Please refer to Chapter on Treatment of Vitamin D Deficiency. It's interesting to note that the prevalence of primary hyperparathyroidism has increased tremendously in the last three decades. This precisely coincides with the widespread usage of sunscreen lotions and an epidemic of obesity, both of which have contributed to the epidemic of vitamin D deficiency.

Combined Primary Hyperparathyroidism And Secondary Hyperparathyroidism

Even in these true cases of primary hyperparathyroidism, there is often a component of secondary hyperparathyroidism, which is easily treatable with vitamin D. Consequently, with proper vitamin D supplementation, your PTH level comes down, although it may not get into the normal range.

In general, when you are diagnosed with Primary Hyperparathyroidism, your physician

often does not even bother to investigate your vitamin D level. Hence, your vitamin D deficiency remains undiagnosed with all of its negative consequences. Often, you are even given the advice to *stop* taking vitamin D, as your physician is afraid that vitamin D will further increase the calcium level in your blood. The reality is actually quite opposite.

In a study (3) from Warwickshire Institute for the Study of Diabetes, Endocrinology and Metabolism, University Hospitals in the UK, researchers observed forty consecutive patients with primary hyperparathyroidism and coexistent vitamin D deficiency. They found that those patients who were treated with vitamin D had a significant drop of 21% in their PTH level, compared to those who did not receive vitamin D. They followed these patients up to 54 months and found treatment with vitamin D to be safe, without any increase in the calcium level in the blood or any detrimental effects on the kidneys.

When To Consider Parathyroid Surgery

In the late stage of parathyroid disease (tertiary or primary hyperparathyroidism) due to chronic vitamin D deficiency, if your blood calcium remains elevated above 11 mg/dl even after you have achieved an optimal blood level of vitamin D (discussed in Chapter 26, on Treatment of Vitamin D Deficiency), you should consider parathyroid surgery.

Some people with elevated blood calcium level may also develop kidney stones. These patients should have parathyroid surgery. High calcium in the blood leads to high spillage of calcium in the urine and consequently, increases your risk for calcium stone formation in the kidneys. This high spillage of calcium in the urine can be easily diagnosed with a test ordered by your physician. In this test, called 24 hours urine for calcium, you collect your urine for 24 hours and take it to the laboratory for calcium testing. Contact the laboratory in advance for special instructions as well as a special bottle to collect your urine.

If you have high blood calcium, high PTH level and your 24 hours urine calcium is more than 300 mg, you are at high risk for calcium stone formations in the kidneys. You may consider parathyroid surgery even if you don’t yet have kidney stones.

Some patients with tertiary (primary) hyperparathyroidism may develop severe osteoporosis and are at risk for fracture of their bones. They should also consider parathyroid surgery.

You Need Vitamin D Replacement Even After Parathyroid Surgery

Parathyroid surgery does not treat the disease itself: vitamin D deficiency. Symptoms of vitamin D deficiency such as body aches, pains and chronic fatigue are not going to go away just by doing parathyroid surgery. Many physicians are not aware of this fact. Typically, patients undergo parathyroid surgery, but still no one orders vitamin D level. Please remember that even after parathyroid surgery, you will need proper replacement with vitamin D.

Perhaps now, you can understand why an early diagnosis and proper treatment of vitamin D deficiency can save you from a lot of misery. You can prevent body aches, pains, osteoporosis, kidney stones and parathyroid surgery.

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Chapter **7**

Vitamin D Deficiency And Osteoporosis

What Is Osteoporosis?

In simple terms, osteoporosis means “weak bones.” With weak bones, you’re at increased risk of breaking a bone even after a trivial trauma that otherwise wouldn’t cause a fracture.

Diagnosis Of Osteoporosis

The most commonly used test to diagnose osteoporosis is called Bone DXA (Dual-energy X-ray Absorptiometry). It’s like getting an X-ray and only takes about 15 minutes. The test uses X-rays, but in a very small amount. The test is usually done at the hip and lower back (lumbar spine). Sometimes, it is also done at the forearm. A much less frequently used test is called Quantitative CT scan of the spine. Exposure to X-ray radiation is much higher in this test compared to the bone DXA test. Sometimes, an ultrasound is also used to screen people for osteoporosis, but results of an ultrasound should be confirmed with a bone DXA.

All of these tests measure your bone mineral density (BMD). In reports using the bone DXA test, you get a number called T- score. This T- score is obtained by comparing your bone density to the average bone density of young people from data stored in the machine. In this way, we guess your bone density from when you were young. Scientifically speaking, this isn’t very accurate, but it’s the best we have to work since very few people have their bone densities tested at a young age. Normal T-score is above -1 SD (Standard Deviation). If your T score is between -1 and -2.5 SD, your diagnosis is osteopenia, and if this score is at -2.5 or below, your diagnosis is osteoporosis. In other words, osteopenia is a mild, early stage of weakening of bones and osteoporosis is a more advanced stage.

Who Gets Osteoporosis?

While no one is immune, the following conditions increase your risk for Osteopenia/Osteoporosis:

- Anyone with vitamin D deficiency
- People with low Calcium intake, such as those who avoid dairy products for a variety of reasons.
- Elderly men and women
- Post-menopausal women
- Men with low testosterone
- Patients on steroids
- Patients with an over-active thyroid gland
- Patients who receive too much thyroid hormone in a pill form
- Patients with Diabetes
- Patients with Rheumatoid arthritis
- Low Vitamin K2 in diet

The Relationship Between Vitamin D Deficiency and Osteoporosis

In medical literature, it's well established that vitamin D deficiency is a major cause for osteoporosis. A number of studies have clearly shown that people with osteoporosis are often low in vitamin D. In one such study (1), researchers looked at the bone mineral density (BMD), calcium intake and vitamin D level of 4958 women and 5003 men living in the USA. They found that there was a direct correlation between vitamin D level and bone mineral density (BMD): the lower the vitamin D level, the lower the bone mineral density and the higher the vitamin D level, the higher the bone mineral density.

In the same study, researchers also found that calcium intake of *more* than about 600 mg per day did not cause any increase in bone mineral density (BMD) in the majority of patients. This obviously contradicts the standard advice to take at least 1500 mg per day of calcium to keep your bones healthy. It's clear that vitamin D plays the predominant role in determining bone strength. Calcium intake of about 600 mg per day is adequate if you have

a good level of vitamin D.

In another study (2), researchers obtained vitamin D levels in 1292 menopausal women with osteopenia or osteoporosis living in France. They found that 90% of these women were low in vitamin D.

The main reason of concern regarding low bone mineral density is that if you have osteopenia or osteoporosis, it increases your risk for fracturing a bone. When you have osteoporosis, even a trivial trauma can cause a fracture.

Is there a direct correlation between the level of vitamin D and risk for fracture?

The answer is Yes. There is overwhelming evidence to show that people with low vitamin D level are at high risk of fracture. The converse is also true: people with a high vitamin D level are at low risk for fracture. One such study (3) comes from Shimane University Faculty of Medicine in Izumo, Japan. The research was carried out in 202 Japanese postmenopausal women. The researchers found that vitamin D level was directly related to BMD: the lower the vitamin D level, the lower the BMD. In addition, lower 25 (OH) vitamin D levels were significantly related to increased fracture risk.

In an interesting study (4), researchers investigated the hypothesis that low vitamin D places you at risk for a fracture of the bone, regardless of whether the trauma is trivial or heavy. The research was carried out at the Hospital for Special Surgery in New York, USA. The researchers found that 59% of all patients (men and women) with a bone fracture, after any degree of trauma, were low in vitamin D. Even more impressive was the finding that up to 80% of women who sustained a fracture after a trivial or heavy trauma were low in vitamin D.

How Does Low Vitamin D Cause Osteopenia and Osteoporosis?

Calcium and Phosphorus are important elements for bone formation. Vitamin D, in adequate amounts, is essential in the proper absorption of calcium and phosphorus from your intestines. Therefore, if you are low in vitamin D, you absorb less calcium and phosphorus from your intestines. Consequently, your bone formation is impaired.

Vitamin D has a direct positive effect on the bone-forming cells in the bone, called osteoblasts. In this way, it plays an important role in the formation of bones

In addition, people with chronic vitamin D deficiency often end up with a serious disease called secondary hyperparathyroidism (see Chapter 6 for details). In this condition,

parathyroid glands in your body start to produce a large amount of Parathyroid Hormone (PTH). This PTH excess causes an increase in bone resorption, (eating away of the old bone) which leads to a decrease in bone mineral density. Because vitamin D deficiency is a very common disorder, it stands to reason that secondary hyperparathyroidism is also more common, although it often remains undiagnosed primarily because physicians don't order a PTH blood level.

In a study from the Universidad de Oviedo Spain (5), researchers assessed vitamin D level and prevalence of secondary hyperparathyroidism in 326 people: 164 women and 162 men. They found the lower the level of vitamin D, the higher the prevalence of secondary hyperparathyroidism. The prevalence of secondary hyperparathyroidism was **33%** in people with 25 (OH) vitamin D level less than 10 ng/mL, **16%** in people with 25 (OH) vitamin D level between 10-18 ng/mL, and **12%** in people with 25 (OH) vitamin D level more than 18 ng/mL. There were **no** cases of secondary hyperparathyroidism with 25 (OH) vitamin D levels more than **40 ng/mL**.

In another study (6) from the University of California, San Diego in La Jolla, California, USA, researchers studied the association between 25 (OH) vitamin D and PTH levels, and their associations with bone mineral density (BMD), and prevalence of hip fractures in 615 community-dwelling postmenopausal women aged 50-97 years. They found that BMD had an *inverse* relationship to PTH levels and *positive* association with 25 (OH) vitamin D levels. In other words, the higher the PTH level, the lower the BMD. In addition, the lower the vitamin D level, the lower the BMD. They also found that all PTH values were normal once vitamin D level was above 48 ng/ml (120 nmol/L).

Therefore, you need your 25 (OH) vitamin D level to be more than about 50 ng/ml in order to prevent secondary hyperparathyroidism and its consequences: osteopenia and osteoporosis. Refer to Chapter 26 on Treatment of Vitamin D Deficiency for how to achieve this level of vitamin D.

Treatment of Osteopenia/Osteoporosis

Perhaps now, you understand one of the most important factors causing osteopenia/osteoporosis is vitamin D deficiency. Therefore, the first step in the treatment of osteopenia and osteoporosis is to achieve a good level of vitamin D. As discussed in Chapter 26 on Treatment of Vitamin D Deficiency, for most people, that means taking a large dose of vitamin D supplement.

Unfortunately, most physicians don't even check vitamin D level in patients with osteopenia/osteoporosis and rush to prescription drugs. Sad, but it is a fact. With this

approach, vitamin D deficiency remains undiagnosed and untreated, which can have serious health consequences. In addition, each one of the anti-osteoporosis drugs is quite expensive and can have serious side-effects, as you will learn later in this chapter. In comparison, vitamin D is cheap and extremely safe.

Over the years, I've seen many patients take expensive anti-osteoporosis drugs faithfully, but their osteoporosis gets worse. When checked, I find these patients to be quite low in vitamin D. Simply treating them with the right dose of vitamin D makes all the difference in the world.

Other researchers are also discovering what I have seen in my patients. In an excellent study (7), researchers from the University of Liège, Belgium looked at the role of vitamin D in postmenopausal women who were taking anti-osteoporosis drugs. They divided these women into two groups: those with vitamin D deficiency and those with adequate vitamin D level. The researchers found that women with adequate vitamin D level had significantly more increase in their bone mineral density (BMD) compared to women who had low vitamin D level. In addition, women with low vitamin D were at significantly high risk for fracture compared to women with adequate vitamin D level. Remember, all of these women in both groups were on anti-osteoporosis drugs. To me, it's clear that *vitamin D is the most important factor in increasing your bone mineral density (BMD) and preventing fractures.*

What Osteoporosis Really Is And How Anti-Osteoporosis Drugs Work.

Most people, including many doctors, don't quite understand what osteoporosis really is.

Let me explain to you what really goes on in the bones when someone develops osteoporosis. Bones, like every other organ in the body, are constantly going through a "death and birth cycle of tissues." **Old bone** is eaten away by specialized cells in the bone called osteoclasts. This process is called bone resorption. Then, another type of cell in the bones called osteoblasts lay down **new bone** in the space created by the resorption of the old bone. This process is called bone formation. These are slow processes and take place over a period of several months.

Bone resorption and bone formation are linked together: Bone resorption is followed by bone formation. One cannot happen without the other. They are tied together. In other words, for bone formation to take place, there has to be bone resorption. If bone resorption dwindles, so does bone formation.

Bone resorption followed by bone formation is a great example of how nature takes care of itself: how it gets rid of the old bone and replaces it with fresh, new bone.

Drugs To Treat Osteoporosis

In the last two decades, we have seen an explosion of anti-osteoporosis drugs. Why? To put it plainly, it's a *huge market with huge profits for drug companies*. It all started with Fosamax (alendronate). The majority of drugs used to treat osteoporosis act by decreasing bone resorption. Hence, these drugs are called "Anti-resorptive drugs." These "Anti-resorptive drugs." are as follows:

Anti-Resorptive Drugs to Treat Osteoporosis

Brand Name	**Generic Name**
Fosamax	Alendronate
Actonel	Risedronate
Boniva	Ibandronate
Evista	Raloxifen
Miacalcin nasal spray	calcitonin
Prolia or Xgeva	Denosumab

*Fosamax, Actonel and Boniva belong to the same family of drugs, which are called bisphosphonates. *Estrogen replacement therapy also acts on bones as an anti-resorptive drug.

These "Anti-resorptive drugs" are primarily used to treat osteoporosis in post menopausal women because there is increased bone resorption in these women. These drugs slow down the bone resorption, and therefore, can slow down bone loss. It may show as an increase in the bone mineral density (BMD) on the bone density test. You and your physician feel great about the results.

Anti-Resorptive Drugs Accumulate Old Bone And May Increase Risk For Fracture.

Let's examine what really happens when someone is on an anti-resorptive drug. By decreasing resorption of *old bone*, these drugs actually cause an accumulation of *old bone*. This gives rise to an increase in bone mineral density (BMD) on the bone density test and creates a *false sense of security*.

In fact, over the years, you may accumulate a lot of old bone and then one day, you may experience a fracture through the middle of your thigh or other unusual fracture with minimal or no trauma. You and your physician wonder what went wrong, because your bone mineral density (BMD) was showing improvement on your bone density test.

Another downside of anti-resorptive drugs is a *decrease* in bone formation as a result of diminished bone resorption. Remember bone resorption and bone formation are interlinked.

Bone formation is further reduced if you don't have adequate levels of vitamin D in your blood. In this way, you can lose most of the gain in bone mineral density (BMD) achieved through slowing down of bone resorption with the use of anti-resorptive drugs and end up with little or no improvement in your bone mineral density (BMD). If vitamin D deficiency is severe, your bone mineral density (BMD) may actually decrease despite taking anti-resorptive drugs.

Therefore, it is absolutely crucial that you have a good level of vitamin D in your blood even when you are on anti-resorptive drug such as Fosamax, Actonel or Boniva.

"Vitamin D Is Included In My Anti-Osteoporosis Drugs, So Why Should I Be Concerned About Vitamin D Deficiency?"

Anti-osteoporosis drugs are now available with added vitamin D. However, a big problem is this: The vitamin D present in calcium preparations and anti-resorptive drugs is usually 400-600 I.U. per day. On the bottle, it indicates that it meets 100% of your daily requirements for vitamin D. So you assume you're taking the correct amount of vitamin D. However, the fact is that most people on this dose are actually low in vitamin D and require a much larger dose.

Is There Any Drug That Increases Bone Formation?

There is a relatively new drug called Forteo (teriparatide) that acts by increasing bone formation. However, there are some concerns you have to keep in mind. Forteo has to be given by daily injection, is very costly and it may cause bone cancer.

Side-Effects Of Anti-Osteoporosis Drugs

Every medicine can have potential side-effect. There is a basic principle in clinical medicine: You take a drug if its potential benefit outweighs its potential side-effects.

Most people get on an anti-osteoporosis drug without being fully aware of its potential side-effects.

Here is a list of common as well as rare potential side-effects of these drugs.

Drug	Potential side-effects
Fosamax (alendronate) Actonel (risedronate) Boniva (Ibandronate) *All three of these drugs belong to the same family called Bisphosphonates.	Nausea, heartburn and stomach upset. Atypical fractures such mid-thigh fractures. Delayed healing of fractures. “Melting away of jaw bones” medically known as osteonecrosis. Increased incidence of cancer of the esophagus.
Evista	Increased risk for cancer of the uterus. Hot flashes.
Estrogen Replacement Therapy	Increased risk for breast cancer, clot formation, heart attack and stroke. These risks substantially increase with prolonged use (for more than a couple of years) and especially in women older than 60 years of age.
Miacalcin	Nasal stuffiness and congestion. Nasal bleeding.
Forteo (Teriparatide)	Dizziness or fast heartbeat. Muscle cramps and spasms or pain. Swelling, itching and bruising at the injection site. Weakness of leg. High calcium level in the blood. Risk for bone cancer.
	Increased risk for life-threatening infections such as serious skin infections, diverticulitis, other gastrointestinal tract infections, infections of ear, kidneys and urinary bladder, and endocarditis, which is infection of the lining of the heart. Allergic skin reactions, such as eczema and dermatitis. Low blood calcium, which can manifest as spasms, twitches, or cramps in muscles,

Prolia, Xgeva (denosumab)	numbness or tingling in fingers, toes, or around your mouth. Back pain, pain in arms and legs. Generalized muscle pain. Flu-like symptoms. Osteonecrosis (melting away of jaw bone), delayed healing of fractures, atypical fractures such mid-thigh fractures, Potential for increased risk for neoplasms, including those of the breast, ovary and gastrointestinal tract. Calcification of blood vessels. High cholesterol level.

In comparison to these anti-osteoporosis drugs, vitamin D in high doses is extremely safe and cheap. Vitamin D toxicity is extremely rare (see Chapter on Vitamin D Toxicity).

Vitamin D As An Anti-Osteoporosis Agent

Vitamin D plays a pivotal role in bone formation and is an ideal anti-osteoporosis agent. Vitamin D exerts a direct positive effect on the osteoblasts, cells that lay down new bone. In this way, vitamin D *optimizes* new bone formation. It does not causes an accumulation of old bone, as it does not interfere with bone resorption. It does not cause a shortened phase of bone formation either, as it does not decrease bone resorption. Remember, bone formation follows bone resorption and the two are inter-linked.

In addition, vitamin D, in adequate amounts, is essential for the proper absorption of calcium and phosphorus from your intestines, which are important ingredients for bone formation.

In summary, vitamin D, calcium and phosphorus in the correct amounts are essential for bone formation. You can prevent osteoporosis in the first place if you take the proper amount of vitamin D in your younger years. Even when you are diagnosed with osteopenia or osteoporosis, you can make a big difference in your bone health by taking a good dose of vitamin D.

How much Calcium? Please refer to Chapter 29: Vitamin D, Calcium And Magnesium.

Role Of Vitamin K2 In Preventing Fractures

Vitamin K is not only important for blood coagulation, but appears to play an important role in the health of bones. In recent years, vitamin K, especially Vitamin K2, has been found to be important for the health of bones and teeth.

Vitamin K2 helps to incorporate calcium and phosphorus into the bones via a complex mechanism: There is a special protein in the bone, termed as osteocalcin, which is involved in maintaining the strength of the bone. Normally, osteocalcin undergoes a chemical change, termed gamma-carboxylation for it to be active and carry out its function. Vitamin K2 is essential for gamma-carboxylation of osteocalcin. In this way, vitamin K2 is intimately involved in keeping our bones strong.

If you are low in vitamin K2, there is a decrease in the gamma-carboxylation of osteocalcin. In other words, there is under-carboxylation of osteocalcin. Think of under-carboxylated osteocalcin (ucOC) as an inactive (abnormal) form of osteocalcin. When you are low in vitamin K2, blood level of under-carboxylated osteocalcin (ucOC) rises. Therefore, the blood level of under-carboxylated osteocalcin (ucOC) has been considered a sensitive marker of vitamin K2 status in the bone. A high level of under-carboxylated osteocalcin (ucOC) indicates vitamin K2 deficiency and is found to be associated with weak bones and a greater risk of fracture.

Can Vitamin K2 Supplementation Prevent Fractures?

Is there clinical evidence to show that vitamin K supplementation can reduce the risk of fracture in individuals suffering from osteoporosis? The answer is yes!

In a study (8) from the Research Institute and Practice for Involutional Diseases, Japan, researchers recruited a total of 241 patients with osteoporosis. Fifty percent of these patients received placebo and fifty percent of patients received vitamin K2. These patients were followed for 2 years. The incidence of clinical *fractures* during the 2 years of treatment in the placebo group was *higher* than the vitamin K2-treated group. The blood levels of under-carboxylated osteocalcin (ucOC) at the end of the 2 years in the placebo and the treated group were 3.0 ng/ml and 1.6 ng/ml, respectively. In addition, the blood level of normal osteocalcin showed a significant rise - 42% from the basal value - in the treated group at 2 years, compared to 18% for the placebo group. There was no significant change in the bone density at the lumbar spine. The researchers concluded that their findings suggest that vitamin K2 treatment effectively prevents the occurrence of new fractures, although the vitamin K2-treated group did not show any increase in lumbar bone density. Furthermore, vitamin K2 treatment enhances gamma-carboxylation of osteocalcin.

In an analytical study (9) from Hangzhou Xiasha Hospital, China, researchers analyzed the data from nineteen randomized controlled trials. There were a total of 6759 participants. Researchers found that postmenopausal women with osteoporosis who took vitamin K2 had a significant improvement of bone density at the lumbar spine. In addition, vitamin K2 significantly decreased the incidence of vertebral fractures. The level of undercarboxylated osteocalcin ((ucOC)) came down and the level of normal osteocalcin increased in women who took vitamin K2.

In conclusion, there is a mounting clinical evidence to clearly show the beneficial effects of vitamin K in preventing fractures in postmenopausal women with osteoporosis. Vitamin K exerts its beneficial effect on the bone through osteocalcin, a protein in the bone that seems to play an important role in the process of *mineralization* of the bone. Calcium and Phosphorus are important ingredient for the mineralization of the bone. That is where vitamin D is crucial. Vitamin D increases absorption of Calcium and Phosphorus from the intestines. In this way, Vitamin D and Vitamin K appear to act in concert in keeping our bones strong.

Effects Of Combination Therapy With Vitamin K2 And Vitamin D On The Bone

Both vitamin K2 and vitamin D exert beneficial effects of the strength of bone. It makes sense to combine vitamin K2 and vitamin D to keep our bone healthy, in particular, to prevent as well as treat osteoporosis. An interesting study (10) from Erciyes University, Turkey investigated the role of combination therapy with vitamin K2 and vitamin D on the bones of children with Thalassemia major, who frequently suffer from weakening of the bones. The researchers enrolled twenty children (12 girls, 8 boys; age varied from 3 to 18) with thalassemia major, who underwent regular blood transfusion and iron chelation therapy. These children received dietary supplement with vitamin K2 (50 mcg of MK7) and vitamin D (5 mcg calcitriol). Their bone mineral density was evaluated at the baseline, sixth, and 12th month of treatment. The researchers found a significant improvement in the bone mineral density at the lumbar spine of these children at the sixth and 12th month of treatment.

Natural Sources Of Vitamin K

Vitamin K naturally exists in 2 forms, namely phylloquinone (K1) and a group called vitamin K2, also called menaquinones or MK, with several sub-types. MK4 and MK7 have been clinically studied the most.

K1 is widely distributed in green and leafy vegetables such as spinach, lettuce, broccoli, kale, watercress and chard.

Vitamin K2 is mostly present in the following foods: grass-fed butter (MK4), eggs (MK4), yogurt (MK7), fermented cheese (MK7), fermented soy, called natto (MK7), kimchi (MK7) and sauerkraut (MK7).

How Much Vitamin K2 Supplement?

Vitamin K2 as Menaquinone-4 (MK-4) has been used in Japan for the treatment of osteoporosis, at a daily dose of 45 mg. However, in a recent study (11), researchers from Japan used a low-dose of MK-4 supplementation as 1.5 mg per day for 6-12 months in postmenopausal women, and showed there was an improvement in bone health. In another recent study (12), researchers from the Netherlands used a low dose of MK-7 as 0.18 mg. per day in postmenopausal women for 3 years. MK-7 at this small dose prevented age-related decline in bone mineral density.

Please refer to Chapter 30 :Vitamin D And Vitamin K2, for detailed information on this important vitamin.

My Approach To The Treatment Of Osteopenia/Osteoporosis

When I see a patient with osteopenia/osteoporosis, first of all I check their vitamin D level, which often turns out to be low. I also evaluate these patients for other causes of osteopenia/osteoporosis, as outlined in the beginning of this chapter.

I put these patients on a good dose of vitamin D which is usually in a range of 5,000-15,000 units of vitamin D3 per day. Details for determining the proper dose of vitamin D are discussed in Chapter 26: Treatment of Vitamin D Deficiency. I also recommend vitamin K2 supplementation, as enough clinical data exists that has convinced me about its beneficial role in maintaining bone health in post-menopausal women.

In my patients, I monitor mineral bone density (BMD) every two years. In most patients, vitamin D in large doses alone is sufficient to improve bone mineral density (BMD) or at least keep BMD from getting worse.

Rarely, a patient may have a good vitamin D level yet continue to have low bone density as estimated by the T-score on a bone DXA test. Then, I may consider adding an anti-osteoporosis drug. However, before I add any anti-osteoporosis drug, I discuss efficacy and potential side-effects of each of these medications and let my patient decide which potential side-effects they are willing to gamble on. In this way, my patients make an educated, well-informed decision when they choose to take an anti-osteoporosis drug.

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Chapter **8**

Vitamin D Deficiency And Steroid Use

Physicians often prescribe oral steroids to treat a number of chronic diseases such as asthma, arthritis and ulcerative colitis, to name just a few. Many patients receive epidural shots of steroids for chronic low back pain.

Most people, including many physicians, don't realize the devastating effects of steroids on vitamin D level in the body. *Steroids pretty much eat away your vitamin D*. Most people are low in vitamin D to start with. Steroid use further lowers their vitamin D level. These patients then suffer the consequences of vitamin D deficiency and develop severe muscle weakness and osteoporosis.

In addition, steroids directly affect the muscles and bones, worsening muscle weakness and osteoporosis. Muscle weakness primarily affects the muscles around the hips and thighs, causing difficulty in standing and walking. Consequently, these patients can easily fall. With their bones already weakened due to steroid-induced osteoporosis, they easily break their hip or vertebra in the back. A hip fracture further impairs mobility and a fracture of the vertebra causes incapacitating back pain.

Steroids Antagonize The Effects of Vitamin D

Steroids (even inhaled steroids) antagonize the effects of vitamin D. For example, in **bone**, vitamin D enhances bone formation by stimulating specialized cells, (osteoblasts), increasing calcium absorption from the intestines and preventing secondary hyperparathyroidism. Steroids do exactly the opposite: they have an inhibitory effect on osteoblasts, decrease calcium absorption from the intestines, increase calcium wasting from the kidneys and cause secondary hyperparathyroidism. In this way, steroids cause rapid bone loss (osteoporosis).

In addition to bone, some of the other opposing effects of vitamin D and steroids are as follows:

- Vitamin D boosts up the immune system whereas steroids suppress the immune system.
- Vitamin D reduces blood pressure whereas steroids increase blood pressure.
- Vitamin D reduces insulin resistance whereas steroids increase insulin resistance.
- Vitamin D builds up muscles whereas steroids cause myopathy, (muscle weakness.)

It is pretty obvious that steroids antagonize the effects of vitamin D.

What Is The Mechanism?

One known mechanism is that steroids alter the vitamin D receptor. Steroids also cause an increase in obesity and consequently, decrease the available circulating vitamin D. That's why there are such widespread clinical findings of vitamin D deficiency in people taking steroids.

Could there be other mechanisms? Probably yes and we will learn about them as more and more researchers devote their efforts to this non-profit, non-glamorous field of medicine. However, from a clinical standpoint, the message is very clear. Steroids rob you of the beneficial effects of vitamin D. It has been shown that in a brief duration of 5 days, steroid use causes an elevation in parathyroid hormone level and an increase in calcium wasting in the urine.

Therefore, I recommend my patients to double or even triple their dose of vitamin D while they take steroids, provided they don't have any history of kidney stones. No drug available today effectively treats steroid-induced osteoporosis. Here is one situation where prevention is your best treatment. Your best defense is a good dose of vitamin D. Unfortunately, many physicians don't check vitamin D level, but immediately prescribe an anti-osteoporosis drug, such as Fosamax (alendronate), Actonel (Risedronate), Boniva (Ibandronate), or Prolia ((denosumab)), which doesn't work effectively in steroid-induced osteoporosis. Beware! Next time someone puts you on a steroid, you must increase your daily dose of vitamin D. You'll save your bones and avoid a lot of misery in the years to come.

Chapter **9**

Vitamin D Deficiency And Infections

Normally, we are equipped with our immune system to fight off infections. But why do we continue to suffer from recurrent, prolonged infections, often requiring antibiotics and antiviral drugs? What has gone wrong with our immune system?

Let's first take a look at what is the immune system. Metaphorically speaking, the Immune System is the "police" of the body. The function of the Immune System is to recognize and eliminate any bad elements such as viruses or bacteria, which can cause damage to the body.

The Immune System consists of a variety of cells with each category of cells having a unique function assigned to it. For example, some cells are specialized to fight off acute infections such as the common cold, flu and pneumonia while another type of cell deals with chronic infections such as valley fever, AIDS and tuberculosis. Some cells are even specialized to kill cancer cells. Think of cancer cells as renegade cells which have acquired special, albeit abnormal characteristics. These cancer cells feed their own kind by fast replication, meanwhile starving and damaging the rest of the body by depleting the body's resources. A healthy Immune System recognizes the danger of cancer cells and moves to destroy them.

Perhaps now, you understand what an important role your immune system plays in keeping you healthy. If you have a weak immune system, you're at risk for all sorts of infections as well as cancers.

What Are The Factors That Weaken Our Immune System?

There are four factors that weaken our immune system.

- Vitamin D deficiency
- Stress: physical as well as emotional

- Some medications which suppress the immune system such as steroids, interferon and other drugs to treat autoimmune disorders, hepatitis C and various types of cancer

- Poor Nutrition

Vitamin D Deficiency

Modern research has clearly established that vitamin D plays a vital role in the *normal* functioning of the Immune System. In response to an invading pathogen such as a virus or a bacterium, vitamin D helps immune cells to produce a number of antimicrobial chemicals, in particular a chemical called cathelicidin antimicrobial peptide (*camp*), which works like an antibiotic, but without the side-effects associated with antibiotics.

Common Colds, Flu

Vitamin D is crucial to boost up your own immune system to fight off viruses that cause the common cold. Several studies have shown that individuals low in vitamin D are at increased risk for common colds. An excellent study (1) from Massachusetts General Hospital in Boston, USA found a clear link between vitamin D deficiency and common colds.

Another excellent study (2) comes from The Hospital for Sick Children in Toronto, Canada. Researchers followed children and adolescents, 3-15 years, who developed a common cold, confirmed with viral culture. They made the amazing discovery that low vitamin D (less than 30 ng/mL) increased the risk of common cold by 50%.

Vitamin D supplement can help prevent and fight off even the most severe form of flu, such as Swine flu (H1N1 flu) that broke out in the summer of 2009. There are several anecdotal reports from physicians who noted the occurrence of *Swine Flu* was rare in people taking vitamin D supplements compared to those who did not. In my own clinical practice, only one patient had *Swine Flu* in the fall of 2009 despite the fact that *Swine Flu* was widespread in our community.

In my practice, patients repeatedly comment that they *rarely* catch cold now that they are on vitamin D supplement. I tell my patients to triple the dose of vitamin D supplement for 3 days if they develop cold/flu. It significantly shortens the duration of cold/flu symptoms.

In addition, I recommend the following steps to treat colds/flu: Take plenty of rest, drink plenty of liquids, eat fresh fruits, take Zinc and vitamin C throat lozenges, clean your nasal passages and throat frequently with warm water and inhale steam at least three times a day.

Avoid over-the-counter cold remedies. Why? These remedies primarily consist of a **nasal decongestant**, an **antihistamine**, a **cough suppressant** and a **pain reliever**. Each one of these ingredients can cause severe side-effects. For example, a nasal decongestant can raise blood pressure, cause rapid heart beat and may even cause a heart attack. Most antihistamines often cause drowsiness and its serious consequences, such as a car accident. They can also cause acute retention of urine and an acute episode of glaucoma. There is some recent evidence to incriminate them in causing Alzheimer's dementia.

Cough suppressants really do not work except for brief periods. Pain relievers such as Acetaminophen (Tylenol in the USA) can cause liver damage. Other pain relievers, such as Ibuprofen, Naprosyn and Naproxen, can cause stomach upset and rarely, bleeding from the stomach and acute renal shut down in patients with diabetes and any cardiovascular disease or chronic renal disease.

In addition, here is the biggest problem: **These treatments often prolong the illness**, leading to prolonged use of these medications which culminates in the unnecessary prescription of antibiotics, which have their own potential serious side-effects.

How Do These Drugs Prolong The Illness?

You need to understand how your body responds to an attack by an army of viruses: The affected areas, such as the nose, sinuses and throat, get inflamed, which enhances blood circulation to these areas, bringing in an army of your Immune cells to fight off the invading viruses. As a result, there is an increased production of secretions in the nose and throat area. In addition to killing off viruses, the body also flushes away the invading viruses in these secretions.

Now, consider how a nasal decongestant works: These drugs reduce the blood flow to the nose and throat area. How does an antihistamine work? By drying up the secretions in the nose, sinuses and throat area. Isn't it obvious that these treatments work against your immune system and help to prolong your illness?

Another problem: For your immune system to effectively fight off viruses, it needs full support from your entire body. In order to conserve energy, the body must rest and provide as much energy to the immune system as it needs. That's why there is sneezing, watery eyes, body aches and pains, exhaustion, fever and headaches. All of these symptoms try to force you to take rest. However, you decide to take cold-flu medicines that temporarily control your symptoms and you continue with your work and other activities instead of resting. Once the effect of theses medicines wears off, you feel worse. Then, you take the next dose and the vicious cycle continues.

Tuberculosis

Patients with tuberculosis are particularly low in vitamin D. Typically, tuberculosis affects individuals who are poor and live in crowded dwellings in inner cities coated with pollution. Poverty leads to malnutrition and lack of sun exposure leads to vitamin D deficiency. In particular, children living under these socioeconomic conditions often become victims of tuberculosis.

A study (3) published in 2008 in the *Pediatrics Infectious Disease Journal,* in which researchers from a tuberculosis clinic in the UK, found that vitamin D was low in all but one child. In other studies, researchers have found vitamin D supplements to be a helpful adjunct in the treatment of tuberculosis, especially in those cases resistant to the usual drug treatment.

Life-threatening Bacterial Infections (Sepsis)

Serious bacterial infections can spread to the blood and then, to various organs. This is called sepsis, which happens despite the use of strong antibiotics. Sepsis can lead to failure of organs such as lung failure, heart failure, kidney failure, liver failure and coma. Sepsis constitutes one of main reasons for admissions to Intensive Care Unit (ICU) and it carries a high mortality.

Does vitamin D deficiency play a role in sepsis? The answer is yes. When you are low in vitamin D, your immune system does *not* work optimally to fight off bacterial infection. In an excellent study (4), researchers from the University of Colorado, USA, enrolled eighty-one patients presenting in the emergency department. Among them, 53% had severe sepsis. Researchers made the startling discovery that patients with low vitamin D (less than 30 ng/mL) had more than a 2-fold increased risk of severe sepsis, compared to those who had a vitamin D level more than 30 ng/mL. In addition, all four patients who died had vitamin D levels less than 30 ng/mL.

Another excellent study (5) comes from two world-renowned teaching hospitals of the Harvard University in Boston, USA. In this study there were three thousand three hundred eighty-six patients, 18 years old or older, in whom 25-hydroxyvitamin D was measured prior to hospitalization between 1998 and 2011. These patients were admitted to two hundred nine medical and surgical intensive care beds. The researchers concluded that vitamin D deficiency prior to hospital admission is a significant predictor of sepsis. Additionally, patients with sepsis who are low in vitamin D have an increased risk of mortality despite their treatment in a critical care unit.

Urinary Tract Infections (UTI)

Urinary Tract infections is a common problem. Is there a relationship between vitamin D deficiency and urinary tract infections? The answer is yes. In an excellent study (6) from Adiyaman University, Turkey, researchers enrolled 82 children experiencing a first episode of urinary tract infection, with no underlying risk factors, and 64 healthy control children. They found that the blood levels of vitamin D among children with urinary tract infection were significantly lower than those of the healthy children.

Not only in children, but vitamin D deficiency appears to predispose adult females to recurrent urinary tract infections. In a recent study (7) from Bar-Ilan University, Israel, researchers found that vitamin D deficiency was associated with a 4-fold increase in the risk of recurrent urinary tract infections.

Hepatitis C infection

Hepatitis C infection affects your liver. You may end up with cirrhosis of liver or even cancer of liver. Modern day treatment does not eradicate hepatitis C virus in a significant percentage of patients. Can vitamin D be a helpful adjunct in the treatment of hepatitis C? A study (8) from Assiut University, Egypt. investigated this question. These researchers found that vitamin D levels were low in patients with hepatitis C infection, as compared to healthy controls. Adding vitamin D supplement to the conventional hepatitis C treatment significantly improved the response rate. In addition, vitamin D supplementation decreased the risk of bone fractures.

C. diff (Clostridium difficile) Infection

C. diff infection is becoming increasingly common. You typically develop it after you have received a course of antibiotics, usually in a hospital setting. However, you can develop it even without the history of antibiotic use or admission to a hospital. Symptoms typically include diarrhea, blood and mucus in the stools, and malnutrition if infection becomes chronic. Some patients experience life-threatening complications such as perforation of the intestines and sepsis. Does vitamin D deficiency play a role in C. diff infection? In a recent study (9), researchers from Akron General Medical Center, Akron, USA, found that the patients with vitamin D deficiency had longer duration of diarrhea and higher risk of sepsis due to C. diff, as compared to those patients who did not have vitamin D deficiency.

Another excellent study (10) comes from Massachusetts General Hospital, Boston, USA. These researchers found that the low level of vitamin D was associated with an increased risk of C. diff infection.

It is pretty clear to me that a good level of vitamin D can help you prevent serious bacterial infections. Even if you develop a bacterial infection/sepsis, vitamin D can help you

recover from it. Unfortunately, when you are in the hospital, no one pays attention to your vitamin D needs. Often, you end up not taking any vitamin D during your hospital stay, the time when you need it the most. How ironic!

Therefore, next time you are in the hospital, ask your physician to allow you to continue the vitamin D supplement that you have been taking at home. The only exception to this rule is if you have high calcium in the blood. Share this information with your physician. I actually triple the dose of vitamin D in my patients when they develop an infection, because that's when they need it the most.

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Chapter **10**

Vitamin D Deficiency And Autoimmune Diseases

Sometimes the Immune System itself goes haywire, seemingly becoming *paranoid* and mounting pre-emptive strikes against normal cells of the body, reacting as if they were dangerous and needed elimination. This is the basis of "autoimmune disorders." For example, if your Immune System kills off your insulin producing cells (beta cells) in your pancreas, you develop Type 1 diabetes. If the target of the attack is your respiratory system, you develop asthma. If the target is nerve tissue, you develop Multiple Sclerosis (MS). If the target is the thyroid gland, you develop either Hashimoto's thyroiditis or Graves' disease. If the target is the intestines, you develop Crohn's disease or Ulcerative colitis. If the target is joints, you develop Rheumatoid arthritis or Systemic Lupus Erythematosus (SLE). Perhaps now, you can appreciate how important it is to keep your Immune System normal in order to enjoy true health!

Modern research has clearly established that vitamin D plays a vital role in the *normal* functioning of the Immune System. In response to an invading pathogen such as a virus or a bacterium, vitamin D helps immune cells to produce a number of antimicrobial chemicals, in particular a chemical called cathelicidin antimicrobial peptide (*camp*), which works like an antibiotic, but without the side-effects associated with antibiotics.

On the other hand, when immune cells are inappropriately *alarmed* and become *overactive* and kill your own tissues, as happens in autoimmune diseases, vitamin D calms these overactive immune cells.

When it comes to cancer, vitamin D works through several mechanisms including your immune cells. I elaborate on this subject in Chapter 11, Vitamin D Deficiency and Cancer.

These are breakthrough discoveries! So far, traditional medicine has *ignored* the immune system's natural capacity in the treatment of infections, autoimmune diseases and cancers. For infections, all it can offer is antibiotics, which often have serious side-effects. For cancers, all it can offer is chemotherapy, radiation and surgery; each modality comes with an array of horrendous side-effects and complications. For autoimmune disorders, all it

can offer is drugs that blindly suppress the immune system. Each one of these immune-suppressing drugs has a long list of side-effects and complications. Hopefully, modern medicine will embrace the new amazing discoveries about the role of vitamin D as a natural antibiotic, a natural anti-cancer and a natural immune modulator. And this could *revolutionize* the practice of medicine.

Asthma

There is strong link between vitamin D deficiency and asthma. In the USA, the prevalence of asthma has increased dramatically from about 3 % in the 1970's to about 8% in recent years. Experts in the field of asthma speculate the epidemic of asthma to be linked to the epidemic of vitamin D deficiency, as both of these epidemics started in the last few decades.

The northeast tops the USA in the prevalence of asthma. In this region during winter, there is inadequate UVB from the sun for the synthesis of vitamin D. Therefore, scientists wondered whether vitamin D deficiency could be responsible for the development of asthma and whether vitamin D supplementation could be helpful in the prevention and treatment of asthma.

In a study (1) from Brigham and Women's Hospital, Boston, USA, researchers measured vitamin D level in 1024 children with mild-to-moderate persistent asthma and followed these children over a 4-year period for severe attacks of asthma, requiring a visit to the emergency department or admission to the hospital. They found a clear association between low level of vitamin D and severe attacks of asthma.

Not only children, but adults with asthma are also at increased risk for severe attacks if they are low in vitamin D. In a study (2) from the University of New Mexico, Albuquerque, USA, the researchers analyzed vitamin D levels in 92 adults with asthma treated at their hospital over a span of five years. They found the risk of severe asthma attack was reduced by 59% if your level of vitamin D was above 30 ng/ml. This is an amazing finding. If some drug showed this type of result, it would become the standard of treatment. Sadly, physicians continue to ignore the health benefits of vitamin D in treating asthma patients.

An upper respiratory tract infection often triggers an attack of asthma. Children and adults low in vitamin D are at an increased risk for upper respiratory tract infections. Therefore, vitamin D supplement may *prevent* an attack of asthma by preventing upper respiratory infections. In addition, vitamin D reduces inflammation in the bronchial tree. In this way, it may be helpful in treating the asthma attack as well.

Physicians often use steroids to treat severe asthma, but sometimes patients are resistant to steroids. This is known as steroid-resistant asthma. Vitamin D has been shown to make steroid treatment more effective in these individuals. In a recent study (3) from L.M. College of Pharmacy, India, researchers showed vitamin D improves steroid efficacy and attenuates its side-effects in an animal model of asthma.

Sound medical research has shown that vitamin D plays a significant role in the development of the Immune System and lungs during fetal growth. Studies (4) have shown that vitamin D supplementation during pregnancy can substantially reduce the risk of asthma in a child.

In summary, vitamin D deficiency increases the risk of the development of asthma as well as its exacerbations. A good vitamin D level can prevent an attack of asthma. In addition, a good vitamin D level is helpful in treating the asthma attacks.

Fibromyalgia, Rheumatoid Arthritis, Osteoarthritis, Psoriatic Arthritis, Systemic Lupus Erythematosus (SLE)

Vitamin D deficiency is extremely common in patients with fibromyalgia, rheumatoid arthritis, osteoarthritis, psoriatic arthritis, lupus (SLE) and various other rheumatologic diseases. This is an area of intense research.

A number of studies have shown vitamin D level to be low in patients with fibromyalgia. Can vitamin D supplementation improve fibromyalgia? A well designed study (5) from the Clinical Research Center, Saudi Arabia enrolled 100 women with fibromyalgia. Sixty one women were found to have markedly low vitamin D level (less than 20 ng/ml). These women received vitamin D as 50,000 IU once weekly until their blood level of 25-OH vitamin D exceeded 50 ng/mL. Forty two (69%) of these women showed a marked improvement in their fibromyalgia once their vitamin D level rose above 50 ng/mL.

This finding is in line with my clinical observation at the Jamila Diabetes and Endocrine Medical Center. You need high doses of vitamin D to show an impact on autoimmune disease. I aim for 25-OH vitamin D to be close to 100 ng/ml in my patients with autoimmune disorders. Some studies in literature that do not show an improvement with vitamin D supplementation use miniscule doses of vitamin D.

Several studies link a low level of vitamin D to various types of arthritis. In 2015, a study (6) from Sestre Milosrdnice Clinical Hospital Centre, Zagreb, Croatia found low vitamin D (less than 30 ng/ml) in 94% of patients with rheumatoid arthritis, 97% of patients with osteoarthritis and 74% of patients with psoriatic arthritis.

A study (7) from the University of Iowa, USA, showed that vitamin D intake was inversely associated with risk of rheumatoid arthritis. People with a higher intake of vitamin D were at low risk for the development of rheumatoid arthritis.

Patients with rheumatoid arthritis also suffer from muscle aches and pains (fibromyalgia). Could it be related to low vitamin D? In 2014, a well designed study (8) from Cairo University, Egypt, found that rheumatoid patients with fibromyalgia had lower vitamin D levels compared to those rheumatoid patients who did not have fibromyalgia. Vitamin D level also correlated with the quality of life in rheumatoid patients.

Several studies also indicate low vitamin D plays a role in patients with SLE (Systemic Lupus Erythematosus). In one study (9), researchers from the University of Western Ontario, Canada found that over 50% of their SLE patients were very low in vitamin D. They also made an interesting observation: hydroxychloroquine, a commonly used drug for rheumatologic disorders, interfered with the conversion of vitamin D to its active form. Therefore, if you take hydroxychloroquine, you may require much higher doses of vitamin D supplement to compensate for the inhibitory action of hydroxychloroquine on vitamin D conversion.

In another study (10) researchers from Medical University of South Carolina, Charleston, USA, found 67% of their SLE patients to be very low in vitamin D, and there was a trend for all patients to be low in vitamin D.

Multiple Sclerosis (M.S.)

Multiple sclerosis is a chronic debilitating disease that affects the brain, spinal cord and the nerves. It usually starts in young adulthood and practically robs a person's quality of life. There are recurring episodes of neurologic dysfunction which can result in partial or complete loss of function of an organ. Usual symptoms are loss of vision, difficulty in speech, lack of balance, tremors, loss of bladder control, vomiting, and sometimes, paralysis of an arm or leg.

While the exact cause of M.S. remains unknown, genetics, geographic location and immune dysfunction play a significant role in causing and perpetuating M.S.; Researchers have known for a long time that M.S. is primarily is a disease of northern Europe, the northern U.S. and Canada. It is rare in Africa and Asia. Even in the USA, its prevalence in the south is 50% less than in the north. In order to find the exact cause of M.S., most researchers have focused on finding an environmental factor, such as a virus. However, all that research has failed miserably.

Some researchers, on the other hand, looked at the obvious: M.S. occurs more frequently in northern areas with less sunshine. They speculated on the role of vitamin D deficiency in causing M.S. This quest finally led to the landmark experimental studies (11, 12) in which vitamin D supplementation completely prevented M.S. in animal models. Vitamin D therapy also prevented the progression of M.S. in these experimental animals. These miraculous findings led researchers to believe that vitamin D is a natural inhibitor of M.S.

In 2015, a tantalizing study (13) came from Thomas Jefferson University, Philadelphia, USA. This study sheds light on the mechanisms how vitamin D may prevent as well as treat M.S. These researchers showed that vitamin D significantly increases proliferation of the "mother brain cells" called Neural Stem Cells and enhances their differentiation into neurons and the myelinating cells in the brain and spinal cord.

Based on these findings, researchers in the field of M.S. now recommend that vitamin D supplementation be an integral part of treatment of individuals with M.S. In addition, those who are genetically at a high risk for developing M.S. should be supplemented with vitamin D.

In these patients, a good level of vitamin D (a level between 50-100 ng/ml or 125-250 nmol/L) should be targeted. How to achieve this level is discussed in Chapter 26: Treatment of Vitamin D Deficiency.

Autoimmune Diabetes Mellitus (Type 1 Diabetes)

Type 1 diabetes mellitus (DM Type 1) usually affects younger individuals, often children. Rarely, it can affect older persons.

DM Type 1 is an autoimmune disease. In simple terms, your immune system starts malfunctioning. It misidentifies your own insulin producing cells in the pancreas as foreign and starts destroying them. It mounts an ongoing attack on your insulin producing cells until it eventually kills them all. Consequently, you can't produce any more insulin, your blood glucose escalates and you're diagnosed with diabetes.

Vitamin D Level In Type 1 DM Patients

I test vitamin D level in all of my patients with DM Type 1. I find it to be low in virtually all of them. My experience is in line with other researchers in this field. In a study, (14) researchers from the Joslin Diabetes Center, Boston, USA, noted that the vast majority of their Type 1 diabetic patients were low in vitamin D. The study was done in children and

teenagers.

Can Vitamin D Deficiency Cause Type 1 Diabetes Mellitus? Can It Be Prevented With Vitamin D Supplementation?

True researchers (the ones NOT working for drug companies) were intrigued with the possibility that vitamin D deficiency could be causing DM Type 1 by interfering with the normal functioning of the immune system. Indeed, this turns out to be the case. Ground breaking research (15) from Finland showed a clear relationship between vitamin D deficiency and risk for developing Type 1 diabetes. It also showed Type 1 diabetes can be prevented by adequate vitamin D supplementation

This study (15) began in 1966 when a total of 10,821 children born in 1966 in northern Finland were enrolled in the study. Frequency of vitamin D supplementation was recorded during the first year of life. At that time, the recommended dose of vitamin D for infants in Finland was 2000 I.U. per day. These children were then followed for 31 years for the development of Type 1 diabetes. Researchers made the amazing discovery that those children who received the daily recommended dose of 2000 I.U. of Vitamin D during the first year of their life had an almost **80%** reduction in the risk for the development of Type 1 diabetes compared to those children who received less vitamin D.

This is an astounding study! If some drug achieved this kind of results, it would hit the headlines and become the standard of care at once. Sadly, even many diabetes experts are not aware of this great study.

Investigators in the USA continue to spend millions of dollars in their pursuit of a “drug” to prevent Type 1 diabetes. So far, this kind of research has produced disappointing results. Amazingly, they have largely ignored the strong evidence that shows the outstanding role of vitamin D in preventing Type 1 diabetes. Vitamin D is not a drug. There is no glory or huge profits in simply telling people to take enough vitamin D.

It is interesting to note that the recommended allowance of vitamin D for infants in Finland was reduced from 2000 I.U. to 1000 I.U. per day in 1975 and then further reduced to 400 I.U. per day in 1992. For comparison, in the USA it has been 200 I.U. a day and recently it has been raised to 400 I.U. a day. This reduction in the daily allowance had no scientific basis except the observation that this amount of vitamin D is present in a teaspoonful of cod-liver oil which has long been considered safe and effective in preventing rickets.

In the last decades, the incidence of Type 1 diabetes in Finland has been climbing, which is most likely related to the decrease in the daily recommended allowance of vitamin

D. As of 1999, Finland has the highest reported incidence of Type 1 diabetes in the world (16). In Finland, the yearly sunshine (and therefore vitamin D skin synthesis) is much lower compared to more southern areas. Therefore, the population in Finland is at even higher risk for vitamin D deficiency.

In another excellent study (17), researchers found vitamin D supplementation during infancy can significantly reduce the risk for developing Type 1 diabetes. This study was carried out in seven centers in different countries across a variety of populations in Europe.

Autoimmune Thyroid Diseases

Autoimmune thyroid disease has a wide range of manifestations: It is the most common cause of underactive thyroid (technically known as hypothyroidism). In some individuals, it can cause overactive thyroid (technically known as hyperthyroidism). When autoimmune thyroid disease causes underactive thyroid, it is called Hashimoto's thyroiditis and when it causes overactive thyroid, it is called Graves' disease.

The usual symptoms of underactive thyroid are fatigue, weight gain, mood disorders, dizziness, muscle cramps, cold intolerance, hair loss, frequent menses and memory loss.

The usual symptoms of overactive thyroid are: irritability, hyperactivity, heart palpitations, tremors, shakiness, excessive sweating, heat intolerance, weight loss, bulging eyes, infrequent menses, osteoporosis, anxiety and panic attacks. Rarely, patients can develop psychotic symptoms such as hallucinations, delusions and irrational behavior. Sometimes patients can have predominant eye symptoms such as watery, bulging eyes and double vision. Very rarely, patients can also have excessive thickening and swelling of their skin in the lower legs.

If hypothyroidism or hyperthyroidism remains untreated for a long period of time, a person can lapse into a coma and death can occur.

Typically, physicians treat underactive thyroid by giving thyroid hormone in the form of a pill. In the case of overactive thyroid due to Graves' disease, we either give an anti-thyroid drug or destroy the thyroid gland by exposure to radioactive iodine. Almost all Graves' disease patients treated with radioactive iodine end up with underactive thyroid (hypothyroid). They then need to take a thyroid hormone pill for the rest of their life.

In medical literature, genetics is the main factor recognized as the contributory factor for causing autoimmune thyroid disease and of course, there's nothing you can do about that. However, I check vitamin D level in all of my patients with autoimmune thyroid disease-

Graves' disease as well as Hashimoto's thyroiditis- and find it to be low in all of them. I treat them with a high dose of vitamin D. As the vitamin D level rises, thyroid antibodies start to come down. I am convinced that vitamin D deficiency is a major factor causing autoimmune thyroid disease. Interestingly, in an experimental study (18) from the University of California-Los Angeles (UCLA), USA, vitamin D deficiency was found to cause Graves' disease in laboratory animals. In an excellent clinical study (19) from Diskapi Yildirim Beyazit Training and Research Hospital, Turkey, researchers found that vitamin D level was low in all of their Hashimoto's thyroiditis patients. In addition, they observed the lower the vitamin D level, the higher the thyroid antibody level in these patients with Hashimoto's thyroiditis.

In addition to vitamin D deficiency, I find two other factors to be commonly present in patients with autoimmune thyroid disease. These are: fear and a high carbohydrate diet. Both of these factors are the other major causative factors for autoimmune thyroid disease.

Based on these observations, I developed a new, effective strategy to treat Hashimoto's thyroidits as well as Graves' disease. I have seen some amazing results in these patients. To learn more in this regard, please refer to my books, "Graves' Disease And Hyperthyroidism" and "Hypothyroidism And Hashimoto's Thyroiditis."

Inflammatory Bowel Disease (IBD)

Inflammatory Bowel Disease (IBD) is a chronic disease of the intestines which not only diminishes quality of life, but often results in debilitating complications.

There are two main clinical forms of IBD: Ulcerative colitis and Crohn's disease.

The usual symptoms are: bloody diarrhea, abdominal cramping, excessive gas, weight loss and fatigue.

Complications of IBD include: perforation of the intestines, fistula formation, intestinal obstruction and colon cancer.

The medical treatment for IBD patients consists of a wide array of drugs, all of which aim to reduce inflammation of the intestines. Most patients receive high doses of steroids, with their serious side-effects including reduction of vitamin D level. Many of the other drugs also have serious side-effects, such as risk for tuberculosis, renal failure and lymphoma.

Despite use of these drugs, patients often continue to have relapses of symptoms. Many patients end up losing part their intestines. Colon cancer is also much more common in patients with ulcerative colitis than in the general population.

To me, the current treatment is a band-aid approach. We physicians keep trying to suppress inflammation by one drug or another without examining the very basic question: What is the real cause for the inflammation and what can we do to treat this root cause? Based on my own clinical experience and extensive scientific studies in this field, I developed a deeper approach for treating my patients with IBD, discussed later in this chapter. First, let's investigate the relationship between IBD and low vitamin D.

The Link Between IBD And Vitamin D Deficiency

Vitamin D is almost always low in patients with IBD. As we know, low vitamin D leads to malfunction of the immune system. It is intuitive to conclude that Vitamin D deficiency plays a vital role in the development and progression of IBD. Once IBD develops, patients often spend more time indoors, in hospitals and recovering at home which further lowers their vitamin D level.

In addition, the small amount of vitamin D that people get from their food is also lost in patients with IBD due to intestinal malabsorption. Consequently, vitamin D level in these patients drops even lower. Low vitamin D further impairs the immune system and thus a vicious cycle starts: low vitamin D causes IBD, which causes further reduction in Vitamin D, which then causes further disruption of the immune system and more progression of IBD.

Can Vitamin D Supplementation Help Patients With IBD?

The answer is yes!

One experimental study (20) from The Pennsylvania State University, University Park, USA, showed that vitamin D can prevent the symptoms of experimental IBD. In an excellent clinical study from (21) the University Hospital Bratislava, Slovakia, the researchers found that vitamin D supplementation with high doses to bring 25-OH vitamin D level above 50 ng/ml, significantly improved the health-related quality of life in their patients with Ulcerative Colitis and Crohn's disease. But supplementation with low dose of 800 IU per day did not have any clinical benefits. This finding is in line with my observations at the Jamila Diabetes and Endocrine Medical Center. I aim a level of 25-OH vitamin D to be at least 50 ng/ml in my patients. How to achieve this level is discussed in Chapter 26: Treatment Of Vitamin D deficiency.

My Approach To The Treatment Of Autoimmune Diseases.

I do treat the symptoms of an autoimmune disease with traditional medical practices such as giving thyroid hormone to underactive thyroid patients. However, I also look deeper

and treat factors that resulted in the development of the autoimmune disease in the first place. If you don't treat the underlying cause of immune dysfunction, it will continue to erupt to the surface in the form of another autoimmune disease.

In medical literature, it is well known that a person with one autoimmune disease is at high risk for developing other autoimmune diseases.

What Causes Autoimmune Diseases?

1. Genetics

Autoimmune diseases tend to congregate in families. You're at high risk for developing an autoimmune disease if you have a family history of these diseases. However, not *every* genetically predisposed individual (not even twins) develops an autoimmune disease. Acquired factors play an important role in bringing out the disease in these individuals with a genetic predisposition. These acquired factors are discussed below.

2. Vitamin D Deficiency

As I have elaborated in this chapter, there is strong evidence to incriminate low vitamin D as an important factor in the causation of autoimmune diseases.

3. Diet

Extensive scientific studies have clearly established that diet plays an important role in the causation and progression of autoimmune diseases. Certain genetically predisposed individuals are not able to digest starches and sugars properly. The partially digested starches and sugars provide fertile grounds for bacteria and yeast to thrive in the intestines, causing "bacterial overgrowth." The byproducts of these micro-organisms cause inflammation of the intestinal walls, making them more permeable. Large molecules of partially digested food can then leak into the blood stream. This is called *Leaky Gut Syndrome*, which in turn, activates your immune system unnecessarily which then starts to malfunction. Therefore, starches and sugars play an important role in causing and perpetuating autoimmune disease.

4. Stress

Stress is a well known factor in the causation of autoimmune disease. Stress, especially in the form of fear, causes your body to produce excess amounts of cortisol, a hormone produced by the adrenal glands. An excessive amount of cortisol is known to weaken the immune system.

Based upon the four factors described above, I give the following advice to my patients with autoimmune diseases. Genetics, of course, you can't change but you can do a lot about the other three factors.

Vitamin D Supplements

Check your vitamin D level (for details please refer to Chapter 25, Diagnosis of Vitamin D Deficiency). Aim to keep your vitamin D level between 50 and 100 ng/ml (125 nmol/L to 250 nmol/L). To achieve these levels, most people require vitamin D supplementation in large doses (See Chapter 26, Treatment of Vitamin D Deficiency).

Special Diet

WHAT NOT TO EAT

1. No processed food

No canned foods, snack bars, or pre-cooked dinners. Have fresh foods, real foods and organic foods. The true nutritional value of a food (compared to what is written on the food label) is lost when it is processed, stored or frozen. Try to grow your own vegetables and fruits. In addition, use a local farmer's market to buy fruits and vegetables. Remember, if a fruit or vegetable has traveled hundreds, if not thousands of miles, it has lost its true nutritional value.

2. Eliminate Starches

Starches are refined carbohydrates. What is a carbohydrate? In chemical terms, a carbohydrate consists of carbon, hydrogen and oxygen atoms.

As a dietary source, carbohydrates are divided into three types:

A. Monosaccharides, which consists of only one type of simple sugar, such as glucose or fructose. A monosaccharide does not require any further breakdown in the intestines before its absorption into the blood.

B. Disaccharides, which consists of two molecules of monosaccharide bonded together. For example, table sugar (sucrose) consists of glucose and fructose. Milk sugar (lactose) consists of glucose and galactose. A disaccharide requires further breakdown in the intestines before it can be absorbed into the blood. For example, sucrase, an enzyme in the

intestinal wall, breaks down sucrose into glucose and fructose. Lactase, another enzyme in the intestinal wall, breaks down lactose into glucose and galactose.

C. Polysaccharides, which consists of hundreds to thousands of glucose molecules bonded together. During normal digestion, these polysaccharides are broken down into glucose, which is then absorbed into circulation. Digestion of polysaccharides is a complex process, which requires several digestive enzymes, including maltase in the small intestines.

A lot of individuals with Autoimmune diseases cannot properly digest polysaccharides due to deficiency of the specific enzymes in the intestines. Partially digested polysaccharides become a great food for bacteria and yeast to grow, which leads to bacterial overgrowth and Leaky Gut Syndrome.

The main polysaccharides in our diets are starches. Therefore, eliminate all starches from your diet. Starches include wheat, rice, oats, barley, rye, corn, potatoes, sweet potatoes and yams.

There is another polysaccharide in our diet, called cellulose, which cannot be broken down in human intestines. Therefore, it does not become food for bacteria. Cellulose is our dietary fiber, an important ingredient for our health. It prevents rapid absorption of glucose, lowers cholesterol and forms bulk for the stools to prevent constipation.

It is interesting to note that in nature, plants contain carbohydrates as starch, cellulose and simple sugar, mainly fructose. After a plant is harvested, it goes through processing which gets rid of cellulose and what is left behind is starch. Therefore, we refer to starches as refined carbohydrates.

Some individuals with Autoimmune dysfunction even develop loss of the intestinal villi, which are finger-like projections on the intestinal surface that are extremely important for digestion and absorption of polysaccharides. This is what we call Celiac disease or Gluten Sensitivity. There is a blood test to diagnose Celiac disease. The blood test aims to detect several special antibodies, called anti-tissue transglutaminase antibodies (tTGA) or anti-endomysium antibodies (EMA). Consider having this test done. If the test for Celiac disease is positive, then you should stay on a Gluten-free diet for the rest of your life. A Gluten-free diet means to eliminate all wheat, barley, oats and rye from your diet. You need to read labels carefully.

3. Say No to Sugar, Sugar Substitutes and Sugar Alcohols, but Yes to Honey

Say goodbye to sugar, even brown sugar and sugar-containing food items. Why? Sugar

causes Leaky Gut Syndrome. This is how: A sugar molecule consists of glucose and fructose. During digestion, each sugar molecule has to be broken down into glucose and fructose by an enzyme called sucrase, before it can be absorbed from the intestines into the blood. A lot of individuals with Autoimmune Dysfunction do not have enough sucrase to digest sugar. Undigested sugar then serves as fertile ground for bacterial overgrowth in the intestine, which can lead to Leaky Gut Syndrome. As a result, there is unnecessary stimulation of the immune system, as I explained earlier.

You can use honey as a sweetener, because each honey molecule consists of only glucose. It does not require any breaking down in the intestines before its absorption into the blood.

Avoid artificial sweeteners such as Sucralose (Splenda), Saccharin (SugarTwin, Sweet'N Low), Aspartame (Equal, NutraSweet), Acesulfame (Sunett, Sweet One) and Neotame.

Also beware of sugar alcohols such as Sorbitol, Mannitol, Xylitol, Lactitol, Maltitol, Erythritol, Isomalt, Hydrogenated starch hydrolysates (HSH).

These artificial sweeteners are widely used in processed foods, including sodas, powdered drink mixes, chocolate, cookies, cakes, chewing gum and candies. These products are typically marketed as sugar-free and low calorie, which obviously has great appeal to the general public.

As a general rule of thumb, stay away from all processed food items. These are NOT natural, regardless what they claim. These are synthetic substances that may have started out from a natural substance, but the final product is far from anything that exists in nature. For example sucralose (in Splenda) is made when sugar is treated with trityl chloride, acetic anhydride, hydrogen chlorine, thionyl chloride and methanol in the presence of dimethylformamide, 4-methylmorpholine, toluene, methyl isobutyl ketone, acetic acid, benzyltriethlyammonium chloride, and sodium methoxide, according to the book Sweet Deception. This processing obviously makes sucralose unlike anything found in nature.

Artificial sweeteners and sugar alcohols can give rise to a number of side-effects, including gas and abdominal cramping. Why? Because these chemicals are usually not absorbed properly and become a fuel for bacterial overgrowth in the intestines. Some even cause neurologic symptoms such as confusion, headaches or dizziness. In addition, there are serious concerns about their long term safety.

Avoid any food item that contains high fructose corn syrup, as it provides fuel for the growth of bacteria in the intestines and contributes to Leaky Gut Syndrome. In addition, it

also leads to obesity, diabetes, heart disease and liver damage.

Here are some common food items you should avoid because they are loaded with starches and sugar or sugar substitutes.

Bread, rice and pasta. Bread includes white bread, whole wheat bread, sourdough bread, French or Italian bread, bagels, croissants, biscuits, hamburger buns, rolls, pita, Indian naans, tortillas, tacos and many more similar bakery products.

Potato chips, Nachos, French fries.

Rice including white, brown as well as wild rice.

Waffles, pies, donuts, pancakes, pastries, cookies, candy and cakes.

Chocolate, cereals, pizza, chewing gum.

4. No Sodas, No Fruit Juices and No Alcohol.

Do not drink any sodas, even diet versions. Why? Because sodas are loaded with high fructose corn syrup and sugar. Diet sodas use artificial sweeteners and sugar alcohols.

Also avoid fruit juices, because fruit juices from grocery stores contains only a small amount of real juice and a lot of sugar water. Avoid even freshly squeezed, natural juice. Why? Because you end up consuming a high amount of natural sugar, fructose. For example, instead of eating just one whole orange, you will have to use 3-4 oranges to get about a cup of pure orange juice.

Instead of fresh juice, eat two to three Fresh fruit servings per day. Why? Because whole fruits not only contain sugar (fructose), but also the pulp, which slows down the absorption of sugar. That's why there is less of a rise in blood sugar level after eating a whole fruit, as compared to fruit juice, which causes a rapid rise in blood sugar level.

Avoid alcoholic beverages. Why? Because alcohol is a medically well known toxin for the liver, pancreas, brain and nerves. In addition, alcoholic beverages contain carbohydrates and sugars. For example, most beer comes from malted cereal grains, most commonly malted barley and malted wheat.

WHAT TO DRINK?

Water should be your beverage of choice. In a restaurant setting, order water for your drink. Many people order a soda or a dessert in a restaurant under peer pressure.

Remember your body has not changed because you are in a restaurant.

WHAT TO EAT?

1. Vegetables

For clarification, when I use the term vegetables, I refer to the leaf and stem part of the plant, excluding the roots (such as potatoes, sweet potatoes and yam), which are basically starches.

Eat plenty of vegetables. Include vegetables in every meal. They are a great source of vitamins, minerals and fiber. They are bulk forming, fill up your stomach and satisfy your appetite. They also slow down the absorption of sugar from carbohydrates in your diet.

In general, vegetables contain only small amounts of carbohydrates, which is usually fiber. For example, 1/2 cup of cooked spinach contains only 3 gm of carbohydrates, out of which 2 gm is fiber. Spinach, like many other green leafy vegetables, is a great source of Vitamin A, Vitamin K and Manganese.

Use fresh vegetables of the season. Get them from your own vegetable garden or from a farmers' market. Try to steam them or lightly fry in olive oil.

Use raw vegetables in your salads, such as cucumber, bell pepper, spinach and tomatoes.

2. Fruits

Eat one to two fresh fruits or 1/2 cup per day. Always use fruits which are in season. Either get them from your own fruit trees or from a farmers' market. Avoid fruits and vegetables which have traveled all around the world.

There is tremendous wisdom why certain fruits and vegetables grow in a certain season and climate. We humans may never be able to comprehend this wisdom. Suffice it is to say that if you live in sync with nature, you will avoid a lot of health problems.

For example, nature produces summer fruits for people in a particular area who are also experiencing summer temperatures. Now, you may be in the winter season, but your grocery store is loaded with summer fruits, brought thousand of miles away from the other side of the equator. Without thinking, you grab these produce items as novelty items. Remember fruits and vegetables are just foods, not items for mental entertainment or ego enhancement.

In general, fruits are a great source of vitamins and minerals, especially potassium. Fruits contain carbohydrates, but they are mainly simple sugars, fructose, which are easily absorbed from the intestines, because they do not require any further breakdown.

Fruits are a great source of antioxidants. In this way, they help to neutralize the damaging effects of free oxygen radicals that are released as a byproduct of the metabolism of food in the cell or when the body is exposed to cigarette smoking or radiation. These free oxygen radicals can damage the structures inside the cell. This is called oxidative stress and it may play a significant role in causing diseases such as cancer and heart disease. Anti-oxidants help to neutralize oxidative stress. Anti-oxidants consists of Beta-carotene, Vitamin A, Vitamin C, Vitamin E, Lutein, Lycopene and Selenium.

Brightly colored fruits are loaded with anti-oxidants. Fruits that are highest in antioxidant contents are pomegranate, blueberries, strawberries, cranberries, cherries, dates, plums, oranges, apples and pineapples.

Fruits are also a good source of fiber, especially avocados, apple, pear, guava, dates, cherimoya, pomegranate, passion fruit, blueberries, blackberries, raspberries, mango, orange, figs and kiwi fruit.

Avocado, guava, dates and cherimoya are a great source of protein. Avocados are also loaded with omega 3 fatty acids, vitamins C and E, carotenoids, selenium, zinc and phytosterols, which help to protect against heart disease and inflammation.

3. Nuts/Seeds

Nuts and seeds are an excellent source of nutrition. They are a great source of Monounsaturated Fatty Acids (MUFA) and omega-3 polyunsaturated fatty acids. Together, these are called the good fats. Why? Because these fats help to increase good (HDL) cholesterol and lower bad (LDL) cholesterol.

Nuts are also a good source of protein, vitamin E (an anti-oxidant) and fiber. They are also low in terms of carbohydrates. For example, 100 gm of almonds provides you with 21 grams of protein, 12 grams of fiber and only 20 grams of carbohydrates. Compare it to 100 grams of Quinoa, which provides you with roughly 13 grams of protein, 6 grams of fiber and 69 grams of carbohydrates.

Nuts are also packed with vitamins and minerals such as magnesium, phosphorus, potassium, selenium, manganese, folate, copper, calcium and zinc. In addition, nuts contain phytosterols, such as flavonoids, proanthocyanidins and phenolic acids.

There is mounting evidence to show that nuts may reduce oxidative stress and

inflammation. Clinical studies show that nuts can reduce the risk of heart disease, age-related brain dysfunction and diabetes.

Almonds, pine-nuts, pistachios and peanuts contain more protein than other nuts. Macadamias contains the highest amount of monounsaturated fatty acids, followed by hazelnuts, pecans, almonds, cashews, pistachios and Brazil nuts. Walnuts contain the highest amount of polyunsaturated fatty acids, followed by Brazil nuts, pecans, pine nuts, pistachios, peanuts, almonds and cashews.

Nuts also contain a small amount of saturated fat, the so called bad fat. Almonds contain the least amount of saturated fat and Brazil nuts the highest. While all nuts contain some selenium, Brazil nuts have the highest quantities. Selenium is a good antioxidant, helps the immune system and may prevent some cancers.

Pine nuts are one of the richest sources of manganese, which is an important co-factor for the anti-oxidant enzyme, superoxide dismutase. Consequently, pine nuts are good anti-oxidants. In addition, pine nuts contain the essential fatty acid pinolenic acid, which works as an appetite-suppressant by triggering the hunger suppressant enzymes, cholecystokinin and glucagon-like peptide-1 (GLP-1) in the small intestine.

Technically, peanuts are not actually nuts but legumes. Dry beans, peas and lentils are some other examples of legumes.

Like nuts, seeds are a good source of protein. For example, 100 grams of seeds will provide you with 30 grams of protein. Seeds are an excellent source of the amino acids tryptophan and glutamate. Tryptophan is converted into serotonin and niacin. Serotonin is an important regulator of our mood. Low serotonin can lead to depression. That's why many modern anti-depressant medications, such as Prozac, Zoloft, Paxil, Celexa and Lexapro act by increasing the level of serotonin in the brain. Glutamate is a precursor for the synthesis of γ-amino butyric acid (GABA), which is an anti-stress neurotransmitter in the brain and can help to reduce your anxiety.

Like nuts, seeds are also loaded with vitamins and minerals. Pumpkin seeds can block the action of an androgen, DHEA (Dehydroepi-androsterone). This may be helpful in preventing prostate and ovarian cancers.

With so many health benefits, I recommend nuts and seeds to all of my patients with Autoimmune Disorders. However, nuts can cause you to gain weight. Therefore, use nuts in small amounts.

Use raw nuts and seeds. Do not use salted, sugar-coated or chocolate-coated nuts or seeds for obvious reasons.

4. Meats/Poultry/Fish

Eat meats, poultry and fish, including shell fish. These are excellent sources of protein, vitamins, minerals and contain no carbohydrates. For example, 1 oz (28 grams) of cooked Atlantic salmon contains 6 grams of protein, 3 grams of fat, is loaded with Omega 3 fatty acids, and is also a good source of Thiamin, Niacin, Vitamin B6, Phosphorus, Vitamin B12 and Selenium.

Red meat is an excellent source of protein, iron and vitamins, especially vitamin B12. For example, 1 oz (28 grams) of ground Beef, (95% lean meat/5% fat, crumbles, cooked, pan-browned, hamburger) contains 8 grams of protein, 2 grams of fat, and No carbohydrates or sugar. It does contain 20 mg of cholesterol which is only 7% of the daily recommended value. Compare it to 1 oz (28 grams) of cooked Quinoa which contains only 1 gram of protein, 1 gram of fat and 6 grams of carbohydrates, but no cholesterol.

Weight for weight, Quinoa contains only 1/8 of the amount of protein present in beef, but carries the *myth* of being the best source of protein in the mind of many people. Amazing!

Eat red meat 2 - 3 times per week. Select lean cuts. Avoid processed meats such as cold cuts, salami and hot dogs, as these often contain added sugar and carbohydrates.

Eat Chicken and/or turkey once a day. These are great sources of protein and vitamins.

Eat Fish 1 - 2 times a week. In addition to providing you with protein and vitamins, these are great source of Omega-3 fatty acids, which are good for your cardiovascular health. However, overconsumption of fish can lead to mercury poisoning.

Remember, vitamin B12 is lacking in plants. Therefore, you often become low in vitamin B12 if you are on a vegan OR vegetarian diet.

5. Dairy

Eat a cup of regular, plain yogurt everyday. It is a great source of healthy bacteria for our intestinal health. It is also a good source of protein and calcium as well.

Include a moderate amount of cheeses in your diet. If you are trying to lose weight, then limit the use of cheese.

Drink a cup of milk per day, provided you are not Lactose Intolerant, which is more prevalent in patients with Autoimmune diseases. If you have Lactose intolerance, you should try Almond milk.

A lot of individuals with lactose intolerance do well on yogurt and cheeses.

6. Eggs

Eggs are a great source of protein, vitamins and minerals, especially Riboflavin, Vitamin B12, Phosphorus and Selenium. Eggs contain no carbohydrates. Therefore, they are a great nutritional source for people with Autoimmune disorders.

People are overly concerned about the cholesterol content of eggs. Cholesterol is present in the yolk of the egg. If your LDL cholesterol is elevated, then you should use only egg whites.

HOW TO EAT?

Eat three regular meals per day. Dinner should be the lightest meal of the day, lunch the heaviest and breakfast the modest meal. Eat dinner at least 3 hours before bedtime.

Avoid snacks, especially when you're watching TV or working on a computer. If you absolutely must have a snack, then try something like nuts, carrot sticks or other raw vegetables.

Get involved in your food. Read labels on food while you are in the grocery store. You'll be surprised how many food items contain sugar, fructose syrup and corn syrup. Avoid these food items.

Try to prepare your meal yourself, at least over the weekend. Avoid buffets! When you opt for a buffet meal, you want to get the most for your buck (after all, you're only human) and you generally end up overeating. Try to eat at home as much as possible.

If you are trying to lose weight, keep a diary of the food you eat. You may be amazed at how much you really eat, contrary to what you thought.

Eat when you are hungry, not because you're sad or on a computer or you have to socialize with family members and friends. People often eat because of psycho-social reasons. That's why they continue to gain weight.

Be aware of your eating habits. Eat slowly and enjoy every bite of your meal. Don't watch TV while eating. Many people overeat because they get too involved in watching a TV show or reading a newspaper and don't keep track of their food intake.

Read these recommendations frequently. This will serve as a reminder. Watch your conditioned mind and see how it tries to lure you to eat foods that you know you should not

Stress Management

A discussion about stress and its management could fill a book – literally. Here is a brief overview of my strategy to manage stress.

What I have discovered is that patients with autoimmune diseases worry a lot, about every little thing. When you worry, your body thinks that it is under attack. The immune system, therefore, gets into a high alert state to fight off the offending agent. But there is no one to fight off! Confused, it starts to attack its own organs, causing a variety of diseases.

Why do we worry? Use logic and you will realize, the underlying cause of "worrying" is fear.

The Origin Of Fear

What is the origin of fear? It originates when you're thinking about the future. I call it the "*What If* Syndrome."

- What if I miss my flight?
- What if Wall Street goes down?
- What if I lose my job?
- What if I have another attack of asthma? Crohn's disease? lupus?
- What if I develop diabetes and die a miserable death like my mother?

If you look at your fear closely, you'll understand its true origin. You realize that you're holding on to some negative experience of your own or of other people (Maybe you read about it or saw it on T.V.). You *do not* want it to happen to you ever, because it was (or could be) so painful. The mere thought that it may happen triggers a wave of fear and anxiety in you. Fear causes a release of adrenaline and cortisol from your adrenal glands. Both of these hormones damage your body. Adrenaline raises your blood pressure, increases your heart rate and may even cause chest tightness and chest pain. Cortisol plays havoc on your immune system.

So, How Can I Be Free Of Fear?

You can be free of fear if you use logic. Obviously "what if" or "what may' is a creation of your own mind, isn't it? It may or may not happen. It's not a problem in reality, not happening at this moment, right? Therefore, it's a phantom, an illusion. If and when it

happens, at “that time, the present moment,” you’ll be able to take care of it.

For example, you’re stuck in traffic on your way to the airport and there’s nothing you can do about it. You start worrying. “What if I miss my flight and then I’ll miss my interview for this job I really want and my best chance to get this dream job will evaporate” and on and on. You get so fearful from the drama that your mind creates that you may end up having chest tightness and pain and find yourself heading to a hospital. **Or** you can choose not to think about ‘what if,’ but instead stay in the present moment, focus on your driving and arrive at the airport safely. You may or may not be late. If you are late, you will deal with it. Therefore, live in the Now, stay in reality and you won’t have any fear.

Take action in the present moment. For example, eat right, exercise regularly and take vitamin D every day. There’s a good chance you won’t develop diabetes. However, if you just keep worrying about diabetes and don’t take any actions, you may develop diabetes. Take real action in the present moment and don’t worry about the results.

In summary, autoimmune dysfunction is a complex process and medications are a very superficial approach. Treat your autoimmune disorder at its roots by : a good dose of vitamin D, special diet and in-depth stress management.

Please refer to my book, “Stress Cure Now” for a more detailed stress management.

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Chapter **11**

Vitamin D Deficiency And Cancer

Dermatologists have successfully hammered one thought into all of us: sun exposure may cause skin cancer, so wear sunscreen while you're out in the sun. What dermatologists don't tell us is that the vitamin D we get from sunshine can also prevent serious cancers such as breast, colon, pancreatic and prostate cancers.

Mounting scientific evidence shows a strong link between vitamin D deficiency and cancer. Wouldn't it be wonderful if we could prevent cancer by optimizing vitamin D level in the body? Even in patients with a diagnosis of cancer, proper vitamin D supplementation plays an important role in treating cancer and preventing its recurrence.

What Promotes Cancer Growth?

In the last two decades, research has clearly shown two factors can promote growth of cancer: **Vitamin D deficiency and Insulin Resistance Syndrome**.

First, let's examine how cancer develops. In your body, old cells are constantly dying and fresh new cells are being born. In other words, there is a continuing cycle of *death* and *birth* of cells. There is also a fine balance between the death and the birth of cells. Vitamin D is involved in the death of cells, called apoptosis, and insulin is involved in the growth of new cells. Now consider a scenario where vitamin D is low in the body and insulin level is high. Both of these factors cause a *shift* in the normal balance of the death and birth of cells. Low vitamin D causes a decrease in the death of cells and a high insulin level causes an increase in the growth of cells. The net result is an enormous increase in the number of cells. This is exactly what happens when you have cancer; an unlimited growth of *abnormal* cells in your body.

A high level of insulin is present in people with Insulin Resistance Syndrome (also known as Metabolic Syndrome). Briefly, Insulin Resistance Syndrome consists of obesity, hypertension, low HDL cholesterol, high triglycerides, pre-diabetes or diabetes, polycystic ovary syndrome and high uric acid level. You don't have to have all of these features. Just a

couple of them are enough to have a diagnosis of Insulin Resistance Syndrome. Some complications of Insulin Resistance Syndrome include: coronary artery disease, stroke and fatty liver. For an in depth look at Insulin Resistance Syndrome, please read my book, “Take Charge of Your Diabetes.”

We could call vitamin D deficiency and high insulin level two important *promoters* of cancer. It’s interesting to note that vitamin D deficiency worsens Insulin Resistance Syndrome which results in a further increase in insulin level.

In addition, obesity, which often plays a central role in Insulin Resistance Syndrome, also causes vitamin D deficiency. Obesity is the obvious common denominator for insulin resistance and vitamin D deficiency. For a long time, physicians have known obesity to be a strong risk factor for cancer. Now we understand that vitamin D deficiency and insulin resistance are two pathways for how obesity is linked to cancer.

Both vitamin D deficiency and Insulin Resistance Syndrome have reached epidemic proportions, affecting hundreds of millions of people around the world. What’s alarming is that both vitamin D deficiency and Insulin Resistance Syndrome are getting worse. It is intuitive to predict that we will continue to see increasingly large numbers of cancer cases as time passes.

Evidence For The Link Between Vitamin D Deficiency And Cancer

Is there is any evidence to show a link between low vitamin D level and cancer? The answer is **yes**. The evidence is *overwhelming*! A large number of studies have shown a link between low vitamin D and cancer. Researchers from the University of California-San Diego, USA, published an excellent article (1) in the *American Journal of Public Health* in 2006. They analyzed scientific studies investigating the relationship between vitamin D level and cancer risk. These researchers found 30 studies on colon cancer, 13 studies on breast cancer, 26 studies on prostate cancer and 7 studies on ovarian cancer. In the majority of these studies, researchers concluded that people with a *good* level of vitamin D had a *lower* risk for developing these cancers.

Colon Cancer

The sun exposure—vitamin D—cancer hypothesis was first proposed by Cedric and Frank Garland in an article (2) published in 1980, in *International Journal of Epidemiology*, to explain the geographical variation of colon cancer mortality rates in the United States for 1950–1969, highest in the Northeast and lowest in the Southwest

In 2005, an excellent study (3) was published in the *Journal of Steroid Biochemistry and Molecular Biology*, in which researchers concluded that individuals with 25 (OH) Vitamin D level of 33 ng/ml (82 nmol/L) or more had 50% lower incidence of colorectal cancer.

In another excellent study (4) from Harvard School of Public Health in Boston, USA, was published in 2007 in the *Journal of the National Cancer Institute*, in which researchers pooled data from two studies: Health Professionals Follow-up Study (HPFS), a large ongoing study of male health professionals living in the United States, and the Nurses' Health Study (NHS). Their analysis showed there was an almost 50% reduction in the risk of colon cancer, comparing the highest with lowest levels of 25 (OH) Vitamin D.

Another study (5) was published in 2007 in the *Journal of the National Cancer Institute*. In this study, researchers from the National Cancer Institute, Bethesda, USA, investigated if there was any association between vitamin D level and cancer mortality. A total of 16,818 participants in the Third NHANES (National Health And Nutrition Examination Survey) were followed from 1988-1994 through 2000. They found a convincing 72% risk reduction for colorectal cancer mortality for 25 (OH) vitamin D levels of 32 ng/ml (80 nmol/L) or higher compared with levels less than 20 ng/ml (50 nmol/L). However, they did not find any risk reduction for any other cancer mortality.

Breast Cancer

In a review (6) from Harvard School of Public Health in Boston, USA, published in the *Annals of Epidemiology* in 2009, the author reported there was about 30% reduction in the risk for breast cancer, comparing the highest with lowest levels of 25 (OH) vitamin D. In addition, vitamin D intake was associated with a lower risk of pancreatic cancer, but not with prostate cancer.

A recent excellent study (7) comes from King Abdulaziz University in Jeddah, Saudi Arabia. It was published in 2013 in the *American Journal of Clinical Nutrition*. This was a case-control study. There were 120 breast cancer cases and 120 controls, without breast cancer. Blood was drawn for 25 (OH) Vitamin D levels in all women. Researchers found that women with level of 25 (OH) vitamin D less than 10 ng/mL (25 nmol/L) had a 6-fold increased risk for invasive breast cancer as compared to women who had 25 (OH) vitamin D of ≥20 ng/mL (45 nmol/L).

Other Cancers

While almost all studies consistently show a relationship between low sun exposure/low vitamin D and high risk for colon cancer, some but not all studies also show a link between low vitamin D and high risk for breast cancer, especially in premenopausal women. For

other cancers, the studies are not consistent to show the relationship between low vitamin D and increased risk for cancer.

Could it be that sunlight exposure can prevent cancer in ways other than vitamin D? An excellent review article (8) was published in 2013 in the *European Journal of Cancer*. In this review, the authors from the Netherlands reviewed all published case-control and cohort studies for cancer of the colon, prostate, breast and non-Hodgkin's lymphoma (NHL), and their relationship to both sunlight and vitamin D. They found that almost all epidemiological studies suggest that chronic (not intermittent) sun exposure is associated with a reduced risk of the cancer of colon, breast, prostate and NHL. In colon and to a lesser degree in breast cancer, vitamin D levels were found to be *inversely* associated with cancer risk. In other words, the lower the vitamin D level, the higher the risk of colon and breast cancer. In the case of prostate cancer and NHL, however, no associations were found with vitamin D level. They hypothesize that in prostate cancer and NHL, sunlight potentiated pathways other than vitamin D, such as modulation of the immune system, the circadian rhythm, and the degradation of folic acid might play a role in reduced cancer risk.

Scientific studies have also found higher rates of cancer mortality in regions with a higher latitude (less vitamin D from sunshine) as compared to regions closer to the equator (more vitamin D from sunshine).

Physicians have made another interesting observation: people diagnosed with cancer in the months of summer and autumn have better survival rates as compared to individuals diagnosed with the same type of cancer in the months of winter. The logical explanation for this difference in survival is that there is more vitamin D from sunshine in the months of summer and autumn as compared to the months of winter.

Therefore, vitamin D level at the time of diagnosis of cancer can have a prognostic value. In one such study (9), researchers from the Institute of the Population-based Cancer Research, Oslo, Norway, followed 123 patients with prostate cancer and found that patients with a good level of vitamin D at the time of diagnosis of prostate cancer had a better survival rate.

Can Vitamin D Supplementation Reduce The Risk Of Cancer?

A randomized clinical trial (10) was published in the *American Journal of Clinical Nutrition* in 2007, in which researchers from Creighton University in Omaha, Nebraska carried out a population-based, double-blind, randomized, placebo-controlled trial in postmenopausal women older than 55, in a 9-county rural area of Nebraska. These women

were randomly assigned to receive 1400-1500 mg supplemental calcium/day alone (Ca-only), supplemental calcium plus 1100 IU vitamin D3/day (Ca + D), or a placebo.

They followed these women for 4 years. Results: all cancer incidence was lower in women who took calcium plus vitamin D (Ca + D) than women who took calcium alone (Ca only) or just the placebo. The researcher concluded that improving calcium and vitamin D nutritional status substantially reduces all-cancer risk in postmenopausal women.

How Vitamin D May Work To Prevent Or Treat Cancer

Vitamin D may prevent or even help in slowing down the progression of cancer. But how? Here are some proposed mechanisms:

- Vitamin D promotes the death of cells, technically we call it *apoptosis* of cells.
- Vitamin D can turn on and off certain genes, involved in cancer cell growth.
- Vitamin D can cut off the blood supply to the cancerous tissue in its early stages.
- Vitamin D may prevent cancer cells from spreading.

Can Vitamin D Help In The Treatment Of Cancer?

The answer is probably yes!

Vitamin D may not only help to prevent cancer, but it may also help in the treatment of cancer.

An excellent review article (11) was published in *Dermatoendocrinology* in 2009, in which the author identified sixteen vitamin D sensitive cancers, according to various studies. These cancers included Esophageal, Gastric, Colon, Rectal, Gallbladder, Pancreatic, Lung, Breast, Ovarian, Hodgkin's lymphoma, and Non-Hodgkin's lymphoma. The author used a well established Hill's criteria to investigate *causality* between low vitamin D and cancer. He concluded that vitamin D *reduces* the risk of developing many types of cancer and *increases* survival once cancer has been diagnosed.

In summary, vitamin D deficiency is a major risk factor for a variety of cancers. Vitamin D supplementation may prevent as well as help in the treatment of cancer.

Also remember vitamin D is only one *piece* of the puzzle. There are many other factors that contribute to the development and progression of cancer. These factors include

obesity, insulin resistance, stress, unhealthy diet, cigarette smoking, environmental pollutants, radiation and certain drugs. Most of these factors are related to our life-style, which most of us are *unwilling* to change. In general, we look for easy, quick fixes in the form of pills, without changing our life-style. That's why we are facing such an epidemic of cancer and other health issues

If you are serious about preventing cancer, look at the big picture, make changes in your life-style, take care of your vitamin D needs and don't be stressed out. Take actions, but don't be *obsessed* with thoughts of cancer or other health issues.

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Chapter **12**

Vitamin D Deficiency And Heart Disease

When it comes to heart disease, everyone thinks of cholesterol. What most people don't know is that vitamin D deficiency is also linked to heart disease. Is there any scientific evidence to show the relationship between vitamin D deficiency and heart disease?

Evidence For The Link Between Vitamin D Deficiency And Heart Disease

Scientific evidence to show the link between vitamin D deficiency and heart disease continues to grow. In an article (1) published in 1989 in *Lancet,* a respected British Medical Journal, a researcher noted a relationship between latitude and heart disease: the farther you live from the equator, the lower you are in vitamin D and the higher your risk for heart disease.

Over the years, numerous studies continue to show a relationship between low vitamin D level and heart disease. However, this vital information hardly received any public attention until 2008 when two studies finally got the attention of the news media.

In the first study (2), published in January 2008 in *Circulation* (the official journal of the American Heart Association), researchers of Framingham Heart Study in Framingham, USA, followed 1739 participants for the development of heart disease. The mean follow-up was 5.4 years. These researchers found a nearly 2-fold increase in the risk for heart disease in individuals who had a low level of vitamin D.

In the second study (3), published in the June 9, 2008 issue of the *Archives of Internal Medicine* (the official journal of the American Medical Association), investigators from Harvard School of Public Health in Boston, USA, looked at the level of vitamin D in 18,225 men in the Health Professionals Follow-up Study: These men were free of any heart disease at baseline. During a 10 year follow-up period, 454 men developed a heart attack. The results were stunning: the lower the vitamin D level, the higher the risk for heart attack. Men whose 25 (OH) vitamin D level was at least 30 ng/mL (75 nmol/L) had roughly half the risk of a heart attack compared to men who had a 25 (OH) vitamin D level below 30 ng/mL (75 nmol/L).

An excellent study (4) was published in 2012 in the *American Journal of Cardiology*. In this study, researchers from the University of Kansas, USA, studied 25 (OH) vitamin D level in 10,899 patients. Only 3,294 (29.7%) were in the normal vitamin D range (> 30 ng/mL or 75 nmol/L)) and 7,665 (70.3%) were deficient. Vitamin D deficiency was associated with several cardiovascular-related diseases, including hypertension, coronary artery disease, cardiomyopathy, and diabetes. In addition, vitamin D deficiency was a strong independent predictor of all-cause death. Patients whose 25 (OH) vitamin D level was less than 30ng/mL (75 nmol/L), were at 2.6-fold increase risk of overall mortality.

An excellent study (5) from Medical University of Graz, Austria, was published in the *Journal of Clinical Endocrinology and Metabolism* in 2008. These researchers from Austria measured 25 (OH) vitamin D levels in 3299 Caucasian patients who were routinely referred to coronary angiography. During a median follow-up time of 7.7 years, 116 patients died due to heart failure and 188 due to SCD (Sudden Cardiac Death). Their findings were amazing: 25 (OH) vitamin D level was *inversely* correlated with congestive heart failure. In other words, the *lower* the vitamin D level, the *higher* the risk of heart failure. In addition, there was a 2.84-fold increased risk for death due to heart failure, and a 5-fold increased risk for SCD (Sudden Cardiac Death) in patients with severe vitamin D deficiency (25 (OH) vitamin D <10 ng/mL or 25 nmol/L.)

A provocative study (6) published in the May 2013 issue of *Coronary Artery Disease*, comes from Istanbul School of Medicine, Turkey. In this study, researchers investigated 222 patients for coronary artery blood flow rate, endothelial function (endothelium is the lining of the blood vessel wall) and carotid intima-media thickness, which is a measure of atherosclerosis (hardening of the arteries). They measured 25 (OH) vitamin D level in all of these patients.

Vitamin D level was low (less than 30 ng/mL or 75 nmol/L)) in 49% of the patients. They found a strong correlation between low vitamin D status, and slow coronary blood flow, endothelial dysfunction and atherosclerosis, all of these parameters indicate high risk for a heart attack.

Is There Evidence To Show That Vitamin D Supplementation Can Reduce Heart Disease?

The answer is yes.

In the same study (4) from the University of Kansas, Kansas, USA, vitamin D supplementation was associated with a 61% increase in survival. The author concluded vitamin D deficiency was associated with a significant risk of cardiovascular disease and

reduced survival. Vitamin D supplementation was significantly associated with better survival, specifically in patients with documented deficiency.

Another study (7) was published in *European Journal of Heart Failure* in 2012, in which researchers from Hadassah University Hospital in Jerusalem, Israel, evaluated the level of 25 (OH) vitamin D in 3009 heart failure patients. Only 8.8% of these patients had their vitamin D level above 75 nmol/L (which is equal to 30 ng/ml). Vitamin D deficiency was associated with increased mortality and vitamin D supplementation reduced mortality by 32%.

How Vitamin D May Prevent Heart Disease.

A provocative study (8) was published in 2009 in *Circulation*. These researchers from Washington University in St. Louis, USA, looked into the mechanism of how vitamin D may prevent coronary heart disease. Narrowing of the arteries develops due to accumulation of LDL cholesterol in the specialized cells in the arterial wall called macrophages. Once macrophages are ballooned out with LDL cholesterol, these are called *foam cells*, which then give rise to the formation of *plaque* in the arterial wall. These investigators found that vitamin D was able to prevent the uptake of LDL cholesterol by the macrophages and prevent the formation of foam cells. An amazing discovery!

In addition, vitamin D has been shown to decrease inflammation and insulin resistance, two other important mechanisms involved in the development of coronary heart disease.

In the last three decades, heart disease has become so prevalent that it's the number one killer in the USA. During the same time period, vitamin D deficiency has grown to epidemic proportions. Compelling scientific evidence indicates that vitamin D appears to be a significant factor in heart disease. Vitamin D is cheap, has virtually no side-effects and has many benefits in addition to cardiovascular benefits. Isn't it time to get on board and take charge of your vitamin D needs?

In addition to diet and exercise, you should consider taking vitamin D supplements in order to prevent heart disease.

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Chapter **13**

Vitamin D Deficiency And Diabetes Mellitus

Diabetes has reached epidemic proportions in the USA and around the globe. There are two types of diabetes mellitus: Type 1, which affects about 5% of diabetics and Type 2 which affects about 95% of diabetics.

TYPE 1 DIABETES

Type 1 diabetes typically affects children and young adults. Rarely, it can develop in older individuals as well.

The usual symptoms of Type 1 Diabetes are: frequent urination, excessive thirst, blurry vision, weight loss and fatigue.

A less frequent but potentially life-threatening presentation of diabetes is known as DKA (Diabetic Keto Acidosis). In this condition, you develop shortness of breath, nausea or vomiting, abdominal pain, dehydration, dizziness, fatigue, somnolence, disorientation and even coma. Death can occur if this condition is not promptly treated.

Insulin is the treatment for patients with DM Type 1. Treatment is necessary for the rest of your life.

The Relationship Between Vitamin D Deficiency And Type 1 Diabetes.

Type 1 diabetes develops due to malfunctioning of the immune system. As I discussed in Chapter 10, mounting scientific evidence indicates that vitamin D plays a vital role in the normal functioning of the immune system and vitamin D deficiency can lead to malfunctioning of the immune system. Consequently, your own immune system starts to attack and kill your own insulin producing cells in the pancreas, reacting as if they are invading viruses that must be destroyed. Once you are *unable* to produce insulin, you develop Type 1 diabetes.

Evidence For The Link Between Vitamin D Deficiency And Type 1 Diabetes.

Researchers have investigated the level of vitamin D in patients with Type 1 diabetes and found it to be low in the vast majority of these patients. In 2009, a study (1) was published in the *Journal of Pediatrics*. In this study researchers from the Joslin Diabetes Center, Boston, USA, noted that the vast majority of their Type 1 diabetic patients were low in vitamin D. The study was done in children and teenagers. In my clinical practice, I check vitamin D level in all of my Type 1 diabetic patients and find it to be low in virtually all of them.

Is vitamin D deficiency in Type 1 diabetics just a coincidence or is it causally related to the development of Type 1 diabetes? An excellent experimental study (2) published in *Science* in 1980, showed that vitamin D deficiency causes a 48% reduction in insulin secretion. In this way, vitamin D deficiency is clearly one of the factors that contributes to the development of Type 1 diabetes. Other factors being genetics, stress and diet. There is some scientific evidence to incriminate childhood vaccinations in the development of Type 1 diabetes.

Not only does vitamin D deficiency lead to the development of Type 1 diabetes, it may also contribute to the development of diabetic complications. In a recent study (3), researchers from Osaka University, Japan found that Vitamin D deficiency is significantly associated with eye disease (retinopathy) in Type 1 diabetics.

Evidence That Vitamin D Can Prevent Type 1 Diabetes.

Scientific evidence now exists to show that proper vitamin D supplementation can prevent Type 1 diabetes. As I discussed in Chapter 10, one such study comes from Finland. This study (4) began in 1966 when a total of 10,821 children born in 1966 in northern Finland were enrolled in the study. Frequency of vitamin D supplementation was recorded during the first year of life. At that time, the recommended dose of vitamin D for infants in Finland was 2000 I.U. per day. These children were then followed for 31 years for the development of Type 1 diabetes. Researchers made the amazing discovery that those children who received the daily recommended dose of 2000 I.U. of Vitamin D during the first year of their life, had an almost 80% reduction in the risk for the development of Type 1 diabetes compared to those children who received less vitamin D.

This is a ground breaking study! If some drug achieved this kind of results, it would hit the headlines and become the standard of care at once. Sadly, even many diabetes experts are not aware of this astounding study even though the study was published in 2001 in the prestigious British medical journal called the *Lancet*. Investigators in the U.S. continue to

spend millions of dollars in their pursuit of a “drug” to prevent Type 1 diabetes. So far, this kind of research has produced disappointing results. Amazingly, they have largely ignored the strong evidence that shows the outstanding role of vitamin D in preventing Type 1 diabetes. Vitamin D is not a drug. There is no glory or huge profits in simply telling people to take enough vitamin D.

It is interesting to note that the recommended allowance of vitamin D for infants in Finland was reduced from 2000 I.U. to 1000 I.U. per day in 1975 and then further reduced to 400 I.U. per day in 1992. (For comparison, in the U.S. it has been 200 - 400 I.U. a day). This reduction in the daily allowance had *no* scientific basis except the observation that this amount of vitamin D is present in a teaspoonful of cod-liver oil which has long been considered safe and effective in preventing rickets.

In the last decades, the incidence of Type 1 diabetes in Finland has been climbing, which is most likely related to the decrease in the daily recommended allowance of vitamin D. As of 1999, Finland had the highest reported incidence of Type 1 diabetes in the world (5). In Finland, the yearly sunshine (and therefore, vitamin D skin synthesis) is much lower compared to more southern areas. Therefore, the population in Finland is at even higher risk for vitamin D deficiency. In a recent study (6) from the University of Turku, Finland, researchers discovered that the level of vitamin D in young children in Finland increased after 2003, due to the public awareness about vitamin D supplementation. Subsequently, the rising incidence of Type 1 diabetes has plateaued since 2006. This is a strong epidemiological evidence that vitamin D deficiency contributes to the development of Type 1 diabetes. At the same time, vitamin D supplementation reduces the risk for the development of Type 1 diabetes.

Not only in Finland, but in other countries as well, scientists have discovered the amazing power of vitamin D supplementation in preventing Type 1 diabetes. In one such study called EURODIAB (7), researchers found vitamin D supplementation during infancy can significantly reduce the risk for developing Type 1 diabetes. This study was carried out in seven centers in different countries across a variety of populations in Europe.

How can Vitamin D Prevent Type 1 Diabetes

Type 1 diabetes develops due to death of the beta-cells of the pancreas. Technically, we call cell-death as apoptosis. Can vitamin D supplementation prevent the apoptosis of beta-cells? In one experimental study (8), researchers from the Institut National de la Santé et de la Recherche Médicale, France, showed that vitamin D can prevent the development of Type 1 diabetes in mice by preventing the apoptosis of beta-cells. They also showed that vitamin D can prevent apoptosis of the human beta-cells as well.

Can Vitamin D Be Helpful In Patients With Type 1 Diabetes?

In an experimental study (9) from Goethe-University Hospital, Germany, researchers showed that vitamin D supplementation in Type 1 diabetics may exert beneficial effects on the immune cells and shift immunity to self-tolerance. In this way, vitamin D may help to prevent further loss of beta-cells, if given in the early stages of Type 1 diabetes.

In a clinical study (10) from King Fahad Armed Forces Hospital, Saudi Arabia, researchers enrolled eighty patients with Type 1 diabetes and gave them vitamin D supplement as 4000 IU a day for 12 weeks. They observed a direct effect of vitamin D supplementation on improving blood glucose control in these patients.

TYPE 2 DIABETES

Although Type 2 diabetes typically affects adults, recently its incidence among teenagers is on the rise. Type 2 diabetes develops due to insulin resistance, a process in the body that makes it harder for insulin to do its job of keeping blood glucose normal. The body responds to this resistance by producing more and more insulin. After a few years of escalating insulin resistance, the body can't keep up with the huge demands for insulin production. At that point, insulin production starts to decline relative to insulin resistance. Consequently, blood sugar starts to rise.

If your fasting blood glucose rises into the range of 100-125 mg/dl, you have pre-diabetes. When your fasting blood glucose is above 125 mg/dl, you have diabetes. You go through a period of pre-diabetes for many years before you eventually become diabetic. In addition, if your blood test for Hemoglobin A1c is more than 6.5%, you have the diagnosis of diabetes.

Because Type 2 diabetes develops gradually, patients typically do not experience the usual diabetes symptoms such as excessive thirst and excessive urination, unless their diabetes remains undiagnosed for a very long period. Type 2 diabetes is usually diagnosed on a routine blood test. For details, please refer to my book, "Reverse Your Type 2 Diabetes Scientifically."

The Relationship Between Vitamin D Deficiency And Type 2 Diabetes.

Is there a relationship between vitamin D deficiency and development of Type 2 diabetes? The answer is yes. Life-style factors that are well known to cause Type 2 diabetes include obesity, old age and physical inactivity. It's interesting to note that all of these factors also cause vitamin D deficiency.

Vitamin D is important for normal glucose metabolism. It acts through several mechanisms on glucose metabolism:

1. Vitamin D directly acts on insulin producing cells in the pancreas to produce more insulin.

2. Vitamin D directly acts on the muscle and fat cells to improve insulin action by reducing insulin resistance.

3. Vitamin D reduces inflammation which is commonly present in patients with Insulin Resistance Syndrome and Type 2 diabetes.

4. Vitamin D indirectly improves insulin production and its action by improving the level of calcium inside the cells.

Now you can understand the important role vitamin D plays in keeping blood glucose normal. Intuitively, vitamin D deficiency can lead to diabetes.

Evidence That Links Vitamin D Deficiency To Type 2 Diabetes.

Is there any scientific evidence to link vitamin D deficiency to Type 2 diabetes? The answer is yes. Numerous scientific studies have found vitamin D to be low in patients with Type 2 diabetes.

An excellent study (11) was recently published in 2013 in *Diabetes Care*, the official journal of the American Diabetes Association. In this study, researchers from Harvard Medical School in Boston, USA, analyzed a total of 21 prospective studies to explore the relationship between vitamin D deficiency and risk for developing Type 2 diabetes. There was a total of 76,220 participants and 4,996 individuals developed Type 2 diabetes. The risk of developing Type 2 diabetes was reduced by 50% in individuals with the highest levels of 25 (OH) vitamin D as compared to the lowest levels. Each 4 ng/ml (equal to 10 nmol/L) increment in 25 (OH) vitamin D level was associated with a 4% lower risk of developing Type 2 diabetes.

Evidence That Vitamin D Can Prevent Type 2 Diabetes.

Is there evidence to show that vitamin D can prevent the development of Type 2 diabetes? The answer is yes. In a study (12), researchers from Helsinki, Finland collected health data in men and women from the ages of 40 to 74. None of these individual had Type 2 diabetes at the start of the study. They followed these individuals for 22 years to see the pattern of development of Type 2 diabetes. These researchers found that people who had a higher level of vitamin D were less likely to develop Type 2 diabetes. Thus, vitamin D

appears to have a protective effect against the development of Type 2 diabetes.

In another study (13), researchers from Tufts-New England Medical Center in Boston, USA, found that vitamin D and calcium supplementation were able to reduce progression from pre-diabetes to diabetes. This protective effect of vitamin D was similar in magnitude to other measures which have been shown to reduce the progression from pre-diabetes to diabetes, such as a weight reducing diet, intense exercise and use of the drug metformin.

Can Vitamin D Be Helpful In Patients With Type 2 Diabetes?

Can vitamin D supplementation be helpful if you have already developed Type 2 diabetes? The answer is yes. In a well-designed study (14) from Shandong University, China, researchers enrolled 164 Type 2 diabetics. They divided these diabetics into two groups: one group received vitamin D supplement and the other group served as the control group. At the end of 12 weeks, the vitamin D supplement group had a significant reduction in fasting blood glucose, Hemoglobin A1c, weight, waist-line and insulin resistance, in comparison to the control group. This is a compelling study to show the beneficial effects of vitamin D supplementation in Type 2 diabetics.

In summary, vitamin D has the potential to prevent Type 1 as well as Type 2 diabetes. It is also helpful in the treatment of diabetes, Type 1 as well as Type 2. In addition, vitamin D can prevent the devastating complications of diabetes such as heart attacks and kidney failure. Unfortunately, most diabetics continue to be low in vitamin D. Many diabetics are on a long list of expensive medications, but unfortunately, all too often, vitamin D is not included. Sadly, most physicians don't pay attention to the important relationship between vitamin D and the health of a diabetic patient. Isn't it time that proper vitamin D supplementation become an integral part of diabetes management?

At the Jamila Diabetes And Endocrine Medical Center, vitamin D supplementation is an integral component of diabetes management, Type 1 as well as Type 2.

For an in depth, complete discussion of insulin resistance and Type 2 diabetes, please refer to my book, "Reverse your Type 2 Diabetes Scientifically."

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Chapter **14**

Vitamin D Deficiency And Fatty Liver

Fatty liver simply means deposition of fat in your liver. Fatty liver is also called Non-Alcoholic-Fatty-Liver-Disease (NAFLD). It is reaching epidemic proportions. According to a study (1) from The University of Texas, Dallas, USA, NAFLD affects 80 million Americans. Even more alarming, the prevalence of NAFLD is rapidly increasing in children and adolescents (2), according to researchers from the University of California, San Diego, USA.

The spectrum of fatty liver (NAFLD) ranges from simple steatosis (deposition of fat) to inflammation of liver cells, called Non-Alcoholic SteatoHepatitis (NASH), to cirrhosis of the liver. In about two-thirds of patients, NAFLD follows a rather benign course, whereas in 30-40% of patients, steatosis advances to inflammation of liver cells (NASH) and about 10 % of patients end up with cirrhosis.

What Causes NAFLD?

Obesity, high triglycerides level and Type 2 Diabetes are well known risk factors for NAFLD (3). Patients with Metabolic Syndrome (also known as Insulin Resistance Syndrome) are at high risk for NAFLD (4, 5). Insulin resistance appears to play the central role in the pathogenesis of NAFLD (6). According to estimates by the American Association of Clinical Endocrinologists, 40% of adults in the USA suffer from Insulin Resistance Syndrome (7). Therefore, it is no surprise that NAFLD is reaching epidemic proportion.

Association Between Vitamin D Deficiency And NAFLD

Most patients with NAFLD are low in vitamin D. Most patients with NAFLD are also overweight. Overweight individuals are particularly prone to vitamin D deficiency because vitamin D is fat-soluble. It gets trapped in fat and less amounts are available for the rest of the body.

As we observed earlier, low vitamin D *worsens* insulin resistance, the key mechanism

for the development of NAFLD. Can vitamin D deficiency lead to fatty liver independent of insulin resistance? In a provocative study (8) from Sapienza University of Rome, Italy, researchers showed a *direct* association between vitamin D deficiency and the presence of NAFLD in individuals with various degree of insulin-resistance.

Therefore, vitamin D deficiency appears to have a dual mechanism in contributing to NAFLD: by worsening insulin resistance and a direct detrimental effect on the liver cells.

Diagnosis And Treatment Of NAFLD

Despite its prevalence of epidemic proportions, and at times serious consequences, NAFLD often remains undiagnosed. The main reasons for the lack of diagnosis are:

1. Most patients don't have any specific symptoms.

2. There is no specific blood test or readily available imaging study that is highly specific or sensitive for diagnosing this condition. Often, it is incidentally discovered on an ultrasound or CT scan of the upper abdomen done for some other reason, such as upper abdominal pain. Even an ultrasound of the liver fails to detect fatty liver in its early stages.

3. A Liver biopsy is considered by the "experts" to be the gold standard for diagnosing NAFLD. Considering the huge number of patients, a liver biopsy is not a practical solution. In addition, a liver biopsy is an invasive procedure with potential serious complications.

Even after a diagnosis of NAFLD is made, there is *no* effective treatment. You and your physician are therefore left with an *uncertain* picture about the diagnosis and treatment of this very common disorder.

At the Jamila Diabetes & Endocrine Medical Center, I developed a *breakthrough* practical approach to the diagnosis and treatment of NAFLD. As insulin resistance plays a central role in the pathogenesis of NAFLD, we decided to treat these patients by treating their insulin resistance. Being an endocrine practice, we already had extensive clinical experience in treating patients with insulin resistance. Therefore, we employ the same approach in treating patients with NAFLD as we do in treating patients with insulin resistance.

Criteria For The Diagnosis Of NASH:

As I mentioned earlier, NASH (Non-Alcoholic SteatoHepatitis) is the more serious form of fatty liver that develops in about 30-40% of patients with fatty liver. At this stage, there is inflammation of liver cells, which results in the release of enzymes called "liver

transaminases." These enzymes are **AST** = Aspartate Transaminase and **ALT =** Alanine Transaminase. These are readily available blood tests and are part of the frequently done chemistry panels in every day clinical practice. AST is more specific to liver damage due to alcoholic liver disease, while ALT is more specific to NASH (Non-Alcoholic SteatoHepatitis). Therefore, we use the following clinical parameters to identify patients with NASH.

- Elevated ALT
- No more than 2 drinks (about 20 g) of alcohol per week.
- Negative serology for Hepatitis A, B, and C.
- Absence of a drug known to cause liver toxicity.
- Presence of at least 2 of the features of Insulin Resistance Syndrome (IRS).

Features of Insulin Resistance Syndrome are as follows:

- Abdominal obesity (BMI > 25).
- Hypertension (BP > 130/85 mm Hg).
- Elevated serum triglycerides > 150 mg/dl.
- Low HDL (< 40 mg/dl in male, < 50 mg/dl in female).
- Pre-diabetes (fasting blood glucose 100-125 mg/dl {Impaired Fasting Glucose, IFG} or 2-hr blood glucose > 140 mg/dl in a 2-hour Oral Glucose Tolerance Test {Impaired Glucose Tolerance, IGT}.
- Type 2 diabetes, fasting blood glucose equal or more than 126 mg/dl or Hemoglobin A1c (HbA1c) more than 6.5%.

Treatment Plan

The usual treatment for NAFLD/NASH is in rudimentary stages and is often unsatisfactory. Weight reduction is currently the standard treatment. In clinical practice, sustained weight reduction is an uphill task, as most clinicians are well aware. Most patients adhere to a weight reducing diet for only a short duration and then go back to their previous eating habits and regain the weight they lost. The process of insulin resistance and NAFLD/NASH continues to progress. Therefore, weight reduction alone is not a practical solution. Moreover, studies investigating weight loss in NASH/NAFLD have been of short duration and of poor quality (9). In addition, even experts treating NASH/NAFLD usually do

not pay any attention to vitamin D deficiency in these patients.

At the Jamila Diabetes and Endocrine Medical Center, we employed our “Insulin Resistance Syndrome treatment strategy” to treat NASH. This strategy consists of Five components:

- A low carbohydrate diet,
- Walking about 30 minutes a day.
- Stress management
- Vitamins, including a high dose of Vitamin D
- Drugs: Metformin and Pioglitazone

We share with you our own clinical study on the effectiveness of our treatment approach in patients with fatty liver who had advanced to the stage of NASH. A total of 12 patients were enrolled, 5 females (42%) and 7 males (58%). The mean age was 50 years (range 36 to 66). All patients were overweight.

Four patients (33%) had pre-diabetes and five patients (42%) had Type 2 Diabetes. Eight patients (67%) had hypertension. Nine patients (75%) had low HDL cholesterol. Nine patients (75%) had elevated triglycerides level. Mean duration of follow-up was 48 months (range from 3 to 84 months).

ALT normalized in 66% of patients within 3 months, in 75% of patients at 6 months, in 83% at 12 months and eventually in all patients.

In addition, none of the patients experienced any side-effects from these drugs. Patients with pre-diabetes did not progress to diabetes. Patients with diabetes achieved excellent control of diabetes.

By employing this treatment approach, we continue to achieve excellent results in all of our patients with fatty liver and NASH.

References:

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Chapter **15**

Vitamin D Deficiency And High Blood Pressure

High blood pressure, medically known as hypertension, has reached epidemic proportions in the USA and around the world. Traditionally, the known risk factors for developing hypertension are: ethnicity, old age, obesity, physical inactivity and stress. Does vitamin D deficiency play any role in the development of hypertension? Scientists wondered. They started to explore this question and were amazed at their findings.

Evidence That Links Vitamin D Deficiency To Hypertension

In one study (1), scientists discovered that blood pressure was strongly correlated to the distance from the equator. In other words, the farther you lived from the equator, the less vitamin D you obtained from the sun and thus, the higher your blood pressure.

In another study (2), researchers investigated blood pressure differences in individuals of African origin, now living in various parts of the world. They discovered that blood pressure in people of the same ethnicity was higher among those living in northern regions compared to those residing closer to the equator.

In another study (3), scientists investigated blood pressure variations in seasons. They discovered that people living in the same area had higher blood pressure during winter as compared to summer. Less vitamin D from sun exposure during winter was the obvious explanation for higher blood pressure observed during the winter months.

These observational studies led scientists to look deeper at the relationship between vitamin D and blood pressure. In large scale studies (4,5) in the USA, vitamin D levels were measured in thousands of men and women. In each one of these studies, vitamin D deficiency was found to be an important risk factor for developing hypertension.

How Does Vitamin D Deficiency Cause Hypertension?

In most people, hypertension develops due to three mechanisms:

- Over-stimulation of a special system in the body, called Renin Angiotensin Aldosterone System (RAAS).
- Insulin resistance.
- Stress through the “Mind-Body” connection.

1. Renin Angiotensin Aldosterone System (RAAS)

Renin is a chemical in the body which causes production of another chemical, Angiotensin, which in turn raises blood pressure. Angiotensin also stimulates another chemical, called aldosterone, which further raises blood pressure. Aldosterone also reduces potassium in the blood.

Scientific studies have clearly shown that Vitamin D inhibits the RAAS by inhibiting renin. Lack of vitamin D therefore, results in the activation of the RAAS and subsequently, hypertension develops.

2. Insulin Resistance

Insulin is a hormone, a chemical in your body, produced by special cells in the pancreas. Insulin then enters the blood steam and exerts its effects on various organs in the body. Due to a variety of reasons, cells in the muscles, fat and liver become resistant to the action of insulin. This is called insulin resistance. In response to insulin resistance, your pancreas produces more and more insulin. These large amounts of insulin cause retention of salt and water by the kidneys and subsequently, your blood pressure becomes elevated.

Vitamin D has been shown to reduce insulin resistance. People deficient in vitamin D lack this beneficial effect and eventually, their insulin resistance worsens, causing an elevation in blood pressure.

Insulin resistance is caused by a variety of factors, vitamin D deficiency being just one of them. Other factors causing insulin resistance are: genetics, obesity, physical inactivity, old age and stress. Insulin resistance not only causes hypertension, but has various other manifestations which include low HDL (good) cholesterol, pre-diabetes, diabetes, heart disease, stroke, polycystic ovaries and fatty liver.

3. Stress Through The Mind-Body Connection

Your blood pressure is also under the control of your brain through the mind-body

connection. That's how stress causes an increase in blood pressure. The connection between stress and high blood pressure is now common knowledge.

Evidence That Vitamin D Can Reduce Blood Pressure

Once scientists clearly recognized the relationship between vitamin D deficiency and high blood pressure, they then wanted to see if blood pressure could be reduced with vitamin D supplementation. In one study (6), researchers gave vitamin D 800 I.U. per day for 6 weeks to elderly women who had vitamin D deficiency. These researchers found that vitamin D supplementation caused a 9% reduction in blood pressure.

In another study (7), patients with mild hypertension were randomly assigned to receive UVB or UVA exposure from a UV lamp three times a week for six weeks. Skin exposure to only UVB (and not UVA) produces vitamin D. Consequently, the blood level of vitamin D rose by 162% in patients receiving UVB. In these patients, blood pressure dropped by 6 mm Hg.; Meanwhile, for those in the UVA group, there was no change in blood pressure.

Can vitamin D be used as an add-on to treat hypertension. In an excellent study (8) from China, researchers divided their patients already on a blood pressure medication to receive either vitamin D or a placebo. There were 63 patients in each group. At the end of six months, vitamin D caused a significant reduction in blood pressure readings.

Vitamin D - A Natural Anti-Hypertensive Agent

Vitamin D is truly a natural anti-hypertensive agent. It is cheap, safe and has many health benefits in addition to lowering high blood pressure. Unfortunately, most physicians are unaware of these facts and don't utilize vitamin D in the treatment of hypertension. Instead, they place patients on expensive drugs with many potential side effects. Even more important, these drugs don't treat the root causes of hypertension, and therefore, sooner or later, more medications are needed to control hypertension. Many people end up on two, three or sometimes even more medications to control their hypertension.

My Approach To Treating Hypertension

I am not against using medications. I do use drugs to treat hypertension in my patients. However, I also go deeper, educating my patients about the root causes of hypertension, most of which are due to our modern life-style. I guide them towards life-style changes including weight loss, physical activity and stress management. I also instruct them about the proper dosage of vitamin D (discussed in detail in Chapter 26 Treatment of Vitamin D

Chapter **16**

Vitamin D Deficiency And Kidney Disease

Vitamin D deficiency has a dual relationship to chronic kidney disease.

1. Chronic kidney disease causes vitamin D deficiency.

2. Vitamin D deficiency worsens chronic kidney disease, increasing your odds of ending up on dialysis.

Chronic Kidney Disease Causes Vitamin D Deficiency

Vitamin D deficiency is a common problem in patients with chronic kidney disease. As discussed earlier in Chapter 2, vitamin D is synthesized in the skin. After its production, vitamin D enters the blood stream and reaches the liver where it undergoes a chemical change known as hydroxylation. Hence, vitamin D is converted to 25 (OH) vitamin D (25 hydroxy vitamin D), also called Calcifediol. It re-enters the blood stream and reaches the kidneys where another chemical reaction (hydroxylation) takes place. At that point, 25 (OH) vitamin D is converted to 1,25 $(OH)_2$ vitamin D (or 1,25 dihydroxy vitamin D), also called Calcitriol. It re-enters the blood stream and exerts its biochemical effects. Therefore, Calcitriol is considered the active form of vitamin D.

Now let's examine what happens as a person develops kidney disease. The conversion of 25 (OH) vitamin D (Calcifediol) to 1,25 $(OH)_2$ vitamin D (Calcitriol) does not take place properly. Therefore, these patients become low in Calcitriol. Chronic kidney disease causes a gradual, but progressive decline in kidney function. Therefore, the formation of Calcitriol gradually decreases. This decrease in Calcitriol causes a decrease in calcium absorption from the intestines.

However, then a compensatory mechanism kicks in: The parathyroid glands in the neck start to produce a large amount of parathyroid hormone (PTH). This large amount of PTH exerts its effects on the kidneys and enhances the conversion of 25 (OH) vitamin D

(Calcifediol) into 1,25 $(OH)_2$ vitamin D (Calcitriol). But, it comes at a price. The high amount of PTH dissolves calcium from the bones, which then become weakened. In addition, if this compensatory increase in PTH production remains unchecked, patients end up with tumors of the parathyroid glands and a high blood calcium level. For these reasons, patients on End-stage kidney disease are given Calcitriol (or its synthetic analogue) supplementation. This prevents the compensatory increase in PTH production and therefore, prevents weakening of bones and tumor formation in the parathyroid glands.

Vitamin D Deficiency Worsens Chronic Kidney Disease, Increasing Your Odds Of Ending Up On Dialysis

If you recall from Chapter 15, "Vitamin D Deficiency and High Blood Pressure," there is a special system in the body called the Renin Angiotensin Aldosterone System (RAAS). Renin is a hormone in the body which causes production of another hormone, Angiotensin, which in turn raises blood pressure. Angiotensin also stimulates another hormone, called aldosterone, which further raises blood pressure. Aldosterone also reduces potassium in the blood.

Normal functioning of this (RAAS) system is important in maintaining blood pressure and keeping potassium in the blood in a normal range. However, when your RAAS becomes overactive, high blood pressure (hypertension) develops. *An overactive RAAS and hypertension cause damage to the kidneys and are the two main culprits in the progression of kidney disease.*

An overactive RAAS is often seen in people with diabetes and that's why they often have hypertension and kidney disease as well. Currently, we use two types of drugs to deal with an overactive RAAS: ACE-inhibitors (Angiotensin Converting Enzyme inhibitors) and ARB (Angiotensin Receptor Blocking) drugs.

Now consider Vitamin D. It inhibits the RAAS by inhibiting renin and therefore, counteracts an overactive RAAS in patients with diabetes, hypertension and chronic kidney disease. Therefore, doesn't it make sense to make sure these patients have a good level of vitamin D?

I utilize ACE inhibitors and/or ARB drugs in my patients with diabetes, hypertension and chronic kidney disease, but I also make sure that these patients have a good level of vitamin D which can also help suppress the overactive RAAS.

Unfortunately, most physicians aren't aware of this beneficial effect of vitamin D. Consequently, vitamin D often stays low in patients with hypertension and diabetes. Many

patients are not even on ACE inhibitors or ARB drugs. Unfortunately, many of these patients end up with chronic kidney disease. The sad end result is that the kidneys cease to function and they end up on dialysis.

Now you can understand why proper vitamin D supplementation in every patient with diabetes and hypertension is crucial. This simple strategy can help prevent kidney failure as well as incalculable physical, emotional and economic suffering.

Chapter **17**

Vitamin D Deficiency In Stomach Bypass Surgery Patients

Obesity has reached epidemic proportions in the USA and around the world. Obesity is the root cause of many serious medical conditions including diabetes, hypertension, cholesterol disorder, heart disease, cancer, gall stones, polycystic ovaries and degenerative arthritis. In most cases, obesity is the result of *overeating.*

Many people are *unable* or *unwilling* to change their eating habits. Therefore, they seek out alternatives. Stomach bypass surgery is one such alternative. In recent years, stomach bypass surgery has become an increasingly common procedure in the USA. Most people do lose weight with these procedures, but also develop severe vitamin and nutritional deficiencies as well as endocrine abnormalities, which often go unrecognized and untreated.

Vitamin D deficiency and secondary hyperparathyroidism are the endocrine abnormalities frequently seen in patients after stomach bypass surgery. Secondary hyperparathyroidism is the result of chronic vitamin D deficiency. Hyperparathyroidism means an increase in parathyroid hormone which dissolves calcium from your bones. Consequently, these patients start to experience generalized body aches and pains. Physicians often place them on pain killers and sometimes even anti-depression medications, while the root cause of their symptoms, vitamin D deficiency, remains undiagnosed and untreated.

I have seen several such cases. After years of going from physician to physician, undergoing expensive diagnostic testing and getting a variety of labels for their symptoms such as fibromyalgia and Chronic Fatigue Syndrome, these patients are astonished to discover that it all boils down to vitamin D deficiency. Proper vitamin D supplementation takes care of their symptoms. See Chapter 6, Vitamin D Deficiency and Body Aches, Pains and Chronic Fatigue Syndrome, for details on secondary hyperparathyroidism.

If you're planning to undergo gastric bypass surgery, ask your doctors to check your 25 (OH) vitamin D level and parathyroid hormone level before surgery. You should go on a good dose of vitamin D before surgery and stay on this dose during your hospital stay and

recovery period. (See Chapter 26, Treatment of Vitamin D Deficiency).

You need to be the advocate of your vitamin D supplementation, especially during your hospital stay. Why? Because while you're in the hospital, vitamin D is the last thing on any one's mind. However, you can take care of it by reminding your physician in the hospital. It may actually hasten your recovery.

Afterwards, ask your physician to periodically (about every 3 months) check your 25 (OH) vitamin D level and parathyroid hormone level until you're on a stable dose of vitamin D and your parathyroid hormone is normal. Even after that, continue to have your 25 (OH) vitamin D level checked every 3 months. You should stay diligent about your vitamin D level, as well as other vitamin and mineral supplementation including vitamin B12.

Chapter **18**

Vitamin D Deficiency And Dental Problems

Vitamin D plays an important role in your dental health. Teeth are a form of bone and we know how important vitamin D is for the health of bones. In addition, vitamin D has anti-inflammatory properties and may reduce your risk for periodontal disease.

In an excellent study (1), researchers from Boston University, Boston, USA, found that people with a higher level of vitamin D were less likely to have gingivitis (gum inflammation) as compared to people with a low level of vitamin D. They concluded that vitamin D may reduce susceptibility to gingival inflammation through its anti-inflammatory effects.

In another study (2), researchers from University of Manitoba, Winnipeg, Canada investigated the level of Vitamin D and Parathyroid hormone in children less than 6 years of age, who had developed severe dental caries, (cavities.) Children with dental caries were twice as likely to have low vitamin D level (less than 30 ng/ml or 75 nmol/L), compared to children without dental caries. In addition 68% of children with severe dental caries also had elevated PTH level, indicating secondary hyperparathyroidism, which is associated with weak bones.

In another study (3) from Boston University, Boston, USA, researchers examined tooth-loss in otherwise healthy individuals older than 65. They found that vitamin D and calcium supplementation reduced the risk of tooth-loss by an impressive 60%.

Ever since I started getting my patient's vitamin D at an optimal level, their dentists have expressed surprise at the great condition of their teeth. They often receive compliments from their dentists.

My own story provides a good illustration. One day about thirteen years ago, I felt a sharp pain in one of my teeth while I was having lunch. I saw my dentist promptly, who discovered that a molar tooth had fractured. Why? There was no satisfactory answer. My dentist warned me that I was at risk for more dental fractures in the future. Soon afterwards, I got enlightened about vitamin D and started taking vitamin D3, 10,000 I.U. a

Chapter **19**

Vitamin D Deficiency And Skin Disorders

Skin not only synthesizes vitamin D, but also responds to vitamin D in maintaining its own health. Therefore, vitamin D deficiency may be putting us at risk for several skin disorders.

Vitamin D Deficiency And Psoriasis

Psoriasis is a chronic skin disorder, with periods of remissions and relapses. While there are various types of skin rashes, the most common is in the form of thickened skin plaques, which have scaly, silvery-white appearance. These plaques frequently appear on elbows and knees, although any part of the skin can be involved such as scalp, back and genitals. Sometimes, it can affect nails as well. Occasionally arthritis can develop which is called *Psoriatic* arthritis.

There is no cure for psoriasis at the present time. Often steroids are used to provide temporary symptomatic relief. Steroids have serious side-effects. Is there a better treatment and/or cure for psoriasis?

Psoriasis is an autoimmune disorder, in which immune cells mistakenly start to attack your skin cells. Vitamin D deficiency and stress play an important role in causing any autoimmune disorder, as I elaborated in Chapter 10. Therefore, I recommend vitamin D replacement and stress management in these patients.

In one study (1), published in 1988 in the journal of the American Academy of Dermatology, researchers found vitamin D as a skin cream to be an effective treatment for a majority of patients with psoriasis. This led to the development of a synthetic vitamin D analog called calcipotriene (brand name Dovonex, available as skin cream) which is now commonly used in the treatment of psoriasis.

Oral vitamin D supplementation is also effective for the treatment of psoriasis. According to the authors of a publication (2) from the University of California, Davis, USA, vitamin D

deficiency is associated with the severity of psoriasis. Oral vitamin supplementation not only helps the psoriasis of the skin, but also helps with joint-involvement due to psoriasis.

Vitamin D Deficiency And Vitiligo

Low vitamin D is also associated with a skin condition known as vitiligo, (medically speaking, vitiligo *vulgaris*), which is an autoimmune disorder. In this skin condition, your immune system attacks and kills your melanocytes (pigment forming cells) in the skin. This leads to a loss of skin pigmentation, which is often patchy in distribution. It can affect dark as well as fair skin. Vitiligo is often associated with other autoimmune disorders as well such as Graves' disease, Hashimoto's thyroiditis, and Myasthenia gravis.

An excellent study (3) was published in 2010 in the journal of the American Academy of Dermatology. In this study, investigators from the State University of New York (SUNY), Brooklyn, USA, measured 25 (OH) vitamin D level in 45 patients with vitiligo. They found that 25 (OH) Vitamin D level less than 30 ng/ml was associated with a high risk of developing vitiligo.

Vitamin D Deficiency, Ultraviolet (UV) Radiation And Skin Cancer Risk?

Over 1 million skin cancers occur annually in the USA. 80% are basal cell carcinoma, 16% are squamous cell carcinoma and 4% are melanomas. Traditional knowledge in dermatology links excessive sun exposure to skin cancer risk. Hence, the drumbeat to avoid sun exposure and use sunscreen whenever you are outdoors, which has contributed to an epidemic of vitamin D deficiency. There is strong evidence to link low vitamin D to cancers of the colon, breast and prostate.

Can low vitamin D also be associated with increased risk of skin cancer? This is a question of intense debate at this time. An interesting study (4) from the University of California in San Francisco, USA was published in *Discovery Medicine*. This study showed that lack of Vitamin D Receptor (VDR) in mice actually increased the risk of skin tumor formation upon exposure to UV radiation. The author hypothesized that Vitamin D and its receptor (VDR) acts as a tumor-suppressor agent in the skin upon exposure to UV radiation. In this way, vitamin D may actually prevent skin cancer.

Vitamin D Deficiency And Hair Loss?

There is mounting evidence to shed light on the importance of vitamin D and its receptor (VDR) in regulating the health of hair follicles. In an excellent study (5) from Cairo University in Egypt, investigators found vitamin D and ferritin levels to be much lower in females with hair loss than those without hair loss. Ferritin is a measure of your iron level. Interestingly, there was a direct correlation between the severity of hair loss and the severity of ferritin and vitamin D deficiency. In other words, the lower the level of vitamin D and ferritin, the more severe was the hair loss. They found that a 25 (OH) vitamin D level of less than 27 ng/ml, (which is equal to 67.9 nmol/L) was associated with excessive hair loss.

An interesting study (6) from the University of California in San Francisco, USA, found that the absence of Vitamin D Receptor (and hence, lack of vitamin D action) led to alopecia (hair loss) in mice. Hair loss developed by 3 months after birth and gradually led to nearly total hair loss by 8 months in these vitamin D deficient mice.

Can vitamin D treat alopecia in humans? An exciting case report (7) was published in the *Annals of Dermatology* in 2012, in which investigators from Chung-Ang University in Seoul, Korea successfully treated alopecia in a 7-year old boy, with calcipotriene (50 microgram/ml), a vitamin D analog. Calcipotriene (brand name Dovonex) was applied daily for 3 months. Complete hair re-growth took place in the affected area at 3 months. A punch biopsy was done before the treatment, which showed lack of Vitamin D Receptor (VDR) in hair follicles. A repeat punch biopsy at 3 months showed VDR expression in the hair follicles. There was no relapse of hair loss over the next 6 months. A great study!

Vitamin D Deficiency And Eczema

Eczema is an allergic disorder of the skin. It is also known as atopic dermatitis. It is a chronic skin condition, usually starts in childhood and may persist through adulthood. Patients experience recurring, itchy skin rashes. What causes eczema is not clearly known. Genetics plays a role. Precipitating factors include pollens, skin irritants, skin infections, dust mites, food allergies, and stress. Some patients also suffer from asthma and hay fever.

Vitamin D plays an important role in the normal functioning of the immune system. Vitamin D deficiency is well-known to be associated with other allergic disorders such as asthma. Can vitamin D deficiency play a role in eczema and can vitamin D supplementation be helpful in patients with eczema? An excellent study (8) was carried out in Mongolian children suffering from Eczema. This study involved researchers from Harvard School of Public Health, USA and Health Sciences University of Mongolia, Mongolia. Compared with placebo, vitamin D supplementation (1000 IU per day) for 1 month produced a clinically significant improvement in the severity of eczema.

Vitamin D Deficiency And Chronic Urticaria

Urticaria refers to hives on the skin. Typically, these are raised, reddish, itchy bumps on the skin. The causes of urticaria include stress, allergy to food, drugs, or other environmental agents, and autoimmune dysfunction.

For chronic urticaria, treatment typically consists of an antihistamine such as diphenhydramine (Benadryl), hydroxyzine (Atarax) loratadine (Claritin), cetirizine (Zyrtec), or desloratadine (Clarinex). These antihistamines block Histamine 1 (H1) receptors. Often patients also need drugs to block Histamine 2 (H2) receptors. These drugs include ranitidine (Zantac) and cimetidine (Tagamet). Many patients also need the addition of a 3rd drug, such as leukotriene receptor antagonist such as montelukast (Singulair). A number of patients also need short courses of oral steroids such as prednisone. Some even require more heavy duty immunosuppressive drugs.

Most cases of urticaria involve immune system. Vitamin D is intimately involved in the health of our immune system. Therefore, it is logical to think that vitamin D supplementation should have a role in the treatment of chronic urticaria. In an interesting study (9), researchers from the University of Nebraska, Omaha, USA, recruited 42 patients with chronic urticaria. They randomly divided these patient into two groups. One group received a small dose of vitamin D3 as 600 IU per day, while the other group received a high dose of vitamin D3 as 4,000 IU per day. All of the patients also received triple-drug therapy consisting of cetirizine, ranitidine, and montelukast. Triple-drug therapy decreased Urticaria-Symptom-Severity scores by 33% in the first week. There was an additional 40% decrease in the Urticaria-Symptom-Severity scores in the high, but not low, vitamin D3 treatment group by the end of 12 weeks. The authors concluded that the add-on therapy with high-dose vitamin D3 (4,000 IU/d) could be considered a safe and potentially beneficial agent in patients with chronic urticaria.

It is pretty clear that vitamin D is extremely important for the normal health of skin. Deficiency of vitamin D or lack of vitamin D receptor can lead to a wide range of skin abnormalities, including psoriasis, vitiligo, skin tumor formation, alopecia, eczema and urticaria. Therefore, instead of running away from vitamin D, it's time to embrace it for a healthy skin.

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Chapter **20**

Vitamin D Deficiency And Depression

Can winter blues be a consequence of vitamin D deficiency? Is there a relationship between low vitamin D and mood disorders? The answer is yes!

Scientific studies (1, 2) have shown that people with seasonal mood disorder and depression are frequently low in vitamin D. One study (2) even found that older adults with a low vitamin D level are not only more likely to be depressed, but also may have poor cognitive performance. So, don't blame memory loss simply on getting older. It may be the result of low vitamin D.

Historically, physicians have been unaware of the role of vitamin D deficiency and depression. However, recently some physicians have started to look into the mounting scientific evidence that links vitamin D deficiency to depression. For example, a great study (3) from the Cooper Clinic in Dallas, USA looked at 12,594 patients and found an association between low vitamin D level and clinical depression, especially in those individuals who had experienced depression in the past.

Can Vitamin D Supplementation Improve Depression?

An excellent study (4) from the University Hospital of North Norway looked into this very question. They recruited 159 men and 282 women, aged 21-70 years. Individuals with serum 25 (OH) vitamin D levels less than 40 nmol L (which is equal to 16 ng/ml) were found to have higher depressive symptoms than those with serum 25 (OH) vitamin D levels more than 40 nmol L. Vitamin D supplementation with 20,000 or 40,000 I.U. per week versus placebo showed a significant improvement in depression in the vitamin D treatment groups, but *not* in the placebo group. This study indicates *causality* rather than a simple association between low vitamin D and depression.

Another provocative study (5) was published in 2013 in the journal of Clinical Psychopharmacology. In this study, investigators from Shahid Sadoughi University of

Medical Sciences in Yazd, Iran, did a randomized clinical study in depressed patients. All had vitamin D deficiency. They divided these patients into three groups: The first group received a single dose of vitamin D 300,000 I.U. by injection. The second group received a single dose of vitamin D 150,000 I.U. by injection. The third group did not receive any vitamin D. At 3 months, the group that received vitamin D 300,000 I.U. had significant improvement in their depression score.

When I see any individual who has low mood or depression, I pay particular attention to their vitamin D level. It's almost always low. With proper vitamin D supplementation, I bring their vitamin D level into the optimal range. In my practice, I find these individuals have more zest for life after proper vitamin D supplementation. Their body aches and pains get less severe and perhaps, that also contributes to their overall sense of well-being.

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Chapter **21**

Vitamin D Deficiency And Neurologic Diseases

Vitamin D is an important hormone for normal brain development. In addition, it is also important for the normal functioning of the brain.

Is there any evidence to link vitamin D deficiency to neurologic disorders? There is strong, clinical evidence for the relationship between vitamin D deficiency and Multiple Sclerosis (M.S.),as I explained in Chapter 10. Let's explore if there is any credible evidence to link vitamin D deficiency to other neurologic diseases such as Dementia, including Alzheimer's disease, Parkinson's disease and Autism.

Vitamin D Deficiency And Dementia

An interesting study (1) from the University of Angers, France was published in 2011 in *Dementia and Geriatric Cognitive Disorders*. In this study, investigators divided 40, high functioning women into two groups Those who had 25 (OH) vitamin D level of less than10 ng/ml and those who had 25 (OH) vitamin D level of more than10 ng/ml. After a 7-year follow-up period, women who had severe vitamin D deficiency (level less than10 ng/ml) at baseline were more likely to develop dementia.

The same authors from France published another study (2) in 2013 in the journal of Alzheimers' Disease. They performed an analysis of pooled data (meta-analysis) from nine case-control studies. They concluded that the patients with Alzheimer's disease had lower levels of vitamin D than their matched-control group.

A study (3) from McMaster University in Hamilton, Canada was published in Neurology in 2012. These authors also did a meta-analysis of thirty-seven studies and concluded that low vitamin D was associated with the risk of developing Alzheimers' disease

Then, there was another study (4), published in 2012 in *Cognitive and Behavioral Neurology* from the same researchers in France. In this interesting study, there were three

groups: those treated with memantine (brand name Namenda) alone, those treated with Vitamin D alone, and those treated with a combination of Memantine and vitamin D. At six months, the combination treatment group performed better on a cognition test, called Mini-Mental State Examination (MMSE). Interestingly, the vitamin D alone group did as well as the Memantine alone group. These findings suggest a potential role of vitamin D in treating patients with Alzheimer's disease.

Vitamin D Deficiency And Parkinson's Disease

Parkinson's disease is a degenerative disease of the brain. Usual symptoms of Parkinson's disease include tremors, muscle rigidity, difficulty walking and changes in speech. So far all the medicines to treat Parkinson's disease actually simply control the symptoms, while the disease itself continues to progress with time.

Can vitamin deficiency be playing a role in the causation of Parkinson's disease. The answer is perhaps! There is some experimental evidence to link vitamin D deficiency to Parkinson's disease. Researchers from Rutgers, the State University of New Jersey, published an article (5) in the Journal of Movement Disorder in 2007. They believe that vitamin D deficiency may be playing a significant role in causing Parkinson's disease.

An excellent study (6) came in 2014 from Harbin Medical University, China. These researchers found the risk of Parkinson's disease to be low in people who are regularly involved in outdoor activities and/or take vitamin D.

Due to difficulty in walking that occurs as a result of Parkinson's disease itself, these people are at high risk for falling and fracturing their already weakened bones due to vitamin D deficiency. These patients can benefit tremendously from properly building up their vitamin D levels, which have been shown to strengthen muscles and bones and decrease the risk of fractures.

Vitamin D Deficiency And Autism

An interesting study (7) was published in 2012 in the *Journal of Neuroinflammation*. These researchers from King Saud University in Riyadh, Saudi Arabia measured 25 (OH) vitamin D and anti-myelin-associated glycoprotein (anti-MAG) auto-antibodies in autistic children. Myelin is an insulating material that form sheaths around the nerve fibers, and is crucial for the normal functioning of the brain. They discovered that 25 (OH) vitamin D was less than 30 ng/ml in 48% of autistic children. Increased levels of anti-MAG auto-antibodies were found in 70% of autistic children. Interestingly, vitamin D level had an *inverse*

correlation with the level of anti-MAG auto-antibodies. In other words, the lower the vitamin D level, the higher the level of anti-MAG auto-antibodies. It does make sense. Vitamin D deficiency is now an established factor in causing autoimmune diseases. Can vitamin D deficiency lead to an immune-mediated attack on myelin and induce neurologic changes of autism?

A clinical review article (8) was published in 2012. These authors from the University of Glasgow, UK concluded there is some evidence to link vitamin D deficiency during pregnancy or early childhood to trigger autism in genetically susceptible individuals. Certainly more research is needed in this area.

Vitamin D Deficiency And Amyotrophic Lateral Sclerosis (ALS)

An exciting study (9) from Mayo Clinic, Rochester, USA, was published in 2013 in the Journal of Clinical Neuroscience. Researchers checked vitamin D level in 37 patients with ALS. Eighty-one percent of patients had a vitamin D level lower than 30 ng/mL. Twenty patients were given 2000 I.U. of vitamin D daily. They followed these patients over a 9 month follow-up period for a change in Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS-R) score, and any side effects from vitamin D. ALSFRS-R scores were compared between patients who took vitamin D and those who did not. Amazing discovery. The ALSFRS-R score improved in patients taking vitamin D. No side effects secondary to vitamin D supplementation were reported. Researchers concluded that vitamin D supplementation at 2000 I.U. daily was safe over a period of 9 months and may have a beneficial effect on ALSFRS-R scores for patients with ALS.

Vitamin D Deficiency And Myotonic Dystrophy

Myotonic dystrophy is a chronic, slowly progressing disease which can affect various organs in the body. It is inherited with autosomal dominant pattern.

Myotonic dystrophy is characterized by wasting of the muscles, called muscular dystrophy. Also muscles are difficult to relax, called, myotonia. Two types of myotonic dystrophy exist, Type 1 and Type 2.

Could there be an association between vitamin D deficiency and muscular impairment in patients with muscular dystrophy? The answer is perhaps. A breakthrough study (10) from University of Milan, Italy, was published in 2013. Researchers assessed vitamin D level, Parathyroid Hormone (PTH) and muscle parameters in 31 males with Type 1 myotonic

dystrophy, 13 males with Type 2 myotonic dystrophy and 32 healthy controls. Vitamin D level was low in 88% of myotonic dystrophy patients. Secondary hyperparathyroidism due to vitamin D deficiency was diagnosed in 18% of patients. Serum 25 (OH) vitamin D levels *inversely* correlated with PTH levels. In other words, the lower the vitamin D level, the higher the level of PTH. The levels of PTH *positively* correlated with muscle dysfunction. In other words, the higher the PTH level, the more significant muscle dysfunction. It is likely that vitamin D deficiency may be responsible for muscular dysfunction by causing an elevation in PTH level.

Future Direction

In a recently published provocative experimental study (11), researchers from Aix-Marseille University in Marseille, France demonstrated that vitamin D can repair damaged neurons. They treated rats with an injured nerve of the lower leg, with vitamin D3 or vitamin D 2 at the dose of 100 or 500 I.U./kg/day. They observed that vitamin D3 is more efficient than Vitamin D2 and when delivered at a high dose (500 I.U./kg/day), vitamin D3 induces a significant locomotor and electrophysiological recovery in rats with injured nerve in the legs. A truly breakthrough research finding, which has huge implications for treating neurologic diseases.

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Chapter **22**

Vitamin D Deficiency During Pregnancy and Breastfeeding

A majority of pregnant women are low in vitamin D. Compared to women with fair skin, women with dark skin are even more likely to be vitamin D deficient. According to a study (1) from University of Pittsburgh, USA, 54% of black, pregnant women and 47% of white, pregnant women living in the northern USA were low in vitamin D, despite taking prenatal vitamins. In addition, this study found 46.8% of black newborns and 56.4% of white newborns to be low in vitamin D.

Pregnant women who are low in vitamin D are not limited to the USA, but are a worldwide public health problem. A study from Belgium (2) revealed that 88% of the pregnant women in the area of Liege, Belgium were low in vitamin D.

In a study from Sanjay Gandhi Postgraduate Institute of Medical Sciences, India (3), researchers found 84% of the pregnant women living in sun-drenched India were deficient in vitamin D.

Why Are Pregnant Women Low In Vitamin D?

Most women are low in vitamin D before they become pregnant. The problem simply gets worse during pregnancy. Many pregnant women stay indoors for a variety of reasons. Most women feel nauseated during early pregnancy. Later in the pregnancy, there's a lot of discomfort and fatigue. Staying indoors and resting is therefore quite common during pregnancy.

Don't Rely On Prenatal Vitamins For Your Vitamin D Needs.

Many pregnant women take a prenatal vitamin assuming it meets all of their vitamin requirements. Think again! Prenatal vitamins contain only a small dose of vitamin D - 600 I.U.; Studies (1, 4) have documented that many pregnant women and their newborns have low levels of vitamin D despite taking prenatal vitamins. My own clinical experience testifies to it.

Can Vitamin D Deficiency In The Mother Cause Vitamin D Deficiency In The Newborn?

The answer is yes. The growing fetus derives vitamin D from his/her mother. Therefore, low vitamin D in the mother leads to low vitamin D levels in the fetus. Several studies have found newborns to be low in vitamin D if their mothers were low in vitamin D.

EFFECTS OF VITAMIN D DEFICIENCY

Scientific studies show that low vitamin D during pregnancy may jeopardize the health of the mother as well as the newborn baby.

Studies show the following effects of low vitamin D in pregnant women and their newborns.

Risks To Mother:

1. High Risk for Gestational Diabetes

In the second half of pregnancy, some pregnant women develop gestational diabetes. The known underlying mechanism for gestational diabetes is insulin resistance caused by a variety of factors including placental hormones. Now, we know that vitamin D deficiency worsens insulin resistance and therefore, it is intuitive to consider vitamin D deficiency as one of the factors that causes gestational diabetes. In a study (5) from Royal North Shore Hospital, Australia, researchers found that pregnant women who were low in vitamin D had an increase in fasting blood glucose, blood insulin level and insulin resistance.

2. High Risk for Preeclampsia in Pregnant Women

Preeclampsia is a serious, potentially life-threatening condition that some women develop during the second half of their pregnancy. When a pregnant woman develops preeclampsia, her blood pressure becomes elevated, her ankles swell up and there is excessive wasting of proteins in the urine. There is a real danger to the life of the mother as well as the baby.

In an excellent study (6) from University of Pittsburgh, USA, researchers found that pregnant women who had low vitamin D had a 5-fold increase in the risk of preeclampsia. Studies have also shown that proper vitamin D supplementation (about 1200 I.U. a day) during pregnancy can reduce the risk for hypertension and preeclampsia.

3. Increased Risk for Cesarean Section

An interesting study (7) from Boston University, USA, showed that pregnant women with a low level of vitamin D are at high risk for cesarean section. In this study, researchers found that pregnant women who were low in vitamin D were *4 times* more likely to have a cesarean section compared to women with an adequate level of vitamin D.

Risks To Newborn:

1. Low Birth Weight

Vitamin D plays an important role in the growth of the fetus. Scientific studies have documented that babies born to mothers with low vitamin D level are likely to have low birth weight.

2. Rickets and Soft Skull Bones (Craniotabes) at Birth

Vitamin D plays a vital role in the development of fetal bones. Deficiency of vitamin D can cause a delay in the maturation of the bones and can result in rickets and craniotabes. Rickets refers to bone deformities in children due to vitamin D deficiency. Craniotabes refers to soft skull bones at birth.

Rickets typically causes deformity of the bones of the legs, chest wall and generalized weakness of muscles. A study (8) from All India Institute of Medical Sciences, India, evaluated 98 infants and their mothers for vitamin D status and rickets. Rickets was present in 30% of infants with markedly low vitamin D levels [25 (OH) vitamin D less than 10 ng/ml.] Intake of vitamin supplement, sunlight exposure and mother's 25 (OH) vitamin D were predictors of infants' 25 (OH) vitamin D levels.

Craniotabes is the medical term for the soft skull bones at birth. It's diagnosed if the examiner's fingers can bend skull bones, which then pop back after pressure is released. It's also called "ping-pong ball skull."

Craniotabes can affect up to 30% of otherwise normal newborns. It is presumed to spontaneously heal in most cases by 2-3 months. This has led to the notion (without any scientific background) that physicians need not pay much attention to this condition.

What is the cause of craniotabes? Japanese researchers investigated and found the answer: vitamin D deficiency! In an excellent study (9) from Kyoto University Hospital, Japan, researchers found that the incidence of craniotabes was inversely related to sun exposure during the last *four* months of pregnancy. Incidence was highest if delivery took place during spring, because the pregnant mother had less exposure to the sun during the preceding winter. The incidence of craniotabes was lowest if delivery took place in fall because the pregnant mothers had more sun exposure during the preceding summer.

They also checked vitamin D, parathyroid hormone and x-rays of the hand in infants with craniotabes at one month of age. The results were amazing. Vitamin D level turned out to be low in the vast majority (over 90%) of these infants. More than one third even had early rickets. Those who were solely breast fed without any formula (formula contains vitamin D) had even lower levels of vitamin D. Ten percent of these infants even had secondary hyperparathyroidism. To learn more about secondary hyperparathyroidism, please refer to Chapter 6**:** Vitamin D Deficiency and Body Aches, Pains and Chronic Fatigue Syndrome

3. Decreased Bone Mass in Childhood

Vitamin D is extremely important for the health of bones. Vitamin D starts playing this vital role before you are born, while you are still in the uterus. The effects of low vitamin D on the fetus not only make bones weak at birth, but also appears to continue to adversely affect bones for the rest of childhood and perhaps adult life as well.

In a study (10), researchers from University of Southampton, U.K. followed children born to women with low vitamin D and measured their bone mass at age 9. The researchers were amazed to find that children with low vitamin D level at birth had low bone mass at age 9 compared to those children who did not suffer from vitamin D deficiency at birth. It appears that vitamin D deficiency during fetal development has long term negative effects on the health of bones.

4. Asthma and Type 1 Diabetes During Childhood.

Vitamin D plays an important role in the development of the immune system of the fetus. Therefore, newborns low in vitamin D are at increased risk for autoimmune diseases such as Type 1 diabetes and asthma.

In one study (11) from Harvard Medical School, USA, researchers found that vitamin D intake of pregnant women had an inverse relationship with the development of asthma in their child. In this study, pregnant women taking a higher dose of vitamin D of about 800 I.U. a day significantly reduced the risk of developing asthma in their child compared to women taking a lower dose of about 400 I.U. a day.

In another study (12), researchers from Finland found infants who received a large daily dose of vitamin D (2000 I.U. per day) had an amazing 80% risk reduction for the development of Type 1 diabetes.

5. Maternal Vitamin D Deficiency can also cause other medical problems in infants. These include under-developed teeth, congestive heart failure, low blood calcium and tetany. Tetany refers to involuntary spasms of muscles.

In summary, maternal vitamin D deficiency leads to deficiency of vitamin D in the fetus. Vitamin D deficiency poses risks to the health of the mother as well as the newborn. Moreover, it appears that the imprints of vitamin D deficiency during fetal life persists throughout childhood and perhaps, even into adult life and contributes to a number of chronic illnesses such as asthma, Type 1 diabetes and weak bones.

Therefore, by simply ensuring a good level of vitamin D during pregnancy and infancy, you can give your offspring a healthy start in life.

Low Vitamin D In Breast-fed Infants

Women who breastfeed their infants need more calcium, because calcium is an important ingredient of milk. Therefore, they need more vitamin D, because vitamin D is vital in the absorption of calcium from the intestines.

Breast milk has very little vitamin D. Therefore, women who breastfeed their infant must take a good dose of vitamin D themselves and also give their baby at least a daily dose of 600 I.U. of vitamin D.

Most pediatricians know that human milk is very low in vitamin D. However, what many pediatricians may not know is that low vitamin D in human milk is a reflection of low vitamin D in the lactating mother. It was brilliantly pointed out in a study (13) from Medical University of South Carolina, USA. The researchers showed that the milk of lactating women who had an adequate level of vitamin D contained vitamin D equal to the amount contained in infant formula.

In a novel study (14) from The Aga Khan University Hospital, Pakistan, researchers assessed vitamin D levels in seventy-one nursing mothers and their breastfed infants. Thirty-four mothers (48%) and 37 infants (52%) had *severely* low vitamin D levels (less than 10 ng/mL). A significant correlation was found between serum 25 (OH) vitamin D levels of infants under three months of age and their mothers. Significantly higher levels of vitamin D were found in uneducated mothers, mothers of lower socio-economic class and in those living in mud houses. The researchers found a high prevalence of vitamin D deficiency in nursing mothers and their infants predominantly in the upper socioeconomic class. These mothers of high socioeconomic status in Pakistan tend to follow a western life-styl e, avoiding the sun at all costs, applying sunscreen when outdoors and sheltering their infants from sun-exposure as well.

“So, What Should I Do?”

Get your vitamin D level checked if you plan to get pregnant. Try to get your vitamin D at a good level even before pregnancy. Continue proper vitamin D supplementation during and after pregnancy. Have your vitamin D level checked at least every 2 months during and after your pregnancy. Please note that if you breastfeed your baby, you need even more vitamin D supplementation. For details, please refer to Chapter 26, Treatment of Vitamin D Deficiency.

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Chapter **23**

Vitamin D Deficiency In Children And Teenagers

Vitamin D deficiency is common among children and teenagers. Unfortunately, it remains undiagnosed and untreated. Consequences of vitamin D deficiency during childhood include rickets, decrease in overall strength of bones, a defective immune system, frequent colds, asthma, inflammatory bowel disease, Type 1 diabetes and dental problems.

Vitamin D Deficiency Is Common Among Children

In a study (1) Children's Hospital in Boston, USA, researchers noted vitamin D level to be low in 40% of infants and toddlers. They also noted X-rays changes of rickets in 7.5% and weak bones in 32% of infants and toddlers in this study. These were otherwise healthy children, attending primary care clinics in the USA. This certainly contradicts the belief that rickets doesn't exist in the USA anymore.

In another study (2,) researchers from Medical College of Wisconsin, USA, reported vitamin D to be low in 74% of obese children and adolescents in the Wisconsin area.

In a study (3), researchers checked vitamin D level of Chinese adolescent girls in Beijing and found 89% to be *markedly* low in vitamin D [25 (OH) vitamin D levels less than 20 ng/ml.

Vitamin D deficiency is not limited to the USA, Europe and China, but is a global phenomenon. It's reported to be prevalent in sunny countries such as New Zealand, India, Pakistan, Bangladesh as well as countries in the Middle East.

What Causes Vitamin D Deficiency In Children?

Vitamin D deficiency does not spare children of any geographic location or any race or ethnicity. However, the following factors do make children and teenagers more susceptible

to vitamin D deficiency:

Less exposure to the sun for a variety of reasons including:

A. *Sun phobia among parents*. Avoidance of sun exposure as well as high usage of sunscreen when outside.

B. *Cultural customs* (very prevalent in certain countries) to cover most of the body with clothing.

C. *High latitudes* such as in Canada, the Northeastern USA and northern Europe.

Low milk consumption among toddlers contributes to vitamin D deficiency.

Skin pigmentation decreases the skin's ability to synthesize vitamin D from sun exposure. Therefore, children of African American, Asian and Hispanic descent are even more likely to have vitamin D deficiency.

Obesity is another important factor that causes vitamin D deficiency. Because vitamin D is fat soluble, fat traps vitamin D. Therefore, less vitamin D is available for the rest of the body.

Certain medical conditions such as malabsorption, chronic kidney disease and anti-epilepsy drugs can further lower vitamin D level.

Effects Of Vitamin D Deficiency In Children

1. RICKETS

Severe vitamin D deficiency during childhood causes bones to be so weak that they become deformed. In medical terms, it's called Rickets. In addition, these children also have stunted growth, a deformed chest, muscle weakness and bone pains.

Rickets, once thought to have been almost eradicated in the USA, has re-emerged. Cases of rickets are being reported from states in the north such as Massachusetts and Alaska, but also from sunny states such as Texas and California.

Rickets is being reported all over the world, from countries such as the UK, India, Bangladesh and several countries in the Middle East.

2. DECREASED MUSCLE STRENGTH

Vitamin D is important for the health of muscles. Low vitamin D can lead to muscle weakness. In a study (4) from the University of Manchester in the UK, researchers found vitamin D level to have a direct correlation with muscle strength among teenagers. The higher the vitamin D, the better the muscle strength; the lower the vitamin D, the lower the muscle strength.

3. DECREASED BONE STRENGTH

During childhood and especially during teenage years, you're building your bones. Vitamin D plays a crucial role in building strong bones. This is because vitamin D is important for the absorption of calcium and phosphorus from the intestines and then, in incorporating calcium and phosphorus into the bones. Vitamin D deficiency exerts its deleterious effects on the bones.

A study (5) from University of Helsinki, Finland showed that 62% of adolescent girls were severely low in vitamin D during winter. These otherwise healthy girls had a significant decrease in bone strength as measured by a DXA (Dual energy X-ray Absorptiometry) machine.

In a study (6) from the University of Sydney in Australia, researchers found that 58% of Chinese adolescent girls were low in vitamin D level. Low vitamin D status was associated with low bone density and low muscle strength.

In a study (7) from the University College in Cork, Ireland, researchers found that low vitamin D status adversely affected the bone density of adolescent girls. Those with a good level of vitamin D had stronger bones.

4. HIGH RISK FOR OSTEOPOROSIS

You achieve most of your bone strength (technically called bone density) during adolescence. By the approximate age of twenty five, most of your bone density is achieved. Technically, we call it peak bone density. From here onwards, bone density starts to decline. In later years of life, bone density may decrease to a point where bones can fracture very easily after a trivial trauma. This is called osteoporosis.

It's crucial to achieve a good bone density during adolescence. If vitamin D is low during adolescence, you'll have sub-optimal peak bone strength and suffer from osteoporosis at an earlier age.

5. DENTAL PROBLEMS

Teeth are a form of bone. Vitamin D plays an important role in the health of your teeth. While brushing your teeth is a good thing, don't forget about vitamin D.

6. DEFECTIVE IMMUNE SYSTEMS

As discussed in earlier in Chapter 10, Vitamin D Deficiency and Autoimmune Disorders, vitamin D is essential for keeping the immune system functioning normally. Vitamin D deficiency leads to a defective immune system. Consequently, children low in vitamin D are at increased risk for frequent colds, asthma, inflammatory bowel disease, multiple sclerosis and Type 1 diabetes, and even food allergies.

In an excellent study (8) from The University of Melbourne, Australia, researchers investigated vitamin D levels in infants with food allergies. Infants with low vitamin D (less than 20 ng/mL) were more likely to be allergic to peanut and/or egg as compared to those with adequate vitamin D levels. The authors concluded that an adequate level of vitamin D may be an important factor to prevent food allergy in the first year of life.

7. INSULIN RESISTANCE SYNDROME (METABOLIC SYNDROME)

As I mentioned earlier, Insulin Resistance Syndrome, also known as Metabolic Syndrome, has reached pandemic proportions. What is more alarming is that it is becoming more prevalent among teenagers. Obesity, stress and lack of exercise are three main factors for Insulin Resistance Syndrome. Some of the consequences of Insulin Resistance Syndrome include diabetes, polycystic ovary syndrome, high blood pressure, heart attacks and cancer. Vitamin D is low in obese individuals because vitamin D is fat-soluble and gets trapped in fat. Researchers have been curious to find out if vitamin D deficiency plays a role in Insulin Resistance Syndrome. I believe it does. There is sufficient scientific evidence to link vitamin D deficiency to insulin resistance.

Can vitamin D supplementation treat insulin resistance? In one recent provocative study (9) from the University of Missouri, USA, researchers gave a daily dose of 4000 I.U. of vitamin D3 to obese adolescents. They measured markers of insulin resistance at baseline and then at 3 and 6 months. They observed an improvement in markers of insulin resistance with vitamin D supplementation. The authors concluded that the correction of poor vitamin D status through dietary supplementation may be an effective addition to the standard treatment of obesity and associated insulin resistance.

My Recommendations To Parents Of Children and Teenagers

Don't let your child miss the opportunity of building strong bones!

Sensible Sun Exposure and Vitamin D supplement

Most children and teenagers, like the rest of society, often use sunscreen whenever they are outdoors. Therefore, they hardly get any vitamin D from the sun. If your child doesn't have a history of cancer caused by the sun or any other medical reason to avoid the sun, you should probably let your child be outdoors without sunscreen for about 15-30 minutes a day if their skin is fair or 60-120 minutes if their skin is dark. However, ask your child's health care provider if this amount of sun exposure is appropriate for your child.

In addition, encourage your child to take a vitamin D3 supplement every day. The appropriate amount of vitamin D for your child depends on their size.

DAILY DOSE OF VITAMIN D FOR CHILDREN AND TEENAGERS

Daily dose of vitamin D depends upon your body weight. I recommend 1000 I.U. of vitamin D3 for every 20 Lbs. of body weight.

Two other important factors in this regard are good calcium intake and weight bearing exercises. Dairy products such as milk, cheese and yogurt are good sources of calcium. Weight bearing exercises include power (fast) walking, jogging and running. So go outdoors, jog, run and play real sports such as soccer, basketball and tennis. Have fun and build strong bones at the same time.

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1. Gordon CM, Feldman HA, et al. Prevalence of vitamin D deficiency among healthy infants and toddlers. *Arch Pediatr Adolesc Med*. 2008;162:505-512.

2. Alemzadeh R, Kichler J. Hypovitaminosis D in obese children and adolescents: relationship with adiposity, insulin sensitivity, ethnicity, and season. *Metabolism.* 2008;57(2):183-191.

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Chapter **24**

Vitamin D Deficiency In The Elderly

Vitamin D deficiency is rampant among the elderly. In one study (1) from Oregon University, USA, researchers found that 72% of older men in the USA were low in vitamin D. What's alarming is that most of these men were taking vitamin D supplements. The level of vitamin D was particularly low among obese, sedentary men living in the northern states.

What Causes Low Vitamin D in the Elderly?

A. Less sun exposure

In general, the elderly spend most of their time indoors due to medical illnesses and physical limitation, such as arthritis and heart disease. Often, they end up in hospitals and nursing homes. Vitamin D is the last thing on anyone's mind when you are in a hospital or a nursing home. A study (2) from University of Iceland reported that 72% of elderly patients (men and women) in the hospital were low in vitamin D.

B. Aging causes thinning of the skin

Thin skin is much less capable of synthesizing vitamin D than the thick skin of a young person.

C. Inadequate level of Vitamin D in multivitamins

Vitamin D present in most multivitamins is usually 600 I.U. per day, which is inadequate. That's why these individuals continue to be low in vitamin D despite taking vitamin D supplements.

D. Abdominal Illnesses

The elderly often suffer from a variety of abdominal illnesses which further impair the

absorption of vitamin D. These illnesses include Ulcerative Colitis, and partial resection of the pancreas, stomach or intestines.

E. Some medications interfere with the absorption of vitamin D

Older patients are more likely to take medications which interfere with the absorption of vitamin D. These medications include: Phenytoin (brand name Dilantin), Phenobarbital, Rifampin, Orlistat (brand names Xenical and Alli), Cholestyramine (brand names Questran, LoCholest and Prevalite), and Steroids. In particular, steroids can cause a severe deficiency of vitamin D.

F. Chronic Kidney Insufficiency

Most elderly patients suffer from some degree of chronic kidney insufficiency caused by aging itself and also due to diseases such as diabetes, hypertension and hardening of the arteries.

These individuals are low in vitamin D to start with. In addition, now they become less efficient in converting vitamin D into its active form, 1, 25 $(OH)_2$ vitamin D. Double whammy!

EFFECTS OF LOW VITAMIN D

1. Fatigue

Low vitamin D is one major cause of fatigue that most elderly people experience. In a study (3), researchers from the University of Maryland, USA, found a direct association between low vitamin D level and weakness and exhaustion among men 65 years or older.

2. Body aches and pains

Vitamin D deficiency is a major cause of body aches and pains in the elderly. Low vitamin D can lead to secondary hyperparathyroidism which then results in body aches and pains. For details, see Chapter 6, Vitamin D Deficiency and Body Aches, Pains and Chronic Fatigue Syndrome.

3. Osteoporosis

Vitamin D plays a pivotal role in the health of your bones. Low vitamin D leads to weakening of bones, which is technically called osteopenia (early stage) or osteoporosis (more advanced stage).

4. Falls

Vitamin D is important for the health of muscles, joints and bones. Vitamin D deficiency in the elderly causes muscles and bones to weaken. In addition, the elderly often have arthritis and osteoporosis. Consequently, they can easily fall and fracture their bones, which can have devastating effects on quality of life at this age.

5. Heart disease

Vitamin D deficiency increases your odds of having coronary heart disease. For details, see Chapter 12, Vitamin D Deficiency and Heart Disease. An epidemic of coronary heart disease in the elderly may in part be due to the epidemic of vitamin D deficiency.

6. High Blood Pressure (Hypertension)

Vitamin D deficiency is known to increase blood pressure by activating the Renin Angiotensin Aldosterone System (RAAS). For details, see Chapter 15 on Vitamin D Deficiency and High Blood Pressure (Hypertension). Most elderly are low in vitamin D and also have high blood pressure. The correlation is pretty obvious. Hypertension in the elderly is at least in part due to vitamin D deficiency.

7. Diabetes

Almost all elderly with diabetes have Type 2 diabetes which is caused by a process in your body called insulin resistance. Vitamin D deficiency worsens insulin resistance and thus, contributes towards diabetes. For more information, see Chapter 13, Vitamin D Deficiency and Diabetes.

8. Cancer

Most elderly perhaps fear cancer the most, as it's so prevalent in old age. Vitamin D deficiency is well recognized as a risk factor in causing cancer, especially cancers of the colon, breast and prostate, three major cancers of old age. For more information see Chapter 11, Vitamin D Deficiency and Cancer.

9. Depression

An extremely common problem in the old age. Vitamin D deficiency probably plays some role in depression. For more information, see Chapter 20, Vitamin D Deficiency and Depression.

10. Memory Loss and Parkinson's Disease

Vitamin D is important for the health of our brain. High prevalence of memory loss and Parkinson's disease in the elderly may in part be due to vitamin D deficiency. For more information, see Chapter 21, Vitamin D Deficiency And Neurologic Diseases.

"What Should I Do?"

Perhaps now, you understand the importance of vitamin D in *preventing* so many afflictions in the elderly. Even if you have one of these conditions, proper vitamin D supplementation can help a great deal. For details, please refer to Chapters 25 and 26, Diagnosis and Treatment of Vitamin D Deficiency.

References:

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Chapter **25**

Diagnosis
Of
Vitamin D Deficiency

It's easy to diagnose vitamin D deficiency: It's a simple blood test. That's all! However, it needs to be the right test and must be interpreted properly! And that's where a lot of problems arise.

What's The Right Test To Diagnose Vitamin D Deficiency And Why?

Laboratories offer two tests to determine vitamin D level in the blood. In vitamin D deficiency, one of them is low whereas the other one is often normal. Most physicians don't know the distinction between these two tests and may order the wrong test. Consequently, they may say your vitamin D level is normal, when it's actually low.

The right blood test to evaluate your vitamin D status is: 25 (OH) vitamin D (25-hydroxy vitamin D).

The other blood test for vitamin D is 1,25 $(OH)_2$ vitamin D (1,25 dihydroxy vitamin D). *This is the wrong test to diagnose vitamin D deficiency! Why?*

There are two reasons why 25 (OH) vitamin D and **not** 1,25 $(OH)_2$ vitamin D is the right test to diagnose vitamin D deficiency.

Reason 1:

25 (OH) vitamin D stays in your blood for a much longer period of time (half life of about 3 weeks) compared to 1,25 $(OH)_2$ vitamin D (half life of about 14 hours). Therefore, 25 (OH) vitamin D more accurately reflects the status of vitamin D in your body.

Reason 2:

As vitamin D deficiency develops, your body increases production of parathyroid hormone by the parathyroid glands situated in your neck. Parathyroid hormone increases the conversion of 25 (OH) vitamin D into 1,25 $(OH)_2$ vitamin D. Consequently, 1,25 $(OH)_2$ vitamin D level in the blood will stay in the normal range (and can even be high) even if you're low in 25 (OH) vitamin D.

Why Are The Normal Ranges For 25 (OH) Vitamin D Reported By Some Laboratories Inaccurate?

The normal ranges for vitamin D come from the era when our concern was just to prevent rickets. A small dose of vitamin D is enough to prevent rickets. Therefore, a level of 25 (OH) vitamin D of 10 ng/ml (25 nmol/L) or above was established as adequate to prevent rickets. That's why some laboratories report 10 ng/ml (25 nmol/L) as the lower limit of the normal range.

However, in recent years our understanding of the effects of vitamin D has dramatically changed. Now, we understand that vitamin D can do much more than simply prevent rickets. In fact, vitamin D is crucial for maintaining many vital functions in the body, such as a healthy immune system and a healthy heart. In addition, an adequate level of vitamin D helps prevent diabetes, osteoporosis and cancer, as discussed earlier.

To achieve these goals, many experts in the field (including myself) recommend a level of 25 (OH) vitamin D to be at least 30 ng/ml (75 nmol/L). An excellent review of scientific studies (1)

comes from Harvard School of Public Health in Boston, USA, in which authors concluded that the most beneficial blood level of 25 (OH) vitamin D starts at 30 ng/ml (or 75 nmol/L).

Unfortunately, many laboratories continue to report a normal range with the lower limit of 10 ng/ml (25 nmol/L). Now, imagine the following scenario: Your 25 (OH) vitamin D level is 21 ng/ml. Your physician interprets this as normal, because it's in the "normal range" provided by the laboratory. However, you are actually quite low in vitamin D! This happens all too frequently.

Watch Out For The Units Used By The Laboratory

There is another problem that many physicians are unaware of. Different laboratories report vitamin D level in different units. In the USA and around the world, most laboratories report 25 (OH) vitamin D in one of two ways: either as ng/ml or nmol/L.

The conversion factor from ng/ml to nmol/L is about 2.5. For example, if your level is 30 **ng/ml**, you multiply it by 2.5 and will get a number of 75 in **nmol/L**. The lower limit of normal for 25 (OH) vitamin D should be **30 ng/ml or 75 nmol/L**.

Now, let's assume that you are fortunate enough to have a physician who keeps up with the latest information and is proactive about vitamin D supplementation. From attending conferences and reading articles on vitamin D, your physician may simply remember that the lower limit of normal for 25 (OH) vitamin D is 30 (and that's how most physicians remember - just the numbers, without paying attention to the units).

Here's another treacherous case scenario: Your laboratory reports your 25 (OH) vitamin D to be 40 **nmol/L.** Your physician simply looks at the number 40 and tells you your vitamin D is good. In his mind, it's more than 30, so you're fine. In fact, your vitamin D is low because in reality, a level of 40 **nmol/L** is equal to 16 **ng/ml.!!** He totally forgot to look closely at the units.

Also, note that the upper limit of normal as reported by many laboratories is also inaccurate. The upper limit of normal should be 100 ng/ml (250 nmol/L).

Reference:

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Chapter **26**

Treatment Of Vitamin D Deficiency

Most physicians do not know how to properly treat vitamin D deficiency. Sad but true. Why? Because it's not taught during their medical training. Nor do they have much experience in their clinical practice. It's a new field for them.

What amazes me is the advice given in newspaper articles, such as "Experts recommend either 600 units of vitamin D a day or 15 minutes of sunshine a day is enough to get a good level of vitamin D." Based on my clinical experience, I believe these recommendations to be incorrect.

Why Are Recommendations On The Daily Dose Of Vitamin D Incorrect?

I check vitamin D level in all of my patients. The majority turn out to be low in vitamin D. Many of them take the recommended dose of 600 I.U. of vitamin D a day. Many of them also go out in the sun at least 15 minutes a day in sunny southern California, yet they're still low in vitamin D. Based on this kind of sound clinical evidence, it's clear to me that 600 I.U. of vitamin D a day is insufficient. Fifteen minutes of sunshine a day is also insufficient to get a good level of vitamin D.

Many scientific studies have clearly demonstrated that the current recommended dose of 400-600 I.U. of vitamin D per day is not optimal. An excellent review (1) of these studies was published in the *American Journal of Clinical Nutrition*. The authors concluded that the beneficial blood level of 25 (OH) vitamin D starts at 30 ng/ml (or 75 nmol/L) and these levels of vitamin D can not be achieved in most patients with the daily recommended dose of 400-600 I.U. of vitamin D.

It's also *unscientific* to make general recommendations about how much sun exposure can provide you with enough vitamin D. Why? As discussed earlier in Chapter 4, Natural Sources of Vitamin D, there are many variables that determine how much vitamin D you can

get from the sun.

1. Latitude

In areas north of 44 degrees N latitude, sun rays are less effective in producing vitamin D in the skin during winter months. The farther north you live, the less effective skin synthesis is from sun exposure.

2. Season

In the same region, the sun is less intense during winter months. Consequently, skin synthesis of vitamin D decreases during wintertime.

3. Age

As you grow older, the skin becomes thin and less efficient in synthesizing vitamin D from sun exposure.

4. Skin Color

The darker your skin, the less efficient it is in forming vitamin D from sun exposure.

5. Sun screens

If you use sunscreen (like most people in the USA), then your skin can't form vitamin D even if you live in a sunny area like Los Angeles or Miami.

6. Lifestyle

Obviously, if you stay out of the sun, you can't form vitamin D in your skin. Many people work indoors and choose leisure activities that are indoors. Similarly, if you cover your entire skin due to cultural reasons (like many women in the Middle-East), you can't form Vitamin D from your skin, even though you live in a sunny place.

With so many *variables* determining vitamin D level, how could "spending 15 minutes a day in the sun" be an accurate recommendation? For example, a New Yorker spending 15 minutes a day in the sun will have a different vitamin D level than a Texan. Even in New York, a person with fair skin will have a different vitamin D level than a person with dark skin. A teenager will have a different level than a grandparent. The same New Yorker will have a different level of vitamin D during summer versus winter. You can see why the "15 minutes of sunshine a day recommendation" is flawed. The "one size fits all" approach

doesn't work when you have so many variables!

My Approach To The Treatment Of Vitamin D Deficiency

Over the last fifteen years, I've treated thousands of patients with vitamin D deficiency. Based on my own clinical observations, I've developed a unique, scientific yet practical treatment approach that works well for my patients. My approach to treat vitamin D deficiency is as follows:

1. Assess Vitamin D Status

First of all, I assess and treat every person on an individual basis. I order a 25 (OH) Vitamin D level in the blood to assess vitamin D status. This accurately reflects the impact of all of the *variables* in life style such as geographic location, season, ethnicity, working habits, eating habits, outdoor activities and sunscreen application habits. No guess work. No blind recommendations. To me, this is the most scientific approach in determining one's vitamin D status!

2. Aim For An Optimal Level Of Vitamin D

After the lab test, I discuss the results with my patients. As I wrote earlier, the level of 25 (OH) vitamin D should be at least 30 ng/ml (75 nmol/L). Now, you may ask, "But what is the optimal level of vitamin D?" Based on my extensive experience, I believe the optimal blood level of 25 (OH) vitamin D to be in the range of 50-100 ng/ml (125-250 nmol/L). I feel that a vitamin D concentration at this level is important in order to build strong bones, improve immune function, treat aches, pains, chronic fatigue and prevent and treat cancer, heart disease, osteoporosis, tooth fractures, diabetes, high blood pressure, kidney disease and depression and memory loss.

3. How To Achieve An Optimal Level Of Vitamin D

I discuss with each individual patient various options they can utilize in order to achieve an optimal level of vitamin D.

You can get Vitamin D from Four Sources:

A. Sun exposure

B. Diet

C. Vitamin D supplements

D. Ultraviolet lamps

For an average person, it's impossible to get a good level of vitamin D from sun exposure or diet alone. For example, according to my experience, a Caucasian person needs to be out in the sun in southern California in a bathing suit for approximately two to four hours a day to get a good level of vitamin D. In the case of a person with dark skin, the duration of sun exposure will be about ten hours a day. Now how many people can have that kind of lifestyle year round?

In my extensive experience of diagnosing and treating Vitamin D deficiency, I encountered only one person with a good blood level of 25 (OH) vitamin D (above 50 ng/ml without taking any supplements). She was a lifeguard with fair skin who spent about four hours a day, five days a week in the sun in her bathing suit. This amount of sun exposure is not only impractical, but also inadvisable. This degree of sun exposure significantly increases your risk for skin cancer, especially if you have fair skin.

Now consider this: One 8 ounce cup of milk has only 100 I.U. of vitamin D. You'd have to drink 20 - 40 cups a day to get a good level of vitamin D. It's not only impractical, but also inadvisable. Imagine all the calories, the amount of LDL (bad) cholesterol and the natural sugar you'd get from such a huge amount of milk.

A serving of cereal fortified with vitamin D has about 40-80 I.U. of vitamin D. You can imagine how much cereal you'd have to eat to get a good level of vitamin D. There are many negative consequences to eating such a large amount of cereal.

From a practical stand point, I recommend taking advantage of three sources of vitamin D: sun, diet and vitamin D supplements. I never resort to ultraviolet lamps, which are expensive and in my experience, unnecessary.

THE THREE SOURCES OF VITAMIN D

1. Sun Exposure

Sun is an excellent source of vitamin D, but it can also cause skin cancer. Various physicians make extreme recommendations on sun exposure, depending upon their specialty. Dermatologists, with their tunnel vision, exaggerate the fear of skin cancer and recommend avoiding the sun as much as possible. And don't forget to put on sunscreen each time you go outside! On the other hand, physicians solely interested in vitamin D, with their tunnel vision, recommend liberal sun exposure and minimize the fear of skin cancer. In my opinion, both have myopic views, which unfortunately, is a basic flaw inherent to modern

medicine. Physicians think in the narrow range of their own specialty and don't consider the overall whole outlook for the patient.

Sensible approach to sun exposure

Living in the modern world, you can't obtain a good level of vitamin D simply from sun exposure. However, you should try to get some of your vitamin D from the sun.

The aim should be to get as much sun exposure as you can, without getting a sunburn. How long you can stay in the sun without getting a sunburn depends upon your skin type.

In 1975, Thomas Fitzpatrick, MD, PhD, a Harvard Medical School dermatologist, came up with a classification of skin types, known as "The Fitzpatrick Skin Type Classification System." This system classifies complexions and their tolerance of sunlight.

Type I: Light, pale white. Always burns, never tans

Type II: White, fair. Usually burns, tans with difficulty

Type III: Medium white to olive. Sometimes mild burn, gradually tans to olive.

Type IV: Olive, moderate brown. Rarely burns, tans with ease to a moderate brown.

Type V: Brown, dark brown. Very rarely burns, tans very easily

Type VI: Black, very dark brown to black. Never burns, tans very easily, deeply pigmented.

There is a lot of confusion about sun exposure, skin cancer and sunscreen usage. Melanoma is the most lethal form of skin cancer, which typically occurs at areas which are not typically exposed to the sun, such as the upper back and thighs. The melanoma mortality rate has doubled between 1975 and 2010, despite the rise in the use of sunscreens during this time. Most authorities agree that the risk for melanoma include family history, indoor tanning, fair skin, freckles, the number of moles on your skin, exposure to ultraviolet radiation and severe sunburns. Therefore, one should avoid sunburn and tanning booths.

How about sunscreens? There is a lot of confusion, but here are some facts. Both UVA and UVB cause skin cancer. Therefore, do not use sunscreens that provide protection against UVB only. Get sunscreens that protect for both UVA **and** UVB if you are fair skin and want to avoid skin cancer.

What is in the sunscreen also matters. Originally, sunscreens contained Zinc Oxide,

which does not get absorbed through the skin and therefore, does not have any systemic effects on health. However, this type of sunscreen leaves a thick layer of white material on your skin, which is unaesthetic. Therefore, the pharmaceutical industry came with new, aesthetically appealing sunscreens. Unfortunately, these sunscreens typically contain three ingredients which get partially absorbed through the skin and are quite harmful: Retinyl palmitate, Oxybenzone, and parabens. Retinyl palmitate has been shown to increase the rates of cancer. Oxybenzone can cause skin rashes, hives and skin damage. Parabens are linked to an increased risk for breast cancer. Parabens also decrease your testosterone level.

New sunscreen containing micronized Zinc oxide may be a better alternative to traditional Zinc Oxide containing sunscreen for aesthetic reasons.

One should avoid spray sunscreen which causes significant absorption through the lungs and can be quite harmful.

SUNBATHING

Sunbathing in shorts or a bikini is a great way to get vitamin D as well as other benefits of the sun.

Don't sunbath if you have history of skin cancer or any other disease that can worsen with sun exposure.

Here are some tips about sunbathing:

- Don't apply any sunscreen while sunbathing. Remember, a sunscreen with SPF more than 8 will block most UVB and therefore prevent vitamin D synthesis.
- Start out sunbathing with about 2-5 minutes on each side, every day.
- Gradually, increase the duration of sun exposure according to your skin tolerance, which depends upon your skin type.
- A good dose of sun exposure is when your skin gets tanned, or slightly reddish, which fades out in about 24 hours. This is also called Minimal Erythema Dose (MED.)
- Be careful not to get a sunburn.
- A good time to sunbath is in the afternoon, between 1-5 PM. Try to avoid the strong sun at noon.

- Sunny days are better than cloudy days for sun-bathing for the following reason: Clouds decrease the intensity of UVB, but not UVA. Therefore, on a cloudy day, you will get mostly UVA and only small amounts of UVB. Remember, only UVB is responsible for vitamin D synthesis.

- Glass also interferes with UVB, but not UVA. Therefore, sunbathing indoors, next to glass windows in not a good idea.

- In general, people with dark skin need about 5-6 times the duration of sun exposure as compared to fair-skinned individuals in order to synthesize the same amount of vitamin D.

- The duration of sun exposure can be a bit more during winter months and a little less during summer months.

In addition to sunbathing, try to use sleeve-less shirts and shorts in your every day life, if weather and your culture permits.

People with a history of skin cancer should avoid the sun as much as possible and wear sunscreen when they are outdoors.

2. Diet

Diet is **not** a good source of vitamin D. However, you can get some vitamin D from diet. Please note that when you select food, vitamin D should not be the only consideration. You need to take a more comprehensive approach when selecting food, paying attention to overall ingredients.

Different people have different nutritional requirements**,** depending on numerous factors such as age, genetics, weight, metabolism, physical activity, seasonal variation and medical conditions such as diabetes, cholesterol disorder, high blood pressure, heart disease, metabolic Syndrome, menopause symptoms, polycystic ovary syndrome, thyroid disorders and other medical conditions.

As I mentioned earlier, modern medicine suffers from “narrow mindedness” in the sense that every expert gives advice according to his/her specialty without looking at the overall person as a whole. That’s why there are so many different diets, each conflicting with the other, each claiming to be better than the other.

Consider this scenario: In a magazine article, an expert recommends drinking plenty of orange juice because it contains vitamin D. So you start drinking a lot of orange juice without realizing that you’re also consuming large quantities of sugar and potassium in the

orange juice. If you happen to be diabetic, your glucose values will go through the roof. If you have Metabolic Syndrome and are pre-diabetic, your insulin level will skyrocket. If you're an elderly person with diabetes, high blood pressure and kidney failure, your blood sugar will shoot up and your blood potassium may also become elevated, which if not diagnosed and treated appropriately, can be life threatening. As you can see, you can get in a real mess just because you were myopically focusing on improving your vitamin D level.

So, please beware of all ingredients in a food, not just it's vitamin D content.

With this understanding, let us take a closer look at some foods and their vitamin D contents:

MILK

Natural milk does *not* contain vitamin D, but milk in the USA and many other countries is fortified with vitamin D.

However, even fortified milk contains only 100 I.U. per cup (8 oz or 240 ml). *Drink one to two cups a day*. In this way, you get about 100-200 I.U. of vitamin D and other components of milk in a small to moderate amount. Milk is a good source of calcium. It's also a good source of protein and also contains some natural sugar and some fat.

Milk is a much better choice than soft drinks, which are loaded with sugar or other artificial sweeteners which are harmful to your health. Diet drinks have no real nutritional value. Another disadvantage: soft drinks don't have any vitamin D.

People with lactose intolerance obviously should either drink Lactose free milk or avoid milk altogether.

YOGURT

Some yogurts have added vitamin D. Yogurt is also an excellent source of calcium as well as Lactobacillus, a friendly bacteria, which is very important for the health of your intestines.

CHEESE

Some cheeses contain a small amount of vitamin D. Cheeses are fattening and are also loaded with LDL (bad) cholesterol. I advise patients to limit cheeses to reduce weight and also to lower LDL cholesterol.

FISH

Oily fish such as salmon, mackerel and blue fish naturally contain reasonable amounts of vitamin D. The amount of vitamin D in fish remains unchanged if it is baked, but decreases about 50% if the fish is fried. Also, farm raised salmon has only about 25% of vitamin D as compared to wild salmon.

A word of caution about fish consumption!

Too much fish consumption can lead to mercury poisoning. Fish with high mercury content include shark, whale, swordfish, king mackerel, tilefish and tuna (both fresh and frozen tuna). However, canned tuna doesn't seem to be high in mercury because it consists of smaller, shorter-lived species. Fresh water fish which can be high in mercury include bass, pike, and muskellunge.

Therefore, I recommend caution when consuming fish. Moderation is the key. Avoid those fish that contain high levels of mercury. This is particularly true for pregnant women, lactating women, young children and women of child bearing age, as the developing brain of the fetus and newborn is very susceptible to the injurious effects of mercury. For this reason, the Food and Drug Administration recommends that pregnant women, breast feeding women and young children should avoid eating fish with high mercury content.

OTHER FOOD ITEMS

Other foods that contain very small amounts of vitamin D include vegetables, meats and egg yolk.

The following food items are supposed to contain the indicated amount of vitamin D

Cod Liver Oil, 1 Tablespoon = 1360, I.U.	Swordfish, cooked, 3 ounces = 566, I.U.	Salmon, cooked (3.5 ounces) = 360, I.U.
Mackerel, cooked (3.5 ounces) = 345, I.U.	Canned Tuna (3.0 ounces) = 200, I.U.	Sardines canned in oil, drained (1.75 ounces) = 250, I.U.
Raw Shiitake Mushrooms (10 ounces) = 76, I.U.	Fortified Milk, one cup (8 ounces or 240 ml) = 100, I.U.	Yogurt, from fortified milk, 6 ounces = 80, I.U.
Margarine, fortified,1 Tablespoon = 60, I.U.	Fortified Orange Juice, one cup (8 ounces or 240 ml) = 100, I.U.	Fortified Cereal 40-80 I.U. per serving.

Egg, 1 whole (vitamin D is found in the yolk) 20, I.U.	Liver of beef, cooked (3.5 ounces) = 15, I.U.	Swiss cheese (1 ounce) = 12, I.U.

I.U. = International Units

A Word of Caution!

You can't simply rely on the stated quantities of vitamin D in a food item. For example, in one study, researchers found that vitamin D in milk was less than 80% of the stated amount (2). Also, vitamin D content of fish is highly variable.

3. Vitamin D Supplements

From a practical perspective, you don't get enough vitamin D from sun exposure and food. As I mentioned earlier, in my clinical practice in Southern California, I have encountered only one young lady who had a good level of vitamin D from sun exposure alone, without any vitamin D supplement. She was a lifeguard at the beach. For the rest of us, vitamin D supplement becomes the major source of vitamin D.

The Starting Daily Dose Of Vitamin D Supplement

The starting dose of vitamin D supplement varies from person to person. It mainly depends on two factors:

1. What is your vitamin D level?

2. What is your weight?

So, please get your vitamin D level checked and then use the following table as a guide to choose the starting dose of vitamin D3.

25 (OH) Vitamin D level in ng/ml	Dose of Vitamin D3
Less than 10	15,000 I.U. a day
10 - 20	12,500 I.U. a day
20 - 30	10,000 I.U. a day
30 - 40	7,500 I.U. a day
41 - 50	5,000 I.U. a day

Your Vitamin D dose also depends upon your body weight. The heavier you are, the more Vitamin D you need. Why? Because Vitamin D is *fat soluble* and gets trapped in fat. Consequently, less is available for the rest of the body. For this reason, obese people require a larger dose compared to thin people.

The above recommendations are for an average adult, with a weight of about **150 Lbs**. As a guide, add 1000 I.U. for each 20 Lbs. above 150 Lbs. And subtract 1000 I.U. for each 20 lbs. below 150 Lbs.

For some reason, if you cannot get your vitamin D level checked, then here is the formula you can use to calculate the daily dose of vitamin D3. Use 1000 I.U. for every 20 lbs. of your body weight.

Pay Attention To The Units On Your Vitamin D Supplement!

In the USA, the dose of vitamin D is available in I.U. However, in some parts of the world, vitamin D is available in microgram (mcg).

Here is the conversion factor:

40 I.U. = 1 mcg

For example:

400 I.U. = 10 mcg

1,000 I.U. = 25 mcg.

5,000 I.U. = 125 mcg

10,000 I.U. = 250 mcg

50,000 I.U. = 1,250 mcg or 1.25 mg

VITAMIN D2, 50,000 I.U.

When Vitamin D level is below 20, an alternative treatment is to take a high dose of vitamin D2. This is usually given as 50,000 I.U. per week for about 12 weeks. In the USA, you need a physician's prescription for this dose of vitamin D2.

Now vitamin D3 is also available in a dose of 50,000 I.U.

The Maintenance Dose Of Vitamin D Supplement

A common problem arises from traditional medical training which teaches that once your vitamin D stores are replenished, you go back to a daily maintenance dose of 600 I.U. a day. For example, if your vitamin D is very low (let's say less than 15 ng/ml), your physician will likely place you on a high dose of vitamin D2 such as 50,000 I.U. a week for 12 weeks and afterwards, put you back on 600 I.U. a day as a maintenance dose.

Most likely, in the following months, your physician won't check to see what happens to your vitamin D level on this miniscule dose. This kind of practice is based on the medical myth hammered into physicians that once you've replenished vitamin D stores, the problem is somehow cured.

Take a closer look at this myth. Vitamin D stays in your body stores for just a few weeks. Therefore, the "so called cure" of low vitamin D will only last a few weeks and then you'll be back to your usual state of a low level of vitamin D.

For this reason, I check vitamin D level in my patients every three months. What I've discovered is eye opening! In my clinical experience, the maintenance dose of vitamin D depends on the initial starting dose. For example, if a patient requires a high initial starting dose, that patient will need a high maintenance dose. Most people continue to require a high dose of vitamin D to maintain a good level. It makes perfect sense. Why?

It's the overall lifestyle of a person that determines the level of vitamin D. If a person is very low in vitamin D to begin with, it's due to life-style, which in most cases doesn't change after a few weeks of vitamin D therapy. Therefore, it's important to continue a relatively high dose of vitamin D as a maintenance dose, especially in those individuals who are very low in vitamin D to start with.

Most of my patients require a daily dose of 5000 -10,000 I.U. of vitamin D3 to maintain a good level of vitamin D. However, some need up to 15,000 - 20,000 I.U. a day, while others need only 2,000 - 3,000 I.U. a day.

What Type Of Vitamin D? D3 or D2?

Vitamin D2, also known as ergocalciferol, is of plant origin. On the other hand, Vitamin D3, also known as cholecalciferol, is of animal origin. In the natural state, humans synthesize vitamin D3 in their skin upon exposure to the sun. Therefore, I recommend vitamin D3, as this is the physiological type of vitamin D for humans.

Vitamin D: Oral (Swallowing) Or Sublingual (Under The Tongue)?

I recommend the SUBLINGUAL (under the tongue) route for absorption of your Vitamin D supplement as compared to oral ingestion (swallowing). Why? Because sublingual absorption takes vitamin D directly into general circulation, (medically known as systemic circulation), just like when Vitamin D is naturally synthesized in the skin from exposure to the sun. In contrast, vitamin D from oral ingestion is absorbed into local circulation (medically known as portal circulation) from the gut, which takes it to the liver first before entering into systemic circulation. In this way, oral ingestion is not very physiological and sublingual absorption is more physiological. This point becomes even more important in people who have problems with digestion, such as people with pancreatitis, Crohn's disease, Irritable Bowel Syndrome, gluten sensitivity, celiac disease and tropical sprue. It's also a problem for people who take medications that can interfere with intestinal absorption of vitamin D, such as seizure medicines, cholestyramine, orlistat and also for people with stomach bypass surgery, including those with lap-band procedures.

You can get Sublingual Vitamin D3 from online retailers. One such retailer's address is: http://powerofvitamind.com/sublingual_vitamin_d.html

Monitoring Vitamin D Level

I cannot overemphasize the need for close monitoring of your vitamin D level. An individual's response to a dose of vitamin D varies widely. As I mentioned before, because vitamin D is fat soluble, it gets trapped in fat. That means there is less vitamin D available for the rest of the body. Therefore, obese people require a larger dose of vitamin D than lean individuals. As vitamin D is fat soluble, it requires normal intestinal mechanisms to absorb fat. If a person has some problem with fat absorption, such as patients with chronic pancreatitis or pancreatic surgery or stomach surgery, then they may not absorb vitamin D adequately.

During summertime, the sun is stronger and many people spend time outdoors. Therefore, the required dose of vitamin D supplement may go down a bit. In wintertime, the dose of vitamin D may need to go up a bit. However, in a lot of individuals this seasonal variation is little as they mostly stay indoors and apply a good layer of sunscreen when they do go out. The amount of vitamin D people get from their food also fluctuates considerably. In addition, some people take their vitamin D supplement regularly, while others take it sporadically.

Therefore, I check 25 (OH) vitamin D blood level every 3 months and adjust the dose of vitamin D accordingly. My aim is to achieve and maintain a level of 25 (OH) vitamin D in the range of 50-100 ng/ml.

I also check blood calcium to make sure that a person doesn't develop vitamin D toxicity. (See Chapter 28, Vitamin D Toxicity). I recommend monitoring vitamin D and blood calcium level every three months. The blood test for calcium is part of a chemistry panel, usually referred to as CHEM 12 (chemistry 12) or CMP (Comprehensive Metabolic Panel). It's a routine blood test for most people who have an ongoing health issue such as diabetes, hypertension, cholesterol disorder, arthritis, etc.

References:

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Chapter **27**

Vitamin D Supplementation In Special Situations

1. STEROIDS

Because steroids lower your vitamin D, I educate my patients to notify me if another doctor places them on a steroid. When someone takes a high dose steroid in an oral form such as Prednisone or in an injection form such as Solumedrol, Depomedrol or Decadron, I double the dose of vitamin D3 for the duration of steroid intake. In these patients, I check their 25 (OH) vitamin D level every 2 months and change the dose of vitamin D accordingly.

2. MALABSORPTION SYNDROMES

Low vitamin D is extremely common among people with malabsorption syndromes such as Crohn's disease, Celiac sprue, chronic pancreatitis and intestinal, pancreatic or stomach surgeries. In these patients, early diagnosis and treatment of vitamin D deficiency is important or they end up developing another disease, secondary hyperparathyroidism. For details on secondary hyperparathyroidism, see Chapter 6.

In these patients, I check baseline vitamin D level. I find that it is almost always very low. These patients usually require a **large** dose of vitamin D to meet their vitamin D needs. I treat their low vitamin D with doses *twice* as much as my usual strategy to treat vitamin D deficiency discussed in Chapter 26: Treatment Of Vitamin D Deficiency.

I strongly recommend Vitamin D3 as *sublingual* preparation in these individuals.

3. KIDNEY STONES

There is a medical myth that vitamin D supplementation may cause kidney stone formation. For this reason, some individuals may decide not to take vitamin D supplements. Unfortunately, they end up increasing their risk of serious medical conditions such as cancer, diabetes, heart disease, osteoporosis, autoimmune diseases…., as mentioned earlier in this book.

First, let us take a close look why someone develops kidney stones. It is a complex process and varies from person to person. In general, you develop a kidney stone if your

urine becomes supersaturated with calcium, oxalate, phosphate and uric acid. If you are dehydrated, your urine becomes concentrated, which supersaturates stone-forming elements. In addition, these individuals are low in citrate in their urine, which is your defense against stone formation. Low citrate in the urine decreases your ability to prevent stone formation.

Urine pH also plays a vital role in some individuals. For example, a persistently low urine pH (less than 5.5) increases your risk for crystallization of uric acid stone, which often also contains calcium oxalate in it.

Therefore, if you have recurrent kidney stone formation, you need an extensive evaluation by an urologist and endocrinologist to evaluate for the composition of your stone and the metabolic abnormalities that predisposes you to recurrent kidney stone formation. The evaluation by an endocrinologist includes blood and urine tests. Blood tests include Calcium, Phosphate, Parathyroid Hormone (PTH), 25 hydroxy vitamin D, 1,25 dihydroxy vitamin D, Uric acid, Potassium, Chloride and Bicarbonate. Urine tests include pH, Calcium, Oxalate, Uric acid, and Citrate.

The common causes of kidney stone formation include:

- Genetic predisposition for an increased calcium absorption from intestine, excessive excretion of calcium in the urine, or excessive amounts of uric acid in the urine.
- Not drinking enough water, especially during summer months, which makes your urine concentrated. Consequently, your urine gets supersaturated with calcium and oxalate.
- Excessive salt intake which can increase calcium excretion in the urine.
- Excessive meat intake, which increases the amount of uric acid in the urine.
- Gout, in which your urine becomes very acidic (pH less than 5.5), which increases the crystallization of uric acid into stones.
- Intestinal Disorders such as Inflammatory Bowel Disease (IBD), bypass surgery on the stomach, resection of the small intestine or colon and chronic diarrhea from any cause. In these conditions, there is an increase in the amount of oxalate in the urine and a decrease in the amount of the stone-inhibitor, Citrate. Often, these individuals are also dehydrated due to chronic diarrhea.
- Primary hyperparathyroidism (See Chapter 6: Vitamin D deficiency And Body Aches, Pains And Chronic Fatigue Syndrome) Excess production of Parathyroid

hormone causes an increase in your blood calcium level, which causes an increase spillage of calcium into the urine.

- Excessive vitamin C intake which causes an increase in the amount of oxalate in the urine.
- Low Magnesium level in the urine, which is usually the result of inadequate intake or excessive losses in stools due to Inflammatory Bowel Disease (IBD), Irritable Bowel Syndrome and Celiac sprue.
- Chronic kidney infections with special bacteria such as proteus, klebsiella or pseudomonas. These are called urea-splitting bacteria, which markedly raises urine pH to more than 7.5. Then, there is crystallization of magnesium ammonium phosphate stones, which are called struvite stones. Often, there are calcium carbonate and oxalate crystals as well. These stones can become quite large in the shape of a staghorn, and can cause obstruction to the urine flow.
- Some medicines, such as acetazolamide (Diamox) and indinavir (Crixivan), can cause stone formation.
- Rare genetic metabolic disorders such as Renal Tubular Acidosis (RTA, Type 1) and cystinuria can result in stone formation.

Is There Any Association Between Vitamin D Intake And Kidney Stone Formation?

In a remarkable study (1) from Harvard University, Boston, USA, researchers looked at 25-hydroxy vitamin D level and urine calcium level in 169 patients with a history of kidney stones. The researchers found that the majority of these patients (54%) were actually low in vitamin D, with 25-OH vitamin D level being less than 30 ng/ml. Moreover, they did not find any correlation between vitamin D level and calcium level in the urine.

Another provocative study (2) comes from Columbia University, New York, USA. These researchers recruited 29 patients with a history of kidney stone formation who were low in vitamin D. They gave these patients high dose vitamin D as 50,000 IU per week for 8 weeks. They measured calcium level in the blood and urine before and after 8 weeks of high dose vitamin D supplementation. They made the amazing discovery: there was no increase in the level of calcium in the blood or urine with the high dose vitamin D supplementation.

General Recommendations To Prevent Stone Formation

While the specific treatment depends upon your type of kidney stone and the metabolic abnormalities you may have, here are general guidelines that apply to most kidney stone-formers.

- Drink plenty of water, about 12 glasses per day, especially during summer months. Avoiding dehydration is one simple way to prevent kidney stone formation, as stone forming ingredients (calcium, oxalate, phosphate) remain soluble in dilute urine. Consequently, they do not crystallize into stone.

- Reduce the intake of salt (sodium) and meat, which will reduce the amount of calcium and uric acid in the urine.

- Reduce the amount of oxalate in your diet by reducing the consumption of these oxalate-rich foods: tea, coffee, chocolate, spinach, strawberries, rhubarb, wheat bran, beets and nuts.

Vitamin D supplementation in small to moderate amounts does not seem to cause kidney stone formation. However, it is important to monitor your calcium level in the blood as well in the urine, which you should do anyway if you have a history of kidney stones.

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Chapter **28**

Vitamin D Toxicity

Every article written in newspapers and magazines about vitamin D always includes an overly scary caution about vitamin D toxicity. The reader gets the impression that it must be a common consequence of vitamin D supplementation. Some readers get so scared, they decide *not* to take vitamin D supplementation and end up with the health consequences of vitamin D deficiency. What a shame! It's obvious to me that the writers of these magazine and newspaper articles don't actually treat patients with low vitamin D and their knowledge about vitamin D toxicity is very limited and superficial.

What Is Vitamin D Toxicity?

Vitamin D toxicity is defined as "too much vitamin D, causing harm to the body."

What Level Of Vitamin D Causes Damage To The Body?

According to an excellent review article (1) from Queen's University in Kingston, Canada, the author concluded that a blood level of 25 (OH) vitamin D more than 300 ng/ml (750 nmol/L) is considered to cause toxicity. In an animal model (2), blood concentration of vitamin D up to 400 ng/ml (1000 nmol/L) was not associated with any toxicity.

The experts in the field of vitamin D have chosen the normal range of 25 (OH) vitamin D as 30-100 ng/ml (75-250 nmol/L) to provide a large safety margin.

In an excellent study (3) from the University of Toronto, Canada, researchers report 2 cases of high doses of vitamin D. The first gentleman had been taking 4,000 I.U./day for 3 years followed by 3 years of 8,000 I.U./day. Serum 25 (OH) vitamin D levels averaged 52 ng/ml, while taking 4,000 I.U./day of vitamin D3. While taking 8,000 I.U./day of vitamin D3, mean serum 25 (OH) vitamin D levels were 104 ng/ml. There was *no* evidence of vitamin D toxicity. He maintained a normal level of calcium in the blood and urine over the 6 years of the vitamin D3 intake.

The second gentleman was a 39-year-old man diagnosed with multiple sclerosis. He initiated his own dose-escalation schedule. He increased vitamin D3 dose from 8,000 to 88,000 I.U./day over a period of 4 years. At this extremely high dose, his blood 25 (OH)

vitamin D level was 450 ng/ml, and his blood calcium was 2.63 mmol/L (reference range (2.2-2.6 mmol/L). As you can see, even at this super-high dose of vitamin D, his serum calcium was only slightly above the upper limit of normal, without any symptoms of toxicity. At this point, he stopped vitamin D3 supplementation. Two months later, his blood calcium values were within reference range; serum 25 (OH) vitamin D concentrations fell by about one-half, to 262 ng/ml. These results help to clarify the human response to higher intakes of vitamin D3.

I have seen several individuals who have been self-administering a daily dose of vitamin D3 as 15,000 to 30,000 I.U. for several years. Their 25 (OH) vitamin D level often gets above 100 ng/ml, but less than 130 ng/ml. None of them have experienced any vitamin D toxicity. Their calcium in the blood remains in the normal range

How Frequent Is Vitamin D Toxicity?

Extremely rare.

In medical literature, cases of vitamin D toxicity are rare.

A case of vitamin D toxicity was reported (4) from All India Institute of Medical Sciences, India. The patient was a 70-year-old woman with a long-standing history of hypertension and diabetes. She presented with decreased appetite, constipation and episodes of transient loss of consciousness. Her total blood calcium was 12.4 mg/dL (normal range 8.5-10.5 mg/dL) and vitamin D level was 2016 ng/mL. A retrospective analysis of her treatment history revealed that the patient had received 4 intramuscular injections of Architol (vitamin D3), each of 600, 000 I.U., prior to coming to the hospital. With treatment, she recovered.

In another excellent study (5) from SheriKashmir Institute of Medical Sciences, India, researchers described 10 cases of vitamin D toxicity over a decade since 2000. The dose of vitamin D ranged from 3.6 million I.U. to 210 million I.U. over periods ranging from 1 - 4 months. These patients presented with vomiting, excessive urination, excessive thirst, confusion and kidney failure. Nine individuals recovered, while one died due to overwhelming infection.

Another study (6) came from Columbia University College of Physicians and Surgeons, USA. Researchers described 9 patients who presented with elevated 25 (OH) vitamin D levels. All of these individuals reported recently taking an over-the-counter vitamin supplement called Soladek readily available in the Dominican Republic and in Upper Manhattan. Each 5-ml vial of Soladek contains vitamin D_3 (864,000 I.U.) and vitamin A (predominantly retinyl palmitate 123,500 I.U.). The researchers noticed another interesting fact: Most of these patients had a disorder that can be associated with high calcium level:

one had squamous cell cancer of the neck, one had Pneumocystis infection, three had mycobacterial infections, one had lymphoma, one had granulomatous disease and two had hyperthyroidism.

It is pretty obvious that all of these patients with vitamin D toxicity were taking an extremely high dose of vitamin D.

Most of my patients take a daily vitamin D3 dose of 5000 I.U. to 15,000 I.U. (125 mcg to 375 mcg.) I check vitamin D level in all of my patients and have been doing so over the last thirteen years. In the last fifteen years*, I haven't seen a single case of vitamin D toxicity in my patients while they are on vitamin D3 or D2 supplementation!* Most of these patients have a level of 25 (OH) vitamin D less than 100 ng/ml. Rarely, I see someone with a level above 100 ng/ml (250 nmol/L), but less than 130 ng/ml (325 nmol/L.) Even in these patients, blood calcium is almost always normal.

Rarely, I see a patient with a slight increase in calcium level above the normal limit. Simply reducing calcium intake brings the calcium back into the normal range in these patients. I don't consider this slight increase in the calcium level as a case of vitamin D toxicity.

Risk Of Toxicity; Over The Counter Vitamin D3 Versus Prescription Vitamin D, Calcitriol (Rocaltrol).

Let me clarify another issue. When medical writers of newspaper and magazine articles talk of vitamin D toxicity, they make a blanket statement about vitamin D supplements which is a mistake. There are several different preparations of vitamin D supplements. These include Vitamin D3 (cholecalciferol), Vitamin D2 (ergocalciferol), Calcidiol and Calcitriol. Calcitriol is also known as the brand name Rocaltrol.

Calcitriol (Rocaltrol) is a synthetic form of vitamin D and is a drug rather than a supplement. Therefore, it requires a prescription from a physician. It is typically given to patients who have kidney failure and are on dialysis. Calcitriol (Rocaltrol) is also sometimes prescribed to patients whose parathyroid glands have been removed, often inadvertently by a surgeon during thyroid surgery. Calcitriol (Rocaltrol) is much more potent than natural vitamin D3 or D2 and can sometimes result in vitamin D toxicity. Physicians who prescribe calcitriol (Rocaltrol) are typically aware (and definitely should be aware) of this possibility and monitor their patients for vitamin D toxicity.

Can You Develop Vitamin D Toxicity From Too Much Sun?

The answer is No. You can't develop vitamin D toxicity from too much sun exposure. The reason? Nature is smart. The skin forms as much vitamin D as the body needs. Beyond that, it degrades any excess vitamin D into inactive metabolites. Pretty smart!

How Do You Detect Vitamin D Toxicity?

Vitamin D helps in the absorption of calcium from the intestines. Toxic levels of Vitamin D can cause an increase in blood level of calcium. Thus, vitamin D toxicity manifests itself as a high level of calcium in the blood.

The simplest and the most scientific way to find vitamin D toxicity is to check your calcium and vitamin D level in the blood. Everyone should have his/her vitamin D level and calcium checked every three months.

Symptoms Of Vitamin D Toxicity

Symptoms of vitamin D toxicity are due to increase in the blood level of calcium.

Mild increase in blood calcium level : Usually doesn't cause any symptoms.

Moderate increase in blood calcium : Usually causes non-specific symptoms of nausea, vomiting, constipation, poor appetite, weight loss and weakness. Remember these symptoms can be caused by a variety of other medical conditions as well.

Severe increase in blood calcium level : Causes neurologic symptoms such as somnolence, confusion, even coma and heart rhythm abnormalities which can be fatal if not treated promptly.

Treatment OF Vitamin D Toxicity

Rarely, I see a patient whose blood calcium goes slightly above the upper limit of normal while on vitamin D supplementation. I lower their calcium intake and repeat a blood test for calcium in a month. In my experience, the reduction in calcium intake brings down calcium into the normal range.

Very rarely, blood calcium remains slightly elevated. I then check parathyroid hormone level. If it is in the normal range, then I further discuss diet with the patient and try to lower calcium intake. Even in these very rare patients, blood calcium normalizes by lowering their calcium intake. I also keep in mind other causes for elevated blood calcium level such as primary hyperparathyroidism and cancer. I order diagnostic testing in this regard on a case

by case basis. If blood calcium is elevated and parathyroid hormone (PTH, intact) is also elevated and both of these values do not normalize with vitamin D supplementation, then that patient is most likely suffering from primary hyperparathyroidism. If parathyroid hormone (PTH, intact) level is normal and the patient continues to have an elevated calcium level, I investigate the possibility of other causes of high calcium such as Cancer, granulomatous diseases and Benign Familial Hypocalciuric Hypercalcemia.

Rarely, high blood calcium may occur due to vitamin D toxicity which can happen if very high doses of vitamin D are used (such as more than 50,000 I.U. per day) for a long period.

R*emember, there are many causes of an increase in blood calcium level other than vitamin D toxicity. Two such common causes of high blood calcium are: Primary hyperparathyroidism and cancer. If you have high blood calcium, your physician should thoroughly look into various causes of high blood calcium.*

It's important to notify your physician about all the dietary supplements, including vitamin D, which you take. Most physicians don't specifically ask about dietary supplements and often patients don't think to provide this information either. For best medical care, your physician should know all the medicines as well as all the dietary supplements that you take. If your physician determines that a mild increase in your blood calcium level is due to excessive doses of "over the counter" vitamin D supplementation, as evidenced by a high blood level of 25 (OH) vitamin D, you should decrease the dose of your calcium intake in consultation with your physician. In most cases, simply reducing the calcium intake will bring calcium back into the normal range. If your physician advises you to reduce the dose of vitamin D, you should do so. Recheck your calcium level in a month or so to make sure that your blood calcium is back to normal. Recheck your vitamin D and calcium in about 3 months to make sure that these levels are good and you haven't swung in the other direction.

If your blood calcium is high due to "prescription vitamin D", such as **calcitriol**, the treatment will depend upon the degree of high blood calcium and your symptoms. Your physician will manage it accordingly. If your calcium level is moderate to severely high, your physician will likely admit you to the hospital for proper treatment of vitamin D toxicity.

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Chapter **29**

Vitamin D, Calcium And Magnesium

Calcium and magnesium are essential minerals for our body. They are present in the blood, body fluids and inside every cell. They play an important role in the normal functioning of cells. There is a close interaction between vitamin D, calcium and magnesium.

Vitamin D is important for the absorption of calcium from the intestines. Vitamin D has a close relationship with another hormone known as Parathyroid Hormone (PTH) which is produced by the parathyroid glands, four tiny structures lying low in the neck behind the thyroid gland. Under normal conditions, PTH is important in maintaining a normal level of calcium in the blood, which is important for the normal functioning of each and every cell in the body.

Magnesium plays an important role in the synthesis of parathyroid hormone. Low magnesium can lead to a decrease in the activity of parathyroid hormone, which can cause a decrease in the calcium level in the blood.

Magnesium plays an important role in the metabolism of vitamin D as follows: You may recall from Chapter 2 that vitamin D3, after its synthesis in the skin gets into the blood stream where it is carried on a special protein called a vitamin D-binding protein (VDBP). Through blood circulation, vitamin D3 reaches various organs in the body. In the liver, vitamin D3 undergoes a slight change in its chemical structure, under the influence of an enzyme called 25 hydroxylase. At that point, it is called 25-hydroxy cholecalciferol or 25-(OH)-D3 (or calcifediol). It is then carried through the blood stream on vitamin D-binding protein (VDBP) to the kidneys where it goes through another change in its chemical structure, under the influence of an enzyme called, 1-alpha hydroxylase. At that point, vitamin D is called 1,25- dihydroxy cholecalciferol or 1,25-$(OH)_2$-D3 (or calcitriol). This is the *active* form of vitamin D. It gets in the blood stream and goes to various parts of the body and exerts its actions. In addition, 25-hydroxy cholecalciferol can convert into an *inactive* form, called 24,25-dihydroxyvitamin D_3. This action takes place through the action of an enzyme called 24 hydroxylase, located in the kidneys.

Magnesium plays an important role for the synthesis of vitamin D-binding protein (VDBP). Low magnesium leads to low level of VDBP. In addition, magnesium is important for the normal functioning of the three important enzymes in the metabolism of vitamin D: 25

hydroxylase and 1-alpha hydroxylase and 24 hydroxylase. In this way, magnesium seems to play an important role in the normal metabolism of vitamin D. Low magnesium level leads to low vitamin D level and a decrease in the formation of the active form of vitamin D.

Obviously, you need to pay attention to calcium as well as magnesium, in addition to vitamin D.

CALCIUM

Bones are the main storage place for the calcium. A whopping 99 % of calcium is present in the bones and teeth. Only 1% of total body calcium is present in the cells, body fluids and the blood. Out of that, 45% is ionized calcium, which is the active form of calcium. It passes from blood into the cells and regulates various functions of the cells.

Blood level of calcium is tightly regulated between 8.8 and 10.3 mg/dL (2.2 to 2.6 mmol/L). Parathyroid hormone is the main regulator of the blood level of calcium. For example, low calcium in the blood stimulates the production of PTH, which causes reabsorption of calcium from the kidneys into the blood. It also causes dissolution of calcium from the bone into the blood. In addition, it stimulates 1-alpha hydroxylase which converts 25-hydroxy vitamin D into1,25- dihydroxy vitamin D, the active form of vitamin D, which facilitates the absorption of calcium from the intestines. PTH also inhibits 24 hydroxylase and thereby reduces the conversion of vitamin D into its inactive form. The net result is an increase in the supply of calcium (from kidneys, bones and intestines) into the blood, and the level of blood calcium rises into the normal range.

A small amount of calcium is excreted in the urine, about 250 -300 mg per day. The loss of calcium in the urine increases in the following conditions: high salt intake, high protein and carbohydrate intake, furosemide (diuretic), hyperparathyroidism, too much vitamin D. Too much calcium in the urine can increase the risk of kidney stone formation.

Dietary calcium is absorbed mainly in the proximal parts of the intestine called duodenum and jejunum. Net absorption is dependent on the vitamin D level. Absorption of calcium varies from 15 to 70% of the ingested calcium, depending upon your vitamin D level. It is decreased if your vitamin D level is low and increased if vitamin D level is high.

How Much Calcium?

The usual recommended dose of calcium of 1200 mg per day comes from the era when we did not pay any attention to vitamin D and every one was low in vitamin D.

But things are changing now. If you have a good level of vitamin D, you do not need 1200 mg of calcium every day. In fact, this amount of calcium may be too much for you. That's why your blood calcium may become slightly elevated sometimes. In that case, you need to lower your calcium intake. Unfortunately, often your physician may tell you to lower the dose of vitamin D.

When you have a good level of vitamin D (more than 50 ng/mL or 125 nmol/L), you need only about 600-1000 mg of calcium per day.

Sources Of Calcium

Dairy is the best source of calcium, which includes milk, yogurt and cheese, especially brick cheese. Other good sources of calcium include vegetables: spinach, bok choy, broccoli, green snap peas, okra, turnip greens, kale, and beans such as soybeans and lima beans. Other good sources of calcium are eggs, tofu and almonds

If for some reason you don't consume dairy, such as due to Lactose intolerance, then you need to increase the amounts of calcium-rich vegetables, beans, eggs and almonds. If you cannot do that, then you need to take calcium supplements, especially if you suffer from malabsorption syndrome.

Among calcium supplements, I recommend calcium citrate, which is cheap and easily available.

MAGNESIUM

Magnesium plays an important role in the normal functioning of each and very cell in our body. In particular, it is involved in carbohydrate metabolism, insulin secretion, insulin action, muscle contraction and nerve conduction. Low levels of Magnesium increase your risk of insulin resistance, Type 2 diabetes, high blood pressure, heart disease, coronary artery spasms, muscle aches, fatigue, irritability, anxiety, ADD/ADHD, dementia, lupus, menstrual cramping, systemic inflammation, osteoporosis, and kidney stones.

The Epidemic Of Magnesium Deficiency

We are facing an epidemic of Magnesium deficiency. Here are some of the reasons for this epidemic.

- The typical western diet is *low* in food items that contain Magnesium. According to the USDA (United States Department of Agriculture) (18), only 1 out of 3 Americans consumes the recommended amounts of Magnesium in their diet.

- Phosphates in sodas, processed meats and other foods, combine with Magnesium to produce Magnesium phosphate, which is an *insoluble* compound and cannot be absorbed.

- Stress, both physical as well as psychological, causes a *continuous* release of adrenaline, which causes constriction of blood vessels, a rise in heart rate and an increased demand on the heart muscle. The body uses Magnesium to *counteract* all of these negative effects of excess adrenaline. Consequently, less magnesium is available for the rest of the body.

- Old age is also associated with low Magnesium due to a decrease in the absorption of dietary Magnesium.

- There are a number of medical conditions and drugs that can lower your Magnesium level.

Medical Conditions That Can Cause Magnesium Deficiency

The following medical conditions can give rise to low Magnesium level.

- Uncontrolled diabetes causes an increased loss of Magnesium in the urine.

- Chronic malabsorption diseases such as Crohn's Disease, Ulcerative Colitis, Irritable Bowel Syndrome and Celiac Sprue cause a decrease in the absorption of Magnesium.

- Stomach or intestinal bypass surgery causes a decrease in the absorption of Magnesium

- Chronic pancreatic insufficiency causes a decrease in the absorption of Magnesium

- Alcoholism causes a decrease in the absorption of Magnesium

- Acute kidney injury, called Acute Tubular Necrosis, causes an increased loss of Magnesium in the urine

Drugs That Can Cause Magnesium Deficiency:

Diuretics, especially Lasix (Furosemide) and Hydrochlorthiazide, which are commonly used in diabetics for their high blood pressure and weak heart. These drugs cause an excessive wasting of Magnesium in the urine.

Heartburn and anti-ulcer medications, if used for prolonged periods (more than one

year): These drugs include Prilosec (omeprazole), Prevacid (lansoprazole), Nexium (esomeprazole), Protonix (pantoprazole), AcipHex (rabeprazole), Dexilant (dexlansoprazole). Magnesium in diet as well in Magnesium supplements need to be broken down by Hydrochloric acid in the stomach before it can be absorbed. The above-mentioned medicines drastically reduce the amount of Hydrochloric acid in the stomach. That's how they interfere with the absorption of Magnesium.

Steroids such as Hydrocortisone, Prednisone and Dexamethasone cause an increased loss of Magnesium in the urine.

Estrogen, in birth control pills and hormone replacement therapy, cause an increased loss of Magnesium in the urine.

Asthma medications such as epinephrine, isoproterenol and aminophylline, cause more consumption of Magnesium in the cells of the blood vessels to counteract the effects of adrenaline, which creates relative deficiency of Magnesium for the rest of the body.

Antibiotics such as Garamycin (gentamycin), Nebcin (tobramycin), carbenicillin, ticarcillin, and tetracyclines cause an increased loss of Magnesium in the urine.Anti-fungal drugs: amphotericin B, Pentamidine, cause an increased loss of Magnesium in the urine.

Certain Anti-cancer drugs cause an increased loss of Magnesium in the urine.

It's no surprise that we are facing an epidemic of Magnesium deficiency.

Symptoms Of Magnesium Deficiency

Common symptoms of low Magnesium level include:

- Muscle spasms and cramps
- Fibromyalgia
- Irritability
- Anxiety
- Insomnia
- Seizures
- Irregular heart beat/heart arrhythmias/Atrial fibrillation

- High blood pressure
- Chest pain to spasm of coronary arteries
- Chronic fatigue
- Migraine headaches
- Menstrual cramping
- Menopausal symptoms
- Tics
- Lack of appetite
- Nausea/vomiting
- Lack of balance
- Vertigo
- ADD/ADHD
- Dementia
- Constipation

How To Diagnose Magnesium Deficiency

There is a blood test available for Magnesium level in the blood. However, this test diagnoses only severe cases of Magnesium deficiency, because 99% of Magnesium is inside the cells and only about 1% is present in the blood.

The best way to diagnose Magnesium deficiency is through your symptoms, your eating habits, presence of medical diseases and use of medicine, as mentioned above. If you suspect you have Magnesium deficiency, increase your consumption of foods rich in Magnesium and/or take Magnesium supplements, and see what happens to your symptoms. The good news is that in general, Magnesium supplements are safe in individuals without any kidney disease. However, toxicity can develop in patients with kidney disease. Many Magnesium supplements can also cause loose stools. More on it later in the book.

Dietary Sources Of Magnesium

The best way to get Magnesium is through foods that are high in Magnesium. Good dietary sources of Magnesium are seeds, nuts, dark leafy green vegetables and fish. These foods are also important for your overall health, especially if you are a diabetic.

Other foods that contain some quantities of Magnesium include beans, lentils, whole grains and figs.

Seeds and Nuts:

Pumpkin and squash seeds, sesame seeds, Brazil nuts, almonds, cashews, pine nuts, pecans, walnuts.

Seeds and nuts are highly beneficial for your overall health, especially if you are a diabetic. For example, almonds are loaded with good fats (monounsaturated fatty acids), and can help to increase your HDL (good) cholesterol. Almonds are a good source of Biotin, fiber and Vitamin E. Almonds and other nuts also slow down the emptying of the stomach and consequently, slow down the rise in blood sugar after a meal. Therefore, a handful of nuts after a meal is much better for your health than traditional desserts.

Pumpkin seeds are important for your prostate health. Brazil nuts are a great source of Selenium, which is important for the normal functioning of your thyroid, immune cells and prostate gland. However, too much Selenium can cause toxicity. About 1 or 2 Brazil nuts a day provide enough selenium for your body.

Note: Raw nuts are better than roasted nuts, as roasting decreases the amount of available Magnesium.

Dark Leafy Green Vegetables

Spinach, mustard greens, Swiss chard, and kale.

Fish

Mackerel, Halibut, Pollock, tuna, and most other fish.

Beans and Lentils

White beans, French beans, black-eyed peas, kidney beans, chickpeas (garbanzo), soy Beans, and lentils.

Whole Grains

Quinoa, millet, wheat, brown rice. However, diabetics should consume whole grains in small

quantities, as these foods are rich in carbohydrates and can significantly raise your blood sugars.

Magnesium Supplements

If you cannot increase the ingestion of foods that are high in Magnesium, then the alternative is a Magnesium supplement. The daily recommended dose of Magnesium is about 400 mg. In general, Magnesium supplements are safe in individuals without any kidney disease, but toxicity can develop in patients with kidney disease. Oral supplements can sometimes cause loose stools, indicating a need to reduce dosage or change the type of Magnesium supplement.

Types Of Magnesium Supplements:

A number of Magnesium supplements are available. These include:

- Magnesium glycinate
- Magnesium taurate
- Magnesium chloride
- Magnesium lactate
- Magnesium oxide
- Magnesium citrate
- Magnesium sulfate/ Magnesium hydroxide (Milk of Magnesia)
- Magnesium carbonate

Magnesium threonateMagnesium glycinate supposedly has the best absorption and does not cause diarrhea.

Magnesium taurate is supposed to provide a calming effect on your mind.

Magnesium chloride has good absorption, but contains only about 12% of Magnesium. In comparison, Magnesium oxide contains about 60% of Magnesium.

Magnesium citrate and Milk of Magnesia are also stool-softeners.

Magnesium carbonate has antacid properties.

Magnesium threonate is a newer supplement. Supposedly, it works better at the cellular level.

You can choose what type of Magnesium supplement works for you. If you develop loose stools, change to a different preparation and/or lower the dose. In general, Magnesium glycinate does not cause diarrhea.

Chapter **30**

Vitamin D And Vitamin K2

In addition to vitamin D, vitamin K2 appears to play an important role in keeping us healthy, based on intense research over the last decade. For example, both vitamin D and vitamin K2 act synergistically to keep our bones strong.

Vitamin K is a fat-soluble vitamin that was first identified by Henrik Dam in 1929 for its anti-hemorrhagic activities (1). It was later called vitamin K after the Danish word Koagulation. Vitamin K is an essential nutrient for the normal functioning of our body.

There are three forms of vitamin K:

K1 (phylloquinone)

K2 (menaquinones, MK) with several sub-types; MK4 through MK10. Currently MK4 and MK7 appear to be the most important forms of vitamin K2.

K3 (synthetic menadione).

While Vitamin K1 and K2 occur naturally and are nontoxic, vitamin K3 is man-made and can be toxic. Therefore, vitamin K3 should not be used to treat vitamin K deficiency.

EFFECTS OF VITAMIN K

Vitamin K is an essential cofactor for the conversion of glutamate into gamma-carboxyglutamate. This chemical process is called carboxylation. In this way, vitamin K activates a number of proteins in our body.

Role of Vitamin K in Blood Clotting

Vitamin K1 is primarily involved with the clotting process. It activates a number of proteins called clotting factors (Factors II, VII, IX, X) inside the liver. Therefore, vitamin K deficiency can lead to excessive bleeding which sometime can be fatal. A commonly used blood thinner, Warfarin (Coumadin) acts by interfering with vitamin K. Patients on Warfarin

have to be closely monitored in order to prevent excessive thinning of blood.

Role Of Vitamin K2 In Preventing Fractures

In recent years medical science has discovered many other health benefits of Vitamin K in addition to its role in blood clotting.

Vitamin K, especially Vitamin K2 has been found to be important for the health of bones and teeth. Vitamin K2 helps to incorporate calcium and phosphorus into the bones via a complex mechanism: There is a special protein in the bone, termed as osteocalcin, which is involved in maintaining the strength of the bone. Normally, osteocalcin undergoes a chemical change, termed gamma-carboxylation for it to be active and carry out its function. Vitamin K2 is essential for gamma-carboxylation of osteocalcin. In this way, vitamin K is intimately involved in keeping our bones strong.

If you are low in vitamin K2, there is a decrease in the gamma-carboxylation of osteocalcin. In other words, there is under-carboxylation of osteocalcin. Think of under-carboxylated osteocalcin (ucOC) as an inactive (abnormal) form of osteocalcin. When you are low in vitamin K2, the blood level of under-carboxylated osteocalcin (ucOC) rises. Therefore, the blood level of under-carboxylated osteocalcin (ucOC) has been considered a sensitive marker of vitamin K2 status in the bone. A high level of under-carboxylated osteocalcin (ucOC) indicates vitamin K2 deficiency and is found to be associated with weak bones and a greater risk of fracture.

Can Vitamin K2 Supplementation Prevent Fractures?

Is there clinical evidence to show that vitamin K2 supplementation can reduce the risk of fracture in individuals suffering from osteoporosis? The answer is yes!

In a study (2) from the Research Institute and Practice for Involutional Diseases, Japan, researchers recruited a total of 241 patients with osteoporosis. Fifty percent of these patients received placebo and fifty percent of patients received vitamin K2. These patients were followed for 2 years. The incidence of clinical *fractures* during the 2 years of treatment in the placebo group was *higher* than the vitamin K2-treated group. The blood levels of under-carboxylated osteocalcin (ucOC) at the end of the 2 years in the placebo and the treated group were 3.0 ng/ml and 1.6 ng/ml, respectively. In addition, the serum level of normal osteocalcin showed a significant rise (42% from the basal value) in the treated group at 2 years, compared to 18% for the placebo group. There was no significant change in bone density at the lumbar spine. The researchers concluded that their findings suggest that vitamin K2 treatment effectively prevents the occurrence of new fractures,

although the vitamin K2-treated group did not show any increase in lumbar bone density. Furthermore, vitamin K2 treatment enhances gamma-carboxylation of osteocalcin.

In another analytical study (3), researchers from the Institute for Integrated Sports Medicine, Keio University School of Medicine, Japan evaluated the effect of vitamin K Supplementation on the bones of postmenopausal women. They analyzed seven clinical trials. Their findings showed that high dose vitamin K(1) and vitamin K(2) supplementation improved indices of bone strength in the hip bone and reduced the incidence of hip fractures. Vitamin K treatment did not cause a significant increase in bone density. They concluded the beneficial effect of vitamin K1 and vitamin K2 supplementation on the bones of postmenopausal women is mediated by mechanisms other than bone mineral density.

In another analytical study (4) from Hangzhou Xiasha Hospital, China, researchers analyzed the data from nineteen randomized controlled trials. There were a total of 6759 participants. Researchers found that postmenopausal women with osteoporosis, who took vitamin K2, had a significant improvement of bone density at the lumbar spine. In addition, vitamin K2 significantly decreased the incidence of vertebral fractures. The level of undercarboxylated osteocalcin ((ucOC)) came down and the level of normal osteocalcin increased in women who took vitamin K2.

In conclusion, there is a mounting clinical evidence to show the beneficial effects of vitamin K2 in preventing fractures in postmenopausal women with osteoporosis. However, there is conflicting data on the effect of vitamin K2 on bone mineral density. What is clear is that vitamin K2 exerts its beneficial effect on the bone through osteocalcin, a protein in the bone that seems to play an important role in the process of *mineralization* of the bone. Calcium and Phosphorus are important ingredient for the mineralization of the bone. That is where vitamin D is crucial. Vitamin D increases absorption of calcium and phosphorus from the intestines. In this way, Vitamin D and Vitamin K2 appear to act in concert in keeping our bones strong.

Effects Of Combination Therapy With Vitamin K2 And Vitamin D On The Bone

Both vitamin K2 and vitamin D exert beneficial effects on the strength of bone. It makes sense to combine vitamin K2 and vitamin D in keeping our bone healthy. An interesting study (5) from Erciyes University, Turkey investigated the role of combination therapy with vitamin K2 and vitamin D on the bones of children with Thalassemia major, who frequently suffer from weakening of the bones. The researchers enrolled twenty children (12 girls, 8 boys; age varied from 3 to 18) with thalassemia major. These children received dietary supplement with vitamin K2 (50 mcg of MK7) and vitamin D (5 mcg calcitriol). Their bone

mineral density was evaluated at the baseline, sixth, and 12th month of treatment. The researchers found a significant improvement in the bone mineral density at the lumbar spine of these children at the sixth and 12th month of treatment.**Vitamin K2 And Diabetes**

Diabetic patients are at increased risk of fractures due to weakening of the bones as well as other factors (peripheral neuropathy, obesity, disequilibrium) that makes them more susceptible to falling down. Can vitamin K2 reduce the risk of fractures among diabetics? A good review (6) on this topic comes from Keio University School of Medicine, Japan. According to the authors, clinical studies of Type 2 diabetic patients have shown low osteocalcin concentration to be associated with an increased risk of fractures. And vitamin K2 administration in a Type 2 diabetic rat model has been shown to increase serum osteocalcin as well as bone strength.

Vitamin K2 and the Cardiovascular System

Vitamin K2 also activates (carboxylates) another protein, called Matrix Gla Protein (MGP), which is present in LDL cholesterol in your blood. Activated MGP exerts important beneficial effects on your arteries: It may prevent calcification of the arteries, including coronary arteries and the aorta.

Some individuals are at high risk for the calcification of arteries. These are patients with diabetes, chronic kidney failure, hyperparathyroidism and atherosclerosis. A number of factors place these patients at increased risk of calcification of the arteries. These are stress, high blood pressure, high calcium and high phosphorus in the blood (high Ca x P product). These factors can initiate a process in which smooth muscle cells in the blood vessels transform into bone-like cells, which then start to deposit bone-crystals (hydroxyapatite) in the cell wall. Hydroxyapatite bone crystals are made up of calcium and phosphorus. MGP can inhibit the formation of hydroxyapatite crystals. In this way, MGP may play a crucial role in preventing calcification in the arterial walls.

As mentioned earlier, vitamin K2 is essential to activate (carboxylase) MGP. The levels of dephosphorylated, un-carboxylated MPG (dp-ucMGP) are used as a marker for vitamin K deficiency in the blood vessels and have been found to correlate with cardiovascular morbidity.

Can Vitamin K2 Prevent Heart Disease?

Is there clinical evidence to show that vitamin K2 supplementation can reduce the risk of heart disease? The answer is yes!

In an excellent study (7) from Erasmus Medical Center Rotterdam, The Netherlands, the researchers evaluated the effects of dietary intake of Vitamin K1 and Vitamin K2 on coronary heart disease, aortic atherosclerosis and overall mortality in 4807 men and women over the age of 55, who lived in a defined district of Rotterdam in the Netherlands. The study had a mean duration of follow-up of 7.2 years. Intake of vitamin K2, but not vitamin K1, was found to be associated with a decrease in the risk of coronary heart disease, aortic atherosclerosis and overall mortality.

Main dietary sources of vitamin K1 in this study were green leafy vegetables and vegetable oils. For vitamin K2, the dietary sources were meats and eggs (MK4 only), fish, sauerkraut, cheese, and other dairy produce (MK5 through MK10). The authors made an interesting observation that cheese has not been established as a dietary risk factor for cardiovascular disease in epidemiological studies, despite its high levels of saturated fat and salt. They hypothesized that vitamin K2 in cheese could exert a beneficial effect in the cardiovascular system and that the high cheese consumption in France and Mediterranean countries may possibly account for lower prevalence of coronary heart disease.

In another study (8) from University Medical Center Utrecht, The Netherlands, the researchers investigated if there was a link between dietary intake of vitamin K1 and vitamin K2 with calcification of coronary arteries in a cross-sectional study among 564 post-menopausal women. They found that sixty-two percent of the women had coronary calcification. Vitamin K2 intake was associated with *decreased* coronary calcification. They concluded that high dietary vitamin K2 intake, but probably not vitamin K1, is associated with reduced coronary calcification. Adequate vitamin K2 intakes could therefore be important to prevent cardiovascular disease.

Vitamin K2 And Cancer

Vitamin K2 appears to be an anti-cancer agent, according to several recent scientific studies. In an experimental study (9) from Tokyo Medical University, Japan, researchers showed that vitamin K2 showed anti-cancer properties against leukemia cells in their laboratory. In another experimental study (10) from Tokyo Medical University, Japan, researchers were able to show anti-cancer properties of vitamin K2 in lung cancer cells in their laboratory. In an experimental study (11) from Showa University, Japan, researchers were able to show anti-cancer properties of vitamin K2 against ovarian cancer cells in their laboratory. In an experimental study (12) from Shanghai Jiao Tong University, China, researchers were able to show anti-cancer effects of vitamin K2 in liver cancer cells in their laboratory. In an experimental study (13) from University of Illinois, USA, researchers were able to show anti-cancer effects of vitamin K2 in prostate cancer cells in their laboratory. In

another experimental study (14) from Kawasaki Medical School, Japan, researchers showed an inhibitory effect of vitamin K2 on the Multiple myeloma cells. In another experimental study (15) from Thomas Jefferson University, USA. researchers showed that vitamin K1 as well as K2 were able to inhibit the growth of pancreatic cancer cells in their laboratory.

In these studies, vitamin K2 was able to either kill cancer cells or stop their further growth or even change their growth into normal cells. These are exciting new studies, although still experimental and done on cancer cells in the laboratory. In any case, vitamin K2 brings a new hope in dealing with cancer. Vitamin K2 does not seem to have any side-effects. It is definitely worth-trying if you are dealing with a cancer.

Natural Sources Of Vitamin K

Vitamin K naturally exists in 2 forms, namely phylloquinone (K1) and a group called vitamin K2, also called menaquinones or MK, with several sub-types. MK4 and MK7 have been clinically studied the most.

K1 is widely distributed in green and leafy vegetables such as spinach, lettuce, broccoli, kale, watercress and chard.

Vitamin K2 is mostly present in the following foods: grass-fed butter (MK4), eggs (MK4), yogurt (MK7), fermented cheese (MK7), fermented soy, called natto (MK7), kimchi (MK7) and Sauerkraut (MK7).

Vitamin K2 is also produced by healthy intestinal bacteria, but in small amounts. Unfortunately, broad-spectrum antibiotics kill your healthy intestinal bacteria. In an excellent study (16) from the University of Saskatchewan, Canada, researchers were able to show a significant reduction in the amount of vitamin K2 stored in the liver, after the use of the broad-spectrum antibiotics. Use of probiotics may be able to restore normal intestinal flora and the synthesis of vitamin K2.

A small amount of vitamin K1 (about 10%) is converted to vitamin K2. But you cannot depend on vitamin K1 for all of your dietary needs of vitamin K2, as humans cannot absorb more than about 200 mcg of vitamin K1.

Vitamin K2 Supplements: MK7 Versus MK4

Most people cannot get adequate amounts of Vitamin K2 from their diet. Therefore, they need to take vitamin K2 supplement.

Vitamin K2 in supplements:

Vitamin K2 as MK4 in supplements is synthetic. It is made from the extract of the tobacco plant. To get it from dairy products and eggs would be very expensive.

On the other hand, MK7 in supplements usually comes from natto, which is fermented soy and is part of Japanese cuisine. Natto, however, is highly unpalatable for most non-Japanese. But MK7 from natto in supplement form does not have a bad taste.

Another advantage of MK7 over MK4: MK7 has a long half-life of about 3 days, which means it stays in your body longer as compared to MK4, which has a very short half-life of about one hour. Therefore, you can take a MK7 supplement once a day, but you will have to take a MK4 supplement three to four times a day to maintain a good level of vitamin K2 in your body.

How Much Vitamin K2 Supplement?

The optimal dose of vitamin K2 is not established yet. In clinical studies, researchers have used a wide range for a daily dose of vitamin K2.

In Japan, vitamin K2 as Menaquinone4 (MK4) is the standard medical treatment for osteoporosis. They use it as a daily dose of 45 mg. However, in a recent study (17), from the National Institute of Health and Nutrition, Japan, researchers used a low-dose of MK-4 supplementation as 1.5 mg per day for 6-12 months in postmenopausal women, and showed there was an improvement in bone health. In another recent study (18), researchers from Maastricht University, The Netherlands used a low dose of MK7 as 180 microgram per day in postmenopausal women for 3 years. MK7 at this small dose prevented age-related decline in bone mineral density.

Kidney dialysis patients are particularly prone to arterial calcification. In a study (19) from the University Hospital Düsseldorf, Germany, researchers assessed the status of vitamin K2 in their hemodialysis patients by measuring their dephosphorylated-uncarboxylated MGP and uncarboxylated osteocalcin levels. They found their patients were quite low in vitamin K2 as demonstrated by a 4.5-fold higher dephosphorylated-uncarboxylated MGP and 8.4-fold higher uncarboxylated osteocalcin levels compared with controls. Vitamin K2 supplementation was given as 135 microgram per day to one group of patients and 360 microgram per day to another group. They found the response rates in the reduction in dephosphorylated-uncarboxylated MGP levels were 77% and 93% in the groups receiving a daily dose of 135 microgram and 360 microgram of MK7, respectively.

In summary, vitamin K is a fat-soluble vitamin. Vitamin K1 is involved in blood clotting,

while vitamin K2 has its effects on a wide range of other tissues in the body. Vitamin K2, in concert with vitamin D, may prevent osteoporosis, especially in post-menopausal women. It may prevent calcification of arteries and therefore, reduce the risk of cardiovascular disease. It also appears to be a promising anti-cancer agent.

At the Jamila Diabetes And Endocrine Medical Center, I recommend vitamin K2 as MK7 in a dose of 200 microgram per day. So far, I have not seen any side-effects from vitamin K2 in my patients.

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In Summary

In recent years, we've discovered that vitamin D is not only important for the health of bones, but plays a crucial role in the health of almost every organ system in the body. Vitamin D is important for the *prevention as well as treatment* of chronic fatigue, muscle aches and pains, cancer, diabetes, heart disease, high blood pressure, osteoporosis, autoimmune disorders, kidney failure, dental problems, skin disorders, neurologic disorders and depression.

Unfortunately, most people are not reaping these miraculous health benefits of vitamin D. Why? Because most people are low in vitamin D! We are facing a true pandemic of vitamin D deficiency. The main reasons for this epidemic are our modern life-style, misconceptions about vitamin D and the suboptimal daily recommended dose of vitamin D contained in daily vitamins and calcium formulas.

Vitamin D deficiency can be easily diagnosed with a simple blood test, 25 (OH) vitamin D. Many physicians make the mistake of ordering 1,25 (OH)2 vitamin D instead, which is the *wrong test* to diagnose vitamin D deficiency. Why is it the wrong test? Because it's often normal and may even be high in people who are actually suffering from vitamin D deficiency.

The only good natural source of vitamin D is the sun. How much vitamin D your skin can synthesize from sun exposure depends upon several factors such as latitude, season, time of the day, color of the skin, age, sunscreen lotions, air pollution and shade. You need a significant amount of sun exposure on naked skin to get enough vitamin D from the sun. This degree of sun exposure poses a significant risk of skin cancer, especially in fair-skin people. Food items contain very small amounts of vitamin D. *The best way to get an optimal level of vitamin D is sensible sun exposure and a vitamin D supplement. Most physicians don't know the dosage amount of vitamin D supplement to recommend*.

Based upon my extensive clinical experience, I recommend vitamin D3 in a daily dose of 5,000 - 10,000 I.U. (125 - 250 microgram) for most of my patients. I aim for an optimal blood level of 25 (OH) vitamin D in the range of 50 - 100 ng/ml (125 - 250 nmol/L).

I check 25 (OH) vitamin D and calcium blood level in my patients every three months to ensure they achieve an optimal level of vitamin D and maintain it. By employing this strategy, I achieve a good level of vitamin D while preventing vitamin D toxicity. In my extensive clinical experience, I have *not* encountered any vitamin D toxicity in my patients on vitamin D3 or vitamin D2 supplements.

Recently, vitamin K2 has emerged as another important vitamin to keep us healthy. It acts in concert with vitamin D to keep our bones strong, while it keeps our arteries free of calcium deposition. It also appears to possess anti-cancer properties.

By employing my unique, scientific approach to diagnose and treat vitamin D deficiency, as well as adding vitamin K2 supplement, I am seeing great health benefits in my patients. Nothing can be more rewarding! You too, can benefit from this strategy, but you should do so with the blessing of your own health care provider. Good luck in taking charge of your vitamin D and vitamin K2 needs!

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