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Good Red Blood

Excerpted from Dr Colgan's forthcoming book, The Running Power Program

Canadian middle-distance champion Megan Brown suffered from iron deficiency for years before being properly diagnosed. She was finally helped back to health and top performance by the Female Athlete Triad Coalition http://www.femaleathletetriad.org/.

Results from the usual blood tests given to an athlete in the US and Canada, are compared with "normal ranges" which the blood-testing laboratory authorities obtain from average results from representative samples of the adult populations. These ranges do not represent athletes, even recreational athletes, because they are based on samples designed to represent the public at large. That is, the ranges considered "normal" cannot avoid reflecting the poor health status of the public.

In America and Canada, the samples for the "normal ranges" are drawn from populations that are predominantly sedentary, overweight, over-medicated, and unhealthy.[1,2] If you are a healthy runner, of normal weight, and your blood tests are compared with normal ranges, as most tests are, then the conclusions from some of those tests may bear little relation to your ability to run.

At the Colgan Institute, we have compiled records of the blood status of more than 10,000 athletes over the last 31 years, on more than 50 different blood tests. From these tests, we have derived reference ranges of blood tests from athletes at recreational to Olympic level, who are in good condition and performing well without any health problems. These are the reference ranges we now use to determine an athlete's status. After 3-4 months of training, we test them again to ascertain whether our training and nutrition programs are having the desired effects on their biochemistry.

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Here I can cover only one small part of that biochemistry: your capacity to carry oxygen and deliver it to muscles. We will examine what constitutes good red blood for a runner, and how you can improve your red blood status if it is below the Colgan Institute reference ranges for athletes.

The three most common measures of oxygen-carrying capacity are, red blood cell count, hematocrit, and hemoglobin level. There are many other indices. Below are the Colgan Institute ranges for these three common measures, derived primarily from runners, triathletes, and track and field athletes. These ranges differ considerably from the "normal ranges" used for medical purposes.

Blood Test	**Simple description**	**CI Reference Range**
Red Blood Cells (RBC) (Oxygen-carrying cells)	Males 4.6-6.6 mL/cu mm	Females 4.3-5.9 mL/cu mm
Hematocrit (% of blood made of red cells)	Males 40-54%	Females 37-47%
Hemoglobin (Oxygen carrying pigment)	Males 14.5-18.0 g/dL	Females 13.0-16.5 g/dL

The bloodstream of male runners in good condition carries 4.6 to 6.6 million red blood cells per cubic millimetre. The bloodstream of female runners in good condition carries 4.3-5.9 mL/cu mm. The proportion of a runner's blood composed of red cells, the hematocrit, ranges from 40-50% for males in good condition, and 37-47% for females. A hematocrit of 50 provides 25% more red blood cells than a hematocrit of 40. About one-third of each red cell is composed of hemoglobin, the red pigment made of iron and other nutrients that carries almost 100% of your oxygen. Hemoglobin levels range from 14.5-18.0 g/dL for male runners, and 13.0-16.5 g/dL for female runners, in good condition.

Other systems being normal, the higher the hemoglobin, and the greater the hematocrit, the more oxygen delivered to your muscles. Chapters 9 and 10 outlined strategies of intermittent hypoxia and altitude training that increase hemoglobin and hematocrit, but these improvements occur only if the body has a sufficient supply of nutrients to provide the raw materials to make the additional cells and oxygen-carrying pigment. The major nutrient involved is iron.

Kenyan runners training at Lornah Kiplagat's High Altitude Training Center at Iten in the Great Rift Valley. http://www.lornah.com/ Note the leading feet poised for a forefoot strike, a key aspect of the running form I have emphasized throughout this book. In their diet, Kenyan runners also typically consume over 400% of the Recommended Dietary Allowance of iron, about 33 mg of elemental iron per day, very similar to the amount we recommend below.[2]

Iron Depletion in Athletes

In 1991, we reviewed more than 50 studies showing low hematocrit, low hemoglobin, reduced performance and low iron stores, in a large proportion of athletes from recreational to Olympic status.[3] Production of hemoglobin largely depends on your body's use of iron. Note that I wrote, "use of iron" not, "iron intake". Analysis of an runner's

diet will not tell you much about their iron status.[4,5] Simply popping iron pills will not fix it either.[6] With all the evidence against the use of excessive iron supplements since 1990, especially the liver damage and promotion of infections by iron, it is hard to understand why they are still sometimes prescribed at up to 300 mg per day of elemental iron for athletes.[7]

Iron depletion in athletes has not improved during the three decades we have observed widespread use of these ineffective practices of dietary analysis and excessive iron supplementation. Prevalence of iron depletion in female athletes in a variety sports remains at 25- 35%, more than twice the prevalence of 12-16% found in the general public.[8-13] Despite the common belief that female athletes are more likely to have iron depletion because of menstrual blood loss, male athletes have a much higher prevalence compared to the male general public. In males in the general public, prevalence of iron depletion is about 2%. In male athletes, however, prevalence of iron depletion varies with the sport, from 10-12% in a variety of sports, including running, to 15% in basketball players, and 36% in elite gymnasts.[8-13]

Iron depletion is serious business. It reduces VO2max, impairs muscle function, increases glycogen use, increases muscle fatigability, and inhibits improvements from training, even when hemoglobin levels may still be within the athletes' range given above. It also causes muscle and bone degeneration that may permanently impair performance.[14-19]

Measurement of Iron Depletion in Runners

Usual medical blood tests still measure serum iron and hemoglobin as indicators of iron-deficiency anemia. They are of no value to healthy athletes, because they were developed to measure disease in sedentary people. An athlete's iron store can be virtually exhausted before these tests show an abnormal level. The hemoglobin test is useful only to show how much of your iron store is being converted into hemoglobin. In conjunction with hematocrit and red blood cell count, it is a fair indicator of the oxygen-carrying capacity of the blood. It tells you little about iron in the muscles themselves, where it is essential for the myoglobin, an iron-dependent, oxygen-binding protein that increases the efficiency of oxygen use. Iron is also required for the cytochromes, an organized system of proteins involved in energy production, and for numerous iron-dependent enzymes. But, even all these measures combined tell you little about your iron store.

Unfortunately, the blood tests of serum iron and hemoglobin are still used to assess iron status in athletes. They fail to detect iron depletion, resulting in the athlete continuing to train ineffectively for months or even years. Eventually, muscle and skeletal injuries caused by the depletion sideline them permanently, or they are lucky enough to come under the care of someone who knows how to treat them. Meanwhile they have lost years of effective training.

In a study representative of the evidence, famous Olympian, and sports medicine expert, Doug Clement found that 80% of a group of female endurance runners were iron depleted. Not one of them, however, had a hemoglobin level less than 12 g/dL, the usual medical reference level for possible anemia.[20]

In another recent, representative study, a 21-year-old female collegiate cross-country runner experienced a decline in performance during her freshman year. She continued to experience abnormal fatigue and poor running performance despite several medical interventions. Two-and-a-half years after initially seeking medical help, she was finally diagnosed with iron deficiency with anemia. By then she had lost two seasons of effective training, and had developed musculoskeletal damage that required multiple therapies.[21] Canadian middle-distance champion Megan Brown, pictured above, went through the same problem, until she was helped back to health by the Female Athlete Triad Coalition. http://www.femaleathletetriad.org/

Because of these common problems, the Colgan Institute developed a model for iron status of athletes, emphasizing serum ferritin, which provides a good measure of the body's iron store.. We first presented the

model at the World Athletics Championships Medical Congress in Canberra in 1987. Prior to that time, it was difficult for an athlete to obtain a serum ferritin test. It has become widely available since.[22,23]

The serum ferritin test is now used with many athletes, although it is not yet routine in medicine outside of sports medicine clinics, so you may have to ask for it. For male runners, a serum ferritin below 30 ng/dL indicates iron depletion. For female runners, a serum ferritin below 25 ng/dL indicates iron depletion. The table below shows the battery of tests we developed. It shows three stages of depleted iron stores, iron depletion, iron deficient erythropoiesis (deficient making of red blood cells), and iron deficiency anemia.

You can see from the table that red blood cell count and hematocrit may remain within the reference range even in full-blown anemia. Hemoglobin may also remain within the reference range until anemia, as may total iron-binding capacity (TIBC). Only serum ferritin is sensitive enough to detect the first stage.

Serum ferritin, however, is mostly a measure of liver and bone iron stores, not the functional iron in oxygen-processing muscle and other tissues used during running. Serum ferritin is also what is called an acute-phase protein and is increased directly by exercising, and by infections. So, for an even more accurate test, we use a combination of serum ferritin and a stable protein called the transferrin receptor, which occurs on the surface of muscle cells to receive iron. The lower the iron supply in the muscles, the higher the number of transferrin receptors expressed, and the higher their number in serum. This measure is called the transferrin receptor-ferritin index (TfR:SF).[24] It is a good back-up for symptomatic runners whose serum ferritin is marginal, but still above 30 ng/dl for males and 25 ng/dl for females. As yet, this test has not come into widespread use, but specialist sports medicine clinics now have it.

Assay	Reference Range Males (M) Females (F)	Iron Depletion	Iron Deficient Erythro-poiesis	Iron Deficiency Anemia
Serum ferritin (ng/dL)	M 30-160 F 25-100	< 30 ● < 25 ●	< 20 ● < 12 ●	< 20 < 12
Transferrin saturation (%)	30-45	< 30	< 16 ●	< 16
RBC proto-porphyrin (mcg/dL)	35-50	35-50	> 100 ●	> 200 ●
Serum Iron (mcg/dl)	M 60-200 F 60-200	60-200 60-200	< 60 ● < 60 ●	< 40 ● < 40 ●
TIBC(mcg/dL)	300-350	300-350	300-350	> 400 ●
Whole blood hemoglobin (gm/dL)	M 14.5-18.0 F 13.0-16.5	>14.5 >13.0	>14.5 > 13.0	<14.5 ● <13.0 ●
Erythrocytes		Normal	Normal	microcytic ● hypochromic ●
Hematocrit (%)	M 40-54 F 37-47	40-54 37-47	40-54 37-47	40-54 37-47
RBC (mil/mm^3)	M 4.6-6.6 F 4.3-5.9	4.6-6.6 4.3-5.9	4.6-6.6 4.3-5.9	4.6-6.6 4.3-5.9

● Identifying tests at each stage of depletion.

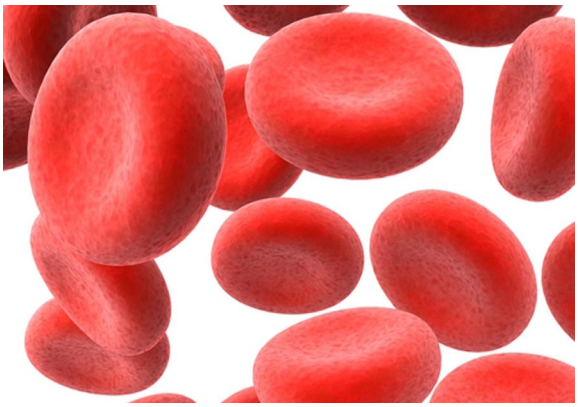
Causes of Iron Depletion in Runners

Sedentary males use about 1.0 mg of iron per day to maintain normal homeostasis. Because of monthly menstrual blood losses, sedentary females use an additional 0.5 mg of iron per day.[25] Runners use those amounts plus a lot more. Runners sweat a lot of iron, crush a lot of blood cells, and bleed into the gut. Research shows clearly that endurance running is tougher on iron status than almost any other sport.[26]

If you sweat for three hours in running training, you can lose

1.0-1.5 mg of iron.[27] When you run, the impact also creates foot-strike hemolysis, the crushing of red blood cells on the soles of the feet. The muscle contraction of hard running also crushes blood cells within the circulation, termed intravascular hemolysis, a problem we first proposed at the Olympic Scientific Congress in 1984.[3] Since then, intravascular hemolysis has been confirmed in numerous sports where there is no foot-strike or other impact, including swimming and rowing.[28] With sweat and hemolysis, you can lose up to 2.5 mg of iron per day, an average loss of 1.25 mg.

Endurance runners are also subject to gastrointestinal bleeding. Different studies have found occult blood in the stool of 8-30% of marathon runners after long training runs and marathons.[29] From internal bleeding during training you can lose an average of about 0.5 mg of iron per day. Other sources of red cell loss caused by running include acidosis, and peroxidation of cell membranes by free radicals.[3]



Adding together daily use of iron in normal body housekeeping, plus sweat, hemolysis, gastrointestinal bleeding, and other losses, male distance runners in moderate training require an average of 3.5 mg of absorbed iron per day, and female distance runners, an average of 4.1 mg per day.

Red blood cells are filled with hemoglobin, the iron-based pigment that transports almost 100% of your oxygen. You need approximately 5 million of them per cubic millimetre of blood to function well in distance running.

Iron in Diet

These required amounts of iron, 3.5 mg per day for male runners, and 4.1 mg for female runners do not seem much, until you realize that that iron absorption is very poor. Dietary iron occurs in two forms, heme, and non-heme. Animal flesh, meats, poultry and fish contain both heme and non-heme iron. Plant foods contain only non-heme iron. Phytates (phosphorus compounds) and fibre in whole grain cereals, beans, and nuts, inhibit iron absorption. Calcium and phosphorus in milk, bind iron and also inhibit absorption.

The US institute of Medicine recommends a dietary iron intake of only 8 mg per•day for males and 18 mg•per day for females. For endurance athletes, some experts recommend 13 mg for males, and higher for premenopausal women, depending on menstrual blood loss.[30] Studies indicate that athletes typically consume these levels of iron.[4,22,23] Yet, as we saw above, iron depletion, low hemoglobin, low hematocrit, and low red blood cell counts occur in a high proportion of runners. From all the studies we have examined, we have to conclude that the amounts of iron generally recommended and consumed are insufficient for the strenuous sport of running.

In a typical recent study, researchers at the University of Missouri assessed the iron status and diet of 49 male and 72 female recreational athletes training in running, cycling, and triathlons. Average age was 27, all were healthy, of normal weight (average BMI=23), and were training for 10-12 hours per week. Dietary analysis showed that all were ingesting at least the recommended level of iron. This group is very similar to groups we see at the Colgan Institute. Using accurate measures of iron status, serum ferritin, plus the transferrin receptor-serum ferritin index, the researchers measured each athlete's iron status. Results showed that: three of the 49 men were iron depleted, one of them to the stage of fully developed anemia. Of the 72 females, 30 were iron depleted, eight to the stage of anemia.[32]

Iron depletion is a serious condition that decimates performance. Yet because of the common blood tests

used, and ineffective dietary analyses, it remains undetected in numerous athletes, who develop it, as was the case with athletes in this study. Get the right tests to ensure that you do not have iron depletion before embarking on the Running Speed Program. If you do have the condition, here is how to fix it.

Getting Enough Iron

Depending on the composition of the diet, we absorb an average of about only about 10% of heme iron, and 2-5% of non-heme iron.[25] Vegetarian runners, confined to non-heme iron, are more likely to be iron depleted. For runners who regularly eat meat, and get heme iron, the best dietary form, the studies reviewed above indicate that the runner's diet should contain about 35 mg of elemental iron per day for males and 41 mg for females.

To get the right amount of iron absorbed into your system. do not take high potency iron tablets. They do not improve iron absorption. They inhibit digestion, and cause gastrointestinal upset, and general feelings of illness. They are designed for people with serious illness, not for healthy athletes short of iron. Do not take them for even a week. You cannot make any quick correction of iron status. It takes at least four months to make the new blood and myoglobin in muscles. High potency iron pills will simply disrupt your training. Clearly, the first and best strategy is to eat foods that are highest in heme iron. Eat some at every meal. Here is the Colgan Institute Short List.

Colgan Institute Foods for Iron Repletion			
Foods Highest in Heme Iron		Foods Highest in Non-Heme Iron	
	mg per 100 grams		mg per 100 gm
Calves liver	14	Blackstrap Molasses	14
Chicken Livers	12	Prunes	4
Bison steak	9	Dark Raisins	3
Oysters	5	Dried cranberries	3
Wild sockeye salmon	5	Broccoli	3
Grass-fed beef	4	Spinach	3
Wild coho salmon	3	Brussels sprouts	3
Free range poultry	2	Collards	2
Fresh tuna	2	Asparagus	2
Lobster	2	Brazil nuts	2
Crab	2	Almonds	2
Shellfish	1	Kale	1

Our second strategy is to eat citrus fruit or a 100 mg vitamin C ascorbic acid tablet with every meal. Vitamin C in the ascorbic acid form increases the absorption of iron.[33] It must be taken with the food.

Our third strategy is to avoid processed carbohydrates, cereals, and legumes. Although they contain non-heme iron, and may even be fortified with iron, they also contain phytates, phosphorus storage compounds that inhibit the absorption of iron. So do the tannins in tea, and so do all forms of antacids.[34]

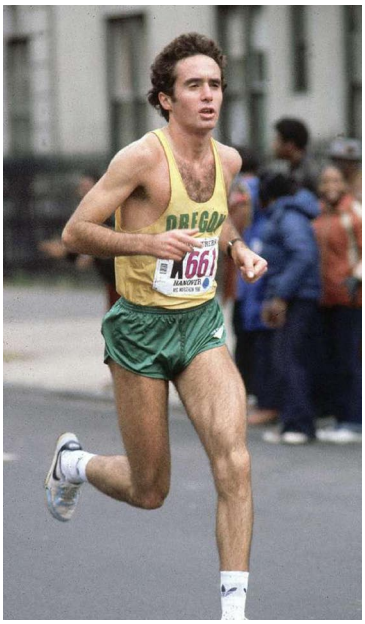
Our fourth strategy is to ensure that the iron-depleted athlete is receiving a sufficient amount of the full

range of essential nutrients that act along with iron to make red blood. If you follow the Colgan Institute program of five small meals per day, and eat according to our book Nutrition for Champions, it is likely that you are receiving these nutrients.[35] Then you simply add citrus fruit or one 100mg vitamin C pill along with each meal to increase your absorption of iron.

The five common foods richest in heme iron, the best form for correcting iron depletion, are: organic calves liver, organic chicken livers, grass-fed bison steak, wild sockeye salmon, and fresh oysters.

Nutrient Supplementation to Improve Iron Status

Numerous runners we see, especially women, restrict their eating as a strategy to maintain low levels of body fat. On examination we find that they are deficient, not only in calories, and in iron, but also in other essential vitamins and minerals that they should be getting from a good athlete's diet.[35] In these cases, we recommend a daily vitamin and mineral pack to be taken once daily along with their main meal. This pack contains 100% of the Recommended Dietary Intake of all the essential vitamins and minerals, plus an additional 35 mg of elemental iron, 500mg of vitamin C as ascorbic acid, 1.0 mg of folic acid, and 200 mcg of vitamin B12. All these additional nutrients are synergistic with iron, either in assisting absorption or in the making of red blood cells and myoglobin. Here are some guidelines for use of these supplements. It is important to know what are the best forms, and how to use them.



Iron supplements come as the ferrous or ferric forms of iron. Ferrous iron is the best absorbed, and is the form we recommend. There are three common types of ferrous iron supplements: ferrous fumarate, ferrous sulfate, and ferrous gluconate. The usual fumarate pill contains 108 mg of elemental iron, and the usual sulfate pill contains 65 mg of elemental iron. These are far too strong for anything but medical treatment of diagnosed anemia. In runners, because of the gastrointestinal effects of running, they cause havoc in the gut and wicked constipation, often leading to antacid use, which then blocks absorption of the iron anyway. These side effects also curtail compliance long before the iron depletion is corrected. Continued use of this excessive amount of iron can lead also to iron overload, which puts the user at serious risk of numerous diseases.[6,7] We do not recommend ferrous fumarate or ferrous sulfate iron supplements for runners.

Alberto Salazar won the Boston Marathon in 1982 in 2:08:52. Struggling with form for more than a year afterwards, he was finally diagnosed with iron deficiency. Alberto is now a great running coach.

I must stress strongly the damage caused by iron overload from excessive supplements of iron. Over three decades, I have seen many runners who have had to withdraw from sport permanently because they were wrongly treated, and developed iron overload disorders because of excess unbound iron from large iron supplements given without supporting nutrients. Iron expert, Douglas Kell of Southampton University, in England, published the latest comprehensive review of research on iron metabolism in October 2010. The extensive research confirms that a majority of degenerative diseases and infections, including multiple sclerosis that attacks many young adults, are partly caused by hydroxyl radicals formed by unbound or poorly bound iron in the body.[36] Do not take strong iron pills.

The usual ferrous gluconate pill contains 35 mg of elemental iron. That is about the right daily amount. At 10% absorption, it yields 3.5 mg of iron into the body. Taken with a meat meal plus vitamin C to maximize absorption, it is also easier on the stomach than other iron supplements. Yet it releases sufficient iron to correct iron depletion in runners. We recommend ferrous gluconate containing 35 mg of elemental iron per day to all athletes who need to improve their red blood system

Additional Nutrients Required Along With Ferrous Gluconate

The ferrous gluconate will not work on its own. You also need to take vitamin C simultaneously to improve absorption of the iron. We recommend 500 mg, of ascorbic acid taken along with the ferrous gluconate. This may seem a large amount, but vitamin C also neutralizes the inhibitory effects of phytates and tannins on iron absorption.[37] It is especially important for vegetarian runners. Research shows that supplements of 500 mg of vitamin C can improve iron status within two months.[38] That's quick.

To increase functional iron in blood and muscles, you also need increased folic acid, Need for folate increases stepwise with iron in order to make an increased supply of red blood cells. That is why pregnant women need additional iron and folate, to build the blood system of the foetal environment in the first five months and to build the blood cells of the fetus after that.[39]

In 1998, concerned at the low level of folate in the American diet, and the spiralling rates of spina bifida and other folic acid deficiency disorders, the US FDA mandated folate fortification of all foods made with enriched grains. Our review of more than 1000 runners since, shows that they eat little of these processed carbohydrate foods, and still get an average of only 269 mcg of folate per day.

It is the same for many US citizens. Prior to fortification, 29% of women of childbearing age (15-44) got 400 mcg or more of folic acid daily. The goal of fortification was to raise that proportion to 50%. Eight years later, excellent controlled research, published in the American Journal of Public Health, shows that, depending on ethnicity, 23-33% of women aged 15-44 now get more than 400 mcg per day.[40] The folic acid fortification of carbohydrates has failed to increase public intake of this essential nutrient.

Consequently, from both the public record and our analysis of runners, we consider that iron depleted runners are somewhat like a mother during the first half of pregnancy. Thus, to ensure that the iron supplementation is used to increase red blood cells and the myoglobin and other iron-dependent tissues used in running, we recommend 1000 mcg of folate per day, the Tolerable Upper Limit of the Recommended Dietary Allowances.

To make the increased number of red blood cells required to correct functional iron depletion in oxygen-carrying tissues, the body also requires sufficient vitamin B12. We and others have found that endurance athletes are commonly depleted in vitamin B12,[41] especially vegetarian runners, and those who restrict food intake to maintain very low body fat levels.[42,43] The body requires only 2-3 mcg per day of vitamin B12 to make sufficient red blood cells, but absorption of this vitamin is very poor, less than 1%. To ensure sufficient vitamin B12, we recommend 200 mcg of cyanocobalamin per day for all runners who need to

improve red blood status.

In research studies of correction of iron depletion in athletes, you will see higher doses than those above. Researchers use the higher doses primarily because the studies are usually restricted to a few weeks duration to keep costs affordable. These studies work by forcing iron into storage to produce statistically significant results. But they often run into the side-effect problems of high doses of iron, which inhibit clinically significant benefits.

You cannot improve the functional iron in the red blood cells and myoglobin proteins that are already formed. You have put just enough iron into the bone and liver stores, and then wait until new red blood cells and myoglobin grow, with sufficient iron in the store to make an increased amount of them.

To correct functional iron depletion, the body has to grow improved red blood cells, an increased number of red blood cells, and an increased number of myoglobin proteins in muscles. A complete turnover of these cells takes at least four months. If you have blood tests showing that you are iron depleted, you can likely correct most of it with a combined supplement of the above nutrients during the 12 weeks of the Running Speed Program. Here is the formula as a table.

Colgan Institute Formula to Correct Iron Depletion in Runners (to be taken with a main meal daily for 4-6 months)	
Ferrous gluconate (providing 35 mg elemental iron)	300 mg
Vitamin C (as ascorbic acid)	500 mg
Folic acid	1000 mcg
Vitamin B12 (as cyanocobalamin)	200 mcg

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Gut Problems May Be Latent Celiac Disease

Dr Michael Colgan

At the Colgan Institute, we often see cases of digestive disorder involving cramping, bloating, constipation, or periodic diarrhea, that have not cleared up with usual antacid or antibiotic medical treatment. These digestive disorders almost always include inflammation of the small intestine, and often damage to the intestine. These symptoms are usually accompanied by fatigue and irritability, or unexplained anxiety. Sometimes they have gone on intermittently for years. Our first step is to remove gluten from the diet. It is often the only step we have to take.

In my research for the diet given in ***Nutrition for Champions***,[1] I covered a great deal of evidence that people of English, Irish, or Middle European ancestry, have a difference in their DNA code that makes it difficult for them to digest a protein called gliaden, a component of the gluten found in wheat, rye, and barley. These people should not eat gluten.

It the most recent study, published in December 2010, researchers used magnetic resonance profiling to analyze the biochemical markers in the blood and urine of 61 patients with celiac disease, 29 with potential celiac disease, and 51 healthy people. They found that those with potential celiac disease had the same profile as those with confirmed disease. Their biochemical markers differed significantly from those of the healthy individuals. The study concludes:

"Our results demonstrate that metabolic alterations may precede the development of small intestinal villous atrophy and provide a further rationale for early institution of gluten-free diet in patients with potential celiac disease, as recently suggested by prospective clinical studies."[2]

The DNA difference that inhibits digestion of gliaden probably evolved before the European wave of humans spread out of Africa, when the human diet was largely carnivorous, and did not include much gluten. Their descendents include about three million Americans already diagnosed with celiac disease, and about another 4-6 million who will likely develop the disease with age and damage, if they continue to eat gluten. Those already diagnosed have full information to avoid gluten. But most of the potential patients, have what is thought to be merely an intermittent digestive disorder, and take no care to exclude gluten from their diet.

If you are suspicious that you may have the DNA which predisposes you to celiac disease, your doctor can order a simple blood test which can detect high levels of certain antibodies found in people with the disease. If these are found, the diagnosis will almost certainly be celiac disease, and the treatment will be a gluten-free diet lifelong. If you have an intermittent digestive disorder like that described above, then following a gluten-free diet may be the healthiest thing you can do. Below is our shortlist of gluten-free foods.

Colgan Institute: Shortlist of Gluten-Free Foods

Fish and shellfish	Fresh meats	Poultry
Fresh Vegetables	Fruit	Dried fruits
Fresh herbs	Nuts	Cheese

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Eggs	Dried peas and beans	Sunflower oil,
Olive oil	Almonds, almond oil	Flax seeds, flax oil
Rice	Rice cakes	Rice crackers
Rice flour (and other gluten free flours)		Corn
Corn tortillas	Popcorn	Cornflour (from the maize plant)
Peppercorns	Tamari sauce	Yoghurt
Cider vinegar	Millet	Quinoa
Sago	Tapioca	Jelly, jams,
Marmalade	Honey	Sugar
Golden syrup	Tea (check herb teas)	Coffee

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Vaccination

Dr Michael Colgan

My recent advice to get the annual flu shot caused numerous questions and comments showing that vaccinations are a controversial topic among parents these days, with some parents reluctant or refusing to give their kids recommended shots.

At one time, I worked with Jonas Salk at the Salk Institute, who invented the polio vaccine that rid the Western world of polio, so, unlike numerous health professionals, I speak from some hands-on knowledge of the processes and great benefits of vaccination.

First, I want to dismiss the uninformed conspiracy theories that vaccination is a government or pharmaceutical companies plot to make people sick and compliant. Vaccination today represents more than a century of scientific progress in medicine. By enabling the immune system to recognise diseases, and mount a defence before they get a foothold in the body, vaccinations have prevented, and practically eliminated many serious and deadly illnesses. These include diphtheria, tetanus, pertussis, polio, rotavirus, many types of influenza, mumps, measles, rubella, hepatitis, chicken pox, pneumonia, meningitis, and, in girls, human papilloma virus (HPV).

Many of the concerns I hear from parents, arose from media misinterpretations of a paper by Andrew Wakefield and colleagues in England, in the medical journal Lancet in 1998, claiming that the measles, mumps, rubella (MMR) vaccinations could cause autism. The conclusions of this paper have been thoroughly discredited by the scientific community since, because other laboratories could not replicate the results, and all the authors except Wakefield have withdrawn and reversed their own conclusions. The Lancet retracted the paper in 2004, and again fully in February 2010.

Now, in January 2011 the whole paper and Andrew Wakefield have been exposed as an outright fraud. The British Medical Journal reviewed the six-million-word transcript of the General Medical Council hearings,

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comparing them with the findings of an investigation by medical journalist Brian Deer, and the research paper in the Lancet. There are huge discrepancies between what was in the children's medical notes and what was published about them in the Lancet.

Wakefield falsified the medical histories of all 12 patients in the study, believed to be because he was hoping to sue vaccine manufacturers. As a result, Dr Fiona Godlee, Editor of the British Medical Journal, has now accused Dr Wakefield of deliberate fraud.

Nevertheless, Wakefield did set off a worldwide scare against vaccinations. Countless well-meaning parents, especially in Britain, the US, and Canada, chose not to vaccinate their children, wrongly led to believe that they were protecting them from autism. Immunization rates for measles, mumps, and rubella have never fully recovered.

Sensing large fees, lawyers also jumped on the bandwagon in such numbers that US legal authorities had to set up special courts, including a federal vaccine court handling the Omnibus Autism Proceeding, in which judges considered the claims of roughly 5,000 families. They have since ruled against parents who claimed that vaccinations caused their children's autism. So have courts in Britain and Europe. For all of this to be a conspiracy by government or pharmaceutical companies, as some people still claim, is nonsensical. Tens of thousands of judges, officials, lawyers, and witnesses would all have to be in the know, and all paid off. Not one has come forward.

But myths are hard to kill. By refusing to accept vaccinations, many parents today are still exposing their children to the risk of contracting one of the serious diseases against which they should have been safe. The US Centers for Disease Control report that missed vaccinations is largely responsible for the large outbreaks of mumps, measles and whooping cough that were previously almost eliminated.

If you want full information on vaccination, Paul Offit, Chief Physician of Infectious Diseases at Children's Hospital, Philadelphia, has written an easy to read book for Parents, entitled, ***Deadly Choices: How the Anti-Vaccine Movement Threatens Us All*** (Basic Books, $27.50). Another good source is, ***Your Child's Best Shot***: ***A parent's guide to vaccination***, 3rd edition by Ronald Gold, MD, MPH ISBN: 0-9781458-0-1, 2006.

What about Toxins in the Vaccine

Other parents have written to me about their fears that toxins in the vaccines may damage their child. The main concerns expressed are about mercury, aluminum, and formaldehyde. Here is the quick bottom line.

Vaccinations used to contain thimerosol, an antiseptic still widely used in contact lens solutions and other medications. Research reviewed in Offit's book above, shows no connection between thimerosol and autism, or other disease. Thimerosol is made from ethyl mercury, a form with very low toxicity. Ethyl mercury is an entirely different chemical from methyl mercury the very toxic form that scaremongers talk about.

As an example, ethyl alcohol is the form of alcohol in beer and wine and has very low toxicity. Methyl alcohol is the form in many industrial solvents and is so toxic it can kill you outright. In any case, because of advances in medical technology, since 2001 thimerosol has been eliminated from child vaccinations. You can even get a thimerosol-free flu shot if you are concerned about it.

Some parents are also concerned about aluminum, used in small amounts in some vaccines to stimulate the immune response. My daughter has just given us a new grandchild. So I understand yet again, from close-up view, how fragile babies appear to be, and how they arouse the feeling that you have to protect them from everything. But, I have to tell you that babies get far more aluminum from food, including mother's milk, than from vaccines.

I also have to tell you that babies are incredibly tough. After leaving the womb, just passing through the birth canal, the newborn is immediately exposed to hundreds of different kinds of bacteria, viruses, fungi, moulds, and yeasts, most of which immediately set too trying to eat it. The immune system immediately springs into action to prevent them. If the immune system was not really tough, humans would never survive even being born. Given that built-in toughness, the immune system has no trouble handling vaccines.

In the first six months of life, a breast-fed baby gets 10 milligrams of aluminum; a baby given a milk-based formula gets about 30 milligrams; a baby given a soy formula gets about 120 milligrams of aluminum. If you yourself as the breast-feeding mother, take one teaspoon of Maalox for an upset stomach, you load your system with 200 mg of aluminum, and pass a proportion of it on to the baby in your milk.

It is not an ideal world. We have polluted our bodies with everything from soup to nuts, to any cream or lotion you put on your skin, to the mass of chemicals we now breathe from the air. As a result, new born infants today already have 10 times as much formaldehyde circulating in their bodies than is found in any vaccine. Breast milk and infant formula also both have more mercury than vaccines.

Today, most children in the US and Canada are vaccinated against 14 diseases. The vaccine schedule in the US and Canada is timed to protect the greatest number of children. Here is the current vaccination schedule although it does vary a little place to place. I would not place my children at risk of a disabling disease for life by failing to get it done.

Childhood Immunization Schedule

For information on which vaccines are covered, and when, in your province visit: www.phac-aspc.gc.ca/im/is-vc-eng.php. We strongly recommend that you only schedule vaccinations when your child is well, and never if they have a cold. Also, if your child will not be exposed to a lot of people outside the immediate family, we would suggest that you wait until they are six months of age to begin their vaccinations.

	0-6 mon	12 mon	18 mon	4-6 yrs	9-13 yrs	14-16 yrs
Diptheria/Tetanus/Pertussis	X		X	X		
Hib[1]	X		X			
Rotavirus[7]						
Mumps/Measles/Rubella[2]	X		X	X		X
Hepatitis B[3]			X		X	
Chicken pox (varicella)[4]		X				
Pneumococcal	X	X				
Meningococcal conjugate[5]	X	X			X	
Flu	X		X			
HPV[6]					X	
Tetanus/Diptheria/Pertussis						X

Notes:

1. Haemophilus influenzae type b (Hib) requires a series of immunizations. The exact number and timing of each may vary with the type of vaccine used.
2. Two-dose programs for MMR are given in all territories and provinces. Second dose MMR is given either at 18 months or 4-6 years of age. If the child is past the age at which the second MMR is recommended, the second dose

can be given 1-2 months after the first.
3. Hepatitis B requires a series of immunizations. In some jurisdictions, they may be administered at a younger age.
4. Given in 1 dose to children between 1 and 12 years old and in 2 doses, 1 month apart for older children. It is not recommended for children under 1 year old.
5. The specific age that your child will be offered the vaccine through the provincial or territorial immunization program depends on the provincial program. Children at higher risk for meningococcal infection should receive a conjugate meningococcal C vaccine as a baby and MCV4 when they reach 2 years of age. All adolescents should receive a booster dose with MCV4 or a conjugate meningococcal C vaccine at about 12 years of age.
6. For girls only. The second dose is given 2 months after the first, and the third dose after 6 months.
7. Your child will need 2 or 3 doses depending on the vaccine. Doses are given at least 4 weeks apart.

NSAIDs in Sport

Abstract from Dr Colgan's forthcoming book, The Running Power Program.

Endurance athletes, especially the elite, use a ton of anti-inflammatory drugs.[1,2] In a study of the 2008 Brazil Ironman Triathlon, almost 60% of entrants reported using NSAIDs. Two thirds of these (128 triathletes) used the drugs immediately before or during the race, not to treat current injuries, but to reduce pain and discomfort, and thus improve performance.[3] Other researchers put NSAID use at 70% in ultra-distance running.[2]

From 2000, NSAID abuse has spiralled, largely because articles in US National news reports revealed widespread use of Toradol as an ergogenic aid in American professional football. Toradol is the trade name of the potent, fast-acting, NSAID, ketorolac tromethamine, made by Roche. It comes as injections and pills. The media revelations might have sunk into oblivion, except for the overtones of secrecy and deceit. Most of the sports writers who reported them preferred to remain anonymous, likely for fear of whistleblower payback.

Research papers in 2002 confirmed the news, but even the journal, Current Sports Medicine Reports, published by the American College of Sports Medicine, stamped its report "Content Not For Reuse".[4] Of course, it immediately got reprinted all over the world, the scare of which has led to a deafening silence about Toradol abuse from sports medicine publications ever since.

Briefly, researchers surveyed the head physicians and the head athletic trainers of the 31 NFL teams. Thirty teams responded, of which 28 reported using Toradol throughout the 2000 season, at an average of 15 players per team. Most teams gave their players a weekly injection throughout the season, and most injections were given on game day. Most medical staffs believed that Toradol provided 50% to 75% pain relief that lasted 24-48 hours.[5]

Toradol use has now spread into college football, hockey, track and field, and running, but is still almost ignored by the NCAA. So there are only media reports to go on. In October 2009, for example, Gene Sapakoff, in the South Carolina Post and Courier reported details of "rampant" use of Toradol in teams throughout the country.[6] Toradol pills are now offered for sale on the internet without prescription.

Toradol is the most effective NSAID, but the injectible form is a prescription drug, so many athletes have asked us if other over-the-counter NSAIDs work to deaden pain and improve sports performance. Usually they want to know about ibuprofen (Advil, Motrin), naproxen sodium (Aleve, Naprosyn), diclofenac (numerous trade names) ketoprofen (Orudis) etodolac (Lodine), celecoxib (Celebrex) or a combination of several. Here is the bottom line, which also includes Toradol.

There is no doubt that oral NSAIDs, taken before running, can reduce exercise discomfort, and may allow

runners to maintain pace longer. It is illogical to state that they would not. More than 30 million Americans use NSAIDs successfully every day to relieve muscle, joint, and other pain and to improve movement, at work and at play. Their mechanisms of action and their effects are well documented.[7]

A study by sports scientist David Neiman and colleagues of Appalachian University, North Carolina, is the most frequently quoted data that suggest NSAIDs do not work to reduce exercise discomfort or to improve performance. In the 2005 Western States 100-mile race, researchers gave 29 entrants 600 mg of ibuprofen the day before the race, 200 mg immediately before the race, and 200 mg about every four hours during the race for a total of 1200 mg ibuprofen on race day. Compared with a control group of 25 entrants who were given nothing, and presumably did not use NSAIDs, the groups who used ibuprofen showed no better finish times.[2]

This study was fatally flawed from the outset. Because NSAIDs do work, about 70% of ultra-distance runners use them habitually in training and in racing,. So the Western States Medical Board would not allow the double-blind, randomised design the researchers wanted to use, because there was no way to ensure compliance. Remember, just to qualify to run the Western States is a big deal. It takes at least a year of training for the day, and you must have already completed a 100-mile race in less than 24 hours, or a 50- or 60-miler in less than 12 hours. Runners who use NSAIDs, are not going to jeopardise their chances to please some researcher.

So, the runners were selected for the ibuprofen group and the control group based merely on their reported prior use of ibuprofen during training and competition. They were matched for age, experience, and previous race times. But by failing to use a double-blind, randomized design, Neiman ended up comparing, a group of runners who had previously achieved certain race times aided by habitual use of NSAIDs, compared with a group of runners who had previously achieved similar race times without NSAIDs. How could he possibly expect to find a difference in the current race, by giving ibuprofen to runners who already used it habitually?

Some running articles focus on Neiman's finding that the ibuprofen groups showed the same perceived exertion as the controls, responding to a numbered card, stuck in front of their faces at various points in the race. Anyone who runs ultra-distance races knows well, that measuring the difference between completely exhausted and totally buggered is something only researchers who have never run one would attempt to do. Because of the lack of a randomized design, none of the statistics that Neiman applied were valid anyway.[8]

The ibuprofen groups did show higher markers of muscle damage. But, rather than demonstrating that the drugs did not work, these results indicate that they worked well, allowing the runners to run harder, up to the threshold of pain and movement protection the ibuprofen provided. That is exactly what millions of Americans do with NSAIDs every day. After presenting the study results, Neiman asked competitors whether they would stop using NSAIDs the next year. The answer, a resounding, "No!"

The performance improvement produced by NSAIDs in sore or exhausted people is not in question. The big problem is NSAID side effects. They work mainly by inhibiting what is termed the cyclooxygenase-2 (COX-2) inflammatory pathway, thus preventing pain. But they also block COX-1, what are called the "housekeeping prostaglandins," that are responsible for protective functions in the gastrointestinal tract and kidneys. By this route, NSAIDs increase gastrointestinal permeability, and, as Neiman found, allow bacteria to escape into the bloodstream. As any rheumatologist could have told Nieman, the increased endotoxemia, and increased immune activation he found, are constant problems of NSAID use that doctors confront on a daily basis. They have nothing to do with running per se.

NSAIDs also inhibit the nuclear-factor Kappa-B (NF-KB) system, which is critical for the normal inflam-

matory process and recruitment of the immune system in healing.[5,6] Muscle pain and injury results in tissue death. The inflammatory response is responsible for the degradation of the dead tissue to allow muscle regeneration. Research shows clearly that NSAIDs mask pain, and, under painful conditions, improve muscle contraction even after injury. But they delay removal of the damaged tissue, delay collagen deposition, and delay muscle regeneration. With habitual use, NSAIDs cause malformed reconstruction of cartilage, tendon, ligament, and muscle. That, plus gastrointestinal damage, are the biggest problems confronting NSAID use in medicine today.[7,9]

The uncontrolled spread of potent NSAIDs into collegiate sports is especially regrettable. They provide a short-term ergogenic benefit at the cost of long-term damage, damage that is often concealed by the cyclic graduation and departure of students from the teams. NSAID use in distance running provides a short-term advantage and is often substituted for the lack of sufficient training. But, if you want to be able to continue your sport as you age, don't use NSAIDs before or during running.

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