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The Important Role of Nutritional Magnesium and Calcium Balance in Humans Living with Stress

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Part I. The Stress Response

The stress reaction is a host of responses necessary for any animal to live in the world. Commonly called the “fight or flight” reaction, we as humans often experience it in rapid heartbeat and increased breathing rate. It comes when we exercise more vigorously than usual, or when we are suddenly and unexpectedly frightened.¹

We are all different. We show a range in how strongly we experience the stress response. Most of us are usually calm and experience the stress response when an unexpected noise frightens us to alertness, or we run to first base as fast as we can in a benefit baseball game which is not on our usual playtime schedule. We breathe harder for awhile and notice our hearts beating faster and harder than usual, but after awhile these responses all calm down, and we are again in our usual state—out of the stress response. Others of us are very low-key, and it takes a lot to disturb our physiological calm. Still others of us are very sensitive to triggers of the stress response and go into it “at the drop of a hat” and to a greater degree than do calmer people. For some, parts of the stress response are almost always engaged—never really calming down all the way—giving one a hyper vigilant or anxious demeanor.

When a stress trigger occurs, the body puts out stress hormones, magnesium and calcium, among other things, into the bloodstream². At the same time, nerve cells begin to “fire”, telling heart and muscles to “speed up, NOW!!!” These blood, nerve

and organ changes make possible the instantaneous and collective rise in the body's heart rate, blood pressure, and other necessities for the “fight or flight” reaction.¹

Much research has been done on the stress response, especially on the effects of stress hormones, such as adrenaline (also called epinephrine) on body, organ and cell. You can get an idea of how widespread the stress response is—affecting every aspect of physiology—by noting some of the reactions to adrenaline, one of the major stress hormones.¹⁴ See Table 1.

Much study at the cellular, biochemical and physiological levels have shown that the stress response vitally involves the influx of calcium into cells, resulting in a drastic change in the cells' internal Magnesium to Calcium Ratio (Mg:Ca).

In simple solutions, such as salt water, all ions are evenly dispersed. Not so in living cells. Ions are carefully and meticulously separated in living cells, and this ion “packaging” is vital to life processes and health. Calcium ions, for the most part, are kept outside cells while magnesium ions are

Table 1

The Effects of Adrenaline: Adrenaline (also called epinephrine) is one of the body's major stress hormones. When adrenaline is released into the bloodstream, it has simultaneous, rapid, and widespread effects on the body. These include:

- widespread effects on circulation, muscles and sugar metabolism
- raised heart rate
- increased heart output
- increased rate and depth of breathing
- increased metabolic rate
- increased force of muscular contraction
- delayed muscular fatigue
- reduced blood flow to bladder (muscular walls relax and sphincters contract)
- reduced blood flow to intestines
- increased blood pressure
- increased sugar (glucose) in the blood
- increased break-down of glucose for energy*, especially in muscle cells
- increased free fatty acids in the blood*
- more oxidation of fatty acids to produce energy*
- more ATP (the cells' primary energy compound) produced*
- blood vessels constrict

*needs magnesium

“During stress response, calcium ions rush inside the cell, and this alters the internal Mg:Ca ratio. This change in ratio exhibits wide effects because, while magnesium and calcium are very similar in their chemistry, biologically these two elements function and react very differently. Magnesium and calcium are two sides of a physiological coin: they are antagonistic to one another yet come as a team.”

kept mainly inside cells. The stress response changes this. During stress response, calcium ions rush inside the cell, and this alters the internal Mg:Ca ratio. This change in ratio exhibits wide effects because, while magnesium and calcium are very similar in their chemistry, biologically these two elements function and react very differently. Magnesium and calcium are two sides of a physiological coin: they are antagonistic to one another yet come as a team. For example,

- Calcium excites nerves, magnesium calms them down.
- Calcium makes muscles contract, but magnesium is necessary for muscles to relax.
- Calcium is necessary to the clotting reaction—so necessary for wound healing—but magnesium keeps the blood flowing freely and prevents abnormal thickening when clotting reactions would be dangerous.

Scientific study shows more and more that the underlying cellular change enabling the

stress response is a low Mg:Ca ratio caused by a large and sudden influx of calcium into cells. The stress response subsides when the cells’ magnesium returns to its dominant presence inside cells, moving extra calcium back outside cells to its “normal” position, thus restoring the cells’ normal Mg:Ca ratio. This underlying principle is present in studies of nerve cell–stress hormone response,⁴ organs such as hearts,³ the high blood pressure response to stress^{5,6,7,8} and the blood clotting reaction during stress,^{9,10,11,12} among many others. See Table 2.

In the normal healthy state, the stress response occurs when necessary, and subsides when the crisis or trigger is over. Since magnesium and calcium—two essential nutrients that must be obtained by the body from its dietary environment—are so essential to this important response, it is not surprising that nutritional magnesium and calcium status can affect the response. Let’s see how.

In the normal, unstressed state, cellular Mg:Ca ratio is high. If this cannot be maintained due to lack of adequate body

magnesium or an overwhelming amount of body calcium, the ratio may not be able to maintain or return itself to its healthy, non-stressed ratio. In such a case, the stress response, in the absence of an appropriate trigger, can occur. This can be seen when nutritional magnesium deficits cause high blood pressure^{5,6} or increased blood “stickiness” (platelet aggregation).⁹ Additionally, since a low Mg:Ca ratio can increase adrenaline secretion as well as cells’ response to adrenaline, a too low magnesium state can keep the stress response from subsiding in a timely way.^{1,14} Even worse, when body magnesium becomes drastically low, this becomes a stress trigger in itself,¹ alarming the body into further stress response without enough magnesium to back it up, resulting in a low magnesium-high stress crisis that can end in sudden death.^{1,14,15}

In the industrialized world we live in a state of chronic, on-going stress. This environmental reality increases our daily need for magnesium in order to maintain a healthy stress response that can calm when not necessary.

Part II. Heart Disease is Often a Magnesium Deficiency

Clearly, an adequate amount of nutritional magnesium in—proper balance with adequate nutritional calcium—is key to a healthy stress response. And yet, today we have diets dangerously low in magnesium.¹³ Add the recent additions of nutritional calcium via supplements and food fortifications meant to stave off osteoporosis, and many of us are getting inadequate magnesium *plus* too much calcium. The result is a large occurrence of heart disease.^{1,13,14,15,16,17,18}

Not all, but much of the heart disease in the industrialized world can be explained

Table 2

Magnesium and calcium are an “antagonistic” team in the “fight or flight” reaction.

Function	Calcium’s influence	Magnesium’s influence
Blood cell clumping (platelet aggregation)	activates	inhibits
Other Blood clotting reactions	encourages	discourages
Nerve excitation	enhances	discourages
Adrenaline secretion	enhances	decreases
Adrenaline response	enhances	decreases
Blood vessel contraction	increases	decreases

by the low magnesium state of these societies.¹³ People with heart disease—for the most part—are people who are in a state of magnesium that is borderline or deficient. Many studies on heart disease patients exist due to medicine's effort to understand and treat this widespread malady. Although not intended as such, this body of research shows us what stress can do to a person in a magnesium deficient state.

Part III. Mental and Emotional Stress Deplete Magnesium

It is commonly accepted that certain traditional risk factors for heart disease exist. These include high cholesterol, high blood pressure, family history of heart disease, and other factors, all of which can be linked to a shortage of nutritional magnesium.¹⁴ Recent studies tell us that stresses—both sudden and chronic—with their high magnesium requirements, are also strong risk factors for heart disease.

these newly found risk factors **cause** heart disease, or are they risk factors because they, as well as heart disease, can all be aspects of low magnesium status? These chronic sources of stress can increase the human need for magnesium as well as be caused by its deficit.

Emotional stress triggers in susceptible people can even bring on sudden death due to heart attack,²⁷ presumably by initiating a stress/low-magnesium crisis. Such emotional “triggers” include work stress, high-pressure deadlines, social isolation and loneliness, low socioeconomic status, anxiety, war, fear of war, anger and rage.²⁸ Identical stress triggers cause more human heart attacks regardless of age, race, gender, or geographic location, including continent.²⁹

Mental stress, such as working out a math problem,³⁰ can be shown to have impact upon the magnesium-stress response connection since it can bring on heart attacks in people with heart disease.

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“Recent studies tell us that stresses—both sudden and chronic—with their high magnesium requirements, are also strong risk factors for heart disease.”

The sudden stress of the L.A. earthquake¹⁹ and the 9/11 World Trade Center attack²⁰ showed an upsurge of adverse heart events in people with heart disease. Even heart patients living in Florida, hundreds of miles away from the WTC attack, showed more adverse heart events in response to 9/11 than in usual times.²¹ Again, adverse heart events in this largely magnesium deficient population show that the triggered stress response tested their magnesium status and found it wanting.

Emotional stress²² and phobic anxiety²³ cause heart problems in patients with heart disease—a population we know to be mostly low in their nutritional magnesium status. Chronic states of emotional stress including a history of childhood abuse, neglect or family dysfunction,²⁴ depression,²⁵ and panic disorder²⁶ must now be added to the list of traditional risk factors for heart disease such as high blood pressure and high cholesterol. Depression can be a symptom of low magnesium status.¹⁴ So can anxiety, panic attacks, irritability, hyperactivity, and over-sensitivity to loud noises.¹⁴ Do

Part IV. Stress, Magnesium and Aging

We are hearing a lot about stress in the health media, and rightly so as this constant companion to our lives brings on the fight or flight syndrome, a stress response that, when activated, has been shown to shorten lifespan.³⁴ When we realize that the stress response is exacerbated when we are low in magnesium, that we are living on low-magnesium foods for the most part, and that our lifestyles are more and more filled with chronic stresses and stressful events, we are not surprised to see that several aspects of magnesium deficiency are remarkably like aspects of the aging process.³⁵

When faced with our stressful lifestyles, coupled with a society presenting a chronically low-magnesium/high-calcium diet, what is our best defense? For many of us, magnesium supplements can help to preserve or restore a healthy Mg:Ca balance, so important to our health in these stressful times.

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