

## Fibromyalgia: Nutritional Support

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**ABSTRACT:** *Fibromyalgia is a rheumatic syndrome that is characterized by generalized musculoskeletal pain, stiffness, and chronic aching, fatigue, and multiple areas of local tenderness called “tender points” that are easily identified during physical examination. These tender points have become the primary diagnostic factor for fibromyalgia. Research studies suggest that fibromyalgia may be the result of any condition that could lead to constant muscle hypoxia, and it has been postulated that fibromyalgia patients may be deficient in certain compounds*

*required for the synthesis of adenosine triphosphate (ATP). Various conventional treatment modalities have been tested in fibromyalgia patients, all with poor results. Evidence suggests that fibromyalgia patients may be deficient in certain nutrients required for ATP synthesis and the respiratory chain, such as magnesium, malic acid, manganese, and thiamin. Nutritional approaches to the treatment of fibromyalgia include supplementation with these nutrients to optimize the nutritional status of the patient.*

Fibromyalgia (FM), a mysteriously debilitating rheumatic syndrome, is taking an increasing toll on our population. The condition, which bears a striking resemblance to chronic fatigue syndrome (CFS), mainly affects women aged 25-50 years (female to male ratio is at least 5:1).<sup>1,2</sup> Both syndromes are characterized by a broad spectrum of physical and emotional symptoms, and both are receiving increasing attention from the medical community.<sup>3</sup>

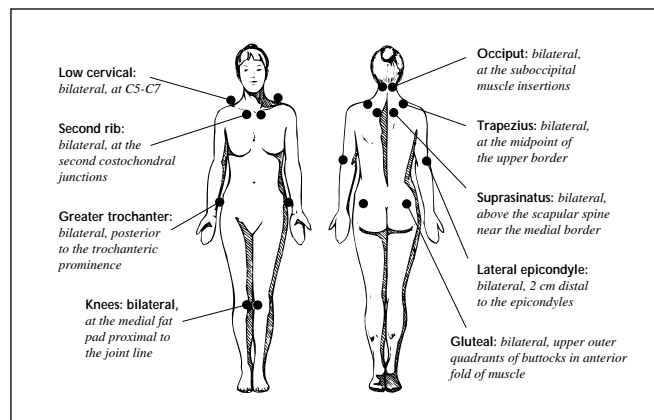
Fibromyalgia, which is generally classified as a soft tissue musculoskeletal condition,<sup>4</sup> resembles CFS in several ways.<sup>5</sup> Both syndromes plague patients with symptoms of chronic musculoskeletal pain, aching, stiffness, disturbed sleep, depression, and fatigue (Table 1).<sup>2,3,5-7</sup> While not all patients experience all symptoms, those with FM have a peculiar sensation of tenderness in specific areas of their body.<sup>1,2,6-8</sup>

The tender point examination (i.e., tenderness in at least 11 of 18 defined points) has become the primary diagnostic factor for FM and helps doctors to differentiate the syndrome from CFS.<sup>8</sup> Tender points are localized areas where slight to moderate pressure elicits a sensation of pain. They are located over muscles and tendon insertions, and can range from mildly irritating to completely debilitating (Figure 1).<sup>7,8</sup> Pain in FM patients has been attributed in part to an unusually high degree of gluconeogenesis. This increased level of muscle tissue breakdown has been hypothesized as one of the main reasons for pain, aching, and fatigue.<sup>9</sup>

**Table 1. Primary Symptoms of Fibromyalgia**

<ul style="list-style-type: none"> <li>• Tenderness of specific anatomical sites (at least 11 of 18 points)</li> <li>• Chronic aching</li> <li>• Stiffness</li> <li>• Sleep disturbances</li> <li>• Pain</li> <li>• Fatigue</li> <li>• Anxiety</li> <li>• Depression</li> <li>• Chronic fatigue</li> <li>• Gastrointestinal disturbances</li> <li>• Subjective soft tissue swelling</li> <li>• Cardiovascular problems (dizziness, palpitations)</li> </ul>
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**Figure 1. Tender Points for Diagnostic Purposes**



Anatomic location of tender points according to the American College of Rheumatology 1990 classification criteria for fibromyalgia.

In order to better understand the origin of the disease, scientists in Sweden have conducted several studies on patients with FM. Muscle morphology, chemistry, and physiology were carefully examined, as were the most prominent symptoms, including muscle pain, muscle fatigue, and muscle stiffness. The authors of a comprehensive review of these studies found that victims of the syndrome appear to have microcirculation disturbances, along with mitochondrial damage and abnormally low phosphate counts – strongly suggesting an energy deficient state in the muscle tissues.<sup>10</sup> These scientists hypothesized that FM might be the result of any condition that could lead to constant muscle hypoxia, specifically through the establishment of abnormal motor patterns.

### CONVENTIONAL TREATMENTS FALL SHORT

Despite long years of research and study, the treatment and management of FM is still not satisfactory. A tricyclic agent known as amitriptyline has been shown to provide some short-term relief; however, the drug is also known to have adverse side effects, including myocardial infarction, stroke, arrhythmia, coma, seizure, and alopecia. Long-term effects of the drug are still not known. One study found ibuprofen to be no more beneficial than a placebo.<sup>11</sup> Of the variety of conventional treatment modalities that

have been tested on FM patients, all have yielded unsatisfactory results.

### ATP SYNTHESIS & THE CRITICAL ROLE OF MAGNESIUM

Some research suggests that FM patients may be deficient in certain compounds required for the synthesis of adenosine triphosphate (ATP).<sup>12</sup> ATP synthesis requires the presence of oxygen, magnesium, substrate, ADP, and phosphate (Table 2). Optimal concentrations of each of these allow healthy mitochondrial respiration and the concomitant production of biological energy. Deficiencies, on the other hand, may slow the Krebs cycle, increase anaerobic glycolysis, increase lactic acid formation, and cause a reduction of maximum lung capacity. This combination of factors may lead to the symptoms of fatigue, depression, and muscle pain.

Some evidence suggests that magnesium, one of the most crucial elements for ATP synthesis, may be below normal ranges in FM patients.<sup>12,13</sup> Magnesium is a critical nutrient for the production of ATP. Mitochondrial uptake and accumulation of magnesium are directly related to the uptake of phosphate required for ADP phosphorylation. Thus, the entire Krebs cycle is a magnesium-dependent

**Table 2. Requirements for the Optimal Synthesis of ATP by Intact Respiring Mitochondria: The Critical Roles of Malate and Magnesium**

Requirements	Primary Sources	Intramitochondrial Conditions Postulated to Cause a Deficiency
Oxygen	Cardiopulmonary	Hypoxia, malate deficiency. Magnesium deficiency.
Magnesium	Food	Excess aluminum, excess calcium.
Substrate	Food	Severe malnutrition, malate deficiency.
ADP	ATP	Phosphate deficiency, magnesium deficiency.
Inorganic Phosphate	Food	Manganese deficiency, excess calcium. Malate deficiency, excess aluminum.
Capacity of the Respiratory Chain	Food/Genetics	Vitamins B <sub>1</sub> , B <sub>2</sub> , and B <sub>6</sub> are essential for the electron transport system in the respiratory chain. All three vitamins require a magnesium dependent phosphate transfer reaction to become biologically active.
Mitochondrial Membrane Integrity	Food/Genetics	Magnesium deficiency may cause mitochondrial swelling, increased membrane permeability, and uncoupling of oxidative phosphorylation.

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mechanism and even a slight deficiency may potentially impair its optimal function. Related problems caused by magnesium deficiency include mitochondrial swelling, increased membrane permeability, decreased selectivity of mitochondrial innermembrane, uncoupling of oxidative phosphorylation, and possibly aluminum toxicity.

### ALUMINUM TOXICITY

Aluminum toxicity may play a role in symptoms experienced by magnesium-deficient FM patients since magnesium is needed to help the body block the toxic effects of aluminum. This needs to be acknowledged and addressed, since aluminum inhibits glycolysis and oxidative phosphorylation resulting in decreased intramitochondrial ATP production.<sup>12</sup> Additionally, due to its high affinity for phosphate groups, aluminum blocks the absorption and utilization of phosphates vital to the synthesis of ATP. This may further contribute to the problem of intramitochondrial phosphate deficiency.

Since it has become widely recognized that aluminum overload can lead to major metabolic disturbances, some researchers have carefully studied means of eliminating the toxic metal, especially from the body's vital organs.<sup>14</sup> They found that, in addition to adequate amounts of magnesium (which helps prevent the toxic effects of aluminum), supplemental malic acid may support aluminum detoxification. Malic acid is a known chelator of aluminum.<sup>12</sup>

### MAGNESIUM, MALIC ACID, AND FIBROMYALGIA

The *Journal of Nutritional Medicine* published a study on the combined effects of magnesium and malic acid on FM patients.<sup>12</sup> The researchers used oral magnesium and malic acid preparations in an open clinical setting. Fifteen patients (ages 32 to 60) ingested 1,200 to 2,400 mg of malic acid with 300 to 600 mg of magnesium for a testing period of 4 to 8 weeks. The results of the study were encouraging: all patients reported significant relief of pain within 48 hours of treatment and, within 4 to 8 weeks, all patients had a significant and measurable decrease in the Tender Point Index (TPI). TPI scores were  $19.6 \pm 2.1$  prior to treatment and  $8.0 \pm 1.1$  and  $6.5 \pm 0.75$  after treatment. Following the 8-week study period, 6 patients were switched to placebo tablets for an additional 2 weeks. The TPI values increased from  $6.8 \pm 0.75$  to  $21.5 \pm 1.4$ . These results indicate the possibility of a very promising nutritional approach for FM.

### MANGANESE AND THIAMIN

Fatigue is one of the most prominent features of fibromyalgia syndrome, and both CFS and FM may have a common link in manganese-dependent neuroendocrine changes, especially along the hypothalamic-pituitary thyroid axis.<sup>15</sup> The cycle begins with hypothalamic production of thyrotrophin-releasing hormone (TRH). TRH stimulates the pituitary gland to produce thyroid stimulating hormone (TSH), which in turn stimulates thyroid production of thyroxin. This is important, since thyroxin regulates the metabolic rate. And with fatigue as one of the major complaints among both FM and CFS patients, hypometabolism due to secondary hypothyroidism fits very nicely into this hypothesis. Manganese, which directly influences the metabolic rate through its involvement in this hypothalamic-pituitary-thyroid axis, may therefore be an important trace mineral for CFS and FM patients.

Thiamin also plays a role in the respiratory chain. In addition, thiamin deficiency symptoms are strikingly similar to many of the symptoms experienced by FM patients. These include apathy, confusion, fatigue, insomnia, depression, paresthesia (numbness or burning in the hands and feet), low blood pressure, low metabolism, and shortness of breath.

Considering the lack of medical treatments and evidence of nutritional factors, it makes sense to implement the use of dietary supplements to optimize the nutritional status of patients with FM. To summarize the first part of our discussion, the nutrients to consider here are:

- Magnesium and malic acid to support ATP synthesis and aluminum detoxification (the addition of vitamin B<sub>6</sub> can support this process).
- Manganese to support neuroendocrine changes.
- Thiamin to support the respiratory chain.

### THE DISEASE-TOXICITY CONNECTION

As with all degenerative conditions, it is highly beneficial to carefully investigate the relationship between toxicity and the presenting condition. This involves a close look at the role of the GI tract, liver function, lymph and cardiovascular function, nervous system balance (sympathetic/parasympathetic), and immune regulation.

With a functional understanding of the important role each of these systems play in both the onset and effective management of FM, and indeed most degenerative illnesses, it becomes clear that a comprehensive clinical approach is required. Such an approach focuses on the following patient characteristics:

1. Mental/emotional states and effective stress management skills.
2. Dietary patterns, i.e., what they eat (with careful attention to both macro- and micronutrient balance) and how they eat (with attention to habits that facilitate or inhibit proper digestion).
3. Postural and exercise habits and biomechanics.

The clinical thrust is to restore key organ system function, and in the case of FM, special attention should be given to resuscitating mitochondrial function. In addition, some evidence suggests that cardiovascular fitness training can help alleviate some of the symptoms of FM as well. According to a study published in the *American Journal of Medicine*, “It is concluded that cardiovascular fitness training is feasible in patients with fibrositis/fibromyalgia and that such training improves subjective measurements of pain-reporting behavior.”<sup>16</sup> In addition to nutritional support and mild exercise, massage, heat treatments, and rest may also help. Improvements resulting from these treatment modalities can be measured by decreased sensitivity at the tender points and improved stamina, energy, and mobility.

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