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## Exercise responsive genes measured in peripheral blood of women with Chronic Fatigue Syndrome and matched control subjects

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### Abstract

**Background:** Chronic fatigue syndrome (CFS) is defined by debilitating fatigue that is exacerbated by physical or mental exertion. To search for markers of CFS-associated post-exertional fatigue, we measured peripheral blood gene expression profiles of women with CFS and matched controls before and after exercise challenge.

**Results:** Women with CFS and healthy, age-matched, sedentary controls were exercised on a stationary bicycle at 70% of their predicted maximum workload. Blood was obtained before and after the challenge, total RNA was extracted from mononuclear cells, and signal intensity of the labeled cDNA hybridized to a 3800-gene oligonucleotide microarray was measured. We identified differences in gene expression among and between subject groups before and after exercise challenge and evaluated differences in terms of Gene Ontology categories.

Exercise-responsive genes differed between CFS patients and controls. These were in genes classified in chromatin and nucleosome assembly, cytoplasmic vesicles, membrane transport, and G protein-coupled receptor ontologies. Differences in ion transport and ion channel activity were evident at baseline and were exaggerated after exercise, as evidenced by greater numbers of differentially expressed genes in these molecular functions.

**Conclusion:** These results highlight the potential use of an exercise challenge combined with microarray gene expression analysis in identifying gene ontologies associated with CFS.

### Background

In a state of health, physical exercise has a quantifiable effect on neuroendocrine, autonomic, and immune systems influencing metabolic and immune responses. However, in the initial phase of acute illness, there is an avoidance of physical stressors so energy can be dedicated to healing and a return to homeostasis. While physiologic disturbance in acute illness is transient, chronic illnesses, such as chronic fatigue syndrome (CFS), have prolonged disturbances that have a debilitating effect both physio-

logically and psychologically. Consequently, activities that are physiologic stressors, such as physical exercise, exacerbate the symptoms that define CFS.

CFS is a complex, multifactorial illness whose etiology and pathophysiology remain unclear [1]. CFS is defined by a characteristic symptom complex in the absence of other medical or psychiatric conditions with similar clinical characteristics [2,3]. Subtle differences in hypothalamic-pituitary-adrenal axis function [4], immune system