

Contact Information:

Kevin Byrne, MD, MPH
888-464-1905
kbyrne@corpmed.com
www.corpmed.com



Ergonomics and Epidemiology

By Kevin Byrne, MD, MPH

Cumulative Trauma Disorders (CTDs) present a host of problems because of their prevalence and financial impact. Although CTDs are pervasive in many segments of our society, they are still perceived with skepticism. Common statements include, "the evidence for these illnesses is not scientifically proven," or "even ergonomic experts cannot agree on remediation strategies."

Perhaps these are simply empty, self-serving statements to support an anti-regulatory stance, but the argument brings up some questions that all people in the ergonomics field should appreciate. How can there be such controversy? How can the very existence of these disorders be denied?

Relating a disease to risk factors that operate over a long period (latency) is inherently difficult. The effort required to prove that smoking causes disease is a case in point, and even now tobacco representatives deny the allegation. However, the concept that illnesses can result from chronic exposure has been around since Hippocrates in the fifth century BC. During the middle part of this century, researchers using biostatistical and epidemiological techniques to study populations determined that long-term exposure to certain dietary and lifestyle factors could increase the risk of such diseases as cancer, heart attack, and stroke.

Similar types of studies have now determined that chronic exposure to awkward posture, excessive force, repetition, and other factors would lead to CTDs in workers.

While there are discrepancies in the ergonomic literature on the relative strength of the various risk factors, this is to be expected, since most of the studies are quite small. Furthermore, they involve a disparate set of populations, tasks performed, and study

design. These factors make it impossible to combine the studies (via a meta-analysis) to achieve greater statistical power.

Despite these limitations, there is a surprising degree of consistency that the standard risk factors mentioned above do, over time, promote the set of disorders we refer to as CTDs or RSIs (repetitive strain injuries).

NIOSH has done an incredibly good job of sorting through a myriad of studies in their publication, *Musculoskeletal Disorders and Workplace Factors* (DHHS or NIOSH Publ No: 97-141), in which they group the studies into risk factors for different body parts, and then summarize and critique them. It is hard to imagine a more useful review of the scientific literature on CTDs. Just a cursory review of the NIOSH report reveals that a great deal of work has been done on CTD causality and intervention strategies, and that we can indeed draw worthwhile conclusions. I wonder how many ergo-skeptics have read this book.

It would be extremely expensive to design a study to firmly establish the causes and prevention of CTDs, as is now being proposed in Congress. In order to ferret out the relative strengths of several risk factors, which act in concert over time to produce a disease, the study would have to be very large and extend over a sufficient time period. Also, the subjects and controls would have to be examined by a clinician at the beginning and end of the study. It's staggering to think of all the costs involved.

As a rough comparison, let's look at the studies that finally proved the relative strengths of the cardiovascular risk factors for atherosclerosis, the disease process underlying heart attacks and strokes.

In the 1960s it was suspected that high blood cholesterol, high blood pressure, diabetes, smoking, and extreme obesity were risk factors—about the same number as we've identified for CTDs. The statistics required to analyze multiple risk factors—multivariate regression—effectively dilute the relative contribution of each contributor. In other

words, when several risk factors are involved, a larger number of participants must be selected and carefully followed over a number of years. Thus, to scientifically validate the various CTD risk factors, the studies must be absolutely huge and extend over many years. For comparison, the landmark research programs that sorted out the role of cardiovascular risk factors cost approximately \$100 million each! Is it any wonder that no organization has stepped up to prove the existence and causation of CTDs?

Thus we are in an analogous position to that of the 1960s with regard to lung cancer, emphysema, heart attacks, and strokes. As clinicians, we have undeniable evidence for the existence of CTDs and clear indicators, albeit not entirely consistent, for their causation and prevention. Should we wait until there is absolute proof to act proactively? After all, absolute proof is never reached in science. Even Newton's laws and Einstein's theories have been modified. And for the obstinate ergo-skeptics, I wonder how many large, randomized, blinded placebo-controlled crossover studies they use to direct daily decisions regarding purchasing, marketing, finance, and personnel.

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