Physiological Criteria for Physical and Mental Fatigue

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ABSTRACT

A prerequisite for maintaining alertness during long working hours is to tailor a task to a worker. A high demanding task, either physical or mental, can induce fatigue that will attenuate workers' performance, leading to decreased productivity or even accidents.

Until the last few decades, physical activity was dominant among industrial or agricultural workers, making it essential to establish criteria for grading tasks during a working day. Although from first glance human energy expenditure during a specific task could be considered as a reliable indicator, physiological studies have shown that heart rates are best indicators of human "strain". Not only are heart rates (HR) proportional to the physical load but they respond to other environmental factors, such as ambient temperatures. Data pertaining to such standards and their limitations will be discussed during the presentation.

As well as those standards are, for grading physical activities, HR are almost useless in predicting stress during mental tasks. Mental activities, although known to induce strain or fatigue, are characterized by very small changes of HR.

Less than three decades ago Rohmert et al. demonstrated that air controllers, while having relatively constant HR, decreased their Heart Rate Variability (HRV) during periods of high traffic at the airfield. Since then numerous studies have supported this finding and today, by calculating another derivative of ECG signal, namely spectral analysis of RR interval, we have a quick, sensitive, non-invasive and reliable method of estimating mental fatigue.

The presentation will demonstrate how by using electrophysiological techniques we can estimate the physiological strain of both manual laborers during their work shift and of subjects performing mental tasks in the laboratory. We suggest that the physiological methods can detect strain and slight decreases of alertness at real time, thus preventing accidents.