

Chapter 29

Application of Biomechanics Instrumentation in Occupational Health Research

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ABSTRACT

Occupational morbidities during manual material handling operations are routine at workplaces. This is a global burden contributing substantially to the economy. The multifactorial etiology for musculoskeletal disorders (MSDs) along with workplace stressors require multidisciplinary preventive effort. Biomechanics plays a pivotal role in occupational health research quarrying into the root cause analysis of posture, load handling, muscular loading, balance, and stability at work. Sophisticated instrumentation and experimental techniques assist in understanding the biomechanical mechanisms of MSDs and ergonomic principles, etc. Kinetic, kinematic, isotonic, isokinetic, as well as isometric experimental modes investigate body postures and muscular responses. Foundation of biomechanics instrumentation and injury mechanism would aid researchers alongside ergonomists in dealing with identification, assessment, and control of workplace risks through participatory ergonomics approach. Judicious utilization of this discipline would approach a long-term sustainable solution to protect health and safety of workers at the workplace.

DOI: 10.4018/978-1-6684-2405-6.ch029

BACKGROUND

Biomechanics is the study of the mechanics of a living body, especially of the forces exerted by muscles and gravity on skeletal structure. This discipline is most common in sport science, where the laws of mechanics are applied in order to gain a categorical understanding of athletic performance through mathematical modeling, computer simulation and measurement. In this era of advanced research regime, applied subfields of biomechanics including kinesiology, gait analysis, musculoskeletal biomechanics, ergonomics, human factors engineering and occupational biomechanics have been extended beyond sport biomechanics.

Biomechanics is meticulously close to engineering discipline; as often traditional engineering sciences are used to analyze biological systems (Aström & Murray, 2010). In this advanced research arena, biomechanics has turned on the computerization of the technologies. It would be imperative to mention that this discipline incorporates an integrated series of analysis techniques during a single experimental work simulation. Computational biology approaches in biomechanics and biomedical engineering also open up avenues for the importance of integrating the disciplines of engineering with medical technology and clinical expertise. Such integration is ought to have a major impact on health care in the near future. Researchers focus on two general areas of biomechanics- kinematics and kinetics. In kinematics, human motion during an activity is only monitored; while in kinetic studies, motion along with forces and torques involved in the activity is taken in to account.

Occupational biomechanics emerged as a sub-discipline within the general field of biomechanics that studies the physical interactions of workers with their tools, machines, and materials to improve the working condition, enhance worker performance while minimizing the risk of musculoskeletal disorders/injuries (MSDs). Since, occupational health deals with performance of a worker, sustainable livelihood factors such as anthropometric measurements, individual risk factors (age, gender, inherited genetic characteristic), workplace risk factors (methods, materials, machines, environment, and physical stressors), psychological factors, economic concerns and return to work issues are considered during biomechanics study. Occupational biomechanics research thus provides intellectual inputs as a subsidiary discipline during the development of important ergonomics guidelines.

Musculoskeletal Disorders are one of the major causes of variety of morbidity, and have a significant influence on health and quality of life. It imposes an enormous burden of cost on the healthcare system (Jenkins et al., 2016). Especially work-related MSDs are the commonest source of morbidity among workers in range of occupation, resulting in physical impairment and disability to psychological stress. MSD is considered as a primary contributor to the global burden of non-communicable diseases and the reported global prevalence ranges from 14-42% (Sharma, 2012). In the American workplace too, work related musculoskeletal disorders account for one of the largest category of claims in workers' compensation (Bhattacharya, 2014). Studies in various other countries revealed that the prevalence of MSDs in Malaysia (~21%) (Veerapen et al., 2007), Israel (35%) (Sharma, 2012), India (26%) (Yashobant & Rajkumar, 2014) is substantial and alarming. An ICMR Task Force Study in three centres of India reported a prevalence of 7-11.5% (Sharma, 2012), with functional limitation to 85% people with nearly 10% absenteeism.

Given the multifactorial etiology for MSD and its association with individual and workplace risk factors, their reduction and prevention will require a multidisciplinary effort. The science of ergonomics, biomechanics, epidemiology and medicine together better understand the interdependence of MSD, as

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