Efficacy, usability and acceptability of exoskeletons for workers assistance: A Systematic Review of current and potential application

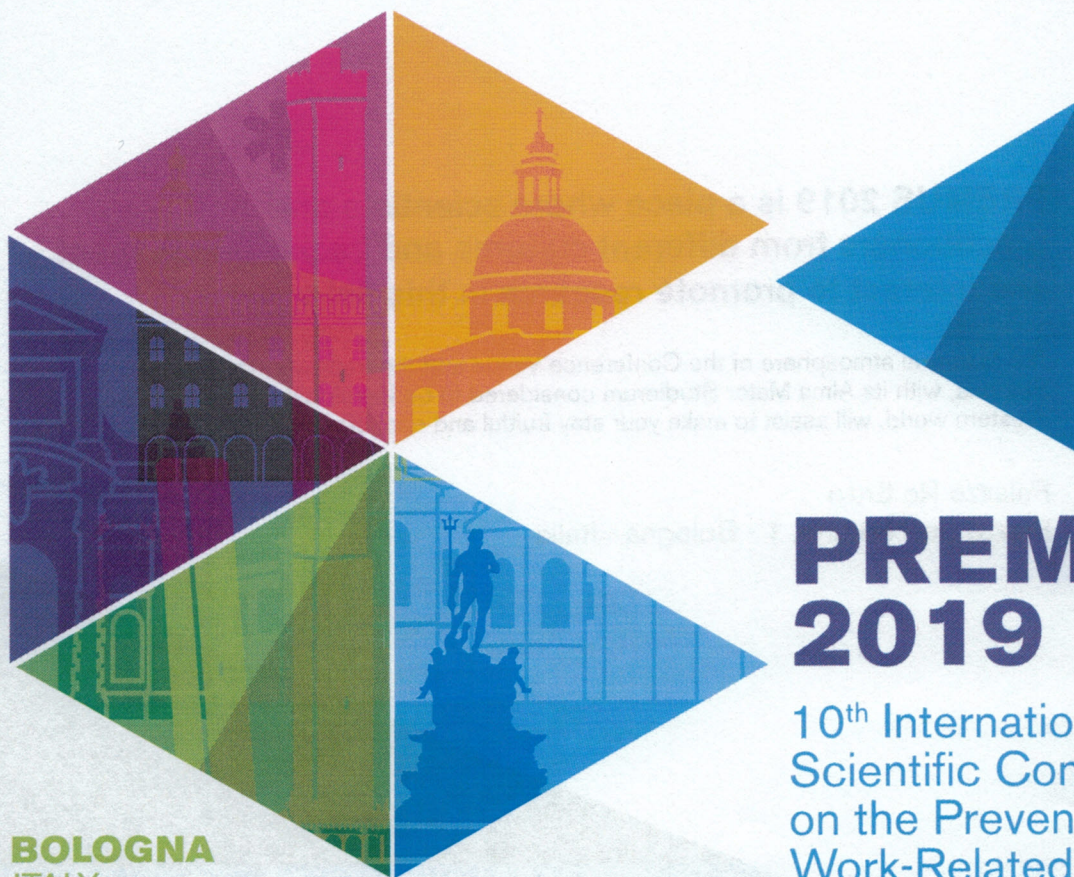*Angela Carta[1,5]; Maria Grazia Lourdes Monaco[2]; Stefano Biancini[3]; Stefano Porru[2,4,5]*

[1]University of Brescia, Department of Medical and Surgical Specialties, Radiological Sciences, and Public Health, Brescia, Italy; [2]Occupational Medicine Unit University Hospital of Verona, Verona, Italy; [3]University of Verona Post-Graduate School of Specialization in Occupational Medicine, Verona, Italy; [4]Dept. of Diagnostics and Public Health University of Verona, Verona, Italy; [5]University Research Center Integrated Models for Prevention and Protection in Environmental and Occupational Health (MISTRAL) - University of Brescia, Brescia, Italy

Background: To summarize the state-of-the-art of current literature about the use of exoskeletons for biomechanical overload reduction among worker.

Methods: A literature search was conducted in PubMed, Scopus, WebofScience and Embase from 2014 to 2019, using specific keywords: "exoskeleton" OR "wearable device" OR "assistive device" OR "wearable robot" AND "work" OR "worker" OR "working" OR "profession" OR "occupational activity". Inclusion criteria have been defined: observational and experimental studies, both from peer-reviewed journals and conference proceedings, working setting or work purposes, English language. Study quality was assessed by the Newcastle Ottawa Scale. Data was reported according to the PRISMA statement.

Results: From the database search, 6461 references (511 from Pubmed, 2728 from Scopus, 2705 from WebofScience, 517 from Embase) were retrieved and screened based on their titles and abstracts; of these, 150 full-text papers were obtained for further assessment. A total of 45 articles, including active and passive exoskeletons study, were finally included in this review. About the body structures assisted by device, spine (13 studies), upper limbs (19 studies), lower limbs (7 studies) or several body districts at the same time (6 studies) were investigated. The device's effectiveness was evaluated by different parameters: muscle effort (with surface electromyography, the Borg scale and/or questionnaires); cardio-metabolic engagement; kinematics parameters; workers' performance, usability and acceptance (mostly with questionnaires). Selected studies show an overall good impact on musculoskeletal effort but some authors suggested the need of improving workers usability and acceptance and the possible assessment of overload redistribution (i.e. from spine to upper limbs), with zero final benefits.

Conclusions: Exoskeletons use is increasing in order to reduce biomechanical overload and improve work performance: the available literature shows promising results. Further studies in real working environments are needed in order to better define their advantages for workers, in terms of fatigue reduction and usability while maintaining safe working

PREMUS 2019

10th International Scientific Conference on the Prevention of Work-Related Musculoskeletal Disorders

BOLOGNA
ITALY
2 • 5
SEPTEMBER 2019

From research to evidence based sustainable interventions and practices