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A framework of the manual materials handling principles to evaluate the physical exposure

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A FRAMEWORK OF THE MANUAL MATERIALS HANDLING PRINCIPLES TO EVALUTE THE PHYSICAL EXPOSURE

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INTRODUCTION

- Manual materials handling (MMH) is associated to work-related musculoskeletal disorders (MSD).
- Some evidence suggest that MMH training was unable to reduce MSD [1].
- The theoretical content of existing trainings has been criticized where the importance of maintaining an aligned posture is emphasized to reduce this risk without considering the complexity of the work context [2].
- The lack of physical practice could also influence the ineffectiveness of many MMH training [3].
- A new MMH training with progressive practical exercises and goal-oriented feedback has been developed.
- To evaluate a MMH training and the competency of handlers, parameters of their physical exposure should be assessed.
- ➢ **The objective was to develop a framework of the manual materials handling principles related to the physical exposure of the workers both qualitatively with visual observations and quantitatively with biomechanical variables.**

METHODS

- The principles were identified throughout many research projects and interventions dedicated to manual materials handling conducted over several decades.
- The general idea was to include all components that can influence the physical exposure and aspects related to the expertise of handlers.
- Ten subjects achieved various MMH tasks to test the different variables associated to the principles.
- To generalize results, variability was introduced in handled masses, dimension of the load, type of load, type of grip, box height, distance between pallets, initial distance of the box, pace, and handling technique.

RESULTS

MMH principles	Visual cues	Operating mode / Technique	Biomechancial variables
Alignment	Load position	Reduce the distance of the load	Length of the moment arm
		Centre the load / Face the load	Angle of the moment arm
	Posture	Maintain natural spinal curves / Avoid asymmetry	Joint angles (trunk inclination, 3D lumbar angles)
Stability	Use of bodyweight	Counterweight / Broaden base of support / Lower CoM	Static (base of support, CoM)
		Controlled and synchronized weight transfer	Dynamic (XCoM, ZRAM, CoP, stabilizing and destabilizing force)
	Control	Type of grip (rigid vs flexible)	Type of grip and body contacts
Loading	Joints sharing	Prioritize bulky muscles (ex: flex your knees)	Relative joint moment
	Use the load	Work with the load / Benefit from load properties (form, rigidity, mass, grip)	Potential, kinetic & elastic energy / friction
	Path	Reduce the loading time	Loading duration
		Choose the shortest path	Body path (trajectory / steps)
	Use the environment	Maximise supports / Benefit from friction	Path of the load (loaded vs not)
Rythm of the transition	Transition (phases)	Footstep strategies	Foot positions
	Fluidity	Avoid velocity variation (direct the effort in the working orientation) / Synchronise the body	Load path (trajectory, jerk, fluidity)
			Inter-joint coordination
	Tempo	Initiate movement / Choose an adapted velocity	Load velocity at transitions

CONCLUSION

- This theoretical framework may improve the risk assessment of handlers by ergonomists or biomechanists.
- Polyvalent approach usable qualitatively with visual cues and quantitatively with biomechanical instruments.
- The training of novice handlers could benefit from the framework and even provide direct feedback with portable instruments.

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