# THE ACCURACY OF VERBALLY REPORTED PEAK DYNAMIC HAND FORCES AS INPUTS INTO BIOMECHANICAL SPINE MODELS

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## INTRODUCTION

Hand forces are required inputs to many biomechanical spine models [1]. Collecting accurate hand forces in the workplace (e.g. with a force gauge) can interfere with workers, may require mocking up jobs off line, and may not be possible if interacting with other humans (e.g. nurses and patients). Previous authors have quantified the error in self-reported hand forces [2], but not during more gross body movements such as those used during manual material handling. Therefore, the purpose of this study was to determine the accuracy of verbally reported peak dynamic hand forces for a variety of pushing and pulling tasks and to quantify the effect of training on performance.

## METHODS

40 participants (20 male, 20 female) performed symmetric and asymmetric pushes and pulls at 3 different force levels (low (10%-30% MVC), med. (40%-60% MVC) and high (70%-90% MVC)) and three heights (knee, waist and head), against a wall-mounted pneumatic cylinder in series with a force gauge attached to a handle (Fig.1). Air pressure within the cylinder was adjusted via a solenoid, which controlled the magnitude of the hand forces required to move the handle. Following MVCs, participants were randomly assigned to one of four training groups: 1) (control) 100% MVC exertions with no feedback for any of the 12 tasks; 2) exertions at 100% MVC with feedback for all 12 tasks; 3) feedback at 50% and 100% MVC for all 12 tasks; 4) feedback at 50% and 100% MVC for only 3 tasks. During training, visual feedback of exertion levels during ramped contractions was provided on a monitor. After training, participants performed the tasks without feedback and were asked to estimate their exertion levels and report them verbally as a % of maximal effort. Differences between the estimated and the actual exertion levels were recorded.

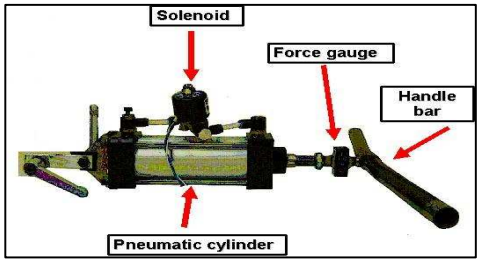


**Figure 1.** Apparatus for dynamic hand force estimation.

## RESULTS AND DISCUSSION

Across all tasks, participants on average underestimated their actual force exertion by 14%, but the error was similar across all training groups (Fig. 2). Males had significantly less error than females (13.1% vs.15.5%). Pushing tasks had greater associated error at high and medium force levels, but less error at low force levels compared to pulls, although the overall mean difference between pushes and pulls was only 2% MVC.

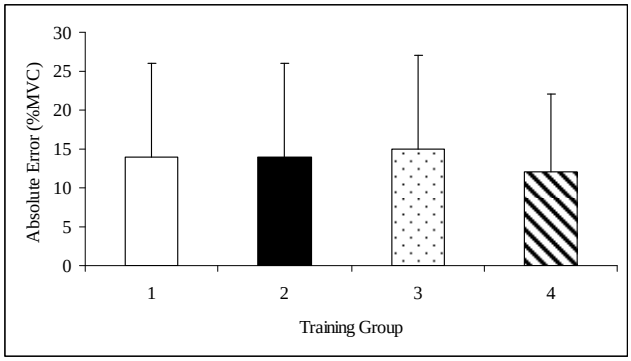


**Figure 2.** Mean (SD) absolute error (%MVC) between the four training groups.

The amount of error in verbalized hand forces did not improve with more feedback during training. While it is generally agreed that some level of training is a necessary step in psychophysical methods [3], the results here suggest that less training was sufficient for this type of activity. Less training makes this method more reasonable for field use. As the complexity of the tasks is increased it has been suggested that the amount of error in self-reporting will increase as well [4]. This is an important consideration when using the current method in the workplace on tasks that are not as constrained as those in this study.

## CONCLUSIONS

This study suggests that less training is as effective as more training for obtaining verbalized peak dynamic hand forces. This technique is more convenient and less obtrusive than other more direct methods for estimating hand loads and will help facilitate biomechanical analyses of tasks that are not feasible currently without physically interfering with the workers (e.g. nurses performing patient transfers). Establishing correction factors to adjust for errors in reported loads in field collections is an important next step.

## REFERENCES

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