## Defining repetitive hand exertions for exposure assessment.

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Numerous criteria have been used for hand exertions (Stetson, et al., 1991; Wiktorin et al., 1993, Marshall and Armstrong, 2004; Bao, et al., 2006). Similarly, repetition has been quantified in various ways (Radwin et al., 1993; Moore and Garg 1995, Latko et al. 1997, ACGIH Worldwide, 2001). The Threshold Limit Value for Hand Activity Level (ACGIH Worldwide, 2018) exposure guideline has revised the criteria for hand exertions from the original guideline published in 2001, potentially leading to inconsistent interpretations of hand activity level (HAL). Repetition rate and duty cycle are therefore dependent on the category of forces considered. Bao, et al. (2006) observed that that different definitions of repetitive exertions lead to measuring different physical exposure phenomena and produce very different results. Furthermore, there were poor correlations between different measures of repetitiveness estimated using different methods. We compared observed HALs obtained for the NIOSH supported upper extremity consortium study against frequency and duty cycle computed HALs based on video records for the same task and applied different criteria for negligible, non-negligible, and forceful exertions. We defined an exertion as a visible hand or forearm muscular effort while grasping an object or applying a force (e.g. hold, manipulate, trigger, push, pull, or handle an object) during task performance, regardless of the force required. Exertions were categorized by their magnitude of force, ranging from negligible exertions (i.e. Borg CR10<1 or MVC≤10% level of force), to non-negligible exertions (i.e. Borg CR10≥1 or MVC>10% level of force) and forceful exertions (i.e. pinch force ≥ 9N or power grip force ≥ 45 N, or Borg CR10≥2).

## The revised 2018 acgih threshold limit value for hand activity: comparison to the 2001 acgih tlv for the prevention of carpal tunnel syndrome.

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ACGIH® develops voluntary workplace exposure indices, thresholds, and limits to prevent injuries due to biomechanical exposures. In 2001, a threshold limit value (TLV®) for Hand Activity was adopted to prevent MSD among workers performing repetitive single task jobs (ACGIH, 2001). Recent studies examined the risk of new cases of carpal tunnel syndrome (CTS) for exposures above and below the 2001 TLV (Bonfiglioli et al., 2013; Kapellusch et al., 2014) and concluded that it was not sufficiently protective of workers, leading to a revision of thresholds (Rempel, 2018). We will summarize the effect of applying the 2018 TLV® versus the 2001 TLV® to data from an occupational cohort study.
For each worker, we used the 2018 TLV® equations to categorize workers into: (1) below the Action Limit (AL), (2) between AL and TLV, and (3) above TLV and compared them to 2001 limits. The 2018 TLV® might have prevented 28% of CTS cases that occurred below the 2001 AL. Similarly, 26% of workers classified as below TLV by the 2001 thresholds would have been classified as above TLV by the 2018 threshold and might also have been prevented. The 2018 TLV® is demonstrated to improve the protection of workers who perform hand intensive tasks from risk of CTS.

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