Long lasting muscle fatigue after standing work

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Introduction: Prolonged standing work is known to induce discomfort and the resulting muscle fatigue is associated with back and leg pain even in the absence of load manipulation. Several studies have proposed that the progressive accumulation of muscle fatigue effects may lead to these disorders, as fatigue generated by sustained low-level exertions exhibits long-lasting effects (Edward, 1988; Adamo et al. 2009). This study aimed to determine the most appropriate methods to quantify muscle fatigue and symptoms associated with standing work, and to estimate the possible influence of age and gender on leg muscle fatigue. The results obtained with three methods are reported here.

Methods: 14 men and 12 women from two different age groups (18-30 years, N = 14 and 50-65 years, N = 13) simulated standing work for 5 hours. The standing work was interrupted by a 5-minute seated rest break at the end of the first, third and fourth hour, and a 30 minutes lunch break at the end of the second hour. In addition, the younger group was also tested on a control day during which the participants remained mostly seated. Muscle fatigue was quantified by electrically induced muscle twitches (Muscle Twitch Fatigue - MTF) in the gastrocnemius-soleus and tibialis anterior muscles, variations of the Center of Pressure (COP) and subjective evaluation of discomfort using the body drawing of the Nordic questionnaire (Kuorinka et al. 1987). Measures were taken before the standing work (baseline), after the second hour, immediately after the 5th hour and 30 minutes later following a seated rest period.

Results: The MTF showed no sign of fatigue after the first 2 hours and a significant fatigue effect (≈35% decrease) after the 5th hour of standing work that persisted beyond 30 minutes after the end of the workday. MTF was not affected in the control day. The COP method showed a significant increase in sway speed and path length over time during the standing workday. Subjective evaluations of body part discomfort indicated a moderate but highly significantly increased perception of fatigue in the lower extremities and back, immediately after the end of standing work, however 30 min post work fatigue ratings were not significantly different from pre-work. Age and gender, when applicable, did not significantly influence fatigue effects.

Discussion: Development of muscle fatigue was not observed after the first 2 hours of simulated standing work but accumulated afterwards, although a 30-minute lunch break was provided. The persistence of fatigue, as indicated by objective measures, after the end of the experimental period leads us to suggest that occupational activities requiring standing work are likely to contribute to lower extremity and/or back disorders. The lack of congruence between subjective and objective methods as early as 30 min post work, confirms previous results concerning fatigue induced by grip force exertions (e.g., Adamo et al. 2009) and strongly emphasizes that the long lasting effects of fatigue are not properly perceived. Considering a 35% decrease in MTF, this dichotomy indicates that subjective evaluations may not be appropriate to evaluate the long-term influences of fatigue. In addition, these results also point out a limitation of an otherwise considered “protective mechanism” (Noakes, 2013). As the effects evidenced by fatigue-induced COP changes were significant but of a somehow modest magnitude, the MTF method appears more adequate and sensitive to quantify long-term fatigue effects associated with prolonged standing work and therefore, to assess the adequacy of work-rest cycles. This assumption is in agreement with previous work seeking discrimination of fatigue effects in upper limb repetitive tasks (Bystrom and Franson-Hall, 1994; Adamo et al. 2002, 2009).

Keywords: muscle fatigue, standing work, muscle twitch force, discomfort, age, gender
References


