



## Evaluation of the effect of a paver's trolley on productivity, task demands, workload and local discomfort

Henk F. van der Molen<sup>a,b,\*</sup>, Martin Kunst<sup>c</sup>, P. Paul F.M. Kuijer<sup>a</sup>, Monique H.W. Frings-Dresen<sup>a</sup>

<sup>a</sup> Academic Medical Center, University of Amsterdam, Coronal Institute of Occupational Health, PO Box 22700, 1100 DE Amsterdam, The Netherlands

<sup>b</sup> Arbouw, Harderwijk, The Netherlands

<sup>c</sup> Expertise Centre of the Labour Inspectorate of the Ministry of Social Affairs and Employment, The Hague, The Netherlands

### ARTICLE INFO

#### Article history:

Received 11 October 2009

Received in revised form

13 October 2010

Accepted 3 November 2010

Available online 27 November 2010

#### Keywords:

Intervention

Workload

Work demands

Construction work

### ABSTRACT

The objective of this study was to determine the differences in the number of paving stones laid (productivity), task demands, energetic workload, body region discomfort and preference when laying paving stones with or without use of a paver's trolley ( $n = 8$ ) in a within-subject controlled study of pavers. The number of paving stones laid and the task demands were measured by means of systematic observations at the workplace. The energetic workload was determined using the percentage of heart rate reserve (%HRR). Body region discomfort was measured using visual analog scales, and the workers' preference was ascertained via interview. The use of a paver's trolley had no effect on productivity, %HRR or body region discomfort compared to working without a paver's trolley. The duration of knee-straining activities did not differ between working with (141 min) and without (146 min) the paver's trolley. However, six of the eight pavers indicated that, given suitable circumstances, they wanted to use the paver's trolley.

**Relevance to industry:** To reduce the chance of work-related low back and knee complaints among pavers, the duration, frequency and intensity of lower back and knee-straining activities should be limited by means of technical measures such as mechanical paving. The paver's trolley does not appear to reduce knee-straining activities and therefore does not appear useful in reducing the risk of knee complaints and disorders.

© 2010 Elsevier B.V. All rights reserved.

## 1. Introduction

The work of a paver is physically demanding, particularly on the lower back and knees (Burdorf et al., 2002, 2007). The one-week prevalence of lower back and knee complaints among Dutch pavers was 42% and 22%, respectively, in 2005 (van der Molen et al., 2005). Various methods can be utilized when paving by hand. This study addresses the method in which the paver first levels the sand base and then manually lays the paving stones onto the sand base. The paver then crawls on his knees over the paving stones that have already been laid before laying the next stones. Forward bending of the back and extreme flexion of the knees are frequent and sustained body postures over the course of a normal work day. Epidemiologic studies indicate that prolonged kneeling increases the risk of osteoarthritis of the knee (Bierma-Zeinstra and Koes, 2007).

Forward bending of the back is a well-established risk factor for non-specific low back pain (Lotters et al., 2003). The selection of appropriate work-rest regimens for static muscular work in industrial settings, such as the construction industry, may be an efficient way to reduce these risks (El ahrache and Imbeau, 2009).

A "paver's trolley" was developed in response to complaints from pavers about sitting on their calves and crawling on their knees (Fig. 1). The paver's trolley is a low trolley with three casters at the front for maneuverability and two large wheels at the back. The rear section is fitted with ankle pads and can be adjusted in order to accommodate pavers' differing leg lengths. Knee pads without fixing straps are mounted to the trolley. The paver can sit on an adjustable saddle, which supports his upper body weight, thereby relieving the pressure on his knees and calves.

Local discomfort is found to be a predictor of local musculoskeletal complaints (Hamberg – van Reenen et al., 2008) and is therefore a suitable outcome measure in intervention studies of short duration. Triangulation with multiple measurement strategies, such as observation of knee-straining activities, reduces the bias that is associated with a single-measurement approach (van der Beek et al., 2005; Parakkat et al., 2007). In collaboration with

\* Corresponding author. Academic Medical Center, University of Amsterdam, Coronal Institute of Occupational Health, PO Box 22700, 1100 DE Amsterdam, The Netherlands.

E-mail address: [h.f.vandermolen@amc.nl](mailto:h.f.vandermolen@amc.nl) (H.F. van der Molen).