

# OXYGEN UPTAKE IN SNOW SHOVELING WITH MODIFIED SHOVEL IN ELDERLY SUBJECTS

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## INTRODUCTION

Snow shoveling in the winter is hard manual labor in cold, northern regions, in most of which society is aging. For the elderly people the task is considered a physically intensive activity, associated with local muscle pain of the lower back. It was confirmed that the amount of stooping and squatting were reduced when using a modified shovel with a second handle. Additionally, less oxygen uptake was observed when using the modified shovel [1]. This study compared oxygen uptake during the shoveling of snow between a regular shovel and a modified shovel to determine how the second handle on the shovel shaft affects the oxygen demand during the shoveling in elderly subjects.

## METHODS

Six healthy elderly male subjects, who were all right-handed, volunteered to participate in the laboratory experiments. The mean (*SD*) of their heights, weights and ages were 1.61 (0.04) m, 67 (10) kg and 70 (2) yrs., respectively. They received an explanation of the experimental protocol and provided informed consent prior to testing. The experiments were all conducted under the supervision of a doctor.

Different types of shovels were used in the study, a regular shovel and a modified shovel with a second handle. The regular shovel is a commonly used one. The modified shovel resembles the regular shovel in its shape, but an additional second handle is mounted perpendicularly to the main shaft.

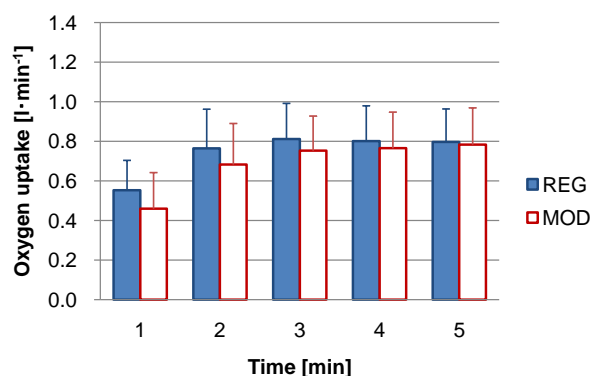
The subjects conducted a series of tests, which consisted of two trials of snow shoveling for 5 min each in the laboratory, on the different two days. The first trial involved shoveling with the regular shovel, and the second with the modified shovel. Each of the trials contained total of 50 tasks of shoveling simulated snow, a 2.5 kg stuffed bag, at a predetermined rate of 10 strokes per min, paced by a metronome. One task involved scooping up the snow placed diagonally left in front of the left foot and throwing it to a 0.9 m high target board 2 m away from the subjects.

Oxygen uptake ( $VO_2$ ) was measured every 10 s with using a metabolic measurement device (VO2000, MedGraphics, USA) during the trials. Heart rate (HR) was recorded every 5 s (POLAR ACCUREXplus, Polar Electro, Finland) simultaneously. These variables were averaged over 1-min interval during the trials.

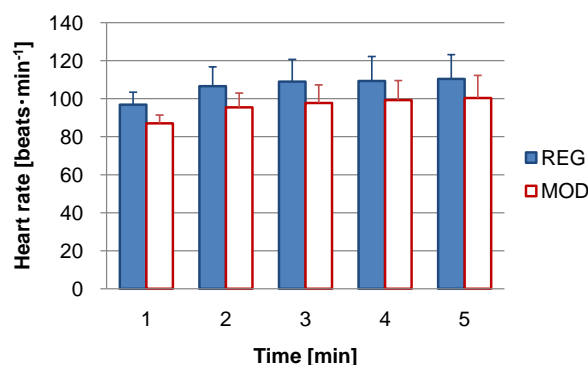
All data were expressed as means (*SD*). Two-way ANOVA was used to determine significant differences between the regular and the modified shovels on the 1-min values of the measured variables. The *p*-value was considered significant when it was found to be less than the usual level of significance 0.05.

## RESULTS AND DISCUSSION

Figure 1 shows the 1-min values of  $VO_2$  during the shoveling using either the regular shovel (REG) or the modified shovel (MOD). On an average, the 1-min values of  $VO_2$  were 0.73 (0.19)  $l \cdot min^{-1}$  for REG and 0.69 (0.21)  $l \cdot$



**Figure 1:** Oxygen uptake ( $VO_2$ ) during the trials of the shoveling using either the regular (REG) or the modified shovel (MOD).



**Figure 2:** Heart rate (HR) during the trials of the shoveling using either the regular (REG) or the modified shovel (MOD). Significant difference was found in HR between the two shovels.

$min^{-1}$  for MOD, and there was no significant difference between the two shovels. Figure 2 shows the 1-min values of HR during the shoveling. The 1-min values of HR were 106 (11)  $beats \cdot min^{-1}$  for REG and 96 (10)  $beats \cdot min^{-1}$  for MOD, and significant difference was found between the two shovels ( $p < 0.01$ ). These results indicated that the physically burden were reduced when the elderly subjects were shoveling snow using the modified shovel. It suggests that the modified shovel with the additional second handle may enable elderly people to perform shoveling tasks more comfortably.

## ACKNOWLEDGEMENTS

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## REFERENCE

1. Yanagi H, et al. *Proceedings of ISB XXI*, Taipei, Taiwan, Abstract 788, 2007