

Validity of Heart Rate Measurements Obtained Via a Digital Pulse Oximeter During Submaximal Exercise

Christopher J. Kusmiesz, Thomas J. Williams, Shawn C. Kwak, Robert Stanley

United States Army War College, Carlisle, PA, Dunham Army Health Clinic, Carlisle, PA

Pulse oximeters have been used as an alternative method for monitoring heart rate (HR) during exercise. However, there is insufficient data to validate their use as a sole means of monitoring HR during various levels of exercise. **PURPOSE:** To evaluate the accuracy of HR readings obtained from a Nonin Model 7500 digital pulse oximeter compared to the HR readings obtained from a Polar T-31 chest strap.

METHODS: A total of 52 subjects volunteered to participate in the study: 42 males (mean age= 44.3 years, range= 40-55 years) and 5 females (age= 43.8 years, range= 42-45 years). Each subject was fitted with a Polar T-31 HR strap. Subjects were also fitted with a Nonin Model 7500 Digital Pulse Oximeter with a Nonin Model 8000J adult flex pulse oximeter finger sensor and a Nonin Model 8000JFW FlexiWrap single use sensor wrap. The subjects were instructed to walk normally on the treadmill and allow their arms to swing freely. Metabolic gas analysis was completed with a metabolic cart system to measure the subject's oxygen consumption and determine the respiratory exchange ratio. The subjects performed a walking graded exercise test utilizing a modified version of the U.S. Air Force School of Aerospace Medicine protocol until they reached one of the following test termination criteria: 90% of their age-predicted maximal HR, a respiratory exchange ratio of 1.0 or volitional fatigue. All subjects completed 3 minutes of walking recovery. During the last 5 seconds of each stage, simultaneous HR measurements were observed and recorded from the Polar HR monitor display and the digital display on the Nonin pulse oximeter. **RESULTS:** The data analysis revealed a moderate positive correlation between the pulse oximeter versus HR monitor reading with the pulse oximeter becoming less accurate at the end of the 5th stage ($r= 0.74$, $p< 0.000$) when the average HR was > 150 bpm. The results from this study indicate that an increase in motion artifact, associated with vigorous levels of exercise, attributed to the decrease in the digital pulse oximeter accuracy. The results also suggest that a HR > 150 bpm did not contribute to the reduced accuracy of the pulse oximeter during the last stage of exercise.

CONCLUSION: The use of a digital pulse oximeter to monitor submaximal HRs may be acceptable at lower levels of exercise intensity in which excessive arm motion is avoided.