# Impact of Aging on Recreational Surfers' $VO_{2peak}$ During Simulated Paddling


JOSEPH F. MOON, JOANNE T. CAYABYAB, JENNY LOU D. CARDINAL, JEFF A. NESSLER, GEORGE H. CROCKER & SEAN C. NEWCOMER

Department of Kinesiology, California State University, San Marcos, CA, 92096


## Abstract


**Background:** There is a growing body of literature characterizing peak oxygen consumption ($VO_{2peak}$) of young surfers during simulated paddling. Conversely, no data on $VO_{2peak}$ during simulated paddling has been collected in surfers over the age of 30. This paucity of data is surprising given the increasing participation rates of older adults in the sport of surfing. **Purpose:** The purpose of this study was to characterize $VO_{2peak}$ during simulated paddling in recreational surfers between the ages of 18 to 69. **Methods:** Sixty-eight male recreational surfers between the ages of 18 and 69 years participated in this study. Subjects performed a maximal graded exercise test on a surfboard attached to a swim bench ergometer (Vasa). Power output began at 20 watts and increased by 10 watts every minute. Oxygen consumption and heart rate were measured continuously using an integrated metabolic measuring system (ParvoMedics TrueOne 2400) and heart rate monitor (Polar RCX5), respectively. **Results:** Average $VO_{2peak}$ during simulated paddling for subjects from the second, third, fourth, fifth, and sixth decades of age were 31.9±7.1, 26.1±5.3, 28.5±5.7, 24.9±5.1, and 20.9±2.9 ml/kg/min, respectively. Aging resulted in a significant reduction in $VO_{2peak}$ ($r=-0.455$, $p<0.001$) that may, in part, be attributed to a significant reduction in heart rate with age ($r=-0.407$, $p<0.001$). **Conclusion:** $VO_{2peak}$ during simulated paddling on a swim bench ergometer was significantly lower in older adults. Paddling, an upper body exercise, shows similar age-related decline in $VO_{2peak}$ as that of lower and whole body exercise.


## Background

- Surfing is a sport which continues to increase in popularity; participation in the sport among recreational surfers who are over 30 years old seems to be increasing (10).
- Surfers engage in intermittent aerobic paddling bouts with bursts of explosive paddling to catch a wave (1,4,6), which suggests that surfing is a type of high-intensity interval training and is shown as an effective means of increasing maximal oxygen uptake (6,7,9).
- Due to the aerobic nature of paddling, many previous studies have investigated the peak oxygen consumption ($VO_{2peak}$) of young professional surfers during paddling on a swim bench ergometer (1,4,5).
- Data from these previous studies demonstrate that young competitive surfer's $VO_{2peak}$ is comparable to athletes from other sports such as swimming (2).
- It is surprising that there is a paucity of data characterizing the peak oxygen consumption of recreational surfers over the age of thirty years, given the changing demographics of surfing.

## Purpose

The purpose of this study was to characterize $VO_2$peak during simulated paddling in recreational surfers between the ages of 18 to 69.

## Methods

**Subjects**

- Sixty-eight male, recreational surfers ages 18-69 years participated in this study.
- Health and surfing history questionnaires were completed following informed consent.

**Protocol**

- Subjects performed a graded exercise test that started at 20 W and increased by 10 W every minute until volitional fatigue on a modified swim bench ergometer (Vasa, Inc., Essex, Vermont, USA).
- Heart rate (HR) and oxygen consumption were measured continuously using a HR monitor (Polar RCX5) and metabolic cart (ParvoMedics), respectively.

**Statistical Analysis**

- Data reported as mean, standard deviation, and range for each age group.
- Pearson's correlation coefficient (r) and linear regression were used to describe relationships between measured endpoints (e.g. $VO_{2peak}$, $HR_{peak}$, and RER) and age.
- Statistics were performed using Microsoft Excel 2013 at $\alpha = 0.05$.

## $VO_{2peak}$

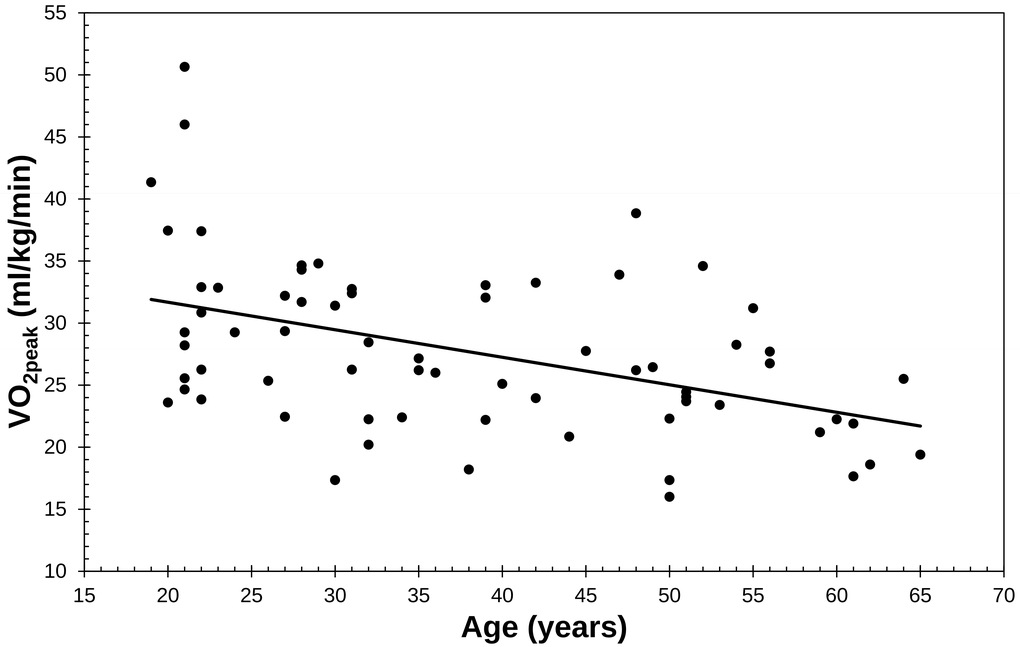


**Figure 1.** Subject's peak oxygen consumption ($VO2_{peak}$) vs. age. $r=-0.455$, $p<0.001$

## RER

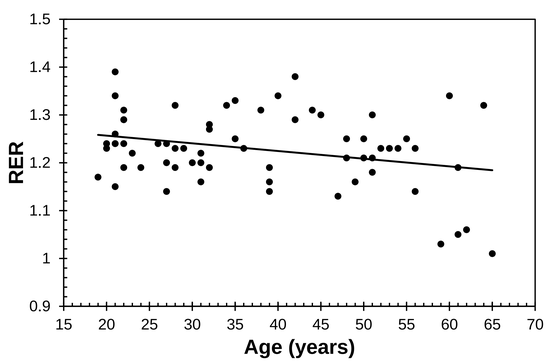


**Figure 2.** Respiratory exchange ratio (RER) vs. age. $r=-0.288$, $p=0.019$

## Heart Rate

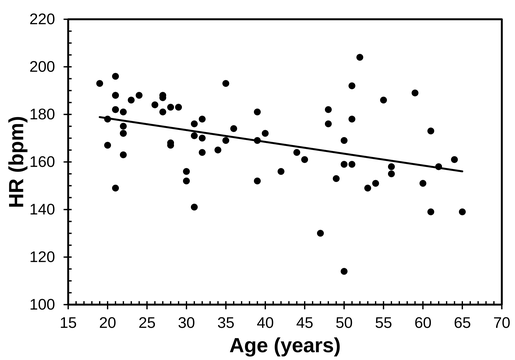


**Figure 3.** Maximal heart rate (HR) vs. age. $r=-0.407$, $p<0.001$

## Age-group analysis

**Table 1.** Measurements of $VO_{2peak}$ criteria between age groups.

| | $VO_{2peak}$ (ml/kg/min) | RPE | RER | $HR_{max}$ (bpm) |
|---|---|---|---|---|
| Ages 18-29 | 31.9 ± 7.1 | 19.2 ± 0.1 | 1.24 ± 0.06 | 179 ± 11 |
| Ages 30-39 | 26.1 ± 5.3 | 19.4 ± 1.4 | 1.26 ± 0.12 | 167 ± 13 |
| Ages 40-49 | 28.5 ± 5.7 | 19.8 ± 0.7 | 1.26 ± 0.08 | 162 ± 16 |
| Ages 50-59 | 24.9 ± 5.1 | 19.8 ± 0.6 | 1.24 ± 0.14 | 166 ± 24 |
| Ages 60-69 | 20.9 ± 2.9 | 19.2 ± 1.0 | 1.16 ± 0.14 | 154 ± 13 |

## Conclusions

- Among the group of sixty-eight recreational surfers (ages 18-69) there was a significant decrease in $VO_{2peak}$ and maximal HR with an increase with age (Figures 1&3).
- RER decrease in older subjects (Figure 2).
- Paddling, an upper body exercise, shows similar age-related decline in $VO_{2peak}$ and maximal HR as that of lower and whole body exercise.

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