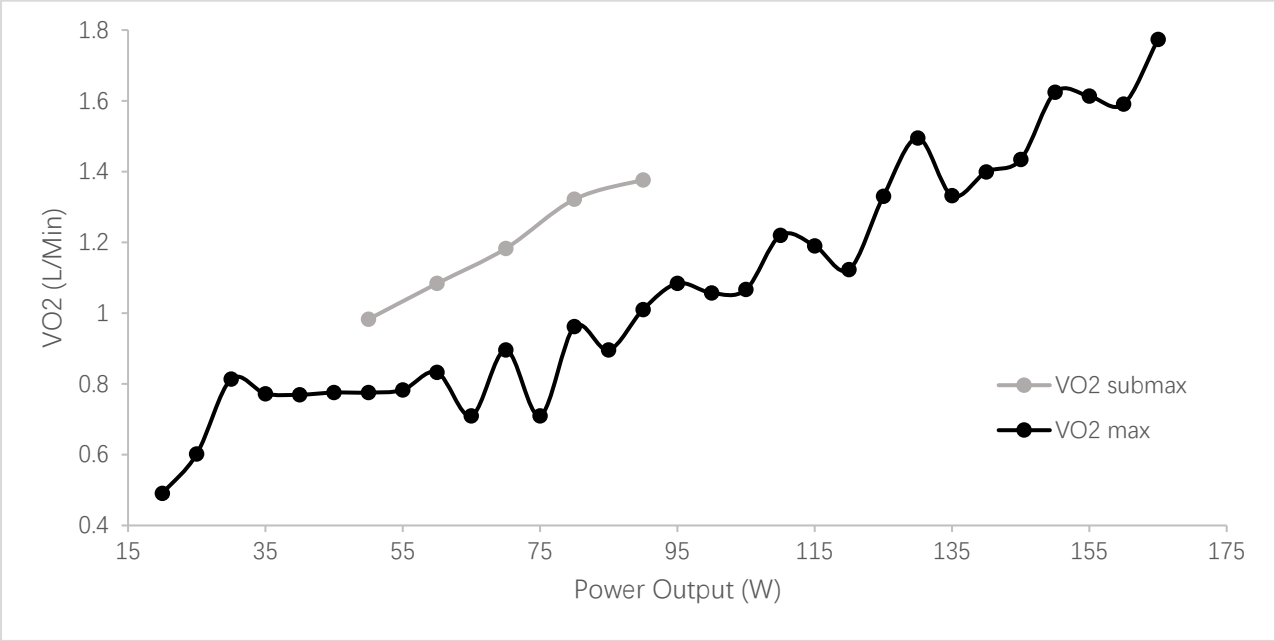
Hypothesis

The relationship between power output and VO2 is curvilinear, as the power output increases, the VO2 will also increase and finally reaches a plateau.

Figure 1

The comparison of power output between V̇ O2 (L·min-1) data from submaximal four-minute step-incremental and V̇ O2 (L·min-1) data from maximal 20W/min RAMP test.



Note. VO2 submax = VO2 measure in submaximal four-minute step-incremental; VO2 max = VO2 measured in maximal 20W/min RAMP test; VO2 = Liter/Minute; Power Output = Watt. All data used are from attached SUBMAX and MAX Excel files.

Discussion

A submaximal four-minute step-incremental test and a maximal 20W/min RAMP test did not produce the same VO2 for a given power output. And the VO2 achieved at a given power output is higher in the submaximal protocol than maximal protocol.

One reason why VO2 is higher in submaximal and maximal exercise protocols at a given power output is due to an increased demand for energy by the muscles. As exercise intensities increase, the body relies more on anaerobic metabolism, which produces energy without oxygen but also produces more lactic acid and fatigue. Thus, the body needs to consume more oxygen to support aerobic metabolism and maintain energy production. What's more, another reason may be due to the increased cardiac output. During exercise, the heart pumps more blood to the working muscles to deliver oxygen and nutrients, which increases cardiac output. This increased blood flow also leads to an increase in oxygen uptake, as more oxygen is transported to the muscles.

Some factors can affect the accuracy and reliability of the research. The exercise protocol used to elicit a given power output can affect the V̇O2 achieved. The submaximal and maximal exercise protocol aim to measure different VO2 responses. A four-minute step-incremental test or other submaximal exercise test is often created to elicit a steady-state VO2 that is lower than the subject's maximal VO2. This indicates that even at the highest power output produced, the VO2 obtained during the test may not be maximal or close to maximal. The goal of a maximal exercise test, such as a 20W/min RAMP test, is to cause the subject to attain their maximal VO2. In 2018, Wheatley and his colleagues found that with workload increases, the cardiopulmonary and metabolic response including VO2, heart rate etc. also increases to the maximum. Whereas in endurance exercise (submaximal), the oxygen demand would be fixed into a given level, typically higher with lower exercise intensity but finally reached a plateau.