Effect of Gear Ratio and Cadence on Gross Efficiency and Pedal Force Effectiveness during Multistage Graded Cycling Test Using a Road Racing Bicycle

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（ロード競技用自転車を用いた多段階漸増負荷サイクリングテストにおけるギア比およびケイデンスが機械的効率とペダル踏力の有効性に及ぼす影響）

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Abstract

Gross efficiency (GE) and index of pedal force effectiveness (IFE) are important factors that enhance cyclists' performance; however, the effects of changing pedal force (gear ratio) and cadence on these indices while riding on a road racing bicycle are poorly investigated. Therefore, this study aimed to investigate the effects of pedal force and cadence on GE and IFE using a road-racing bicycle. To test this, we examined two types of multistage graded submaximal cycling tests: changing pedal force (gear ratio) at a fixed cadence and changing cadence at a fixed gear ratio in well-trained college male cyclists.

Nine male cyclists completed graded submaximal cycling tests (five stages of 4-min submaximal cycling sessions with 1-min passive rest intervals). The work rate of each stage was determined using two principles: changing gear ratio at a fixed cadence and changing cadence at a fixed gear ratio. We determined GE and IFE using respiratory variables and pedal reaction forces, respectively.

Increasing the gear ratio improved GE, and was associated with the IFE. Although increasing the cadence slightly improved GE from the initial level, the increased values then mostly maintained. IFE was almost stable even when cadence increased. Moreover, no significant correlation was observed between the changes in GE and IFE accompanied by increasing cadence. Our data indicates that an increasing gear ratio, but not cadence, may affect GE and IFE while riding on a road racing bicycle.

Our results demonstrated that increasing the pedal force at a fixed cadence linearly improved GE and IFE, even on a road racing bicycle. In contrast, GE and IFE remained almost stable despite an increase in cadence at a fixed pedal force. Although further studies are needed, our data raises the possibility that an increasing pedal force, but not cadence, influences GE and IFE while riding on a road racing bicycle. Moreover, not all training methods to improve IFE may reflect an enhanced GE. We expect these results to provide novel insights for reconsidering pedaling strategies in cycling and training methods to enhance cyclists' performance.