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Conference Abstract

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Cyclist Load-Velocity Relationship during leg-pedaling and how it is correlated with half squat

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Abstract

This study examined how the force–velocity (F–V) profile obtained from maximal "on-bike" sprints corresponds to that derived from the half squat (HS), given the mechanical similarities between both tasks. Eight cyclists completed sprint tests with different gear ratios and an HS assessment using a linear position transducer. Both exercises showed highly linear F–V relationships ($R^2 > 0.85$) with nearly identical optimal power loads. Pedal linear velocity strongly correlated with HS mean propulsive velocity ($r = 0.954$; $R^2 = 0.93$), and maximal power outputs were also almost perfectly associated ($r = 0.971$; $R^2 = 0.95$). These findings support viewing short cycling sprints as a strength-oriented action suitable for velocity-based training and individualized load prescription.

Keywords

resistance; strength; VBT; torque

1 Introduction

As the fundamental source of propulsion in cycling, the pedaling motion can be effectively studied through the force–velocity (F–V) relationship, much like conventional strength exercises such as the half squat (HS) [1]. This study is based on the hypothesis that the F–V profiles obtained from "on-bike" sprint tests and from the HS will show a strong association, as both share key characteristics: a similar vertical and downward force application vector, and a comparable range of motion (which can be matched in both exercises) [2]. Furthermore, previous biomechanical research on cycling has highlighted that the kinematic analysis of pedaling provides valuable insights into how cyclists generate propulsive forces [3].

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Studying the F–V profile of pedaling, as in other sport-specific actions, allows for the characterization of an athlete's ability to apply force across different velocities and external loads. Additionally, anthropometric factors such as body mass, height, and crank length may influence both absolute and relative force production, ultimately affecting F–V profile behavior. Understanding these relationships may help personalize training stimuli and optimize performance according to individual morphological characteristics [4].

2 Material and Methods

Eight cyclists with a peak bike sprint of 16.6 ± 1 w/kg (23.7 ± 2.3 years; 72.9 ± 14.7 kg) completed two sessions on separate days:

(i) "on-bike" sprint test using different gear ratios and a Favero Assioma Duo pedal-based power meter [3];

(ii) half-squat test using a Speed4Lift linear position transducer [4].

F–V relationships were obtained for both exercises, and correlations were computed between variables from both tests. Pedal linear velocity was calculated from cadence and crank length and compared with the mean propulsive velocity (MPV) in the HS.

3 Results

Both exercises exhibited highly linear F–V profiles ($R^2 > 0.85$) and showed virtually identical optimal power load (OPL) values (Figure 1 and 2).

A near-perfect correlation was found between pedal linear velocity and HS MPV (Pearson r = 0.964; linear regression $R^2 = 0.93$), highlighting the strong predictive capacity of one exercise over the other. A very high correlation was also observed between the maximum power outputs of both exercises (r = 0.981; $R^2 = 0.96$).

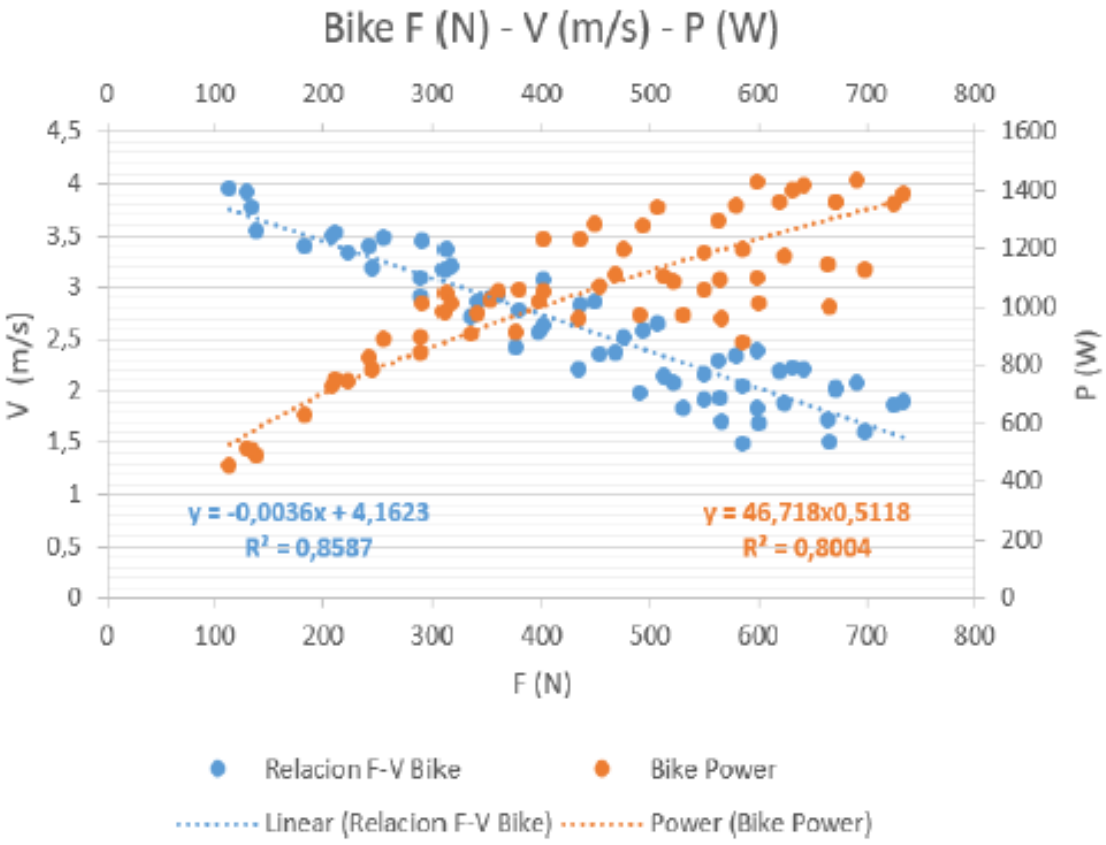


Figure 1. Bike test relationship between Force (N), Velocity (m/s) and Power (W) n=8

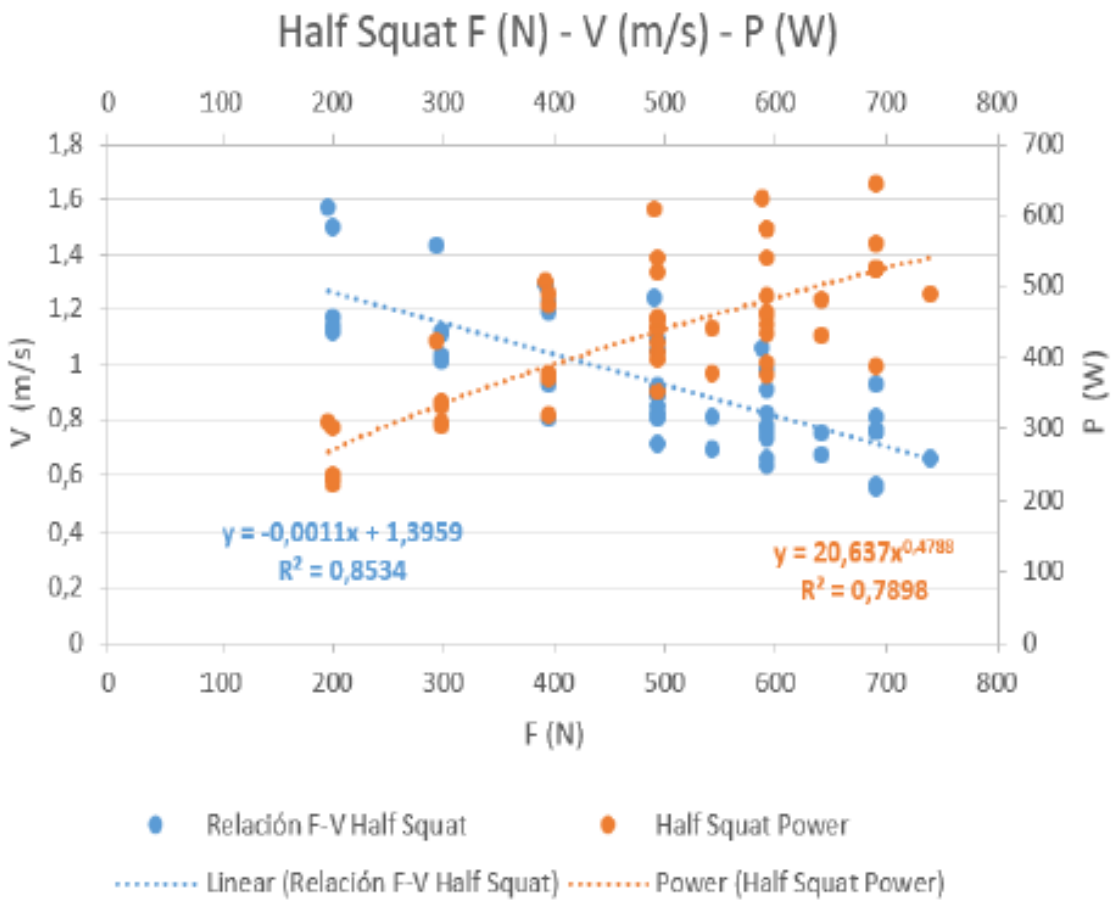


Figure 2. Half Squat test, Force (N), Velocity (m/s) and Power (W) n=8

4 Conclusions

The results support the feasibility of conceptualizing the pedaling action in short sprints as a strength-oriented exercise, enabling the integration of velocity-based training (VBT) principles into pedaling training. This approach facilitates individualized load prescription for both exercises and enhances the capacity to adjust loads for "on-bike" and "off-bike" strength work. Future research should confirm these relationships in larger samples and explore longitudinal changes in both exercises.

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Conflicts of Interest: The authors declare no conflict of interest.

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