Relationship between Ground Reaction Force and Performance on a 200-Meter Dragon Boat Ergometer

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Summary

The performance of dragon boat racing depends on the strength of both upper and lower limbs. However, the lower limb strength is usually neglected. This study aimed to investigate the impact of ground reaction force (GRF) generated primarily by the lower limbs on the performance of a 200-meter dragon boat race. The 200-meter test was conducted using a dragon boat ergometer and the force plate was used to collect the peak force (PF), time to peak force (PF_{time}), and rate of force development (RFD). The results indicated that the PF_{time} (r = .628 to .649) RFD (r = -.498 to -.509) and stroke rate (r = -0.518) had a moderate correlation on the 200-meter time.

Introduction

Previous studies have indicated a significant negative correlation (r = .66) between 200-meter dragon boat sprint performance (time) and total Plantar GRF [1]. Therefore, lower limb strength plays a crucial role in dragon boat rowing. However, the specific characteristics of the force-time curve that determine performance outcomes remain to be clarified. This study aimed to investigate the correlations between the GRF parameters (PF, PF_{time}, and RFD) and 200-meter time.

Methods

Twenty-two national team dragon boat athletes (age 22.1 ± 6.5, weight 72.0 ± 9.1) performed a 200-meter simulated race using a dragon boat ergometer (Multistroke Ergometer, Kayakpro, USA). A force plate (FP-BTA, Vernier, USA) was installed on foot plate to collect GRFs. Before the 200-meter test, each dragon boat athlete performed the same dynamic warm-up on land, including a 10-minute warm-up on the ergometer. After a 10-minute rest period, the maximum effort 200-meter test was performed. The maximum/minimum and average of PF (Fig 1a), PF_{time} (Fig 1b), and FRD (Fig 1c) were analyzed. Pearson correlation analysis was used to assess the relationship between GRF parameters and 200-meter performance. The significance level was set at $\alpha = 0.05$.

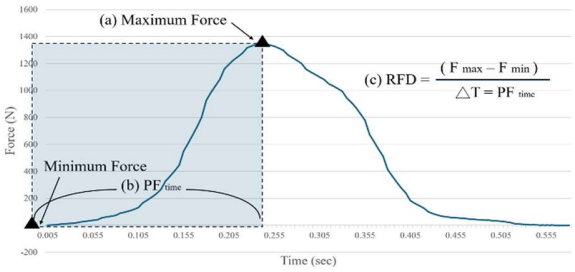

Figure 1: GRF-time curve of dragon boat paddling.

Results and Discussion

The findings (Table 1) showed that the PF was not a key factor affecting the performance of a 200-meter dragon boat race. The significant correlations were found in minimum PF_{time} (r = 0.649), average PF_{time} (r = 0.628), maximum RFD (r = -0.498), and average RFD (r = -0.509) ($p < 0.05$). This results shows that the lower limb GRF should generate maximum force as quickly as possible during each stroke. Stroke rate was significantly correlated with the time of 200-meter (r = -0.518) ($p < 0.05$). This result is consistent with the research of Lee et al. improving stroke rate can lead to better competition results [2].

Conclusions

This study demonstrated that lower limb push-off ground reaction forces during dragon boat rowing were moderately correlated with 200-meter performance. These results indicated that lower limb strength plays a crucial role in dragon boat rowing. Additionally, instead of solely focusing on maximizing strength, training should prioritize the development of explosive power by emphasizing the speed at which force is generated.

Acknowledgments

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References

[1] Wu SW. (2014). *Unpublished master's thesis NTSU.*
[2] Lee WY et al. (2013). *VNJ Taiwan*, **35**:131-141.

Table 1: The correlation between GRF parameters and 200-meter time on using a dragon boat ergometer (N = 22).

200 m (Sec)		Stroke rate (rpm)	Max. PF (N)	Avg. PF (N)	Max. RFD (N/sec)	Avg. RFD (N/sec)	Min. PF_{time} (sec)	Avg. PF_{time} (sec)
	r - value	-.518*	-.330	-.295	-.489*	-.509*	.649*	.628*
	p - value	.014	.134	.182	.021	.016	.001	.002

Statistical significance $p < 0.05$*