THE DIFFERENCE OF FITNESS LEVEL EVALUATED FROM THE MECHANICAL AND EXTERNAL WORK DURING BICYCLE EXERCISE

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INTRODUCTION

The conventional bicycle exercise test has traditionally been used to evaluate physical fitness. The load pedaled by the subjects in the traditional fitness test is actually the resultant force of the tangential and radial forces relative to the crank arm. Whereas the tangential work or power used in the fitness test has been based on the tangential load. Thus variation in the pedaling skill of the subjects will result in under- or over-estimation of the evaluated fitness level. The purpose of this study is to examine the difference in the evaluated levels determined for tangential and resultant pedal loads in bicycling exercise.

METHODS

Seven male subjects (28±4.1 yr, 174±6.2 cm, 67±4.7 kg) participated in this study on two different days. To estimate the $\dot{V}o_2$ max, on the first day of testing the subjects performed an incremental test on a bicycle ergometer. The resistance load was increased at each 0.5 kp every 2 min a target rate 70 rpm continuing until the subject was exhausted. Vo_2 was measured breath by breath using a Metamax system (Cortex Inc.). On the second day of $\dot{V}o_2$ max testing, the subjects pedaled while maintaining an intensity of 30, 50 and 70% of $\dot{V}o_2$ max. Each resistance load test consisted of exercise periods of 5 min with a resting interval of 5 min between each resistance load. Vo_2 were also measured. The original measurement system was constructed to obtain information on the load which was applied to the pedal. The pedal load was measured at the pedal shaft using a strain gauge. The feet were fixed to the pedals with toe clips and straps. The height of the seat position was set to 107% of the symphysis pubis height from the floor. Tangential, radial pedal load and crank angular velocity data were collected and averaged over thirty pedaling cycles at the end of each resistance load. The work rate of the tangential (Tan-w) and resultant (Res-w) components were calculated. An index of effectiveness was calculated using the equation (Tan-w) / (Res-w).

RESULTS & DISCUSSION

Tan-w has been used for conventional physical fitness evaluation, such as the physical work capacity test (Fig.1, Tan-w). But this Tan-w is calculated from tangential pedal load, which is only a part of the subject-induced pedal load. Therefore, we also evaluated the resultant pedal load to eliminate the dependence on the subject's pedaling skill (Fig. 1, Res-w). Table 1 shows Tan-w and Res-w for each %$\dot{V}o_2$ max. The order of fitness level based on Tan-w was clearly different to that based on Res-w. If, based on Res-w, a subject has a higher fitness than another when their level is similar based on Tan-w, it is thought that the subject has an excellent fitness level but poor pedaling skill. The conventional bicycle exercise test is an excellent method to evaluate the bicycle exercise ability. In the case of evaluating physical fitness on a bicycle, both physical fitness and pedaling skill need to be considered.

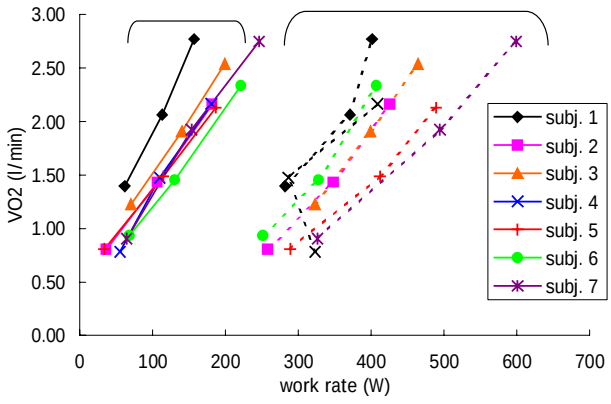

Fig. 1; The relationship between each work rate and $\dot{V}O_2$.

Table 1; Tan-w and Res-w in each %$\dot{V}o_2$ max.

	$PWC_{30\%Vo2max}$		$PWC_{50\%Vo2max}$		$PWC_{70\%Vo2max}$	
	Tan-w	Res-w	Tan-w	Res-w	Tan-w	Res-w
subj. 1	61	282	113	371	157	401
subj. 2	36	258	106	348	182	426
subj. 3	70	323	140	399	199	464
subj. 4	55	323	110	286	180	409
subj. 5	33	289	115	412	186	489
subj. 6	68	251	130	328	221	407
subj. 7	64	326	153	495	246	599
AV.	55	293	124	377	196	456
S.D.	15	32	18	67	29	71

* The values are w.