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EFFECTS OF TRAINING IN AN AERO POSITION ON ANAEROBIC POWER OUTPUT.

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ABSTRACT

EFFECTS OF TRAINING IN AN AERO POSITION ON ANAEROBIC POWER OUTPUT. **Peveler W, P Bishop, J Smith, M Richardson**. **JEP**online 2004; 7(5):52-56. Anaerobic power is a good measure of cycling performance. While previous studies have found that there is an increased metabolic cost when riding in an aero position, the difference in anaerobic power between upright and aero positions have not been examined. This study examined cyclists who never train in aero bars (CT) and triathletes who always train in aero bars (AT). Participants performed two 30 s Wingate tests on two separate days (one trial upright and one aero). For CT, peak power (PP) was significantly (p=0.000) higher in the upright position (768 ± 74.7 Watts) than in the aero position (706 ± 69.4 Watts). In AT PP was found to be significantly (p = 0.003) higher (749.6 ± 111.53 Watts) in the aero position than in the upright position (697 ± 75.9 Watts). CT had significantly (p = 0.022) higher mean power (MP) in the upright position (598.0 ± 45.95 Watts) when compared to the aero position (562 ± 47.9 Watts). There was no significant (p = 0.250) difference found in MP between aero (564.7 ± 63.4 W) and upright (560 ± 59.1 Watts) in AT. From these results it is recommended that athletes train in the position in which they race.

Key Words: Exercise, Cycling, Triathlon, Aerodynamics, Metabolism

INTRODUCTION

In cycling competitions in which drafting is not allowed, riders prefer aero bars because it moves them from an upright position to a lower position, reducing drag (1,2,3). During wind tunnel studies, it was found that at a power output of about 300 Watts aero bars could be expected to reduce work by about 90 to100 Watts in the aero position when compared to an upright position (4). A cyclist competing in a 40-km time trial could shave 90 seconds off their time by using aero bars and riding in an aerodynamic position (1). Previous research has found that cyclists are more efficient in an upright position (4). The difference in anaerobic power has yet to be examined between the two riding positions.

Riding in an aero position changes the angle of the hips when compared to an upright position. In 1995, Heil et al. (5) found that an 11° change in hip angle affected cardiorespiratory responses. There is a similar change that occurs when dropping from an upright position to an aero position. Heil et al. (1997) then looked at changes in lower limb kinematics and hip angle during cycling at submaximal steady state VO_2 and found that cyclists performed better at angles that were most similar to the bikes on which they trained (6). This shows a tendency toward adaptation to training position. Too (1994) examined the effect of trunk angle on power output using a 30-s Wingate test and found that power changed with hip and trunk angle when examining recumbent positions (7).

Power output during cycling can help predict and evaluate race performance. Peak power (PP) has been found to be a good predictor of performance in time trials (8,9,10,11). For example, Hawley & Noakes found that PP is a good predictor of 20-kilometer time trials, and Balmer et al. (2000) found that it is a good predictor of 16.1-kilometer time trials (9,11).

Gnehm et al. (1997) found that there is an increased metabolic cost when testing cyclists in an aero position, but differences in anaerobic power between the two positions has not been examined (4). It would be important to know if there is training specificity between the two positions, and if the increased aerobic cost found in an aero position, also result in reduced anaerobic power? The ability to produce power is extremely important in cycling. Peak power has been found to be a good predictor in cycling performance and is often used in evaluating cyclists (9,10,11,12). The present study tested a group of trained cyclists, who never train on aerobars, and a group of trained triathletes who train only on aero bars. It was hypothesized that the change in angle between the two positions would impact anaerobic power production in a direction that would be specific to training position. Triathletes who train only with aerobars should be more powerful in that position, and cyclists who train in a traditional position should be more powerful in that position.

METHODS

Subjects

Trained cyclists (CT, n=11) and trained triathletes (AT, n=11) participated in this study. The CT subjects had been training and racing for at least one year and did not train using aero bars. Their experience ranged from category 4 racing to one cyclist who qualified for collegiate nationals. The AT subjects had been training and racing for at least 1 year and trained only using aero bars. The AT subjects' experience ranged from sprint to Ironman™ distance races. All subjects were male in order to eliminate potential gender differences. Participants filled out an informed consent form as well as a physical activity readiness questionnaire (PAR-Q) and a health status questionnaire (HSQ) to assess health status in accordance with the policies of the local Institutional Review Board for the Protection of Human Subjects. Subject age was limited to less than 45 years old and more than 18 years old. Participants were asked to report to all trials rested, no training for at least 24 hours, and well hydrated.

Procedures

Both cyclists and triathletes were asked to bring in their cycling shoes and pedals to be outfitted on the ergometer in order to better simulate racing conditions. A 30 s Wingate test was used to determine power output on a cycle ergometer (Monark 824 E, Sweden). There is a strong relationship between ergometer performance and racing performance (8). During the aero trial, the ergometer was fitted with Syntace aero bars (Scott, US). Resistance was set at 0.075 kp/kg body mass (12). The subjects were required to pedal at an all out effort for 30 s. The Sports Medicine Industries (SMI) computerized program (Sports Medicine Industries, St. Cloud, MN) with an infrared sensor was used to record peak power (PP), mean power (MP), and % decrease in power (%D). Subjects were given a rolling start to break initial inertia and then given a 10 s countdown before resistance was applied. Saddle height was set at a knee angle of 25-35° (13) using a goniometer (LeMond Fitness Inc.). Participants were required to conduct two Wingate tests with at least one day of rest between for recovery. One trial was completed in an aero position, and the other was performed in an upright position. Test position was counterbalanced.

Statistical Analyses

Peak power and mean power were compared between the two groups (cyclists and triatheletes) to determine if there was a difference in power output between the two body positions. A 2x2 ANOVA (group x position) was used to compare means. A priori alpha of 0.05 was used to test significance. As a follow up a T-test was used to test the means, with an adjusted alpha level (0.05/2). Data presented as mean ± SD.

RESULTS

Descriptive data of the subjects are presented in Table 1. The 2-way ANOVA was found to be significant at p=0.000, with a significant interaction. For CT, PP was found to be significantly (p=0.000) higher in the upright position than in the aero position (Figure 1). For AT, PP in the aero position was found to be significantly higher (p=0.003) when compared to PP in the upright position. While AT had a significantly higher PP when in the aero position, not all scored higher in that position. Subject #2 (Table 2) scored 15 Watts higher in the upright position, which is a substantial difference. Subject #8 (Table 2) produced basically the same PP in both positions. Neither of these scores greatly affected the overall mean in this study. Individual scores can be seen in Table 2.

Table 1. Descriptive Statistics.

Variable	*CT*		*AT*	
	Range	Mean ± SD	Range	Mean ± SD
Age (y)	20.0-41.0	27.4 ± 7.0	20.0-44.0	33.1 ± 6.7
Height (cm)	168.4-193.0	178.6 ± 6.6	165.1-181.7	174.0 ± 6.1
Weight (kg)	69.0-81.0	7.30 ± 3.6	63.0-83.0	73.8 ± 6.4
Body Fat (%)	5.1-19.9	8.9 ± 4.3	5.1-12.4	10.6 ± 2.3
VO_2max (mL/kg/min)	49.0-73.0	63.2 ±9.0	43.5-63.0	53.0 ± 6.1

Cyclists had a significantly higher (p=0.022) average MP in the upright position when compared to the aero position (Figure 1). Cyclists were found to be able to hold on the average 36 watts more in the upright position than when in the aero position. There was no significant difference (p=0.250) found in MP between aero and upright in AT. While not significant, there did appear to be a slight trend toward higher MP in the aero position for triathletes. Individual scores can be seen in Table 3. Seven of the triathletes scored higher MP in the aero position while subjects 1, 2, 5, and 8 scored higher MP in the upright position.

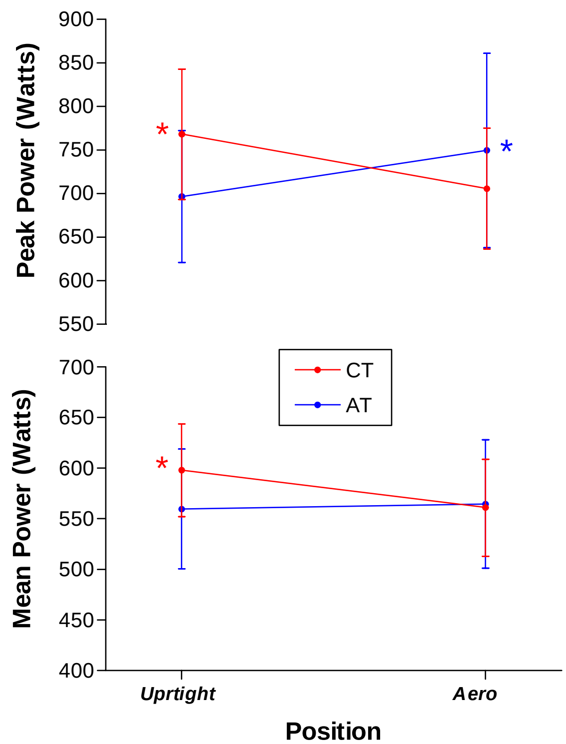

Figure 1. Interaction plots for peak and mean power.
*** = significantly different between Positions.**

Table 2. Individual Peak Power (Watts).

	CT		*AT*	
N=11	Upright	Aero	Upright	Aero
1	831.0	769.0	665.0	728.0
2	886.0	775.0	584.0	569.0
3	724.0	650.0	710.0	733.0
4	726.0	722.0	610.0	652.0
5	749.0	658.0	748.0	766.0
6	741.0	673.0	821.0	938.0
7	790.0	767.0	734.0	853.0
8	702.0	668.0	660.0	659.0
9	659.0	593.0	662.0	723.0
10	984.0	821.0	809.0	908.0
11	745.0	667.0	658.0	717.0

Table 3. Individual Mean Power (Watts).

	CT		*AT*	
N=11	Upright	Aero	Upright	Aero
1	572.0	546.0	529.0	507.0
2	569.0	589.0	524.0	519.0
3	574.0	549.0	586.0	594.0
4	577.0	580.0	486.0	498.0
5	616.0	588.0	614.0	603.0
6	549.0	547.0	664.0	685.0
7	606.0	601.0	637.0	652.0
8	545.0	444.0	535.0	530.0
9	697.0	619.0	494.0	508.0
10	647.0	529.0	570.0	585.0
11	626.0	588.0	518.0	531.0

DISCUSSION

In order to decrease air resistance and increase average speeds, triathletes and cyclists use aero bars in both time trials and triathlons. The effectiveness of aero bars to reduce drag has been well documented (1,2,3). This study examined a group of cyclists and a group of triathletes who differed in the position used during training to determine if anaerobic power would differ and be specific to the position in which these individuals trained. Power is a good predictor of time trial performance and is used by many coaches to test their athletes (8,9,10,11). Anaerobic power between these two positions has not been previously compared.

Previous research has found that there is an expected deficit in aerobic power when cyclists perform using aero bars (14,15,4). Gnehm found a loss of 9 Watts when in an aero position (4). When examining anaerobic PP it appears that when training in the aero position, triathletes perform better in that position. The MP of the triathletes was not found to be different between positions, with a small trend towards higher MP in the aero position by an average of 5 watts. This study expands on Heil's findings, which found that cyclists performed better at angles that were most similar to the bikes on which they trained when looking at aerobic power (6). This also seems to be true for anaerobic power. It was found that cyclists performed better in the position that they train in when examining anaerobic power.

In conclusion, it appears that with regard to PP and MP, that anaerobic power production was generally specific to training position. It is recommended that triathletes train in an aero position in order to perform optimally in that position. Likewise, cyclists need to train in an upright position for the majority of their training. But, cyclists who compete in time trials with aero bars should periodically train in an aero position in order to avoid potential disadvantages in anaerobic power production. A training study is needed to determine how often cyclists need to train in aero bars to improve their time trial performance without negatively affecting the rest of their racing.

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