RACEWALKING AND NORMAL WALKING ANALYSIS

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INTRODUCTION: The purpose of the present study was to observe biomechanical variations in racewalking, starting from normal walking and continuing on up to a maximum racewalking performance supported by the athlete. Tests were carried out on a women's racewalking team who represents Santa Catarina State at national competitions in Brazil. A Gaitway^{TM} instrumented treadmill system was used to verify the differences between normal walking and racewalking. A few studies have been made of race walkers. Some physiological aspects indicated that the speed at which racewalking and running become equally efficient is similar to the crossover speed for conventional walking and running (Hagberg & Coyle, 1984). Another important study was done by Morgan & Martin (1986), who showed the effects of stride length alterations on racewalking economy. Their results support the hypothesis that trained subjects select locomotion patterns that are nearly optimal in terms of the aerobic demands. Cairns et al. (1986) determined that the racewalking gait exhibits some biomechanical characteristics which are different from the walking gait or running. Recently, Brisswalter et al. (1996) suggested that in well trained walkers the energy cost of walking increases with exercise duration, but walkers are able to maintain the same stride duration after the test when treadmill speed is controlled.

METHODOLOGY: Four well-trained female participated in this study. A code was assigned to each: S1, S2, S3 and S4. All the athletes participated at the national competition, where athlete S3 is the only one who did not perform well (see ranking on Table 1). A Kistler instrumented treadmill (Gaitway^{TM}) was used to continuously capture multiple foot strikes in walking and racewalking. The system was able to compute the vertical component of GRF, which was the most important component to qualify walking and racewalking in this biomechanical analysis. For each foot we got the vertical force component and the center of pressure separated into left and right foot. A multiple foot-strike analysis over a period of 12 seconds was done. A period of 3 minutes to get acquainted with the equipment was followed by the 12 sec. Of data collection trials. Each subject walked at different speeds from 5km/h to 10km/h, incremented by 1km/h every 2 minutes. After 30 minutes of resting the athlete restarts the protocol doing racewalking until reaching maximum speed, maintaining the correct style. The first peak force, weight acceptance rate, impulse, cadence, contact time, stride length and angle of progression were determined for each subject. The Gaitway Software calculated average and standard deviations from walking and racewalking parameters acquired. As the Gaitway can isolate right and left foot strikes, we were able to focus on the performances of particular limbs and compare them (symmetry analysis). Comparisons of multiple trials of

different rates and lengths across individuals were also performed. Transition from walk to racewalking was also observed.

RESULTS AND DISCUSSION: For a better understanding, results are presented as individual graphics for each athlete, always showing the walking and racewalking results at different speeds, making it possible to directly compare the obtained curves. All results are plotted in Tables 1 and 2 and Figures 1 to 5. In Figure 1 we present the first peak force for each athlete, walking and racewalking. We observed that the first peak force reached by each athlete at each speed was normally lower when the athlete was performing racewalking. The first peak force had the same behavior for all four athletes in terms of maximum force. The impulse for the three best athletes, S1, S2 and S4 was always less when they performed racewalking than during normal walking at the same speed. Only for athlete S3 was there no significant difference (Fig. 2). Similar results were found in the analyses of stride length, with no differences found for athlete S3 only (Fig. 3). On the other hand, when we observe the cadence (Fig. 4), the lower scores are for normal walking, while during racewalking the values are higher. This means that the frequency in racewalking at the same treadmill speed is greater than that of just walking.

In conclusion, the results showed that the stride length was larger for walking and the cadence greater for racewalking. It was possible to observe that with the increase of speed during walking, the subject tends to increase her stride length, while during racewalking the subject tends to increase her cadence. It could be observed that motions during racewalking are far more efficient than those of normal gait, providing higher speed at a lower applied force.

Table 1 Physical characteristics, ranking and time of practice of all four athletes

Subject	Age (years)	Height (cm)	Weight (Kg)	National Ranking	Practice Time (years)
S1	16	156	48.8	4º	6
S2	28	177	66.1	3º	12
S3	17	165	55.0	6º	5
S4	24	159	51.6	2º	8

Table 2 Comparison between weight acceptance rate means at 9 and 10 km/h speeds

Speed	Variable	Mean	Std. Dv.	n	Difference	T	p
9 km/h	Walking Racewalking	32738.47 17969.59	13062.04 4198.68	8	14768.88	3.87	0.006
10 km/h	Walking Racewalking	37842.39 20585.46	15338.87 7786.89	8	17256.93	3.57	0.009

Furthermore, from the comparison between the weight acceptance rate means, with the treadmill running at 9 and 10 km/h observed for the two gait styles, a significant difference was found between walking and racewalking. This result

showed that walkers have better coordination during racewalking than walking. One of the major findings of our study was that racewalkers develop better performance during racewalking than walking.

CONCLUSIONS: Based upon the results of this investigation, we concluded that racewalking exhibits biomechanical characteristics which are different from those of walking. It was concluded that the maximum force, first peak force, stride length, contact time and impulse were always greater in walking than in racewalking at the same speed. When we compared cadence, we concluded that racewalkers increased the cadence to keep the same speed, while during walking they increased their stride length.

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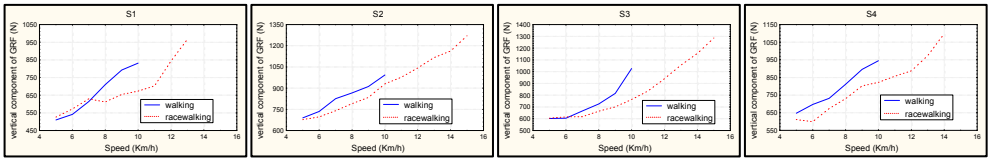

Figure 1 - First Peak Force

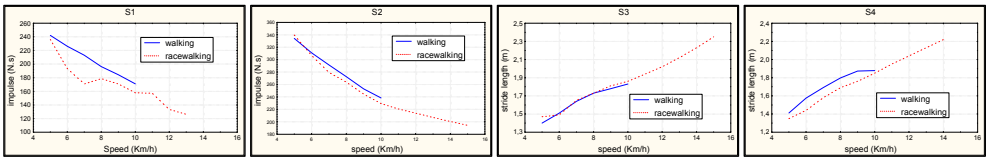

Figure 2 - Impulse

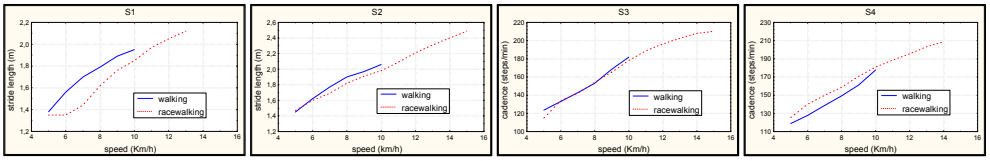

Figure 3 – Stride Length

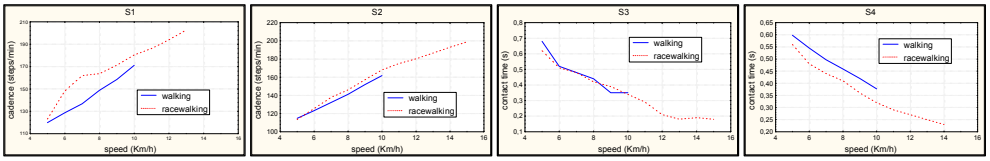

Figure 4 - Cadence

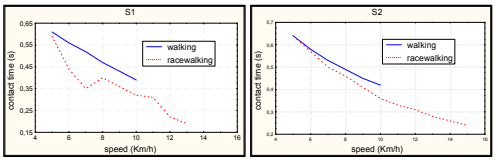

Figure 5 – Contact Time