KINEMATIC ANALYSIS OF CYCLING DURING PREGNANCY

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INTRODUCTION

Included in the 1994 Recommendations for Exercise in Pregnancy and Postpartum published by the American College of Obstetricians and Gynecologists (A.C.O.G.) were the support of non-weight-bearing exercise, the caution against types of exercise in which a loss of stability could occur and cause injury due to morphologic changes, and a caution that many physiologic and morphologic changes continue postpartum such that "pre-pregnancy exercise routines should be resumed based upon a woman's capability" (Neiman, 1995, p. 519). Cycling is indeed a non-weight-bearing activity; however, very little research has been conducted as to the stability of a pregnant woman as she progresses through each trimester and then postpartum.

Pyrie (1987) stated that cycling was a sport made for pregnant women in that it was found to strengthen the pelvic floor muscles used to propel the baby through the birth canal. However, Freyder (1989) described how with the progression of pregnancy, the center of mass (COM) was shifted back'over the pelvis to prevent falling forward causing a new, less stable posture. It was also noted by Artal (1992) that hormonal changes during pregnancy increased the joint motility and thus lessened joint stability. The purpose of this study was to compare the biomechanical changes that occurred during and following pregnancy in the sport of cycling.

METHODS AND PROCEDURES

The subject in this study was a 26 year old, avid cyclist for 3 years, who was familiar with and trained on bicycle rollers and averaged 242 km per week cycling prior to her pregnancy. The subject was filmed (60 fps) while riding on a set of bicycle rollers using a properly fitted road bike in the frontal and sagittal planes at 11, 17, and 33 weeks of gestation and then again at 10 weeks postpartum. In order to safeguard against falling, the bicycle was held stable by a volunteer from a nearby weight room, and during the last trimester, a chest harness was added. Each performance was then digitized and analyzed using the PEAK Performance 2-D movement analysis system. The horizontal and vertical linear displacements of the COM and angular displacements of the trunk and hips were compared. The angle conventions are shown in Figure 1.

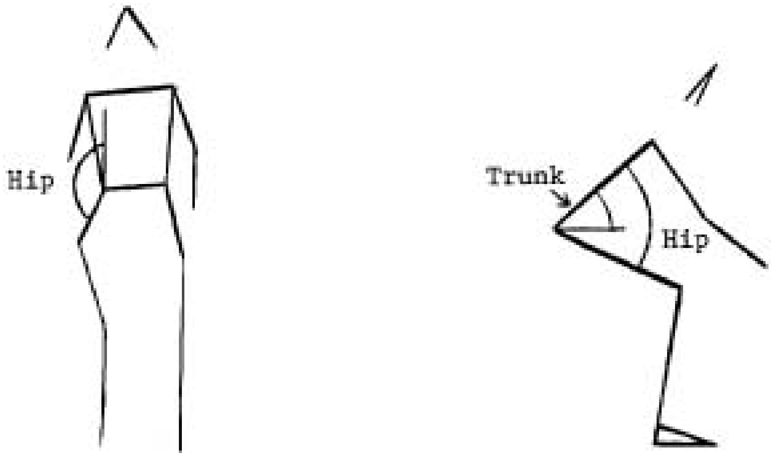


Figure 1. Angle conventions of the hips and trunk.

RESULTS AND DISCUSSION

Depicted in Table 1 are the horizontal and vertical linear displacements of the COM along with the weight of the subject at each filming. The horizontal (side to side) displacement and variability of the COM increased with each trial. This is in agreement with Freyder (1989) who described the shifting of the COM during normal weight gain producing an unstable posture, causing a widening of the base of support, and therefore a wider, waddling gait. There were little to no changes in the vertical displacement of the COG.

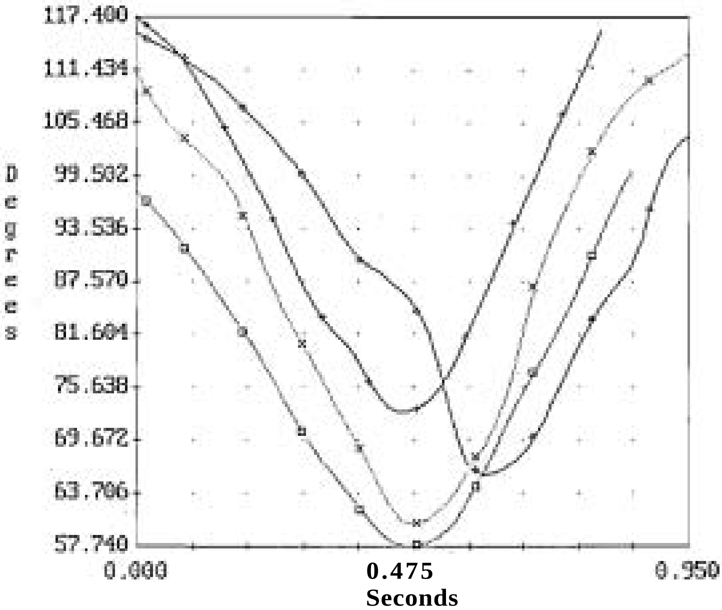
Table 1. Horizontal and vertical linear displacements of the COM in frontal plane.

Trial	Week	Weiaht (kg)	X (m)		Y (m)	
1	11 gestation	61.69	.014	SD=.0042	.017	SD=.0050
2	17 gestation	63.50	.016	SD=.0048	.025	SD=.0073
3	33 gestation	74.39	.017	SD=.0054	.020	SD=.0051
4	10 postpartum	64.86	.028	SD=.0097	.027	SD=.0040

The angular displacements of the hips and trunk are shown in Table 2. The more acute left hip angles viewed from the sagittal plane (see Figure 2) of Trial 1 and Trial 4 are due to the greater body lean of the trunk as seen in the mean (M) angles of the trunk. The shift of the COM and the added weight in Trials 2 and 3 suggested more difficulty in staying in the tuck position and therefore a move to a more upright and unstable position. As pregnancy progressed, it was noted that the right hip angle as shown in the frontal plane, became more acute indicating the "flaring out" of the hips again to accommodate the shifting of the COM, added weight, and preparation for delivery. After pregnancy, a wider range of motion was indicated perhaps due to hormonal changes causing an increase in joint motility as stated by Artal (1992).

Table 2. Angular displacements of hips and trunk (degrees).

	Trial 1	Trial 2	Trial 3	Trial 4
Left Hip Sagittal	R=42 (100-58) SD=13.43	R=50 (116 -66) SD=15.50	R=44 (117-73) SD=14.71	R=53 (113-60) SD=17.79
Right Hip Frontal	R=24 (188-164) SD=5.66	R=36 (181-145) SD=11.98	R=19 (178-159) SD=4.45	R=59 (187-128) SD=13.00
Trunk Sagittal	M=36 SD=.6711	M=42 SD=1.597	M=46 SD=.6215	M=38 SD=2.5751



V: left hip LESP1.ADA Trial 1, V: left hip LESP3.ADA Trial 3
V: left hip LESPZ.ADA Trial 2 V: left hip LESP5.ADA Trial 4

Figure 2. Angular displacements of left hip. Sagittal View

APPLICATIONS AND CONCLUSION

From the results of this study it was concluded that as pregnancy progressed and even at 10 weeks postpartum, the linear horizontal displacement of the COM increased, and during the second and third trimesters, a marked increase in the joint angle of the trunk was indicated. Since both the increase in horizontal displacement and greater upright position of the trunk are associated with greater instability, the results of this study support the recommendations of the A.C.O.G. which caution about exercise in which loss of balance could be injurious especially during the third trimester and the persistance of many physiologic and morphologic changes of pregnancy postpartum.

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