

DYNAMIC POSTURAL STABILITY IN PREGNANT FALLERS, NON-FALLERS, AND NON-PREGNANT CONTROLS

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INTRODUCTION

Approximately 27% of pregnant women report a fall during their pregnancies [1]. Pregnant women undergo numerous anatomical, physiological, and hormonal changes that may be related to the increased risk of falling. Studies of static balance in pregnant women reveal increased anterior-posterior center of pressure (COP) movement during pregnancy [2-4]. Dynamic postural control of pregnant women has not been investigated. It is unknown if pregnant women who have fallen have impaired postural control when compared to pregnant women who have not fallen or to non-pregnant women. Moreover, the effect of exercise on the incidence of falls has not been explored. The **purpose** of this study was to compare dynamic postural stability in pregnant women who have fallen during their pregnancies with those who have not and to a group of non-pregnant women. A second purpose was to examine the effect of exercise on fall incidence in our cohort.

METHODS

Forty one pregnant women (age: 29.5±4.9 yrs, hgt: 1.7±0.7 m, 2nd trimester mass: 74.7±12.1 kg, 3rd trimester mass: 81.6±11.0 kg) and 40 non-pregnant controls (age: 26.5±6.4 yrs, hgt: 1.7±0.6 m, mass: 66.0±8.9 kg) participated. Data were collected on the pregnant women in the middle of their 2nd and 3rd trimesters and on the control women in the week following menses.

After obtaining consent, pregnant subjects were surveyed about previous pregnancies, current exercise participation, current employment, and history of falls while pregnant. Dynamic postural stability data were collected on all subjects using an Equitest system (NeuroCom Inc., Clackamas, OR). Subjects wore a chest and hip harness to protect against a fall. A battery of small, medium, and large fore-aft translation perturbations was delivered to each subject. The magnitude of each was based on

the subjects' height. Three trials of each condition were performed. COP data were collected at 100 Hz. The translation velocity was 15.2 cm/sec. The durations of the small, medium, and large perturbations were 250 ms, 300 ms, and 400 ms, respectively. Reaction time, initial sway, sway velocity, and total sway were determined for each trial. Reaction time was calculated as the time from translation onset until the COP moved independently of the force plates. Initial sway was defined as the maximum fore-aft COP movement immediately following translation. Sway velocity was calculated as the initial sway divided by the time from the onset of COP movement to the time of the initial sway. Total sway was defined as the total fore-aft movement of the COP. A mixed-model ANOVA was performed on each of the four variables ($\alpha=0.05$). Subject was designated as a random factor while fall group (pregnant non-faller, pregnant faller, or control), direction (forward, backward) and magnitude (small, medium, and large) were designated as fixed factors. Tukey post-hoc tests were performed if the ANOVA found differences between subject groups or perturbation magnitudes ($\alpha=0.05$). Finally, a Chi square analysis was performed to examine the effect of exercise on fall-risk in the pregnant women ($\alpha=0.05$).

RESULTS AND DISCUSSION

Eighteen of the pregnant subjects reported falling at least once. A total of 28 falls were reported. Twelve pregnant women withdrew from the study between their 2nd and 3rd trimesters (8 because of medical reasons and 4 for unknown reasons). Therefore, these 18 women who reported falling represent 56% of the sample. No falls required hospitalization, although three required medical care. No subject delivered prematurely because of a fall.

Reaction time was not different between pregnant fallers (124.8±17.7 ms), pregnant non-fallers (126.8±25.9 ms), and non-pregnant controls (124.1±18.6

ms) ($p = 0.09$). Reaction time did not differ between perturbation directions ($p=0.487$), but was less for the large perturbations when compared to the medium and the small trials ($p=0.018$).

Initial sway was less in the pregnant fallers when compared to the pregnant non-fallers and controls ($p < 0.001$). No differences were noted between the latter two groups. Initial sway differed between the small, medium, and large perturbations ($p < 0.001$), but not between the forward and backward perturbations ($p = 0.131$). Sway velocity and total sway were less in the pregnant fallers when compared to their non-faller counterparts and the control participants (both p -values < 0.001). Similarly, both the sway velocity and total sway were significantly different between the forward and backward perturbations as well as the small, medium, and large slides ($p<0.05$). Initial sway, sway velocity, and total sway data for the pregnant fallers, pregnant non-fallers, and non-pregnant controls are shown in Table 1.

Table 1: COP movement variables for the pregnant fallers, pregnant non-fallers, and non-pregnant controls. Data are shown as mean (std dev).

	Pregnant Fallers*	Pregnant Non-Fallers	Non-Pregnant Controls
Initial Sway (cm)	4.03 (1.81)	4.56 (1.81)	4.47 (1.96)
Sway Velocity (cm/s)	23.8 (13.2)	30.0 (13.1)	29.9 (14.2)
Total Sway (cm)	5.97 (2.97)	7.04 (2.81)	7.11 (3.38)

*On each variable, pregnant fallers differed from other groups ($p < 0.05$).

The pregnant fallers demonstrated increased rigidity, as evidenced by the lack of sway following the perturbation. Anthropometric factors most likely did not play a role in whether or not the subject fell. There were no differences in pregnant mass, weight gain during pregnancy, or waist circumference between the fallers and the non-fallers ($p > 0.10$), nor was there a significant interaction between the trimester and fall incidence for any of the variables ($p > 0.80$). The altered response in the pregnant fallers may be due to factors not assessed in this study, such as muscle strength.

Thirty-one pregnant participants reported regular exercise during their pregnancies, while 10 reported no exercise at all. Walking, prenatal yoga, and Pilates were the most common exercises reported. Of the 32 pregnant women for whom we have complete fall and activity data, 18 were categorized as fallers and 25 as exercisers. The distribution of pregnant fallers vs non-fallers and exercisers vs non-exercisers is shown in Table 2. The Chi-square for the fall categorization was 0.50 ($p = 0.480$). The Chi-square for the exercise categorization was 10.125 ($p = 0.001$), meaning that non-exercisers were more likely to fall than those who participated in regular exercise.

Table 2: Categorization of the 32 pregnant subjects based on fall and exercise history. Chi-square = 10.125 ($p = 0.001$).

		Exerciser?	
		No	Yes
Faller?	No	0	14
	Yes	7	11

CONCLUSIONS

Pregnant women who have fallen exhibit altered dynamic postural stability compared to those who have not fallen as well as non-pregnant women. COP movement was markedly limited in the pregnant fallers. The pregnant women who have not fallen demonstrate similar COP movement patterns to the non-pregnant women.

Exercise participation may play a role in reducing fall risk. All of the sedentary pregnant women in our study experienced a fall during their pregnancies. Further investigation of the efficacy of exercise in fall prevention in this population is warranted.

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