

# PODIATRIC VARIABLES ASSOCIATED WITH PREGNANCY

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## Abstract

**Objectives:** Despite extensive data pertaining to normal physiologic changes associated with pregnancy, there are essentially no such information related to podiatric variables in this patient population. Given that low back pain and foot disturbances are some of the most common complaints during pregnancy, we investigated objective podiatric characteristics in healthy pregnant and postpartum women using a real-time pressure mapping computerized insole system.

**Methods:** Forty-four uncomplicated ethnically diverse third trimester gravidas were studied during ambulation using the Tactilus (SPI, E. Hanover, NJ) foot insole sensor system. A subset of 12 women were again studied at least six weeks postpartum for comparison to their predelivery measurements. Statistical analysis was carried out using the paired t-test with  $p < 0.05$  considered significant.

**Results:** The mean (SD) age was 32.4 (5.3) yrs; pre-delivery weight 93.5 (25.9) kgs; postpartum weight 91.4 (27.8) kgs; height 164.8 (7.8) cms. Compared to postpartum measurements pregnancy was associated with a consistent and significant increase in foot length and width. Peak pressures at the ball and heel of the foot were not significantly altered in relationship to pregnancy. The % of gait time in heel strike, midstance and propulsion also did not differ significantly between pregnant and postpartum study periods, although in both groups a high % of the gait cycle was spent in midstance (77.6% and 75.3%, respectively). Both pregnant and postpartum subjects differed with regard to right and left foot center of pressure, although this variable was not further influenced by pregnancy.

**Conclusion:** These are the first data to describe podiatric variables associated with pregnancy using objectively derived foot insole sensor technology. Significant changes in foot dimensions are identified, but these are not associated with changes in peak pressure, gait changes or center of pressure. These objective data are currently being used to correlate with patient-reported symptoms, in an effort to develop orthotics to alleviate back and foot complaints during pregnancy.

## Materials & Methods

### Subject Identification

Study subjects (n = 44) were identified at approximately 36-38 weeks gestation during routine visits to an obstetric clinic. Informed consent was reviewed and signed. A subset of 12 subjects were re-studied at least 6 weeks after delivery.

### Procedures

Subjects enrolled in the study completed a 5-10 minute questionnaire regarding low back pain and foot symptoms. Their feet were examined by the principal investigator podiatrist or his designee. Subjects were asked to walk on a firm surface with the Tactilus (SPI, E. Hanover, NJ) foot insole sensor system placed inside a uniform type of gym shoe. Pressure data were recorded and stored via computer software for analysis later. Following each visit another survey document was completed to examine for changes in low back and feet symptoms. A repeat podiatric examination of the feet was carried out and the Tactilus foot sensing system recordings were repeated.

## Results

	PEAK PRESSURE (Newtons)		
	Predelivery	Postdelivery	
Ball (left)	37.6 (19.1)	51.1 (26.1)	$p < 0.05$
Ball (right)	24.3 (9.5)	20.8 (6.1)	N.S.
Heel (left)	25.7 (7.7)	25.8 (12.4)	N.S.
Heel (right)	26.3 (8.0)	32.0 (9.8)	$p < 0.03$

	CENTER OF PRESSURE (Degrees Off Midline)	
	Predelivery	Postdelivery
Left	10.9 (2.5)	13.0 (3.1)
Right	7.4 (1.7)	7.8 (3.4)

$p < 0.001$  left vs. right  
 $p = \text{N.S.}$  pre vs. post delivery

	LEFT FOOT PHASES OF GAIT (% Time)	
	Predelivery	Postdelivery
Heel	0.2 (0.1)	0.2 (0.1)
Midstance	77.6 (9.6)	75.3 (17.9)
Propulsion	22.1 (9.6)	24.4 (17.9)

$p = \text{N.S.}$  comparing pre vs. post delivery

## Background

Despite the wealth of data pertaining to the normal physiologic changes associated with pregnancy, there are essentially no such information related to podiatric variables in this same patient population. The only available data in pregnancy pertain to gait alterations and ligament laxity. This is remarkable given the empirically recognized, almost universal symptoms of low back pain, foot edema and foot pain reported by pregnant women. Progressive lordosis is a characteristic feature of late pregnancy, as is dependent edema. These alterations clearly should have an impact on a pregnant woman's gait and feet. Similarly, the established increased mobility of the pelvic bones can have a direct effect on maternal posture and subsequent pedal compensation. Lay resources, readily accessible to the general pregnant population, currently advocate a variety of approaches for these implied podiatric problems, including the correction of edema by various approaches. Again, these have never been studied in any organized fashion.

## Objective

The purpose of this pilot project is to investigate objective podiatric related physical findings in the late pregnant and postpartum subjects. Additionally, with the recent advent of non-invasive, computerized pressure sensing and mapping systems, we show objective data pertaining to foot changes related to pregnancy.

## Statistical Analysis

Paired t-tests were used with  $p < 0.05$  considered significant.

## Results

### DEMOGRAPHICS

Age (yrs)	32.4 (5.3)
Height (cms)	164.8 (7.8)
Predelivery Weight (kgs)	93.5 (25.9)
Postdelivery Weight (kgs)	91.4 (27.8)
Ethnicity (W/B/Other) %	58/33/8

### FOOT LENGTH (cms)

	Predelivery	Postdelivery
Left	47.2 (2.5)	42.6 (1.7)
Right	49.2 (2.2)	46.9 (1.7)

### FOOT WIDTH (cms)

	Predelivery	Postdelivery
Left	16.0 (1.0)	13.9 (1.7)
Right	16.5 (0.5)	16.0 (0.5)

$p < 0.001$  comparing pre vs. post delivery

## Conclusions

- $\frac{3}{4}$  These are the first data to describe podiatric variables associated with pregnancy using objectively derived foot insole sensor technology.
- $\frac{3}{4}$  Significant changes in foot dimensions are identified, but these are not associated with changes in peak pressure, gait changes or center of pressure.
- $\frac{3}{4}$  These objective data are currently being used to correlate with patient-reported symptoms, in an effort to develop orthotics to alleviate back and foot complaints during pregnancy.

## Selected References

- <sup>TM</sup> Bird AR, Menz HB, Hyde CC. A prospective investigation of the effect of pregnancy on footprint parameters. [www.latrobe.edu.au/podiatry/ababstract.html](http://www.latrobe.edu.au/podiatry/ababstract.html)
- <sup>TM</sup> Block R, Hess L, Timpano E, Serlo C. Physiologic changes in the foot during pregnancy. J Am Podiatric Med Assoc. 75:297-9, 1985.
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- <sup>TM</sup> Pregnancy and Foot Problems. [www.supportyourfeet.com/pregnancy.htm](http://www.supportyourfeet.com/pregnancy.htm)