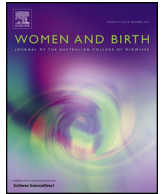




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# Changes in foot posture during pregnancy and their relation with musculoskeletal pain: A longitudinal cohort study<sup>☆</sup>

Francisco Javier Vico Pardo<sup>a</sup>, Andres López del Amo<sup>a</sup>, Manuel Pardo Rios<sup>a,\*</sup>,  
Gabriel Gijon-Nogueron<sup>b</sup>, Cristina Castro Yuste<sup>c</sup>

<sup>a</sup> ABIDOR Research Group, Department of Podiatry at Catholic University of Murcia, Spain

<sup>b</sup> Department of Nursing and Podiatry, University of Malaga, Spain

<sup>c</sup> School of Nursing and Physiotherapy, Universidad de Cádiz, Spain

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### ABSTRACT

**Aim:** To examine foot posture changes during the three trimesters of pregnancy and to determine whether there is a relationship between these changes and the pain experienced in this period.

**Methods:** The study sample consisted of 62 pregnant women who attended the Gynaecology Service at Hospital Santa María del Puerto (Cádiz, Spain), between January 2013 and May 2014. In their first visit, the following sociodemographic and anthropometric data were recorded: age, weight, height and foot size. In addition, information was obtained regarding pain in the lower back, knees, ankles and feet. In this first visit, too, the Foot Posture Index (FPI) was assessed, and three subsequent controls were performed during the first, second and third months of pregnancy (termed Stages 1, 2 and 3, respectively).

**Results:** In Stage 1, the average foot size (i.e., shoe size) was 38.3 (SD 1.5). This size did not change between Stages 1, 2 and 3. However, body weight and BMI did present statistically significant changes during this period ( $p < 0.0001$ ). The FPI varied during pregnancy but no relation was observed between these changes and the onset of pain.

**Conclusions:** During pregnancy, pronation increases but this does not appear to influence the onset of pain in the lower limbs.

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### Statement of significance

#### Problem

Pregnancy causes physiological changes in all organs and in the locomotor system that can cause pain.

#### What is already known

Endocrine changes during pregnancy increase the laxity of the ligaments of the foot, which causes a gradual increase in pronation. Increased body weight and variations in body composition can increase pronation, and this has been associated with lower limb injuries.

### What this paper adds

Pronation of the feet increases during pregnancy but this does not greatly influence the appearance of pains in the lower body.

### 1. Introduction

Pregnancy causes physiological changes in all organs and in the locomotor system.<sup>1</sup> During this period, body weight normally increases by 20% and therefore the foot must have sufficient flexibility so that the longitudinal arch can adapt and be able to absorb the additional weight.<sup>2,3</sup> From a biomechanical standpoint, the gravid uterus moves the centre of gravity forward, increasing lumbar lordosis<sup>4</sup> and affecting the gait, frequently causing pain.<sup>1</sup>

Although most of the weight gained during pregnancy is caused by the growth of the uterus, foetus and breasts, the increased volume of blood, the extravasation of liquid to extracellular tissues and greater water retention all increase the likelihood of oedema, especially during the last eight weeks of pregnancy.<sup>5</sup>

<sup>☆</sup> **Study location:** This study was conducted at Catholic University of Murcia (Spain).

\* Corresponding author at: Department of Podiatry at Catholic University of Murcia (Spain). Campus de los Jerónimos, N° 135 Guadalupe 30107, Murcia, Spain.

E-mail address: [mpardo@ucam.edu](mailto:mpardo@ucam.edu) (M. Pardo Rios).

Endocrine changes during pregnancy increase the laxity of the ligaments of the foot, which causes a gradual increase in pronation, especially from weeks 12 to 34 of gestation,<sup>6,7</sup> and also produce an increase in the length of the foot and the forefoot.<sup>8,9</sup> These changes may contribute to an increased risk of musculoskeletal disorders,<sup>10</sup> inducing complications such as rachialgia and pelvic pain, which may produce a lasting loss of functionality after childbirth<sup>11,12</sup> and worsen self-perceptions of health,<sup>13</sup> possibly giving rise to increased absenteeism.<sup>14</sup>

Increased body weight and variations in body composition can increase pronation, and this has been associated with lower limb injuries such as medial tibial stress syndrome<sup>1</sup> and patellofemoral pain syndrome.<sup>15,16</sup> Extremes of foot posture such as a highly pronated (flat) foot can increase the medial contact area and provoke greater medial forces and pressures.<sup>17</sup> Consequently there is a greater risk of injury in persons with pronated foot types than in those with normal foot types.<sup>18</sup>

The aim of this study is to examine foot posture changes during the three trimesters of pregnancy and to determine whether there is a relationship between these changes and the pain experienced in this period.

## 2. Materials and method

### 2.1. Sample

The study sample consisted of 62 pregnant women treated at the Gynaecology Service at Hospital Santa María del Puerto (Cádiz, Spain) between January 2013 and May 2014. The inclusion criteria

applied were that the women should be less than ten weeks pregnant and in their first or second pregnancy. The following exclusion criteria were applied: having had osteoarticular surgery of the foot in the last 12 months, presenting degenerative osteoarticular disease or neuromuscular disease, having experienced severe foot trauma during pregnancy or in the previous year, not carrying the pregnancy to term, or presenting cognitive problems impeding the communication of information. The study protocol was in accordance with standard ethical and human research principles. Written informed consent for participation and publication was given by each patient, including for the publication of photographs. The study was approved by the Hospital Research Ethics Committee.

### 2.2. Procedure

Of the 101 pregnant women initially recruited to this study, 62 completed it and made three follow-up visits during gestation, at weeks 10–12 (first trimester), 25–27 (second trimester) and 35–37 (third trimester). In the first visit, sociodemographic and anthropometric data were obtained, including age, body weight, height and foot size, by self reporting. In addition, information was obtained on the existence of pain in the lower back, knees, ankles and feet, using a yes/no binary scale.

In every case, the Foot Posture Index (FPI) was determined by a podiatrist (Dr. Javier Vico) with an established high intra-rater reliability for FPI scoring (Intraclass correlation coefficient [ICC] = 0.91–0.98), who was blinded to the purposes of the study and to the participant's identity (Fig. 1). This analysis was



Fig. 1. The six items of Foot Posture Index (FPI).

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