

## High-heeled Shoes in Pregnancy

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Pregnancy causes compensations in the structure and the role of the human body to permit normal development and rescue of the fetus [1,2].

During pregnancy, the body goes through many changes that impact the feet along with the rest of the body. The increasing weight, changing body shape, alters the center of gravity and affects the way of walking. This, in turn, puts pressure on the back, feet, and ankles, which require one to wear the right maternity footwear [3].

Women are disproportionately affected by musculoskeletal disorders. Parous women appear to be at particularly elevated risk for structural and functional changes in the lower branches. The combination of increased weight on joints with potentially greater laxity during pregnancy could lead to permanent structural changes in the foundations. Although arches may become lax during pregnancy. Agreeing to a survey performed by the American Journal of Physical Medicine & Rehabilitation, approximately 60% to 70% of pregnant women's feet become more spacious and more retentive. "The women's arch height and arch rigidity fell considerably from the first trimester to five months after their kid was turned out. This resulted in the distance of their bases, increasing by between 2mm and 10mm" [4].

A relatively recent survey of women's feet during and after pregnancy shows that arch height and arch rigidity decrease significantly from early pregnancy to five months after childbirth, causing corresponding increases in foot length that appear to be lasting [5].

### Why high heels cause so many problems

When a woman gets into high heels, she is repositioning her body's posture to mimic what it's like to walk down a steep mound, causing several key modifications:

- Down force is placed on the balls of the feet instead of being evenly distributed across the entire foot [6]
- Frequent usage of high heels can cause the fibers in the Achilles tendon and calf muscles to squeeze
- Excess pressure is put on the knees
- The thorax and hips are driven forward, causing your back to be out of alignment

### Feet

The elevation of the heels induces a direct consequence on how your weight is spread across your foot.

- **1" Heel** – Pressure to the front ball of the foot increased by 22%
- **2" Heel** – Pressure to the front ball of the foot increased by 57%
- **3" Heel** – Pressure to the front ball of the foot increased by 76%

Wearing high heels can ultimately lead to hammertoe, bunions, ingrown toenails, and even joint disease in your feet.

### Achilles Tendon and Calves

- As the Achilles tendon grows more potent it becomes more difficult to square off the branches.
- Over time it can even make it difficult to be capable to walk when not wearing

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high heels as it shortens the fibers in your calf muscles and Achilles tendons. As a result, when walking around flat-footed it may cause pain as these parts are stretched further than they are used to.

## Knees

- As the weight is shifted to the front balls of the feet, the knees have to shift forward as well to provide balance. As a result, additional pressure is placed along the knees due to this unnatural positioning.
- This added pressure and unnatural alignment can lead to arthritis in the knees, which may require corrective surgery over time.

## Hips

- The hips also have to shift forward to provide relaxation for the body as the bulk of your weight is displaced to the front of your body. This added pressure often leads to pain in the outer hips and presses the spine out of alignment.

## Back

- As the hips and knees are pushed forward to build up for the weight transferring to the forepart of the feet, the lower back is forced to hyperextend backwards to keep the body balanced.
- While this may fix the body an appealing look, what does to the body and back isn't nearly as sensible. It leads to back pain, back spasms, and over time it can lead to arthritis as well.

## Is it Okay to Wear Heels Occasionally?

- While wearing high heels on a semi-steady basis will not have as many problems as wearing them day by day, it is not without danger. Even very occasional use of high heels can lead to foot problems like hammertoes, bunions, and ingrown toenails.

To relieve back pain during pregnancy American College of Obstetricians and Gynecologists (ACOG) recommends wearing low heeled (but not flat) shoes with good arch support, seeking for the correct path to lift objects, and applying heat or cold to the painful area or massaging it [7].

Dananberg and Guiliano reported that shoe inserts appear to propose more effective back pain relief than standard therapies. [8] Likewise, pregnant women need to observe good foot health to prevent nuisance and irritation [9].

Foti and associates evaluated the flat foot walking of pregnant women and found a substantial increase in the anterior pelvic tilting associated with pregnancy that could be explained by the increase in the measure of body mass located in a lower abdomen causing a forward rotating moment that tends to rotate the hip forward [10].

Additionally, Bendix and coworkers found that flattening of the lumbar spine and an inclination of pelvis to roll backwards in response to wearing high heeled shoes relative to barefoot [11].

Opila-Correia investigated the kinematics of high-heel foot

(ranged from 5 cms to 7 cm) gait with consideration for age and experience of the wearer. He found that there were significant difference in the inclination of the pelvis, trunk and upper trunk accommodated for footwear to assist in absorbing the greater vertical lordosis of the trunk as younger ages had more anterior pelvic tilt, more posterior upper trunk and an increased trunk lordosis [12].

Snow and Williams, investigated the effect of different heel heights (1.91 cm, 3.81 cm, and 7.62 cm) on the three dimensional kinematics. They constitute no significant differences or trend among heel heights for pelvic tilt, average lumbar curvature, or range of shoulders and pelvic rotation in the transverse plane [13].

Increasing pelvic rotation while wearing flat shoes can be excused by the postural changes occurring during gestation. Normally the LOG falls approximately 4 cm anterior to the first sacral segment that is nearest to the bloc of the hips around which pelvic rotation occurs [14].

The increased pelvic rotation observed at a heel height of 4.5 cm, was in conformity with the findings of OpilaCorreia, who found that chronically using high heel women had an exaggerated rotation of the hip [12].

Furthermore, Foti and associates investigated the biomechanical alteration in gait during pregnancy and found that in that location was a substantial growth in hip abduction/adduction power due to increased body mass during pregnancy [10]. Eng and winter investigated the kinetic analysis of the lower limbs during walking on normal 9 male subjects and they found that the hip power phases were the result of the hip abductor muscles controlling the pelvis, and a small absorption burst during weight acceptance was the result of external rotation which decelerated the forward rotation of the pelvis [15].

In contrast, Opila-Correia investigated the kinematics different heel heights ranged from 0 centimeters to 2 cm (as low heel) and from 5 cm to 7 cm (as high heel) in nongravid females and he added that pelvic rotation did not significantly differ for different heel heights in both transverse and frontal planes. Also, he explained that the shorter step length of high heeled gait causes illusion of the exaggerated rotation of the pelvis [16].

Furthermore, Eng and winter stated that normally during walking, the plantar flexors eccentrically controlled the forward rotation of the leg over the base (mid stance to terminal stance) and then, concentrically generated a rapid push off [15]. Other investigators found that during the reinforcement phase of the gait cycle, the body must attenuate the vertical forces as the foot makes contact with the soil. This is done by eccentric contraction of the ankle dorsiflexors during ankle plantar flexion and eccentric contraction of knee extensors during knee flexion [17].

Opila-Correia was also found that instability caused by increased plantar flexion of the stands and smaller area of living with high heeled shoes (5 cm to 7 cm) was reflected in a cautious gait style, particularly in inexperienced wearer of high heeled shoes [16].

Snow and Williams showed that the soleus muscle was more powerfully contracted in high heels compared with low heels. Maximum plantar flexion was less in the low and medium heels

(1.91 cm and 3.81 cm, respectively) compared with the high heels (7.62 cm) [13].

Esenyel and coworkers who found that walking in high heeled shoes causes a significant reduction in ankle plantar flexor muscles moment, power and work occurred during the stance phase. This reduced plantar flexor muscles moment resulted in compensatory enhanced hip flexors that assisted in the limb advancement during the stance to swing transition [18].

To conclude, a low heel height heel (<3 cm) is advisable during pregnancy to avoid musculoskeletal discomfort.

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