

At what point do different areas of the sole of the foot feel discomfort?

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Credit: University of Valencia

The Department of Physiotherapy of the University of Valencia, in collaboration with the Institute of Biomechanics of Valencia, has determined the limit pressure point to which different parts of the foot can be subjected before feeling discomfort. These values vary depending

on age, gender, or body mass index. The base of the big toe is the weakest part, and the heel is the area that holds the most pressure. Around the age of 65 there is a turning point with respect to pain tolerance in the sole of the foot. As a novelty, this study has focused on discomfort, a precursor to pain, unlike other research that has looked at the point where pain begins.

"This is a pioneering study, which expands knowledge about these sectors of the population in their response to plantar pressures," said Lirios Dueñas, professor of the Department of Physiotherapy at the University of Valencia and main researcher of this study. She says that this study could help the booming sector of footwear customisation to achieve more comfortable results, as "so far, footwear design focuses on areas where more pressure is exerted during walking, instead of where this pressure has the most effect."

The results of the study, the aim of which is to be able to improve orthopedic treatments and the design of footwear according to the needs of each individual, show clear differences between the variables. In all the spectra studied, the data shows more of a difference between minors and people over 65 than between people aged 20 to 35 and those aged 50 to 65.

The data also reveals that the PDT (an indicator that shows the maximum pressure the subject's soles have undergone before experiencing discomfort) is higher in women than in men. It is also higher in the obese and the elderly compared to the rest. These results could be due to differences in elasticity and skin thickness. Characteristics that deteriorate over time and are more present in areas of greater use or presence when walking.

"Discomfort is a mechanism that warns us of pain," said Lirios Dueñas, "so a lower perception of it can lead to problems such as hyperpressure."

The tolerance threshold for the elderly and overweight is higher, possibly due to lower proprioceptive information, resulting in failures in activating defense and protection mechanisms. In this case, one of these mechanisms would be to change the biomechanics when walking to reduce the load on the affected area.

Women have shown higher tolerance thresholds than men. Different studies point to gender differences in tolerance thresholds in different areas of the body. This is something that, according to professor Dueñas, may be due to social and cultural factors, such as, in this case, the use of more uncomfortable footwear.

A group of 36 people was used to conduct the study, who were chosen while attempting to avoid previous pathologies and other circumstances that may alter the results. With this group, three subgroups were formed: the first between 20 and 35 years of age; the second between 50 and 65; and the last, over 65. Of this total population sample, the number of men and women was equal and about 30% were obese.

The method used is different from other studies that focused on pain when walking. This study has focused on discomfort. To determine the limit point at which you start to feel discomfort, pressure was applied at different points on the sole of the foot at repeated intervals to simulate the act of walking. The pressure stopped increasing the moment the subject said "Stop" and pressed a trigger button with their hand. The mark that reaches the dynamometer at this time is what is called PDT (pressure discomfort threshold) and differs from PPT ([pressure pain threshold](#)), which was used in other studies.

More information: L. Dueñas et al. Influence of age, gender and obesity on pressure discomfort threshold of the foot: A cross-sectional study., *Clinical Biomechanics* (2020). [DOI: 10.1016/j.clinbiomech.2020.105252](https://doi.org/10.1016/j.clinbiomech.2020.105252)

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