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Standing and working well

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Some approximately 60% of workers have to stand for the majority of their working lives, including retail staff, chefs, waiters and waitresses, barbers, hairdressers, factory workers, nurses, surgeons, dentists, warehouse workers and security staff. Footwear for workers who stand has been the focus of a six year partnership between WearerTech footwear and the University of Salford. This partnership was ranked in the top three of 1,000 projects involving UK Universities and companies in spring 2019.

Standing for long periods at work is associated with workplace cardiovascular problems, musculoskeletal pain, fatigue and discomfort. A recent survey showed that, 96% of standing workers identified that they have experienced pain in the previous 12 months. It is prevalent in the lower back (79%), foot (72%) and knee (62%). This pain prevented 37% of individuals from completing their normal work, while 20% took time off and 46% sought the help of a medical professional. Standing work therefore impacts workers, employers,

and health services, too. The teams at the university and WearerTech have therefore been investigating the reason why pain develops when standing and how footwear and insoles can help reduce risks of pain and discomfort. WearerTech has been committed to understanding standing and improving workplace footwear for over 40 years. Through two 'Knowledge Transfer Partnerships' with the university and an investment of over £500,000, it is establishing itself as an internationally leading, knowledge-led brand in the occupational footwear sector.

WORKING WITH EXPERTS

Biomechanics experts at the University of Salford have been investigating what happens when people stand for long periods, how this relates to foot problems and comfort, and helping WearerTech develop footwear and insole innovations that reduce the risk of pain. When standing, footwear is responsible for supporting a worker's weight. Workers who stand for long periods of time say that a good pair of shoes can be the difference between

pain-related distraction at work or being able to work comfortably, thus indicating the importance of workplace footwear. This poses the question of what shoes would workers choose? Whilst there are a plethora of options for running and walking shoes, there are few footwear offerings that target standing and mixed guidance as to the correct footwear to select.

The university and WearerTech use a range of research techniques to understand footwear and the working environment it is used in. In their first study, they interviewed workers to understand their footwear needs. This showed both the importance of footwear safety features and that comfort was key. Next, the teams researched the activities of workers. This showed that chefs spent 87% of their work time standing. However, this was further broken down into different movements including walking, weight shifting, shuffling and static standing. This shows that time spent upright was in itself a range of tasks that might affect risk of discomfort and pain in different ways (*Figure 1*).

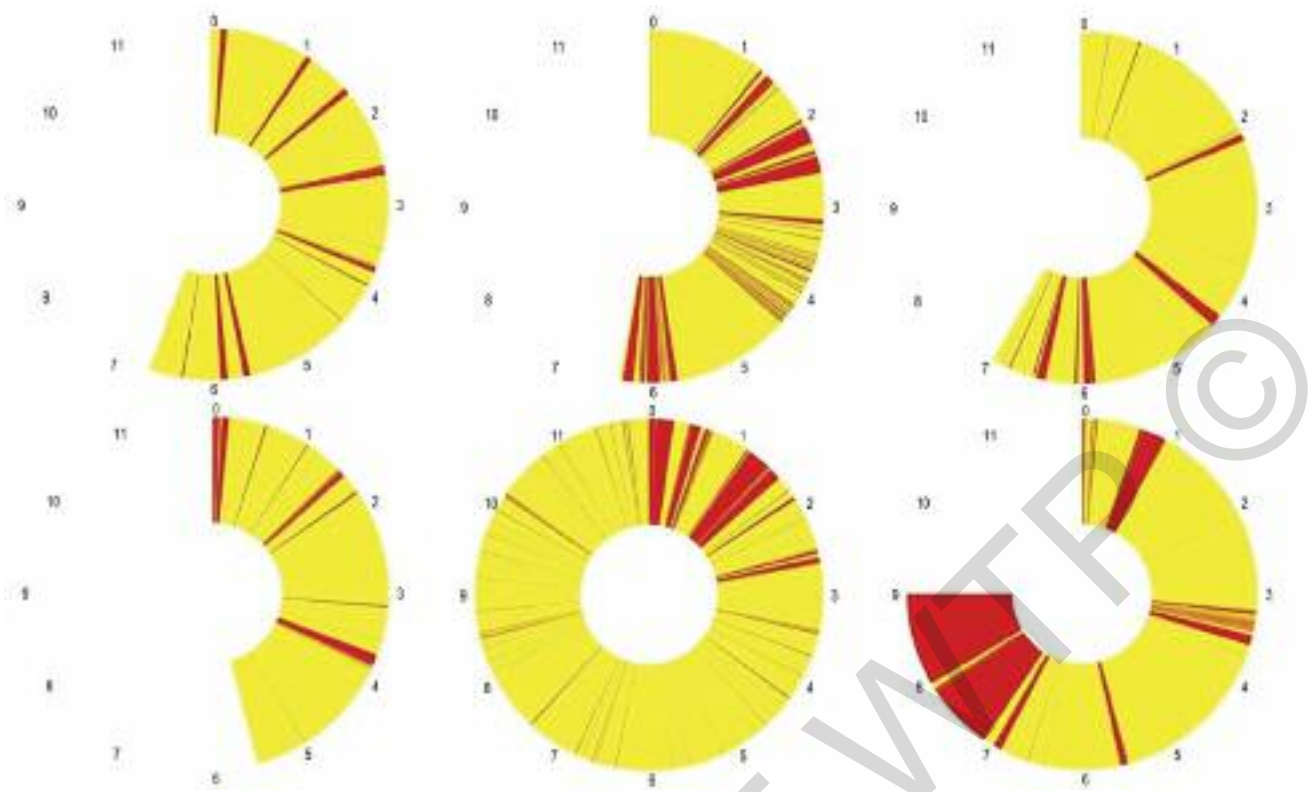


Figure 1: Breakdown of workplace activity of Chefs; yellow areas indicate standing time, red areas indicate sitting time and numbers indicate hours at work.

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The teams also decided to recreate a work place in the university's human performance laboratory so that work place posture biomechanics could be investigated. This allowed the teams to see how shoes with different sole densities performed during three hours of simulated work place tasks. This revealed that pressure under the feet changes over time and in different shoes. In fact, the softer shoe provided an initial reduction in pressure which gradually increased over time. The firmer shoe had higher initial pressures, but the increase in pressure was slower. Critically, by the end of the standing period, the softer shoe had greater plantar pressures than the harder one. This runs contrary to the popular belief that softer is better when it comes to standing footwear.

Further lab research investigated how different material properties in different areas of the footbed affect comfort. This research involved nine insoles with variations of material hardness in their arch and outer areas. This revealed that varying the material properties underneath the foot arch had the greatest impact on comfort. These results led to the design of WearerTech's first range of insoles for their footwear. Later work investigated the factors that influence worker's preferences for a specific shoe and how people identify these factors for themselves. The teams

found that the shape of the foot and the shoe material are key factors affecting preference. Using this allows wearers to select the correct insole material hardness to enable contact between the insole and midfoot that wearers felt was crucial to achieving comfort.

These laboratory studies have offered the first opportunity to understand what is really happening when footwear is worn for long periods at work. Access to in-depth biomechanics and user data feeds logically into product development. Without the use of lab studies the underlying science behind comfort and the requirement for specialised footwear might have remained undiscovered. Using qualitative user studies alongside lab-based biomechanical studies helped the association between the thoughts and feelings of wearers and design features to be investigated for the first time.

Whilst wearers of footwear can tell if a shoe is comfortable or not by wearing it, they often cannot explain why one shoe is more comfortable than another; laboratory studies help us to understand this. Biomechanics study has enabled the teams to delve into wearer reasoning of footwear comfort and helped explain why comfort is different for different people.

WEARER INNOVATION LOOP

A key outcome of the first three years of the partnership was the Wearer Innovation Loop which details how the research we conduct contributes to product development and brings new product to market (Figure 2).

Research: this initiates the loop, gathering information relating to workplace demands, material science and biomechanics. The loop benefits from all the different types of research, allowing us to inform the product development with individual wearer perceptions, biomechanics data, mechanical tests and workplace demands.

Product design: the knowledge gained from research allows footwear to be designed that looks good and encompasses the knowledge gained from research so the shoes can be as comfortable as possible, with the correct protective elements for the workplace.

Product development: at this stage, all previous efforts combine into the production of a wearable product for future stages of the loop. Inclusion of different materials and material properties allows for prototype products to feed into the next stage of product testing.

Environmental testing: this is the stage that differentiates WearerTech. All of the shoes are tested by chefs in real kitchens. This allows feedback on not only the comfort and fit of the shoe, but the performance of safety features such as slip resistant soles and safety toe-caps. The real life performance of these features can often be overlooked. Inclusion of these elements within footwear can often be to pass certification tests which often might not indicate how these features work when worn by the user.

Wearer evaluation: gathering the thoughts of workers during environmental testing allows continuous development of products by feeding their thoughts into future research for new products and also improve existing ones, restarting the innovation loop.

NEW PRODUCTS

The standout development from this research has been a range of insoles that allow for a choice of material under the arch of the foot. Three different densities are used in the arch area of the insole to manipulate contact area and levels of support. These insoles are selected using a selection tool again directly derived from research. The individual identifies their foot arch shape and material preference, allowing them to obtain the most



Scientific research has been central to all WearerTech products.

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suitable insole for their needs. These insoles have greater overall shape to initially increase contact in the medial midfoot as this has been shown to be influential within footwear comfort. The choice of material then tailors this contact to the need of the individual, allowing for pressure distribution across the whole foot.

Changes have been made to existing footwear designs following findings from the research. Leading products have been made with slightly harder sole materials to reflect findings of changes in plantar pressure over time in softer soled shoes. Midsole shapes have

been altered to manipulate the heel height of some shoes, altering the way that people stand. Pressure is distributed further towards the ball of the foot away from the heel, a common site of foot pain. Working with the ongoing partnership, current research priorities are focusing on footwear customisation as technical developments allow customisable elements to be included. This also reflects consumer footwear trends for personalisation. This research will build on the mantra that one type of shoe is not suitable for all and aims to further the understanding of the characteristics that influence footwear preferences for individuals. It is also key to enabling WearerTech customisation tools to support online sales strategies.

COMPANY EVOLUTION

An important impact for WearerTech has been how the use of science and the partnership with the university has been able to transform company structure, investment and aspirations. Attitudes have changed and the benefit of introducing research has been shown within different aspects of the business. The focus of workplace safety footwear is often to pass mechanical tests and gain certification. The requirement of these tests can often lead to development of footwear targeted towards tests rather than the user. All the shoes are tested by wearers to ensure that all features are suitable for the destined environment. The opinions of wearers drive change within the footwear designs, allowing for constant



Figure 2: The Wearer Innovation Loop.

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Different densities of insole are used to manipulate levels of support to the foot.

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development and improvement of footwear to meet user expectations.

As well as user input, market research is now used to gauge attitudes towards aesthetics. This helps to determine the suitability of new styles, allowing for decisions on product ranges to be made using the opinion of potential wearers. As well as being useful at the stage where samples have been made, market research has also been used to

define the current habits of potential target markets allowing for footwear to be designed to suit their needs. Attention is now being focussed on new ways of helping users, such as wearing compression socks at work. These unique changes in the workplace footwear sector highlight the importance of research that has been instilled.

Having a product designed and backed by scientific research also gives the company a distinctive space within the footwear market. In some areas, footwear availability is scarce meaning that there are examples of individuals wearing the same style of footwear at work for the previous 20 years. It is therefore down to the company to make use of the knowledge gained through the partnership with the University of Salford to educate wearers of the importance of wearing footwear that is designed for a specific domain, with input from research and fellow wearers.

Through the development of new products financial benefits are also apparent. The three insole system has enabled WearerTech to expand into new markets, both occupational and geographical. The insole concept will also be used in further developments next year and will further the impact of the existing partnership. Its total impact over the next three years including the effects on NPD, marketing strategies and knowledge gained should be significant. With this positive impact, WearerTech has continued investment within research and new product development with £151,000 invested this year and further investment into a second three-year project with the University of Salford to continue to deliver wearer-led footwear for standing workers. 🍎

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