

## A relação entre as ideias dos designers e a realidade: um estudo de caso em calçados para mulheres com hálux valgo

### *The relationship between designer ideas and the reality: a case study on footwear for women with hallux valgus*

Letícia Takayama, Federal University of Santa Catarina.  
[takayamaleticia@gmail.com](mailto:takayamaleticia@gmail.com)

Giselle Schmidt Alves Diaz Merino, Federal University of Santa Catarina and Santa Catarina State University.  
[gisellemerino@gmail.com](mailto:gisellemerino@gmail.com)

#### Resumo

Hálux valgo (HV), também conhecido como joanete, é uma deformação no pé que causa dor e desequilíbrio motor. Como tratamento conservador, calçados adequados podem prevenir o agravamento da deformação. Para isto, os designers de calçados devem conhecer as características apropriadas do calçado para desenvolver um produto mais adequado para o HV. Sabendo que algumas empresas calçadistas brasileiras produzem calçados para HV, o artigo tem como objetivo analisar e correlacionar as características adequadas do calçado para HV entre as ideias dos designers de calçados e as pessoas relacionadas ao produto como vendedores, mulheres com HV e ortopedistas. Os resultados mostraram que a divergência das características consideradas pelos designers de calçados e outros participantes podem conduzir o projeto de calçados inadequados. Os resultados também sugeriram que a inclusão das perspectivas dos vendedores, mulheres com HV e ortopedistas proporcionaram melhor entendimento da patologia para o projeto do calçado adequado.

**Palavras-chave:** Design de calçado, Joanete, Hálux valgo, Saúde, Projeto.

#### Abstract

*Hallux valgus (HV), also known as a bunion, is a foot deformity that causes pain and motor imbalance. As a conservative treatment, appropriate footwear prevents the aggravation of the deformity. For this, the footwear designers must know the appropriate characteristics of the footwear to develop a product more suitable for the HV. Knowing that some Brazilian footwear companies produce shoes for HV, this paper aims to analyze and correlate the characteristics adequate for the HV shoes between the footwear designers and people related to this product, such as salespeople, women with HV, and orthopedists. Results showed that the divergence of the considered characteristics between the footwear designers' ideas and the other participants can lead to the project of an ill-fitting shoe. Results also suggest that the inclusion of the salespeople, women with HV, and orthopedists perspectives provide a better understanding of the pathology for the project of an adequate shoe.*

**Keywords:** Footwear design, Bunion, Hallux Valgus, Health, Project.



## Introduction

Hallux valgus (HV) is characterized by a lateral deviation of the great toe at the metatarsophalangeal joint (PERERA; MASON; STEPHENS, 2011). Among the foot problems caused by the use of ill-fitting shoes, hallux valgus stands out as one of the most common joint pathology (SAUNDERS; KIESERLING; STEENWYK, 2012), being related to the use of shoes that restrict the movement of the forefoot, such as high heels (BARNISH; MORGAN; BARNISH, 2017; SOEMARKO et al., 2019) or with a pointed toe box (PERERA; MASON; STEPHENS, 2011; HITSCHFELD; HITSCHFELD, 2016).

The female population is more susceptible to the development of the HV due to anatomical characteristics, such as roundness of the articular surface of the first metatarsal head and hypermobility of the first metatarsal bone (PERERA; MASON; STEPHENS, 2011). The prevalence of hallux valgus in women can also be associated with the use of inappropriate shoes, such as high heels or with a pointed toe box, styles more common in female footwear (NGUYEN et al., 2010).

Studies suggest that the average age for HV development is between 30 and 50 years old (HARDY; CLAPHAM, 1951; LAFFENÊTRE et al., 2012). Regarding the Brazilian population, a 2012 research with a sample of 26,339 participants, about 22.4% of the female participants had hallux valgus and mentioned difficulties in finding suitable shoes (CASE, 2012).

As a way to relieve the problems caused by ill-fitting shoes, appropriate footwear for HV can be design as a way to promote health (COUGHLIN; ANDERSON, 2014). Considering the process of developing the shoe, the footwear designers must know which characteristics are more suitable for the users. In this context, this article aims to analyze and correlate the characteristics adequate for the HV shoes between the footwear designers and people related to this product such as salespeople that sells shoes for HV, women with HV, and orthopedists that treat patients with HV.

## Methodological procedures

The research has an applied nature, a qualitative approach, and exploratory and descriptive objectives. Likewise, the research is also related to the project “Development of footwear for health: design guidelines for feet with hallux valgus” (approved by the Federal University of Santa Catarina Ethics Committee under the number 3,494,999) and linked to the results of the master's thesis entitled “GUIDELINES FOR WOMEN'S FOOTWEAR FOR HALLUX VALGUS (BUNION): Design Management in the development of footwear for health”, from the Postgraduate Program in Design at the Federal University of Santa Catarina, which aimed to propose guidelines for the development of shoes suitable for the health of women with HV.

Interviews were carried out as a way to collect information from the community related to the HV shoe, such as footwear designers for HV, salespeople that sell shoes for HV, women with HV, and orthopedists that treat patients with HV. The interviews occurred in 2019 between May and October. The information about the footwear design was collected inside the Brazilian

footwear companies at Vale do Paranhana-RS and Vale do Rio dos Sinos-RS, the information about the sale was collected at physical stores in Florianópolis-SC, and the information about the footwear users (women with HV) and HV treatment occurred in the national territory.

The sample was selected according to availability, agreement, and ability to provide information about the footwear design, footwear sale, footwear use, and HV treatment. The research included a sample of 5 footwear designers (n=5), 10 salespeople (n=10), 10 women with HV (n=10), and 10 orthopedists (n=10). Figure 1 shows the information about the participants' sample.



Figure 1: Information about the participants' samples

The data was collected with semi-structured interviews that questioned the participants' opinion about the adequate characteristics for the HV shoe. The answers of the interviews were recorded in audio and transcribed in text, maintaining the order of the words. The data was analyzed with content analysis (BARDIN, 2011), which involved the codification of the texts, using the NVivo software, and categorization of the codes related to the adequate characteristics of the HV shoe.

## Results - Applied research

The answers of the footwear designers (n=5), salespeople (n=10), women with HV (n=10), and orthopedists (n=10) totaled the number of 261 answers which corresponded to 30 characteristics of the footwear for HV divided into 8 categories, such as 1. Dimensions, 2. Materials, 3. Heels, 4. Toe box, 5. Insole, 6. Sole, 7. Details, and 8. Functionalities.

### 1. Dimensions

The information about the footwear dimensions involved the need to have a bigger width in the forefoot and the need to follow the shape of the bunion. The participants that commented most about the dimensions were the women with HV (38% of all responses about the dimensions) and the participants that commented least about this topic were the salespeople (13% of all responses about the dimensions).

The bigger width of the shoe to better adapt to the HV was mentioned by 100% of the footwear designers (n=5), 40% of the salespeople (n=4), 60% of the women with HV (n=6) and



100% of the orthopedists (n=10). According to Designer 5, the discomfort of the footwear is related to tightness at the bunion. However, the women with HV mentioned that it is difficult to find shoes that are not tight.

The need to follow the shape of the bunion was mentioned by 60% of the women with HV (n=6) and 10% of the orthopedists (n=1). In this sense, Woman 1 suggested the need for an anthropometric survey of the feet as a way to identify the appropriate dimensions.

## 2. *Materials*

The footwear materials involved flexibility, softness, and breathability. The participants that commented most about the materials were the women with HV (40% of all responses about the materials) and the participants that commented least about this subject were the orthopedists (17% of all responses about the materials).

The use of materials with flexibility was mentioned by 100% of the footwear designers (n=5), 90% of the salespeople (n=9), 70% of the women with HV (n=7), and 40% of the orthopedists (n=4). The flexibility was related to the use of materials with elastic properties, such as elastane and polyurethane. For 40% of the orthopedists (n=4), the flexible material can be used as a way to avoid tightening and foot pain, facilitating the HV fit.

For 60% of the designers (n=3), 30% of the salespeople (n=3), 80% of the women with HV (n=8), and 40% of the orthopedists (n=4), the softness of the material was also related to the comfort. According to Woman 3, the softness of the material prevents injuries to the feet. Regarding the types of materials, the leather was mentioned as more suitable according to 20% of the designers (n=1), 30% of the salespeople (n=3) and 50% of the women with HV (n=5) due to the ability to soften and adapt to the shape of the foot.

Regarding the breathability of the material, 20% of the designers (n=1) and 40% of the women with HV (n=4) mentioned that the shoe should promote perspiration as a way to reduce the burning sensation of the foot.

## 3. *Heels*

About the characteristics of the heels, the participants mentioned the need to have low heels, medium heels, a platform sole, do not have a flat sole, and do not have high heels. The women with HV were the participants that commented most about the heel heights (40% of all responses about the heels) and the footwear designers were the participants that commented least on this subject (16% of all responses about the heels).

For 60% of the footwear designers (n=3), 40% of the salespeople (n=4), 80% of the women with HV (n=8), and 50% of the orthopedists (n=5) the ideal footwear for HV should have low heels. In centimeters, according to the footwear designers and orthopedists, the ideal footwear for HV should have a heel between 2 cm to 4 cm.

As for the need to have medium heels, 60% of the footwear designers (n=3) commented that this height (between 5 cm to 7 cm) is recommended for HV as an alternative for the high heels.

The need to have a platform heel was mentioned by 20% of the salespeople (n=2), 80% of the women with HV (n=8), and 30% of the orthopedists (n=3). For the salespeople and women with HV, the footwear should have a front platform on the forefoot as a way to reduce heel height. About the platform definitions, the orthopedists mentioned that the footwear should be around 1 cm elevated in the front and 2 cm to 3 cm more elevated in the back as a way to facilitate the human gait.

Regarding the characteristic commented as not adequate for the HV shoes, 60% of the salespeople (n=6), 20% of the women with HV (n=2), and 60% of the orthopedists (n=6) mentioned that the footwear should not have flat soles, such as slippers, because it can cause pain and HV development. However, 40% of the footwear designers (n=2) mentioned that flat shoes are adequate for women with HV.

The other characteristic mentioned as not adequate for the HV was the high heels, commented by 100% of the footwear designers (n=5), 30% of the salespeople (n=3), and 90% of the women with HV (n=9). According to Designer 3, high-heeled shoes can cause harmful effects on the body due to unbalanced bodyweight distribution. Even though considered harmful, the high-heeled shoe was also mentioned as desired by the women with HV. In this context, according to Designer 4, the footwear companies are looking for ways to create a high-heeled shoe that causes less discomfort.

#### 4. *Toe box*

The toe box formats for HV included the round, square, and pointed shapes. In this context, the women with HV were the participants that commented most about the toe box shapes (50% of all responses about the toe box) and the footwear designers were the participants that commented least on the toe box (11% of all responses about the toe box).

The round toe box shape was mentioned by 40% of the footwear designers (n=2), 10% of the salespeople (n=1), and 90% of the women with HV (n=9). According to the designers, the round toe box shape is more comfortable. Also, according to Woman 3, this shape of the toe box can provide relief from foot pain.

As for the square toe box, 40% of the footwear designers (n=2) and 20% of the salespeople (n=2) commented that this shape is suitable for the HV. Furthermore, according to Designer 4, the square shape is the most recommended format, because it does not cause foot pressure.

The pointed toe box shape was considered inadequate for HV by 60% of the salespeople (n=6), 90% of the women with HV (n=9), and 50% of the orthopedists (n=5). Although Woman 2 reported that she considered the pointed shoe “elegant”, according to the orthopedists the pointed shape of the toe box facilitates the compression of the metatarsal heads, causing pain and the progression of the HV. However, 40% of the footwear designers (n=2) mentioned that footwear companies produce shoes with a pointed toe box, claiming that they are suitable for HV.

According to Designer 5, designing shoes with a pointed toe box was a demand presented by the women with HV.

### 5. *Insole*

As for the characteristics of the insole, the participants mentioned the need for an anatomical adaptation, more thickness, and a cushioned insole. About this characteristic, the participants that commented most about the insoles were the women with HV (64% of all responses about the insole) and the salespeople were the participants that not commented on this subject (0% of all responses about the insole).

The anatomical adaptation of the insole was mentioned by 60% of the footwear designers (n=3) and 60% of the women with HV (n=6). According to the designers, this characteristic of the insole can be acquired by using materials such as latex or EVA (ethylene vinyl acetate), which have properties of memory and adaptation to the foot anatomy.

The need for more thickness of the insole was only mentioned by one of the women with HV (10%, n=1). As stated by Woman 1, the thickness of the insole can provide more comfort by distancing the foot from the floor.

As for the cushioned insole, only Orthopedist 4 (10%, n=1) commented that the cushioned insole can be adequate for the HV as a way to provide the distribution of body load, avoiding the development of the metatarsal pain.

### 6. *Sole*

As for the footwear soles, the participants mentioned those with non-slip characteristics, shock-absorbing mechanism, are produced using a flexible material, or with a rocker shape. The women with HV presented the most mentions about the sole (40% of all responses about the sole) and the salespeople were the participants that did not comment on this subject (0% of all responses about the sole).

The non-slip sole was commented by 40% of the footwear designers (n=2) and 30% of the women with HV (n=3). This characteristic was related by the designers to the use of rubber materials that can provide safety by preventing falls.

As for the shock-absorbing mechanism, 20% of the women with HV (n=2) and 30% of the orthopedists (n=3) mentioned soles that absorb impact and can reduce the overload of the foot at the plantar area.

For 40% of the footwear designers (n=2) and 10% of the women with HV (n=1), the sole should be flexible. For that, according to Designer 5, one of the materials used in the sole to have flexibility is the thermoplastic polyurethane.

Only 20% of the orthopedists (n=2) mentioned the need to have a rocker-type sole, which is a convex sole platform that can transfer pressure points from the metatarsal heads to the center of

the foot during gait. According to the orthopedists, this shape of the sole can reduce the pain and progression of the HV.

### 7. *Details*

The details for the HV footwear included the need to cover the bunion, have pleasant aesthetics, have a variety of models, have bunion protection on the lateral side, do not have thin straps on the upper bunion area, and do not have seams in contact with the foot. The women with HV were the participants that commented most about the footwear details (40% of all responses about the details), and the orthopedists were the participants that commented least about this characteristic (8% of all responses about the details).

The characteristic to cover the bunion was mentioned by 20% of the footwear designers (n=1), 50% of the salespeople (n=5), and 60% of the women with HV (n=6). This detail included the need to hide the appearance of the deformity and protect the foot.

For 60% of the footwear designers (n=3), 30% of the salespeople (n=3), and 60% of the women with HV (n=6), the footwear for HV should present pleasant aesthetics to assure the use of the footwear. As a way to have pleasant aesthetics, the participants commented that the shoe should have a modern aesthetic, suitable for younger users that already have the pathology.

Only the women with HV (20%, n=2) mentioned that they needed a variety of shoe types for different occasions and with a wide range of colors.

For 60% of the salespeople (n=6) and 10% of the woman with HV (n=1), the footwear for HV should have bunion protection on the side as a way to protect the deformation. Also, the participants mentioned the use of elastic materials at this side protection, as a way to adapt to the shape of the bunion.

As for the straps, 20% of the footwear designers (n=1), 20% of the salespeople (n=2), 50% of the women with HV (n=5), and 10% of the orthopedists (n=1) mentioned that the footwear should not have thin straps on the upper bunion area of the footwear that goes over the hallux valgus. This characteristic was mentioned by the participants as a way to hide the deformity and avoid pain caused by the pressure of the strap at the bunion.

As for the absence of internal seams in contact with the foot, 60% of the footwear designers (n=3), 30% of the salespeople (n=3), 10% of the women with HV (n=1), and 30% of the orthopedists (n=3) mentioned the concern with the internal finish of the shoe as a way to avoid injuries.

### 8. *Functionalities*

As for the functionalities of the footwear, the participants mentioned the need to promote comfort, well-being, safety, and lightness. The functionalities were commented most by the women with HV (58% of all responses about the functionalities) and not commented by the salespeople (0% of all responses about the functionalities).

The need to promote comfort was commented by 100% of the footwear designers (n=5), 90% of the women with HV (n=9), and 40% of the orthopedists (n=4). According to the orthopedists, feeling comfort can be related to trying on shoes and not feeling pressure on the foot. For Designer 3, comfort is related to shoe configurations such as the use of soft materials.

For 40% of the footwear designers (n=2) and 20% of the women with HV (n=2), promoting well-being was considered essential for the shoe. According to the footwear designer's responses, well-being can be linked to a shoe that can boost the self-esteem of the users.

As for the safety, only 30% of the women with HV (n=3) said it is important to feel safe wearing the shoe. In that sense, Woman 4 mentioned that safety is related to the use of a rubberized sole, which promotes non-slip footwear.

As for lightness, 40% of the footwear designers (n=2) and 40% of the women with HV (n=4) reported that the footwear should feel light on the feet, like walking barefooted.

## Discussion

In general, the category commented most was 3. Heels, with 67 answers corresponding to 25% of all the total answers. The categories commented most by the footwear designers were 3. Heels and 7. Details (11 answers or 4% of all the answers), the salespeople was 7. Details (19 answers or 7% of all the answers), the women with HV was 3. Heels (27 answers or 10% of all the answers) and the orthopedists was also 3. Heels (14 answers or 5% of all the answers).

Correlating the answers, all the participants mentioned 6 characteristics in common, such as: have a bigger width in the forefoot (1. Dimensions), have flexible material (2. Materials), have soft material (2. Materials), have low heels (3. Heels), do not have thin straps on the upper bunion area (7. Details), and do not have seams in contact with the foot (7. Details). Figure 2 presents the average of the participants' answers according to the categories.

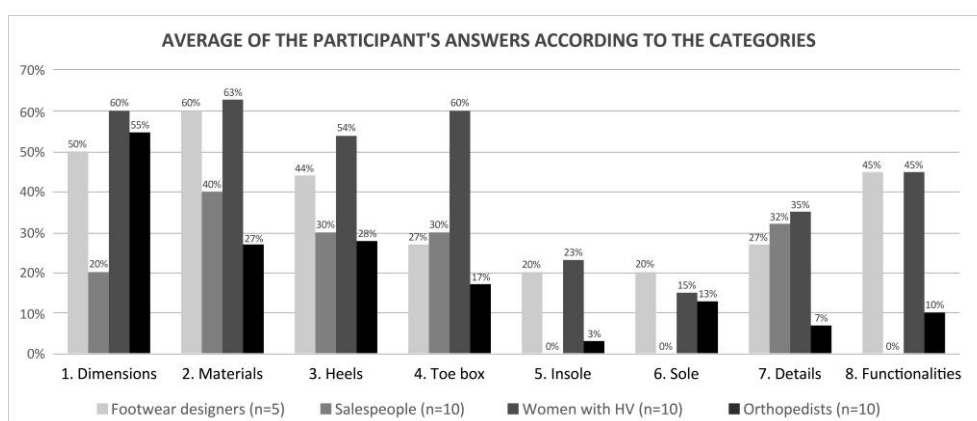


Figure 2: Average of the participant's answers according to the categories

When analyzing the footwear designers' and other participants' answers, the footwear designers considered the pointed toe box (4. Toe box), the use of flat sole (3. Heels) and medium heels (3. Heels) adequate for the HV footwear, characteristics considered inadequate according to other participants. The divergence between the characteristics considered adequate among the



footwear designers and the other participants can lead to the project of an ill-fitting shoe for HV, such as models with pointed toe box, flat sole and high heels (or medium), that can cause the development of pain and deformation of the bunion.

The characteristic not commented by the footwear designers but considered important by the other participants is the need to have a platform (3. Heels). This characteristic was also mentioned by the orthopedists as a way to help gait performance.

When correlating the answers between the footwear designers and the other participants, the salespeople showed 11 characteristics in common (37% of all the 30 characteristics) such as have bigger width in the forefoot (1. Dimensions), have flexible material (2. Materials), have soft material (2. Materials), have low heels (3. Heels), do not have high heels (3. Heels), have round toe box (4. Toe box), have square toe box (4. Toe box), cover the bunion (7. Details), do not have thin straps on the upper bunion area (7. Details), and do not have seams in contact with the foot (7. Details). Figure 3 presents the correlation between the answers of the footwear designers and the salespeople.

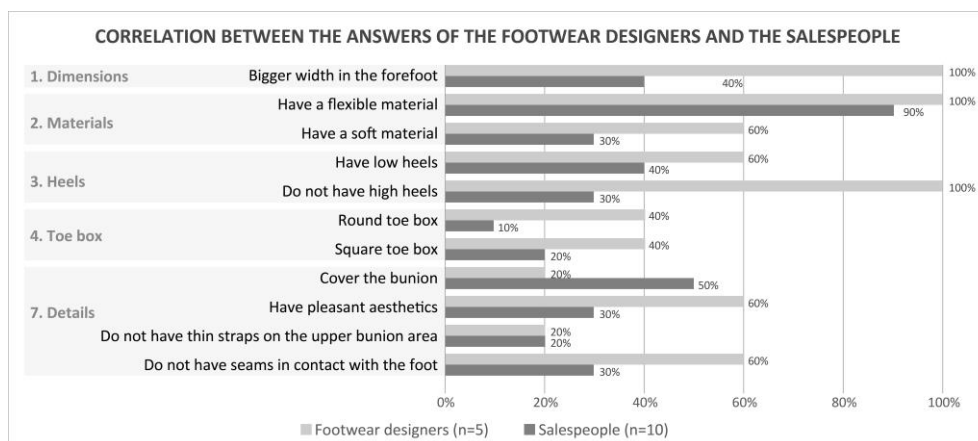


Figure 3: Correlation between the answers of the footwear designers and the salespeople

As for the most common responses, the footwear designers and women with HV shared 17 characteristics in common (56% of all the 30 characteristics). The affinity of the designers with the footwear users (women with HV) are most relevant when mentioning the characteristics of having bigger width in the forefoot (1. Dimensions), have flexible material (2. Materials), have soft material (2. Materials), promote breathability (2. Materials), have low heels (3. Heels), do not have high heels (3. Heels), have round toe box (4. Toe box), have foot anatomical adaptation (5. Insole), have non-slip sole (6. Sole), are produced using a flexible material (6. Sole), cover the bunion (7. Details), have pleasant aesthetics (7. Details), do not have thin straps on the upper bunion area (7. Details), do not have seams in contact with the foot (7. Details), promote comfort (8. Functionalities), promote well-being (8. Functionalities), and promote lightness (8. Functionalities). Regarding the analysis of the answers, the relationship between the footwear designers and the women with HV comments revealed the personal need to have shoes with pointed toe box or high heels, characteristics considered desirable by the women with HV, and also applied on the current footwear for HV. According to the footwear designers, the characteristics of having higher heels (or medium) and pointed toe box are still applied on the

shoes due to the demand presented by the women with HV, that consider these shoes “elegant” and desirable. Figure 4 presents the correlation between the answers of the footwear designers and the women with HV.

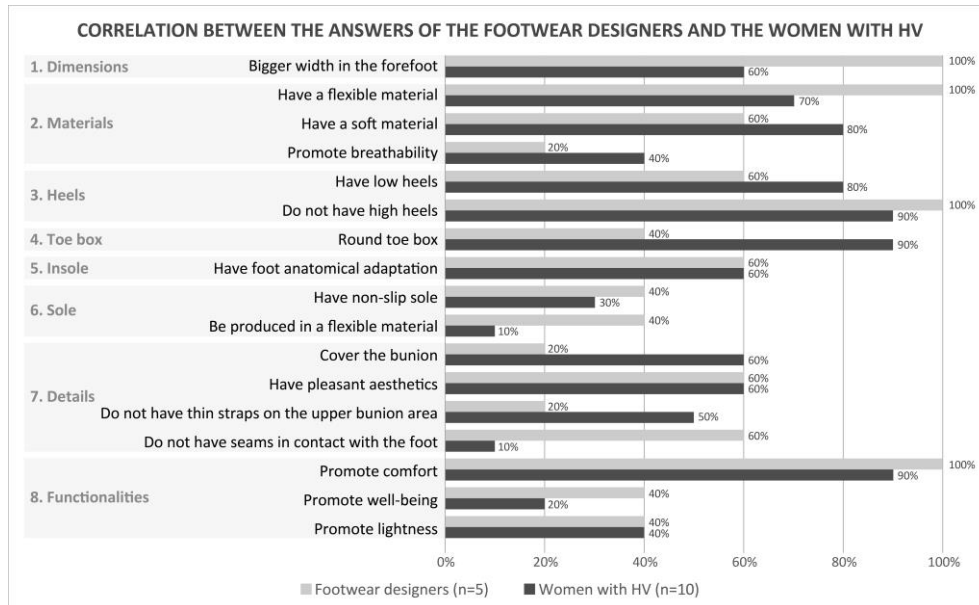


Figure 4: Correlation between the answers of the footwear designers and the women with HV

However, the relationship between the footwear designers’ answers and the orthopedists’ revealed fewer similarities, with only 7 characteristics in common (23% of all the 30 characteristics) such as have bigger width in the forefoot (1. Dimensions), have flexible material (2. Materials), have soft material (2. Materials), have low heels (3. Heels), do not have thin straps on the upper bunion area (7. Details), do not have seams in contact with the foot (7. Details) and promote comfort (8. Functionalities). The divergence between the answers of the orthopedists and the footwear designers can be related to the lack of consideration of the pathology knowledge. In this context, some characteristics that the footwear designers considered adequate for the HV footwear are also considered inappropriate according to the orthopedists, such as the pointed toe box and flat sole, which can cause damage to the foot. Figure 5 presents the correlation between the answers of the footwear designers and the orthopedists.

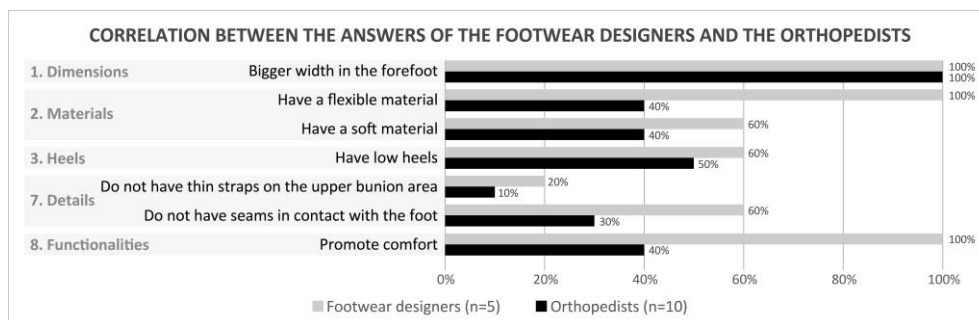


Figure 5: Correlation between the answers of the footwear designers and the orthopedists

## Conclusion

The research collected 30 characteristics adequate for HV. Considering the Brazilian footwear companies that produce shoes for HV, the research provided a way to analyze and compare the footwear characteristics based on the perspective of the individuals related to HV. The characteristics can be used by these footwear companies as a way to have more assertiveness in the manufacture, commercialization, and use of the shoe.

When analyzing the closer relationship between the answers of the footwear designers and the women with HV and the distant relationship between the answers of the footwear designers and the orthopedists, it is known that some characteristics claimed as desirable by the women with HV can also be inadequate for foot health such as the medium or high heels and the pointed toe box. When considering only the desirable characteristics of the shoe according to the users, the footwear designers risk creating an ill-fitting shoe that is not suitable for HV and can cause pain and the progression of the deformity.

If the footwear designers meet only the users' demand, disregarding the knowledge provided by the other individuals, such as salespeople and orthopedists, useful information related to HV is lost during the footwear project. Therefore, the challenge for the footwear designers is to manage the information about the participants to create a product that satisfies the women with HV and also considers the perspective of the individuals related to HV, creating a shoe desirable by the users, appropriate to sell and adequate for the pathology.

## Acknowledgments

The authors acknowledge the Coordination for the Improvement of Higher Education Personnel (CAPES), the Design Post-graduate Program at the Federal University of Santa Catarina (UFSC), the Design Management Group and Design and Usability Laboratory (NGD-LDU) and the participants of this research including the footwear designer, salespeople, women with hallux valgus, and orthopedists.

## References

- BARDIN, Laurence. **Análise de conteúdo**. São Paulo: Edições 70, 2011.
- BARNISH, Max; MORGAN, Heather May; BARNISH, Jean. The 2016 HIGH Heels: Health effects and psychosexual Benefits (HIGH HABITS) study. **BMC Public Health**, [S.l.], v. 18, n. 1, p.1-13, Aug. 2017. Springer Science and Business Media LLC. DOI 10.1186/s12889-017-4573-4.
- CASE, Thomas A. **Os Pés Brasileiros: um estudo profundo de 26.339 pessoas**. São Paulo: Pés Sem Dor, 2012.
- COUGHLIN, Michael J.; ANDERSON, Robert B. Hallux Valgus. In: COUGHLIN, Michael J.; SALTZMAN, Charles L.; ANDERSON, Robert B. **Mann's Surgery of the Foot and Ankle**. 9. ed. Philadelphia: Elsevier, 2014. Cap. 6. p. 155-321.



HARDY, R. H.; CLAPHAM, J. C. Observations on hallux valgus: based on a controlled series. **The Journal of Bone and Joint Surgery-British**, [S.l.], v. 33, n. 3, p.376-391, Aug. 1951.

HITSCHFELD, Emilio Wagner; HITSCHFELD, Pablo Wagner. Hallux valgus en el adulto: conceptos actuales y revisión del tema. **Revista Chilena de Ortopedia y Traumatología**, [S.l.], v. 57, n. 3, p.89-94, Nov. 2016. DOI 10.1016/j.rchot.2016.10.004.

LAFFENÊTRE, O. et al. Hallux valgus: definición, fisiopatología, exploración física y radiográfica, principios del tratamiento. **EMC - Podología**, [S.l.], v. 14, n. 1, p.1-11, Mar. 2012. Elsevier BV. DOI 10.1016/s1762-827x(12)61068-2.

NGUYEN, U. S. et al. Factors associated with hallux valgus in a population-based study of older women and men: the MOBILIZE Boston Study. **Osteoarthritis Research Society International**, [S.l.], v. 18, n. 1, p.41-46, Jan. 2010. DOI 10.1016/j.joca.2009.07.008.

PERERA, A M; MASON, Lyndon; STEPHENS, M M. The Pathogenesis of Hallux Valgus. **The Journal of Bone and Joint Surgery-American**, [S.l.], v. 93, n. 17, p.1650-1661, Sep. 2011. Ovid Technologies (Wolters Kluwer Health). DOI 10.2106/JBJS.H.01630.

SAUNDERS, Carl G.; KIESERLING, Claudia; STEENWYK, Johan. Design of Custom Shoe Lasts for Challenging Feet. In: GOONETILLEKE, Ravindra S. (ed.). **The Science of Footwear**. Boca Raton: CRC Press, 2012. Cap. 14. p. 309-319.

SOEMARKO, Dewi S et al. Hallux valgus among sales promotion women wearing high heels in a department store. **Journal of Orthopaedic Surgery**, [S.l.], v. 27, n. 1, p.1-6, Jan. 2019. SAGE Publications. DOI 10.1177/2309499019828456.

## About the authors

### Leticia Takayama

Master (2020) and bachelor (2017) in Design at the Federal University of Santa Catarina (UFSC). Studied Fashion Design at Parsons School of Design (2015-2016) during an exchange program offered by the Science Without Borders (CAPES). Worked as a scientific researcher (CNPq) at the Design Management Group and Design and Usability Laboratory (NGD-LDU) between 2014 and 2015.

<https://orcid.org/0000-0002-3180-9158>

### Giselle Schmidt Alves Diaz Merino

CNPq Researcher (PQ 2) in the area of Industrial Design. Professor in the Design Department at the State University of Santa Catarina (UDESC), Professor in the Postgraduate Program in Design at the Federal University of Santa Catarina (UFSC). Post Doctorate in Human Factors at UFSC with an internship at the Polytechnic University of Valencia, Spain (2017). Doctorate in Production Engineering at the UFSC (2014). Project Coordinator at NGD-LDU since 2000.

<https://orcid.org/0000-0003-4085-3561>