Age-Based Footwear Design: A Comprehensive Analysis from Infancy to Adolescence and Footwear Manufacturing

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ABSTRACT:
This study aims to investigate the importance of designing footwear according to age-specific needs, from infancy to adolescence. The research takes into account various factors like physiology, psychology, and activity levels, and emphasizes the need to tailor footwear to meet the unique requirements of each age group. The study explores the crucial role of appropriate footwear in promoting foot health and overall well-being. It delves into the specific design requirements for different age groups, such as infants, toddlers, preschoolers, school-age children, and adolescents. Key considerations include flexibility, support, durability, comfort, and style preferences, which evolve alongside developmental milestones and lifestyle changes. By analyzing existing literature and empirical findings, this paper provides a comprehensive analysis of age-specific footwear design principles. The study aims to offer valuable insights for industry professionals and researchers, leading to the development of age-appropriate footwear solutions that enhance both comfort and performance while safeguarding the health of younger demographics. The final fit of the developed shoes was tested to determine the appropriate size for the respective age groups. It was found that shoe size cannot be determined with only one measurement.

Introduction

Footwear, beyond merely serving as a means of protecting our feet, emerges prominently as a fashion element with profound effects on our social and emotional lives. Depending on an individual's taste, the cultural environment they are exposed to, their national and professional identity, social status, gender, and sexual preferences, footwear acquires different roles and meanings (Williams & Nester, 2010) . Moreover, footwear design plays a critical role not only in aesthetics but also in preserving foot health and preventing various orthopedic issues associated with ill-fitting or inappropriate footwear. Footwear design plays a vital role in addressing the evolving needs of individuals across different age groups. This becomes increasingly crucial, especially among younger demographics, with each passing day (Staheli, 2006). The increasing demand for children's footwear has become a significant trend in the footwear industry today. It is expected that the children's footwear sector will increase its market share from $46.74 billion in 2022 to $102.79 billion, with an annual compound growth rate of 8.2% (Fact. Mr, 2022). In this context, the importance of age-specific considerations in footwear design is extremely significant for ensuring optimal foot health, comfort, and style. Studies in the literature underscore the critical role of footwear design for the health and comfort of the younger population, emphasizing the need for customization of design to meet the varied needs across age groups (Silverstein, et al., 2005). The importance of age-appropriate footwear design stems from the need to consider factors such as stages of foot development and physiological growth, as well as sensory integration, especially in children (Biel & Peske, 2009) . Properly designed footwear assists children in developing motor skills and strengthening their posture. Additionally, the quality of footwear materials helps protect children's feet from excessive heat, moisture, and external elements, while also supporting foot health by facilitating natural air circulation. Therefore, footwear design tailored from infancy to adolescence not only supports foot growth but also influences overall health and well-being (Foiasi & Pantazi, 2010).

The foot is one of the most complex structures of the human body, comprising 26 bones and 33 joints supported by ligaments, providing elasticity and functioning harmoniously (Gülçimen & Ülkü, 2008). Babies' feet are typically filled with fat and primarily consist of cartilage; this cartilage gradually ossifies into adult bones over time (Laor, et al., 2010). Feet stand flat on the ground without any organic transverse cross-section, without raising toes or heels. Although the basic structure of the foot is sufficiently developed by the end of the first two years, bones do not fully mature and harden until around age 13 (DuPlessis, et al., 2016). Therefore, wearing appropriate footwear from early ages is important to facilitate bone development. Failure to meet this requirement can lead to various health issues, including minor foot discomforts like blisters, as well as more severe conditions like corns and hammer toes (Hollander, et al., 2017).

Some mechanical problems occurring in the feet can be compared to similar conditions in the hands. While the hand is a complex structure sharing similar functions of movement and balance with the foot, the absence of an organic surface providing an organic transverse cross-section in foot anatomy can lead to various mechanical stresses and discomforts. Therefore, walking barefoot and wearing minimalist shoes are recommended to improve foot health and mechanical functions (Esculier, et al., 2015). Barefoot sole technology is one of the specialized footwear technologies designed to enhance foot health and comfort. By providing closer contact to the foot sole and offering more flexibility, it enables a more natural and comfortable gait. Additionally, being made from lighter and more breathable materials reduces sweating and enhances comfort. This technology supports foot health by providing natural balance and stability and adapting to various ground conditions. Thus, barefoot sole technology offers users a healthier and more natural walking experience (Nagano Hanatsu, 2018).

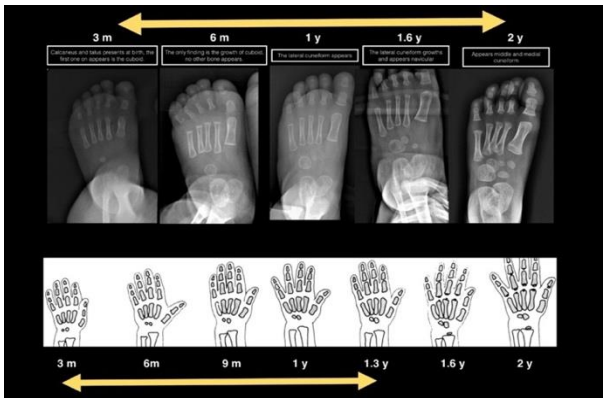

Figure 1. Foot and hand bone development depending on age (Medina, et al., 2024)

In the absence of wearing shoes, the foot tends to lose its organic transverse cross-section by coming into contact with non-organic surfaces. This can affect foot anatomy and mechanics, leading to various foot discomforts. Therefore, footwear design and selection are of vital importance for foot health. During infancy, feet are typically filled with fat and primarily consist of cartilage (Morales-Orcajo, et al., 2015) . During this period, babies explore the world by moving their feet, and foot muscles and ligaments begin to develop. In early childhood, feet grow rapidly and change shape. Before wearing shoes, babies and young children often walk barefoot, which helps strengthen and develop foot muscles and ligaments naturally (D'AoÛt, et al., 2009). At around 6 months of age, as a baby develops the ability to move their feet, the soles of their feet are usually flat and support posture and balance development by coming into contact with non-organic surfaces (Thelen, 1995). At 1 year and 7 months, a child begins to take steps as their foot muscles strengthen, requiring comfortable and supportive shoes to ensure proper foot development. Children aged 4-6 complete the development of their feet and legs while maintaining an active lifestyle. During this period, children's feet undergo more stress and movement through activities such as sports and games. Proper support for their feet contributes to the development of posture and balance skills and maintains foot health in the long term (Alavi, et al., 2014). Overall, foot development from infancy to childhood has a significant impact on posture and leg physiology. Therefore, appropriate shoe selection and regular foot checks are crucial for maintaining a child's foot health and supporting natural development (Murley, et al., 2009).

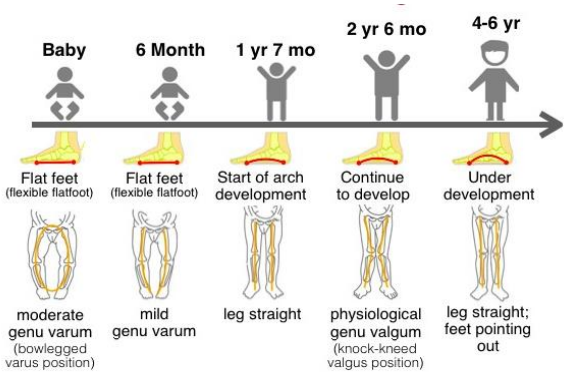

Figure 2. Foot and leg posture development from infancy to childhood (Foot Arch Pro., 2024)

Children's footwear design is executed in accordance with the characteristics of technical materials used in production, aiming to be compatible with foot anatomy and walking physiology. The design process targets the shoe as a whole, focusing on elements such as shape, color, lines, and texture that create a different appearance from previously released shoes and leave a first impression on users. The design process for children's footwear requires special attention, especially considering the needs of different age groups (Davies, et al., 2015). Footwear design can be divided into three main components: sole design, heel design, and upper design (model), and accessory design (Ünal, 2003). Sole design covers the bottom part of the shoe that comes into contact with the ground during walking (Cheng & Perng, 2009). In children's footwear, sole design should be ergonomically designed to support the child's foot health. It is important to stabilize the sole differently from classic element arrangements, yet ensuring a functional and stable structure (Ünal, 2003). Considering children's active lifestyles, slip-resistant and durable soles are also important factors in the design process. Heel design encompasses the section located at the back of the shoe that provides extra support to the foot sole (Herva, et al., 2011). In children's footwear, heel design should be designed to help the child take balanced and firm steps. Using various models in terms of width and height provides proper support for children's foot development (Wegener, et al., 2011). However, it is important for the heel not to be too high or too narrow for the child's comfort and safety. Upper design covers the outer surface of the shoe, usually determining the shoe's model (Wegener, et al., 2011). In children's footwear, upper design should be planned to be comfortable and

flexible according to the child's foot anatomy. Using flexible materials suitable for children's rapid growth and mobility increases the shoe's lifespan while ensuring the child's comfort. (Mauch, et al., 2009). Accessory design encompasses elements that give uniqueness to the shoe and are often visually appealing. In children's footwear, accessory design should be considered to attract children's interest and reflect their personal style. Accessories such as colorful bows, cute figures, bright colors, or characters beloved by children increase their interest in the shoes and encourage them to wear them (Ünal, 2003).

Figure 3 displays the mold of the shoes produced in this study. Particularly considering the lasting impact of shoe molds for low age groups, it should be carefully evaluated. Children's footwear design also involves an important element: molds. Since children's bone development and hardening are not yet complete, molds used in making shoes must be designed accordingly. Especially molds for areas such as the instep, vamp, heel, and sole should be created to fit the anatomy of children's feet. The instep area should be wide because children's feet are generally wider in this region (Adirim & Tina L. Cheng, 2003). A wide instep allows children's feet to settle comfortably and move like a shock-absorbing cushion (Wendy Tyrrell, 2009) (DeMello, 2009). The heel part should be low to increase stability and provide support during walking. The sole should be wide to help children maintain balance.

Figure 3. Size-based molds design

In the industry, children's shoes are often categorized according to age groups. However, due to differences in the growth rates of children's feet among age groups, such categorizations can be misleading. Therefore, numbering and grouping shoe molds may offer a more accurate approach. For instance, categorization is done with names such as first step, toddler, slipper, sandal, and oxford. It's crucial for each number range to have molds specially designed to meet the changing needs and development of children's feet.

Shoe selection is a significant decision, especially for children, as it requires balancing health, comfort, and style. Parents are typically the primary decision-makers in this regard. While they are meticulous in selecting shoes to protect their children's foot health and ensure comfort, they also consider fashion and style. Shoe designers strive to develop products that meet children's needs while balancing health, comfort, and style elements. Parental preferences may vary depending on the child's age and needs. Some parents allow their children to make the choice, while others adopt a more disciplined approach, imposing their decisions and authority (Leicester College, 1993). The degree of this conflict largely depends on the child's age. Additionally, the reflection of fashion and style trends on children's shoes is also a significant factor. For example, parents' interest in shoes that match their children's outfits and children's preference for shoes based on their favorite cartoon characters influence choices (Leicester College, 1993).

	General (%)	Design (%)	Color (%)	Brand (%)
Boys aged 6 and under	34.1	62.1	55.2	24.1
Boys over 6 years old	78.8	77.6	31.3	19.4
Girls aged 6 and under	26.3	70	25	15.0
Girls over 6 years old	71.0	88.1	32.2	11.9

Table 1. The child's influence in percentage terms in the parents' decision-making or purchasing process of children's shoes (Leicester College, 1993)

In recent years, several significant trends have emerged in the children's footwear sector. One of these is the increasing demand for sustainability and the use of eco-friendly materials. Parents prioritize not only their children's health but also the preservation of the environment, hence opting for shoes made from organic materials or recyclable materials. Additionally, with advancements in technology, smart

shoes and wearable technology-equipped shoes have gained popularity. These shoes allow children to monitor their health and activity levels, enhance sports performance, and even experience fun interactive activities (Hayes & Venkatraman, 2016).

Taking into account the aforementioned points, this research focuses on examining the importance of footwear design for the young population. The primary aim is to elucidate the critical role of age-specific considerations in footwear design and identify the key factors influencing young consumers' design preferences and choices. By investigating the interaction between age, developmental stage, and footwear design, this study aims to provide valuable insights into the development of footwear solutions tailored to the diverse needs of young individuals.

1- Priorities and Findings in Footwear Design for Different Age Groups

In the article, a distinction has been made between the age groups of 0-2, 2-5, 5-10, and 10-14 years old. These age groups encompass different stages of physiological growth, and the changes and needs in shoe design vary according to these stages. This differentiation made for each age group helps determine the priorities in shoe design by considering the growth and development processes of children. Considering the physiological characteristics and activity levels of each age group, it becomes evident that there are different requirements for comfort, durability, and performance in shoes.

1-1 Priorities in Shoe Design for the (0-2) Age Group

The period covering the pre-walking and initial walking stages of children aged 0-2 years is characterized by chubby feet. The forefoot of the foot is wide resembling a duck's foot, narrowing towards the heel of the shoe. Shoe design is crucial for supporting and protecting the developing feet of babies and young children. Especially in the 0-2 age group, babies experience critical periods of foot development, and properly designed shoes are vital for healthy foot development. Comfort, flexibility, durability, and safety are prioritized features in the shoes for babies in this age group.

One of the fundamental priorities of baby shoes is the comfort factor. Baby shoes should snugly wrap around the baby's feet without squeezing, tightening, or causing irritation. Research in the literature shows that when materials used in the inner part of baby shoes are soft, breathable, and skin-friendly, babies tend to be more comfortable. Additionally, it is noted that seamless and smooth inner surfaces reduce the risk of harming babies' skin. The soles of baby shoes should be flexible to allow babies' feet to bend and move naturally. Research in the literature demonstrates that flexible-soled shoes strengthen babies' foot muscles and enhance their natural walking skills. Moreover, flexible soles can improve babies' balance and coordination, reducing the risk of falling.

Figure 4. Sole softness in baby shoes

1-2 Priorities in Shoe Design for the (2-5) Age Group

The design of shoes for children aged 2-5 requires special attention to meet their rapidly evolving physical, mental, and emotional needs. This age range encompasses a period where children lead an active lifestyle and engage in various physical activities. Therefore, it is essential that shoes are comfortable and allow children to move freely. Comfort and mobility are prioritized in shoe design to enable children to move comfortably and naturally. Flexible soles, lightweight materials, and slip-resistant designs enhance the comfort level of the shoes while ensuring safety. Additionally, shoes made from durable and water-resistant materials allow children to play outdoors while providing long-lasting wear. The durability and reliability of the shoes should also be considered. Children are often energetic and move quickly, so it is important that shoes have sturdy stitching and high-quality materials. This helps protect their feet and ensures that the shoes last a long time. Supporting foot development is also important in shoe

design. Flexible soles promote the natural movement of foot muscles, while a wide toe box allows toes to move comfortably. This contributes to the healthy development of children's feet. Finally, ease of wearing and removal helps children gain independence and develop dressing skills. Practical closure systems and removable insoles enable children to easily put on and take off their shoes, thereby boosting their confidence.

Figure 5. Shoes suitable for 2–5-year-olds, and the material layers used in the cross section

1-3 Priorities in Shoe Design for the (5-10) Age Group

The design of shoes for children aged 5-10 focuses on three main priorities: performance, comfort, and style. Children in this age group lead an active lifestyle, engaging in daily activities as well as sports and outdoor games, so shoes should be suitable for both. In this context, performance features are important in shoe design. Shoes need to be durable to protect children's feet during energetic activities while also helping them maintain balance. Additionally, providing stability and ankle support helps improve children's coordination and mobility. Comfort is another crucial factor in shoe design for children aged 5-10. The inner part of the shoes should be made of soft and breathable materials, allowing children to feel comfortable and flexible while also preventing sweating. Shoe soles should be designed to enhance foot cushioning and absorb impact, allowing children to move comfortably for extended periods.

Style and fashion are also important considerations in shoe design for children aged 5-10. Children care about the appearance and style of their shoes, so colors, patterns, and decorative details should be chosen to appeal to their interests. Moreover, shoes should align with popular culture trends, allowing children to express their personal style. In conclusion, suitable shoe design for children aged 5-10 balances performance, comfort, and style. These designs ensure that children have durable, comfortable, and stylish shoes that cater to their active lifestyles, allowing them to feel physically comfortable while also expressing their personal style.

1-4 Priorities in Shoe Design for the (10-14) Age Group

The design of shoes for the age group of 10-14 aims to strike a balance between fashion, style, and functionality. Adolescents in this age range expect their shoes to reflect their personal style, especially as they experience increased social interactions. However, shoes must also be suitable for daily activities and sports. One of the priorities in shoe design is fashion and style, as it is important for adolescents to express their individuality through visually appealing shoes. Therefore, designers must closely follow fashion trends and select design elements such as colors, patterns, and decorative details that will capture the interest of adolescents. Performance and comfort are other important factors in shoe design for the 10-14 age group. Given that adolescents in this age range often participate in sports and outdoor activities, shoes need to provide performance and comfort. Shoes should have technical features suitable for sports like running, basketball, and soccer. Additionally, inner soles designed to fit the foot anatomy and provide adequate support should cater to the active lifestyle of adolescents. Durability and quality are also crucial considerations in shoe design.

The energetic and active lifestyles of adolescents necessitate durable shoes made from sturdy materials that protect their feet during daily activities and sports while lasting for a long time. Safety and foot health are important aspects to consider in shoe design as well. Shoes should be designed to fit the foot measurements and anatomy properly to provide comfort and support. Moreover, shoes with non-slip soles and sufficient ankle support can reduce the risk of injuries during sports and outdoor activities. Lastly, considering adolescents' interest in technology and innovation, incorporating technological features such as air cushions, special rubber components, and specialized linings in shoe design can enhance their overall experience. By incorporating all these elements, shoe designs suitable for the 10-14 age group support adolescents' active lifestyles, allow them to express their style, and facilitate safe movement.

2- Design Process for Different Age Groups

2-1 Footwear Design for the (0-2) Age Group

In shoe design, there are significant factors aimed at preserving children's foot health while facilitating their movements and growth. In this context, various types of shoes are available, categorized according to age groups, such as baby shoes, first walking shoes, booties, sandals, and sneakers. However, this classification based on age groups can sometimes be misleading due to differences in children's rates of foot growth. This situation is further emphasized by the lack of a standard classification in the footwear industry. Particularly influenced by the textile sector and the rise of fast-fashion brands, the size ranges attributed to age groups tend to vary. According to the priorities expected from baby shoes, two different product groups are distinguished for the 0-2 age range: pre-walking and walking period. Babies included in the pre-walking group require booties or pre-walking shoes. For instance, the size range for booties typically ranges from 27 to 32. However, these revisions are generally made based on sales performance. During the design process, it is important to have spaces that allow the baby's toes to move comfortably. Designs made in this way not only preserve foot health but also contribute positively to sensory integration and balance skills, supporting the child's hand-eye coordination. The creation of shoe molds is a vital component of the design process and a significant step that determines the final quality of the product. Especially for pre-walking baby booties, properly crafted molds are necessary to ensure the comfort and foot health of babies. The mold creation process must be carried out in accordance with the anatomy and movements of babies' feet. This ensures that the baby shoe fits properly and comfortably on the foot. Proper support for the toes and heel area enhances comfort and helps babies' feet develop healthily.

Figure 6. Developed molds for first step

It is scientifically accepted that all children under 16 months have flat feet since their foot arches generally fully develop around the ages of 6-8. Therefore, special arch support is not needed in baby shoe design. Since the feet of children in this age group are extremely flexible, it is important for the materials used in the design to have flexible properties, and flexibility and not restrict the natural movements of the child's feet are emphasized in material selection.

Rather than providing rigid support, it is important for the shoe to be flexible and moldable to the child's foot. This process is carried out by considering the anatomy and movements of babies' feet. Initially, detailed research is conducted, and data on the sizes and variations of baby feet are collected. Based on this data, the design team creates prototype drawings. These drawings include designs for booties that are tailored to fit baby feet, determining important elements such as sizes, shapes, and stitching details. Subsequently, computer-aided design (CAD) software is used to create the mold design.

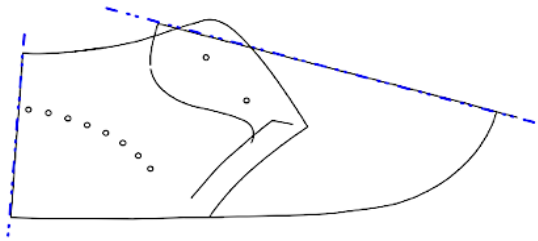

Figure 7. The initial design schematic of the first-step shoe

This design is meticulously determined according to the dimensions and shape of baby feet. After the

completion of the mold design, a prototype is produced and tested under real usage conditions. These tests are conducted to evaluate the suitability, comfort, and safety of the booties. Based on the feedback obtained from prototype testing, necessary improvements are made, and the mold design is optimized. This process ensures the production of booties that are suitable, comfortable, and safe for baby feet. Particularly, it is important for the shoe's heel to elevate the arch of the foot, protect the sole of the foot, and provide resistance against wear and tear. However, in small children's shoes (up to 1 year old), heel-less designs are more common, and heel-less shoes may be preferred in this age group.

Figure 8. Manufactured first-step shoe

Material selection in the design of pre-walking baby booties is of critical importance for product quality and baby comfort. At this stage, materials that do not harm the sensitive skin of babies and allow breathability are generally preferred. Cotton fabrics are commonly used in the production of baby booties because these materials are skin-friendly and provide comfort upon contact with the skin. Additionally, the selection of materials with anti-allergic properties is made considering the skin sensitivities of babies. This attention to material selection is an important factor affecting the quality of the final product and the comfort of babies. Breathable materials such as leather, canvas, or knitted mesh are preferred for the upper parts because children's feet tend to sweat. In recent times, there has been an increase in the use of natural and environmentally friendly materials in designs. Additionally, it is important for the inner materials to have absorbent properties to control moisture and perspiration inside the shoe, ensuring the child's comfort.

In the design of the outer sole, features such as grip, cushioning, and flexibility are prioritized. However, overly sticky and thick outsoles are not often preferred as they can cause stumbling and falls. This balanced approach is employed to ensure both the safety of children and support for their natural movements.

2-2 Footwear Design for the (2-5) Age Group

Designing children's shoes not only focuses on their physical attributes but also takes into account the social needs of children in their environments. This process, particularly for children aged 2-5, emphasizes not only the foot health and development of children but also their social interactions and daily activities. The first step is the collection of anthropometric data regarding the foot structures of the target user group, children aged 2-5. These data include measurements such as foot lengths, widths, heights, ankle circumferences, and other significant dimensions. These data are typically obtained through literature review, field studies, or existing databases. Based on the collected anthropometric data, pattern design is conducted. This involves creating patterns that are shaped appropriately to fit the foot structures of children. The design should take into account the anatomical structure of children's feet and incorporate specific details to provide appropriate support, flexibility, and comfort.

Figure 9. Developed mold for ages 2-5

During the pattern-making process, factors are also taken into consideration. The design and patterns of shoes are optimized to accommodate children's

movements in various activities. For instance, flexible soles support children's natural movements while running or jumping, while sturdy and durable materials ensure longevity for extended use. Computer-Aided Design (CAD) plays a significant role in shoe design for children aged 2-5 years. CAD systems enable designers to model, detail, and analyze shoes in a digital environment. These systems expedite the design process, facilitate the creation of prototypes, and allow for more accurate evaluation of the design. CAD systems provide designers with a wide range of colors and design options. Thus, the colors and patterns preferred by children can be directly applied in the digital environment, ensuring that the design captures children's interest.

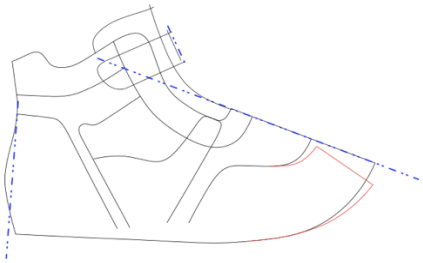

Figure 10. Suitable design for ages 2-5

Figure 11. Manufactured shoe suitable for ages 2-5

2-3 Footwear Design for the (5-10) Age Group

We can define the age range of 5-10 years as a period in which a child's taste and image begin to form. One of the key criteria that influences children's shoe selection during this period is the start of school. As children begin school and interact with their peers, it becomes inevitable for them to emulate their peers and current fashion trends. During these ages, shoes with colorful and eye-catching designs tend to attract children's attention. As seen in the illustration, visual appeal is achieved using a hologram effect on the cheek area of the shoe. The focal point of children's interest is determined as the unicorn figure, one of the current figures, with a colorful pom-pom used on the tail part of the unicorn, and visual appeal is completed with colorful shoelaces. Comfort for the feet is also crucial in this age range. For ease of wearing, a zipper is used. Considering the child's active movement, the use of a closed zipper is highly important.

Figure 12. Developed mold for ages 5-10

During this period, children undergo significant changes in the structure of their bones and muscles in their feet. The arches of the feet begin to develop and the toes lengthen. Additionally, in this age range, children's feet are generally more flexible and prone to taking shape. As the feet widen and the bones and muscles strengthen, children's feet become sturdier and more balanced. Therefore, ensuring compatibility with the child's foot structure is important when selecting shoes. Shoes that are the correct size and shape support the child's foot health and enable comfortable movement.

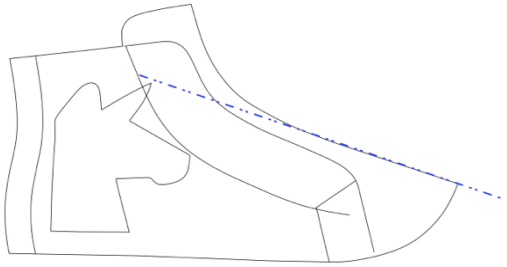

Figure 13. Suitable design for ages 5-10

Care should be taken in the selection of materials used in the production of children's shoes for the 5-10 age group. These materials should support the child's foot health and comfort. Soft and flexible materials should be preferred for the upper part, and breathable synthetic materials help prevent sweating by allowing the feet to breathe. In order to prevent irritation of the feet, inner linings and insoles should also be soft and skin-friendly. The sole materials should be flexible and non-slip, allowing children to play and run safely. Finally, considering that children wear their shoes in challenging conditions, it is essential to choose durable and easy-to-clean materials.

Figure 14. Manufactured shoe suitable for ages 5-10

2-4 Footwear Design for the (10-14) Age Group

Two distinct periods can be distinguished for the 10-14 age group: childhood and adolescence. Children's shoe sizes generally range from 30 to 36. Children included in these periods require shoes that support their health and development. In this age group, shoes should not only protect foot health but also be designed to suit children's active lifestyles. Especially for adolescents, the elegance and durability of shoes play an important role. During the design process, priority should be given to shoes that allow children's feet to move comfortably and provide proper support. The shoe mold should be suitable for the anatomy of adolescents' feet and compatible with their movements. Especially providing correct support to the toe and heel areas ensures not only comfort but also proper development.

Figure 15. Developed mold for ages 10-14

Between the ages of 10 and 14, children's feet are still growing and developing. Typically, during this age range, children's feet become more stable due to the strengthening of bones and muscles. Foot bones ossify more with cartilages, and foot arches become more defined. Both foot length and arches acquire a more robust structure. The rapid rate of foot growth observed in previous periods decreases. Proper molds support children's foot structures and postures, ensuring healthy foot development. Designs catering to both childhood and adolescence are determined by the design team based on measurements and research findings. These designs are crafted considering components that will be suitable for the child's foot structure.

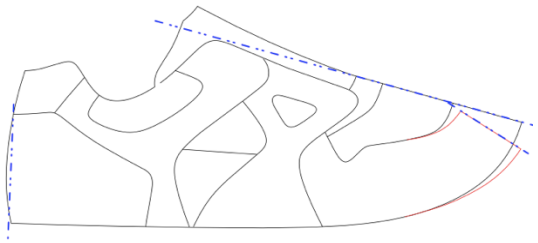

Figure 16. Suitable design for ages 10-14

This design is meticulously prepared with the desired specifications in mind. The mold design has approached that of adults, with longer foot length and increased heel pressure. Shoes are now being produced with designs, fabrics, and patterns resembling those of adult shoes. However, the design continues to incorporate some features characteristic of childhood. Considering all these features, the designer reaches the final design, and prototypes are produced accordingly. Tests are conducted on the prototypes regarding their suitability for active lifestyles, comfort, conformity to foot structure, and

ergonomic aspects. Durability of the shoes is also a significant consideration. After incorporating feedback and making necessary improvements, mass production can commence.

Figure 17. Manufactured shoe suitable for ages 10-14

Material selection is also a crucial factor. Given their active lifestyle, the upper materials used should be comfortable, flexible, and breathable to prevent sweating. They should also provide durability suitable for their active lifestyle and withstand stress. Additionally, they should meet the fashion trends expected by teenagers. In this age group, the fashion factor may sometimes compromise features like comfort and convenience. Looking at the sole design, soles with friction resistance that provide grip and balance come to the forefront. They should also support cushioned cheek hollows. Lightness is also among the preferred characteristics.

3- Conclusions

This study examines the important aspects of infant footwear design and their effects on children's foot health. In footwear design, the use of materials that allow children's feet to move naturally, provide flexibility, and allow breathability is of great importance. Specifically, the absorbent properties of inner materials help control moisture and sweat inside the shoe, ensuring the child's comfort. In the design of the outer sole, a balanced approach is adopted, prioritizing features such as grip, cushioning, and flexibility, while considering the use of excessively sticky and thick outer soles for the safety of children.

In conclusion, the focus in infant footwear design should be on the foot health and comfort of children. In this regard, material selection and design details should be carefully considered. Additionally, it is necessary to continuously review innovations and improvements in footwear design by keeping up with scientific research and technological advancements. It is hoped that the findings of this study will contribute to progress in infant footwear design and promote the healthy development of children.

4- Acknowledgements

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