Preliminary study for Saudi footwear standardization done by Bandar Alghamdi and Qassem Akkam supervised by Dr. Mohamed T.Ibrahim El-Wakad

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Introduction

 The health of foot depends to a great extent on the design of the worn shoes . The design of the shoes depend on the shape of the foot . such foot shape change due to environment, general health, habits, age and gender .Therefore, it is important in designing shoes to consider the actual shape of a specific population . In other words , shoes designed in Europe may not fit comfortably in the middle east and vice versa . Similarly, shoes designed for men can not simply miniturized to be used for female or children. To be able to design a shoes for a specific population a shoe standard should be developed. Such standard is based on same measurement. Among those measurement is foot index. This index is used to classify the foot shape. To be able to design a comfortable shoes.

Failing to wear comfortable shoes may lead to foot deformity. One of the common foot deformity is *hallux valgus.* The earliest mention of such deformity in the literature was in the eighteenth century. During the nineteenth century, its occurrence and etiology were discussed many times. During the nineteenth and twentieth centuries, several expeditions by scientists into the undeveloped areas of the world, noted that hallux valgus is only rarely seen in those who do not wear shoes. And while some still showed a mild increase in the deformity even when wearing the special shoes .

The purpose of this study to classify the foot shape Saudi population as well as determining the existence of *Hallux valgus* foot deformity in Saudi population and it's percentage.

**Review**

1. **Foot shape:**

Knowledge of foot shape is important to design shoes which fit properly. Although many shoes for women are simply scaled down versions of the same shoe for men (Frey, C., 2000), previous studies describe differences between genders particularly at the arch, the lateral side of the foot, the first toe and the ball of the foot. Men have longer and broader feet than women for a given stature (Wunderlich, R.E.; Cavanagh, P.R., 2000), whereby women tend to have a narrower heel in relation to the forefoot and have narrower feet than men in general relative to length (Frey, C., 2000). Besides differences between genders, ethnic origin can also influence foot shape (Hawes, M.R.; Sovak, D. et al., 1994). New methods provide the opportunity to measure the three-dimensional shape of the foot, which may help analyze the difference between genders more precisely. Moreover, it is also an economical method, even for measuring large populations. Similar conclusions can drawn when comparing foot shape of same genders but different age, children, youth and elderly. Therefore, it is important to have different criteria when designing shoes for male, female, young, adults, or populations of different races.

**2. Halux valgus:**

**2.1. What is Hallux valgus**

 The term hallux valgus actually describes what happens to the big toe. Hallux is the medical term for big toe, and valgus is an anatomic term that means the deformity goes in a direction away from the midline of the body . So in hallux valgus the big toe tilts over towards the smaller toes and a bony lump appears on the inside of the foot. As this condition worsens, other changes occur in the foot that increase the problem .

It's common medical term is bunion which is a Latin word meaning enlargement of the joint. Figures 1 show how hallux valgus (bunion) looks like

|  |  |  |
| --- | --- | --- |
| Bunions, hallux valgus, bunion picture | Bunions, hallux valgus, bunion picture | Bunions, hallux valgus, bunion picture |
| Bunion x-ray |

**Figures.1**

**2.2. Occurrence of Hallux valgus**

 According to the National Health Interview survey conducted by the National Center for Health Statistics, this condition affects 1% of adults in the United States. Sscientists report found that the incidence increased with age, with rates of 3% in persons aged 15-30 years, 9% in persons aged 31-60 years, and 16% in those older than 60 years. Also in the report a higher incidence in females versus males, with ratio of 2:1 to 4:1.Whether this finding indicate a truly increased incidence in the female population. However, even when both sexes wore similar sensible, rounded shoes there was still a marked increase in the occurrence of hallux valgus in females compared to males .

Other scientists also note that hallux valgus rarely occurs in those who only wear sandals and other types of shoe gear that keep the first and second toes separated.

The role of genetic predisposition has also been noted, Bunions tend to run in families, but that does not mean that if you have a bunion, your children will inevitably have one too. The connection may be that bunions are a bit commoner in people with unusually flexible joints, and this can be hereditary.

**2.3. Prevention**

##  You may be able to prevent hallux valgus by wearing shoes that fit well and comfortably. You can consult a podiatrist or chiropodist for information about ways to prevent bunions and for guidance about suitable footwear. He or she is likely to advise:

* making sure that the toe of your shoe is wide enough to prevent your toes from being forced together - the widest part of your foot should be in the widest section of the shoe
* not wearing high-heeled shoes too often
* making sure your shoes are not too tight
* soaking and scrubbing your feet when you are in the bath or shower to prevent hard calluses from getting worse
* using soft insoles in your shoes as shock absorbers

**Objective**

**In our research we use foot index for two reasons:**

* To Classify in order to come up with foot standard .
* To determine of hallux valgus problem in Saudi population.

**Method**

 Two groups of males and females we're used in this study. Each group consists of 50 subjects. The age of male group ranged between 17 to 83 with a mean age of 48. The female's group age ranged from19 to 74. The mean age of females group was 50.

Each subject walked with barefoot on **novel Emed-n plate form** (Munich, Germany). The parameters measured by machine are: foot length and foot width.

**1. Foot index:.**

The foot shape was classified according to the **foot index** (FI), defined as:

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The mean FI for each group was computed. The subject's foot shape was classified into three categories; slender, standard and broad by comparing the subject's FI to the corresponding mean FI as follows:

1. The foot is considered Slender if its FI < [(mean FI) – SD]
2. The foot is considered Broad if its FI > [(mean FI) + SD]
3. The foot is considered Standard otherwise.

**2. Halux angle:**

The range of normal values for hallux angle(fig.2) is between 0° and 30°. Although no absolute value can be established to define the boundary between normal and deformed, it has generally become accepted that if the hallux angle becomes more than 15° the patient may be considered to have some degree of foot abnormality.

 **Fig.2**

From the hallux angle data, the **metatarsus-phalanx angle** (MPA) is determined according to the following relationship

 **MPA = 180° – Hallux angle**

According to the MPA the foot type was classified into 2 types as follows:

1. The foot is considered deformed if its MPA < 165
2. Normal otherwise.

**Results**

Result from statistical analysis as shown in table1 and figures 3 to 6 (which conclusion from the appendix. 1) as in the next paragraphs.

**Table1**

|  |  |  |
| --- | --- | --- |
| **Female** | **Male** |  |
| ***L*** | ***R*** | ***L*** | ***R*** |  |
| 30 | 34 | 41 | 37 | ***Standard*** | **Foot type** |
| 19 | 14 | 5 | 8 | ***Slender*** |
| 1 | 2 | 4 | 5 | ***Board*** |
| 5 | 7 | 6 | 6 | ***Deformed*** | **Deformation** |
| 45 | 43 | 44 | 44 | ***Not deformed*** |

Figure.3 shows that **in males**, the most feet type are standard which represent 82% in the left feet and 74% in the right feet. Also we note that 16% of the right feet are slender which is greater compared with the left feet (10%) and the number of broad feet in the right is more than in the left by 2%.

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**Fig.3**

**In females,** the number of standard feet in the right feet (68%) is more than in the left feet (60%) also we observe that the left feet is more slender than the right ones by 10% and the right feet is broader than left by 2%.



**Fig.4**

The findings of this study demonstrate differences between gender regarding important anatomical measurements of the foot. Women have narrower feet than in men. For these measures, lasts for women's shoes cannot only be a downscaled version of those for men’s shoes. For the same given shoe size, women need narrower shoes with a smaller instep height in comparison to men.  **In male**, the deformed foot (12%) is less than non deformed (88%) (fig.5). No differences were noticed from statistical analysis for foot Deformity of male between right and left foot.

**Fig.5**

**In female**, the number of deformed foot is less than non deformed one. Also insignificant differences were noticed for deformed foot between right foot and left foot (fig.6). Seven case for right foot (14%) and five cases for left foot (10%).



**Fig.6**

 In the present Result from statistical analysis, number of cases for feet deformity has been higher in females in the right foot by 2% and lower in the left foot by 2% when compared to males. Deform is almost the same in both male and female, it is represent only by about 10%-14%. This could be due to open type foot worn by Saudi population.

**Conclusion**

 The aim of this study is to classify the Saudi population in terms of foot shape and foot deformity using anthropometric data. Within the limit of this study, the following may concluded:

1. A significant percentage of male and female Saudi population can be classified to have standard feet (>73%)
2. Broad feet are the least percentage (2 – 14 %) in Saudi population.
3. In both male and female population more than 85% can be classified to have normal feet.
4. Deformation of Saudi population feet is less than their Korean one which may be attributed to the different working habits and style of life.
5. This study needs to be expanded to cover larger sample size to be able to set shoe standards for Saudi population.
6. We cannot make the same standard for both male and female due to the differences in gender, age and environment.

**Appendix.1**

**References of Project**

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