

## Foot Shape Determinant Factors for Sudanese Individuals in Khartoum State

Hago Elfadil Haroun<sup>1</sup>, Hala Hashim Amin<sup>2</sup>

Sudan University of Science and Technology (SUST),  
School of Engineering & Technology Industries  
[hagoelfadil@sustech.edu](mailto:hagoelfadil@sustech.edu)

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**ABSTRACT** - This study was conducted to identify the Sudanese foot shape and anatomy as it is necessary in the field of foot wear industry and to study the determinant factors affecting the shape of Sudanese foot for citizens dwelling in Khartoum state. The study was conducted through a questionnaire investigating a sample of 480 individuals from medical cadres operating in medical and health institutions in Khartoum state. The questionnaire addressed most effective determinant factors on the shape of Sudanese feet from Sudanese land vastness, land topography, work, diet and genetic factors. Then the acquired data were subjected to analysis using The Statistical Package for Social Science application program (SPSS). SPSS showed that the land topography is the most effective determinant factor on the shape of Sudanese feet when it is compared with diet and work factors. The work factor is more effective than diet factor. Whereas the genetic factor is the most effective factor on the shape of Sudanese feet when it is compared with land topography, diet and work factors. Generally, it was found that the genetic and land topography are more effective than other factors on determination of Sudanese foot shape.

**Keywords:** Foot Shape, Khartoum State, Social Science, topography.

المستخلص: تناولت هذه الورقة العوامل المؤثرة على شكل الرجل السودانية في ولاية الخرطوم. أسست الدراسة على ملء استبيان لعدد 480 شخص يعملون في المجال الطبي والصحي في ولاية الخرطوم، الغرض من الاستبيان هو معرفة العوامل المؤثرة في تشكيل القدم والعوامل هي تضاريس الأرض، نوع العمل والغذاء ثم الأثر الوراثي. حلت البيانات استعانة بالبرامج الإحصائية للعلوم الاجتماعية (SPSS) الذي أوضح أن تضاريس الأرض أكثر أثراً من نوع الغذاء ونوع العمل. طبيعة العمل أكثر تأثيراً من نوع الغذاء والجانب الوراثي أكثر تأثيراً من تضاريس الأرض والتغذية ونوع العمل. ملخص البحث الجانب الوراثي وتضاريس الأرض هي الأكثر تأثيراً في شكل القدم السودانية.

### INTRODUCTION

The foot has flexible structures of bones, joints, muscles, and soft tissues that enable standing upright and perform activities like walking, running, and jumping. The feet are divided into three sections (hind, mid and fore foot) that collectively give it the known shape. The foot contains more bones than any other single part of the body. Though it has evolved over hundreds of thousands of years in relation to vastly varied terrain and climate conditions, the foot is still vulnerable to environmental hazards such as sharp rocks and hot ground, against which shoes can protect. The foot provides strength for weight bearing; flexibility for propulsion and elasticity for shock absorption<sup>[1]</sup>. The change of the foot shape takes place as early as ninth week of the fetus and it continues

until it reaches eighteenth after birth<sup>[1]</sup>. The changes in the foot shape takes place due to the growth from infancy; weight bearing and movement. The shape of our foot keeps changing continuously while we are walking, running or performing other activities. In addition to the above there are more determinantal factors that contribute to the final shape of foot, which are as follows:

- The vastness of geographical dwelling area and difference in topography that plays a significant role defining the foot shape in terms of size and width because the foot adapts to environmental conditions and the surface of land.
- Foot nature is the key to determine the mass of the foot muscles and bones through

- deposition of protein and fats according to the nutritional value of diet
- c. Different jobs and occupations determine the foot shape because the nature of the job and the status in which the foot in during the performance of such a job as the adaption of foot to such status will considerably have an effect on its shape.
  - d. Genetic variation suggests the supposed-to-be shape of foot according the genetic program.
- As Sudan is a vast country with variable climatic zones and demography. So, the above factors will definitely have some effects on determination of Sudanese foot shape. In this study, this issue was investigated through questionnaire submitted to a number of specialists in the medical sector in Khartoum state.

**METHODOLOGY:**

**Data Acquisition:**

A questionnaire was prepared with 12 questions about the factors affecting the shape of foot in Sudan such as the vastness of Sudan area;

difference in topography; difference in food nature; difference in jobs and occupations and variation. Then a comparison is made between the above mentioned factors in atrial to single out the most affecting one on variation of foot shapes in Sudan, through using two factors each time. The above questionnaire was distributed among 480 medicaldoctors operating in public and private hospitals and clinics in Khartoum state.

**Data Analysis**

The acquired data, the answers provided by the targeted group, were subject to statistical analysis covering percentage and number of positive answers for the first 6 questions of the questionnaire which allow yes or no answer, about whether the above mentioned factors have considerable effects on the Sudanese foot. The second six questions of the questionnaire which are laid in a comparative manner to determine the most effective factor on the variation of the foot shape in Sudan were treated similarly.

**Table 1: The questionnaire results of section one.**

Effect	No answer		Answer no		Answer yes	
	Number	percentage	Number	percentage	Number	Percentage
Geography	21	4.4%	166	34.6%	293	61.0%
Genetics	3	0.6%	6	1.2%	471	98.1%
Diet	21	4.4%	179	37.3%	280	58.3%
Work	6	1.2%	69	14.4%	405	84.4%
Topography	3	0.6%	60	12.5%	417	86.9%
Vastness	8	1.7%	166	34.6%	306	63%

**Table 2: The questionnaire results of section two.**

	Factor 1			Factor 2			Factor 3		
	topo grap hy	wor k	No ans wer	topo grap hy	Diet	No ans wer	wor k	Diet	No ans wer
Number	234	238	8	334	134	12	341	115	24
Percentage	48.8%	49.6%	1.7%	69.6%	27.9%	2.5%	71.0%	24.0%	5.0%

Factor 4			Factor 5			Factor 6		
wor k	Gen etic	No ans	topo gra	Gen etic		Diet	Gen etic	No ans
41	434	5	42	435	3	29	475	5
8.5%	90.4%	1.0%	8.8%	90.6%	0.6%	6.0%	34.6%	1.0%

**RESULTS**

Results were shown in Tables 1 and 2.

**DISCUSSION**

The questionnaire is set to answer question exchanged among researchers in the field of footwear industry such as: are these exchangeable shoes in Sudanese markets suitably fit for Sudanese foot and they don't require further modification as generally agreed that there are marked differences? To answer such enquiries correctly with affirmation or negation for existence of such differences, and then trying to determine the factors that affect differences in foot shape in Sudan. Comparison is carried out between those factors assuming that they may or may not have effect on the difference in foot shape. Moreover, to answer the so-called question, the questionnaire analysis will be the way to reach this goal through analysis.

As such, for the six above questions, positive answers were received from 63%, 84.9%, 84.4%, 58.3%, 98.1% and 61.0% consecutively. This will make it very clear that most of specialists tend to consider that genetic factor have considerable effect on the shape of feet to a greater extent more than that of other factors. Whereas the answers of question one and four show that the vastness of Sudan and type of food has the least effect on foot shape.

**The Seventh Question**

Which factor has the bigger effect on the foot shape, work nature or land topography?

The following results were observed for this question:

1. 238 individuals chose work nature answers, forming 49.6% of candidates.
2. 234 individuals chose land topography answers, forming 48.8% of candidates
3. 8 individuals did not answer the question, forming 1.7 % of candidates

In this question the percentages of answer are nearly to be equal. This means we will not be so confident to state that work nature has an effect more than land topography in Sudan even though the individuals chose the former factor are more than the latter as it is clearly apparent in Figure 1.

**The Eighth Question**

Which factor has the bigger effect on the foot shape, diet or land topography?

The following results were observed for the above question:

- 1) 134 individuals chose diet answers, forming 27.9% of candidates.
- 2) 334 individuals chose land topography answers, forming 69.6% of candidates
- 3) 12 individuals did not answer the question, forming 2. % of candidates
- 4) This proved that land topography has greater effect on the variation of foot shape in Sudan compared with diet.

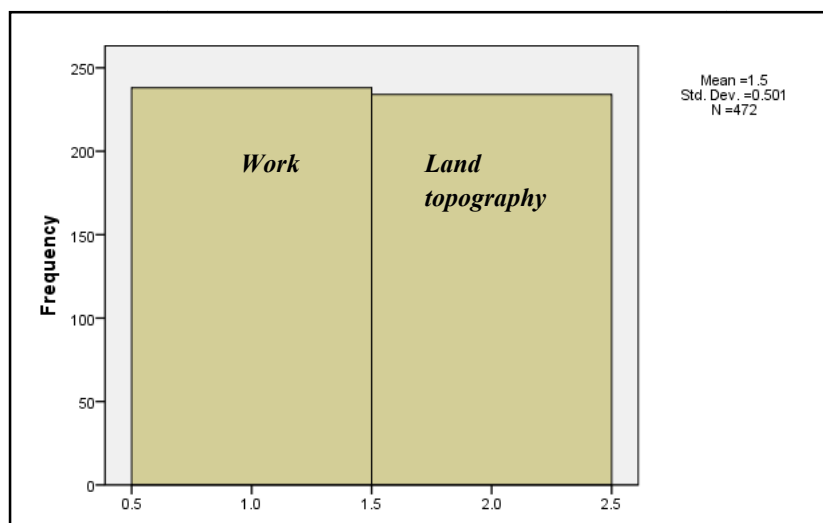


Figure 1: Comparison between work and land topography,

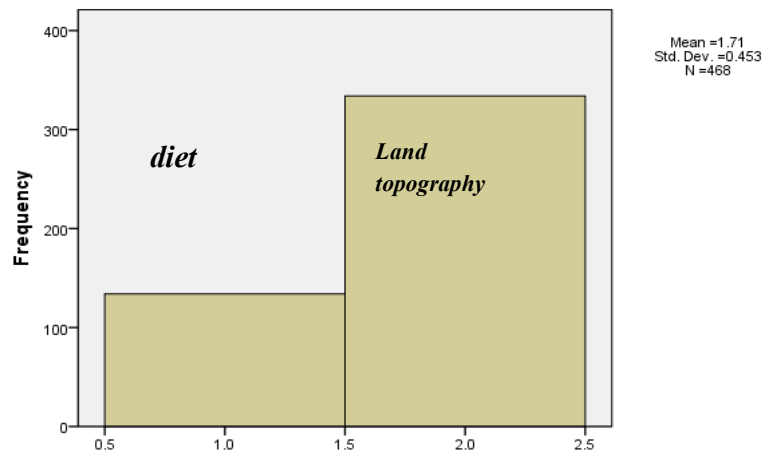


Figure 2: Comparison between diet and land topography,

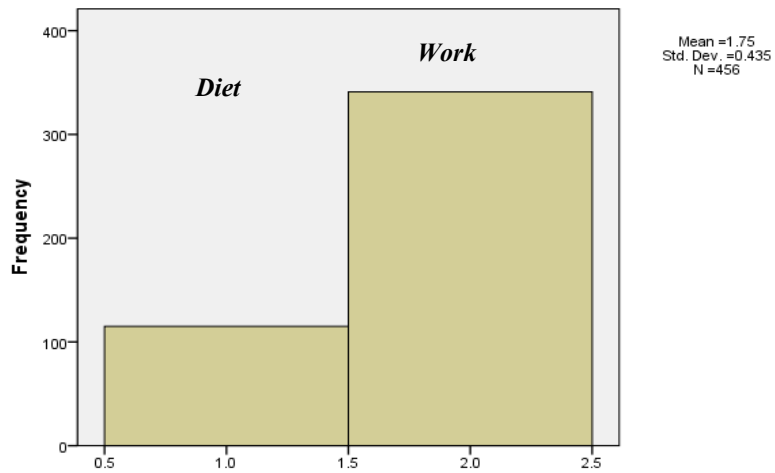


Figure 3: Comparison between diet and human work

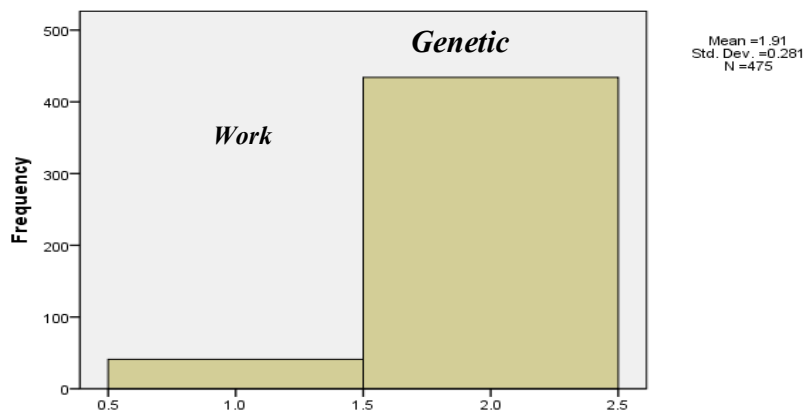


Figure 4: Comparison between human work and genetic factor

**The Ninth Question**

Which factor has the bigger effect on the foot shape, diet or work nature?

The following results were obtained for the above question:

- a. 115 individuals chose diet answers, forming 24.0% of candidates.
- b. 341 individuals chose work answers, forming 71.0% of candidates
- c. 24 individuals did not answer the question, forming 5.0 % of candidates

This proved that work nature has bigger effect on the variation of foot shape in Sudan compared with diet in Figure 3.

**The Tenth Question**

Which factor has the bigger effect on the foot shape, work nature or genetic factors?

The following results were observed for the above question:

- a. 41 individuals chose work nature answers, forming 8.5% of candidates.
- b. 434 individuals chose genetic factors answers forming 90.4% of candidates
- c. 5 individuals did not answer the question forming 1.0 % of candidates

This proved that genetic factor has greater effect on the variation of foot shape in Sudan compared with work nature in Figure 4.

**The Eleventh Question**

Which factor has the bigger effect on the foot shape, land topography or genetic factors?

The following results were observed for the above question:

- 1) 42 individuals chose land topography answers, forming 8.8% of candidates.
- 2) 435 individuals chose genetic factors answers forming, 90.6% of candidates
- 3) 3 individuals did not answer the question forming, 0.6 % of candidates
- 4) This proved genetic that has greater effect on the variation of foot shape in Sudan compared with land topography. Shapes in Sudan as it is clearly apparent in Figure 5.

**The Twelfth Question**

Which factor has the bigger effect on the foot shape, diet or genetic factors?

The following results were observed for the above question:

- 1) 29 individuals chose diet answers, forming 6.0% of candidates.
- 2) 475 individuals chose genetic factors answers, forming 99.0% of candidates
- 3) 5 individuals did not answer the question, forming 1.0 % of candidates

This proved that genetic factor has greater effect on the variation of foot shape in Sudan compared with diet Figure 6.

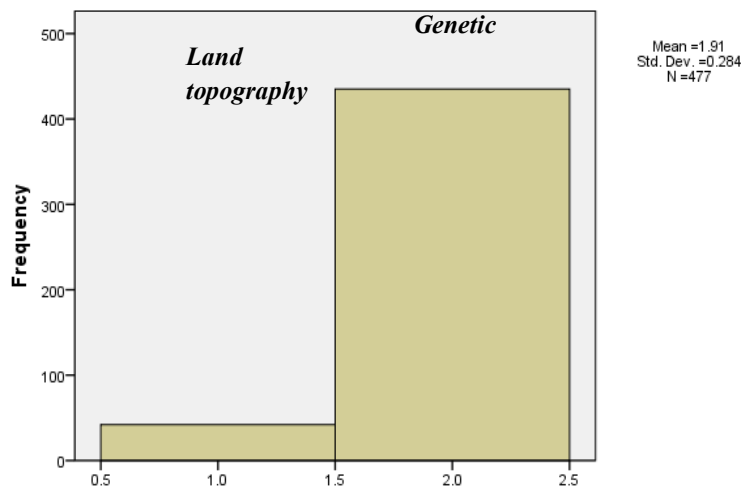


Figure 5: Comparison between land topography and genetic factor

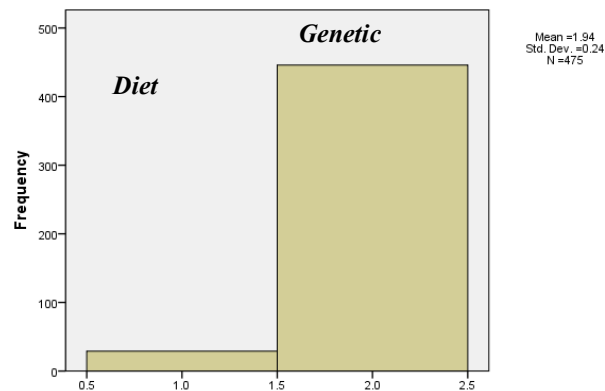


Figure 6: Comparison between diet and genetic factor

### CONCLUSIONS

According to the result and analysis of this work the descending order of the investigated factors on the variation of the Sudanese foot shape are: genetic factors, work nature, land topography, and diet. Genetics, work nature, land topography and diet are the main factors affecting the variation of foot shapes in Sudan. This makes it necessary to carry out undergoing foot surveys for the benefit of footwear researches and industry in order to formulate an appropriate Sudanese size and fitting system.

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