Head and face anthropometric measurements for Saudi Arabian Females

Abdalla Alrashdan, Aisha Alkaff and Shatha Khamis
Industrial Engineering Department
Alfaisal University
Riyadh, Saudi Arabia
aalrshdan@alfaisal.edu, aalkaff@alfaisal.edu, skhamis@alfaisal.edu

Abstract

The study reports face and head anthropometric measurements for Saudi Arabia females' population. Face and head measurement change with time due to environmental and geographical factors. There are many applications relying on this measurements such as face Masks, head masks, glasses, respirators, helmets, clothing, medical and dental fields and plastic surgeries. There hasn't been any study on facial and head measurements on Saudi Arabia, therefore this study is considered as a reference and foundation for Saudi head and face measurements. The data is presented in a standard anthropometric format.

Keywords: Female Anthropometry, Face and Head, Saudi Arabia

1. Introduction

Anthropometry is the human science that deals with collecting and documenting human body measurements. Employing such data during the design stages would produce safer and more usable product (Croney, 1971). Anthropometry in product and workplace design has been applied by many researchers (Hansona et al, 2009; Gite and Yadav, 1989; Motamedzade et al, 2007; Luximon et al, 2016; Wuhrer et al, 2012). Racial background differences and individuals lifestyles contribute largely on population body sizes. Different anthropometric data have been reported for different races residing in different countries. Some examples of anthropometric studies for different countries can be seen in (Ghanbari and Bayat, 2009; Wang et al, 2002; Lewin and Hedegård, 2009; Jahanshahi et al, 2009; Iseri and Arslan, 2009). Head and face anthropometry are utilized in different areas such as equipment design and medicine (Zhuang and Bradtmiller, 2005; Al-jassim et al, 2014).

Industrialization and the improvement of Saudi life style increase the demand of importing industrial and consumer goods. A mismatch between the imported products and Saudi body sizes would likely to occur due to the lack of anthropometric data. Saudi Arabia like other developing countries has limited anthropometric data. There have been some attempts to collect anthropometric data for different Saudi populations (Al-Hazzaa, 1990; Alrashdan et al, 2014) but it is relatively limited. Anthropometric data of human head and face are scarce in the literature and practically non-existent for Saudi Arabia.

The objective of this research is to report face and head anthropometric data of women in Saudi Arabia. The sample contained 150 women. The data is expected to be utilized by designers to design safe, comfortable and highly usable equipment. Moreover, health practitioners can utilize the data to identify face irregularities for such population.

2. METHOD

2.1 Subjects

A total of 150 healthy female subjects were recruited from different age groups. Subjects were college students, government and nongovernment employees and housewives reside in Riyadh, the capital city of Saudi Arabia. It is to be noted that the population of Riyadh come from different areas of the kingdom, whether settled, or

nomads. Five different origins of birth were investigated, namely, North, South, East, West and Center. Each subject is identified according to her origin of birth. When an individual is willing and able to participate, a packet of information was given to her explaining the purposes and the study protocol. The subject then filled out a brief demographic information.

2.2 Measurements

Eighteen anthropometric dimensions for the head and face were collected for all subjects. The features are illustrated in Figure 1. The features are standard in literature and explained in Table 1.

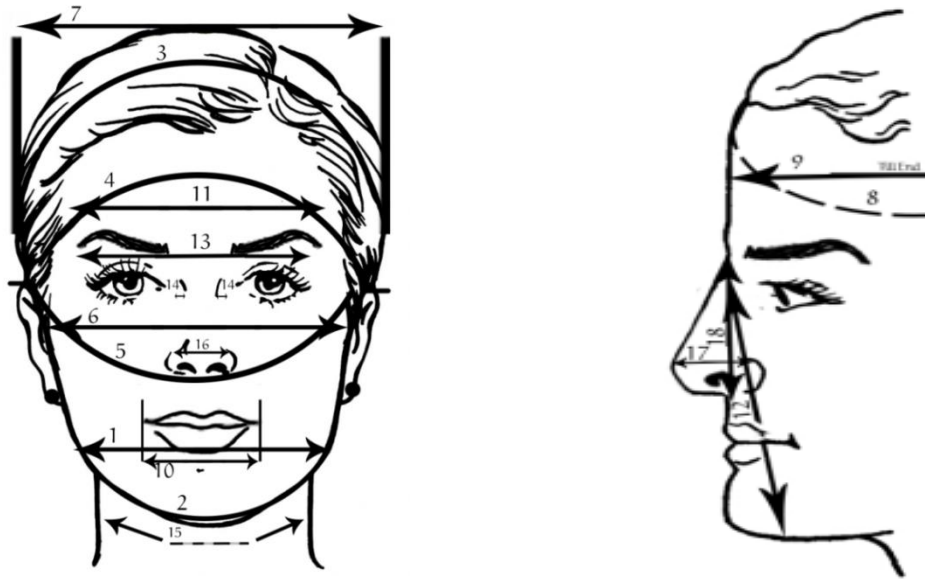

Figure 1: Face and head features

Table 1: Names of the face and head features as referenced in Figure 1

Number	Measurement	Number	Measurement
1	Bigonial Breadth	10	Head Length
2	Bitragion Chin Arc	11	Lip length
3	Bitragion Coronal Arc	12	Menton sillion length
4	Head circumference	13	Maximum frontal breadth
5	Bitragion Frontal Arc	14	Nasal root breadth
6	Bitragion Subnasale Arc	15	Neck Circumference
7	Bizygomatic Breadth	16	Nose breadth
8	Head Breadth	17	Nose protrusion
9	Head circumference	18	Subnasale sellion length

2.3 Equipment

The tools utilized include spreading calipers, sliding calipers, measuring tapes, and marking pens.

2.4 Procedure

Two female experimenters were trained to become accustomed with the measurements' tools and procedure. The subjects were fully informed of the measurement procedure and the purpose of the study. Features are initially identified as skeletal landmarks on the face. The points are marked with a surgical marker or an eye-liner pencil prior to measurement. Finally the measurement are taken using proper tapes or calipers. The subject is seated to decrease postural stress while taken the measurement and make the features more accessible to the experimenter. Measurements were taken to the nearest millimeter and were recorded in centimeters. Normally the investigators worked in a private room to provide the subject with the most preferable environment. All subjects were provided with a non-disclosure agreement to preserve their names.

3. Results

Statistical analysis using Analysis of Variance (ANOVA) was used to identify any significant differences among different populations at α=0.05. Table 2 shows the test results for the Neck Circumference where the p-values of the test are greater than 0.05. Consequently, Neck Circumference is not affected by age or region differences. It was found that no significant difference among age groups or regions for all the 18 face and head measurements under study. Therefore, all collected data at each measurement are grouped and treated as one population. A summary of the anthropometric data is shown in Table 3. This standard representations of the data allows the designers and health practitioners to identify the size range of each measurement.

Table 2: Analysis of Variance for Neck Circumference measurement

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Age	28	335.49	11.982	1.18	0.282
Region	4	44.87	11.219	1.11	0.360
Error	71	719.94	10.140		
Lack-of-Fit	20	236.75	11.838	1.25	0.256
Pure Error	51	483.19	9.474		
Total	103	1141.81			

Table 3: Face and head Anthropometric table

Measurement	Mean	Standard deviation	5th percentile	95th percentile
Neck Circumference	32.63846	3.329488946	27.16145	38.11547
Bitragion Chin Arc	28.925	2.589701411	24.66494	33.18506
Bitragion Coronal Arc	35.50865	29.90450685	-13.6843	84.70157
Bitragion Frontal Arc	26.52404	2.23690342	22.84433	30.20374
Bitragion Subnasale Arc	25.08462	2.832637287	20.42493	29.7443
Head circumference	54.62885	3.934580929	48.15646	61.10123
Menton sillion	10.93835	1.216089737	8.937882	12.93882
Maximum frontal	12.80183	10.81699883	-4.99214	30.59579
Minimum frontal	10.40913	1.342449353	8.200805	12.61746
Lip	4.192019	0.770837606	2.923991	5.460047
Subnasale sellion	5.041346	0.891684313	3.574525	6.508167
Nose protrusion	3.622019	0.565055132	2.692504	4.551535
Nose breadth	4.175673	0.668518896	3.075959	5.275387
Nasal root (right)	0.862596	0.278595304	0.404307	1.320885
Nasal root(left)	0.861471	0.265961212	0.423964	1.298977

Head Length	16.2224	1.718371444	13.39568	19.04912
Head Breadth	13.4012	1.660341467	10.66994	16.13246
Bizygomatic Breadth	12.53923	1.505337562	10.06295	15.01551
Bigonial Breadth	10.2501	1.845433557	7.214358	13.28583

4. Conclusion

Face and head anthropometric measurements for female Saudi population are presented. The data represent a population from 5 different regions of the country with age ranges between 18 to 65 years old. It was found that all face measurements are not affected with age and region differences. The data were combined for all measurements across all ages and regions and presented in a standard anthropometric table. The data was limited due to budget constraints and cultural values that limit number of volunteers. However, it is believed that this work is the first to report face and head measurements for female with this wide age range. The intension is to have a starting point for collecting body sizes especially for females in the country. The data is presented in a standard anthropometric table to assist in designing products that matches Saudi's females face sizes and eliminate any potential hazard or inconvenient as a result of mismatch between their sizes and products' sizes.

References

Al-Hazzaa, M., Anthropometric measurements of Saudi boys aged 6 – 14 years, *Annals of human biology*, vol. 17, pp. 33-40, 1990.

Al-jassim, N., Fathallah, Z., and Abdullah, N., Anthropometric measurements of human face in Basrah, *Basrah Journal of Surgery*, pp. 29-40, 2014.

Alrashdan, A., Alsudairi, L., and Alqaddoumi, A., Anthropometry of Saudi Arabian female college students, *Proceedings of the 2014 Industrial and Systems Engineering Research Conference*, Montreal, Canada, May 31-Jun3, 2014.

Croney, J., *Anthropometrics for designers*, Batsford, London, 1971.

Ghanbari, A., and Bayat, P., Characterization of the head and face in 7- 12-years-old Fars children of Arak (Central Iran): an anthropometric study, *Anthropologischer Anzeiger*, vol. 67, no. 1, pp. 77-81, 2009.

Gite, L., and Yadav, B., Anthropometric survey for agricultural machinery design: An Indian case study, *Applied Ergonomics*, vol. 20, no. 3, pp. 191-196, 1989.

Hanson, L., Sperling, L., Gard, G., Ipsen, S., and Vergara, C., Swedish anthropometrics for product and workplace design, *Applied Ergonomics*, vol. 40, no. 4, pp. 797–806, 2009.

Iseri, A., and Arslan, N., Estimated anthropometry measurements of Turkish adults and effects of age and geographical regions, *International Journal of Industrial Ergonomic*, vol. 39, no.5, pp. 860-865, 2009.

Jahanshahi, M., and Golalipour, M., and Haidari, K., The effect of ethnicity on facial anthropometry in northern Iran, *Singapore Medical Journal*, vol. 49, no.11, pp. 940-943, 2009.

Lewin, T., and Hedegård, B., An Anthropometric Study of Head and Face of Mature Adults in Sweden, *Acta Odontologica Scandinavica*, vol. 28, no. 6, pp. 935-945, 2009.

Luximon, Y., Ball, R., and Chow, E., A design and evaluation tool using 3D head templates, *Computer-Aided Design and Applications*, vol. 13, no. 2, pp. 153-161, 2016.

Motamedzade, M., Choobineh, A., Mououdi, M., and Arghami, S., Ergonomic design of carpet weaving hand tools, *International Journal of Industrial Ergonomics*, vol. 37, no. 7, pp. 581–587, 2007.

Wang, M., Wang, E., and Lin, Y., The anthropometric database for children and young adults in Taiwan, *Applied Ergonomics*, vol. 33, pp. 583-585, 2002.

Wuhrer, S., Chang, S., and Prosenjit, B., Automatically Creating Design Models From 3D Anthropometry Data, *Journal of Computing and Information Science in Engineering*, vol.12, no. 4, 2012.

Zhuang, Z., and Bradtmiller, B., Head-and-face anthropometric survey of U.S. respirator users, *Journal of Occupational and Environmental Hygiene*, vol. 2, no.11, pp.567-576, 2005.

Biographies

Abdalla Alrashdan is an Assistant Professor in Industrial Engineering in the College of Engineering at Alfaisal University. He teaches courses in Ergonomics, Work Design, and Production management. He earned his B.S. in Civil Engineering from Jordan University, Jordan, Master in Engineering Management and PhD from Wichita State University, MS and PhD in Industrial Engineering from Wichita State University in Kansas USA. He has published journal and conference papers. His current research focuses on ergonomics product design and the development of thermal management to Li-Ion batteries using phase change materials. He works as a consultant and production manager at ALL Cell technologies in USA building Li-ion batteries used for electrical cars.

Aisha Alkaff is a senior Industrial Engineering student at Alfaisal University, Kingdom of Saudi Arabia.

Shatha Khamis is a senior Industrial Engineering student at Alfaisal University, Kingdom of Saudi Arabia.