PHOTO-ANTHROPOMETRY OF ADULT EGYPTIAN HAND

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ABSTRACT

Anthropometry is the branch of science dealing with body measurements, its roots dating back since ancient times. It finds its way to many disciplines including medicine, industry, and forensic sciences. Hand anthropometry is an important player in medical diagnosis, manual tools design, and personal identification. Objective: Developing a new technique for Photo-Anthropometry based on hand photos, and to apply this technique on a sample of adult Egyptians. Methodology: Development of a software based on a new technique for Photo-Anthropometry, and testing the software for twenty one hand measurements carried on photos of the right hand of 113 adult Egyptians volunteers (58 males, 55 females) from three different geographical areas (Kafr El-Sheikh, Giza, and Fayoum). Results: The new method is simple, easy, and accurate, as the photo is calibrated to overcome the magnification problem common in photo-anthropometry. The accuracy of the measurements was 0.397%. The new system have a unique feature as it can locate calculated points based on simple landmarks. However the proposed method apply only in co-planner measurements. The mean, standard deviation, and percentiles were calculated for the twenty one hand measurements. In addition, two predictive polynomial equations calculating percentiles of hand length and hand width were developed, as well as sex differences were reported. Conclusion: The new developed method is accurate and easy to use which enable absolute measurements on hand photos.

KEYWORDS: Hand, Anthropometry, Percentiles, Photo, Egypt

INTRODUCTION

Anthropometry have many different definitions, one of the simplest definition "Anthropometry is the measurement of the size and proportions of the human body" (McLorg, 2006). The Britannica defined it as "the systematic collection of the human
"body" (The Editors of Encyclopaedia Britannica, 2019). The German Anatomist Johann Elsholtz publish his work "Anthropometria" on body measurements in 1654 (Contributors, 2019), however body proportions were identified by artists long before.

Peeking to the past, one will find out the Ancient Egyptians, Greeks, and Romans had previously recognized body proportions and it's normal variations. The statue of Seneb sculptured at the time of the old Kingdom reflects Ancient Egyptian awareness of abnormal body proportions (Contributors, Seneb, 2019). Canon of Polykleitos were stated for sculpture proportions based on hand length during the Greek era (Tobin, 1975). Markus Vitruvius Pollio, a Roman architect in his book "De architectura" mentioned different body proportions (Vitruvius, 1521), later Leonardo da Vinci in the Renaissance period redraw the ideal man based on Vitruvius' proportions (Vinci, 1487).

In 1890 Francis Galton discussed the benefits of measurements of mankind and emphasize the importance of quantitative and absolute measurements, as comparing an individual with his peers or with himself at different time may help assessment of health, so anthropometry started to be an applied science in health (Galton, 1890). Anthropometric measurements started to be applied in many applications in different domains including clinical medicine (Kolar, Ferkas, & Munro, 1985), industry (Qutubuddin, Hebbal, & Kumar, 2012) (Ching-yi & Deng-chuan, 2017), architecture (Dempster, 1955), and forensics (Krishan, 2006).

In medicine anthropometry play a key role in diagnosing growth abnormalities, normal growth curves, e.g. for weight and height are used in evaluating child health (Kuczmarski, et al., 2002). Industry make use of anthropometry for manufacturing tools ergonomically (Qutubuddin, Hebbal, & Kumar, 2012). Architecture is one of the first fields recognized the importance of anthropometric measurements even before the term “Anthropometry” was coined (Vitruvius, 1521).

Anthropometry finds its way to forensic sciences since 1882 in which human skeletal remains are used in personal identification, then used in sex (Sangeeta & Kapoor, 2015), race determination, and stature estimation (Krishan, 2006) (Manpreet, et al., 2013).

Anthropometry can be performed directly through set of instruments such as tapes or calipers (Farkas, 1994) or indirectly through two (Ehsanollah, Shiva, & Zadehr, 2013) (Martin & Vigorito, 2012) or three dimensional images (Ashley, Kathryn, Josh, Stefan, & Joel, 2010) or some electrical properties such as bioelectrical impedance for studying body composition (Ward & Müller, 2013).

Direct methods have some limitations including operator-subject measurement as the operator can perform measurements for subject during the meeting time only. Soft tissues deformation due to presser exerted by instruments, landmarks identification are another limitations. (Akbarnejad, Osqueizadeh, Mokhtarinia, & Jafarpisheh, 2017)
The 3D methods are more accurate, more informative but are expensive, non portable as subjects need to go the facilities in which this machine are operating (Yueh-Ling & Mao-Jiun, 2011).

The 2D methods have problems of magnification, perspective error, and also limited to one plane, wherever it have many advantages including storing images for later measurement (Akbarnejad, Osqueizadeh, Mokhtarinia, & Jafarpisheh, 2017), and the 2D images are easier and cheap to be obtained (Yueh-Ling & Mao-Jiun, 2011).

Different approaches are used to reduce magnification error including standardizing subject position and print size (Farkas, 1994), including a scale within the photo, thus measurements can be corrected to represent more accurate values (Hsien & Arnold, 2014).

**AIM OF THE WORK**

Establishing a new measuring technique based on 2D photometry, and preparing a pilot data for the anthropometry of adult Egyptians hand based on the newly developed technique.

**SUBJECTS AND METHODS**

A sample of 113 healthy Egyptian adults volunteers (58 males, 55 females) living in Cairo, Kafr el-Sheikh, and Fayoum governorates, with mean age 41.4±9.5 years have been included in the study.

For each subject a digital photograph for the palmer side of right hand of each volunteer have been taken, the camera was perpendicular to the palmer plan of the hand. The photo included a ping pong ball of 20 mm radius for calibration. A special software “TracerNET” running under windows operating system was used for measurements. Twenty two landmarks (points) were included in the study as listed in table 1.

| Name       | Short Name | Description                  |
|------------|------------|------------------------------|
| RtF1B      | F1B        | Rt Thumb Base                |
| RtF11      | F11        | Rt Thumb 1st Crease          |
| RtF12      | F12        | Rt Thumb 2nd Crease          |
| RtF1T      | F1T        | Rt Thumb Tip                 |
| RtF2B      | F2B        | Rt Index Base                |
| RtF21      | F21        | Rt Index 1st Crease          |
| RtF22      | F22        | Rt Index 2nd Crease          |
| RtF2T      | F2T        | Rt Index Tip                 |
| RtF3B      | F3B        | Rt Middle Base               |
| RtF31      | F31        | Rt Middle 1st Crease         |
| RtF32      | F32        | Rt Middle 2nd Crease         |
| RtF3T      | F3T        | Rt Middle Tip                |
| RtF4B      | F4B        | Rt Ring Base                 |
| RtF4T      | F4T        | Rt Ring Tip                  |
| RtF5B      | F5B        | Rt Little Base               |
| RtF51      | F51        | Rt Little 1st Crease         |
| RtF52      | F52        | Rt Little 2nd Crease         |
| RtF5T      | F5T        | Rt Little Tip                |
| RtWristMC  | WMC        | Rt Wrist Medial Crease       |
| RtWristLC  | WLC        | Rt Wristateral Crease        |
| RtLBP      |            | Rt proximal Lateral border   |
| RtLBD      |            | Rt distal Lateral border     |
| RtMBD      |            | Rt distal Medial border      |

These landmarks were used to define 21 lines listed in table 2. Figure 1 shows both the landmarks and lines.
Table 2 Lines included in the study

| Name  | Short Name | Description               |
|-------|------------|---------------------------|
| RtF1P | F1P        | Rt Thumb Proximal phalanx |
| RtF1M | F1M        | Rt Thumb Middle phalanx   |
| RtF1D | F1D        | Rt Thumb Distal phalanx   |
| RtF2P | F2P        | Rt Index Proximal phalanx |
| RtF2M | F2M        | Rt Index Middle phalanx   |
| RtF2D | F2D        | Rt Index Distal phalanx   |
| RtF3P | F3P        | Rt Middle Proximal phalanx|
| RtF3M | F3M        | Rt Middle Middle phalanx  |
| RtF3D | F3D        | Rt Middle Distal phalanx  |
| RtF4P | F4P        | Rt Ring Proximal phalanx  |
| RtF4M | F4M        | Rt Ring Middle phalanx    |
| RtF4D | F4D        | Rt Ring Distal phalanx    |
| RtF5P | F5P        | Rt Little Proximal phalanx|
| RtF5M | F5M        | Rt Little Middle phalanx  |
| RtF5D | F5D        | Rt Little Distal phalanx  |
| RtF1  | F1L        | Rt Thumb Length           |
| RtF2  | F2L        | Rt Index Length           |
| RtF3  | F3L        | Rt Middle Length          |
| RtF4  | F4L        | Rt Ring Length            |
| RtF5  | F5L        | Rt Little Length          |
| RtWristW | RWW     | Rt Wrist Width           |
| RtHandL | RtL      | Rt Hand Length            |

Figure 1 Using ping pong ball for calibration

The ping pong ball have an extremely important function as its diameter projection in the photo is invariant (constant) under rotation as illustrated in figures 2 and 3.

Figure 2 Non spherical scale have different projection length depending on the relation to the camera plane.

Figure 3 Spherical scale have the same projection regardless of its relation to the camera plane.

Measurements error assessment

To assess the instrumental error of system we measured a known solid object length as shown in the figure 4.

Figure 4 Error assessment with ruler of know length

To assess observational error, 19 measures for 10 hand photos have been measured twice. The error which assessed by square of the difference between each
corresponding measures was calculated as follow

\[ e = \sqrt{\frac{\sum_{1}^{n}(x_1 - x_2)^2}{n}} \]

where \( n \) = number of samples (10), \( x_1 \) the 1st, \( x_2 \) the 2nd measurements

Difference between 1st and 2nd measurements was compared by paired t test. Coefficients of correlation were calculated.

Statistical analysis

Statistical analysis included descriptive statistics, percentiles, paired t test, correlation (Pearson correlation) was done using SPSS ver. 16 and specially developed software.

RESULTS

Instrumental Error

As shown in figure 4, the actual length is 4.00 inches (101.6 mm), the measured length is 101.1964 with total error 0.4036 mm representing 0.00397 of the actual size (0.397%).

Intra-observer error

The results of the paired measurements are shown in table 3 (appendix A). The minimum error was 0.6 mm corresponding to the length of the distal phalanx of the index finger, while the maximum error was 2.36 mm corresponding the hand length. There were no significant difference (assessed by paired t test) among all test variables except for the proximal phalanx length of the ring finger, and hand length and width, the correlation coefficients were positively highly significant for all measurements as shown in table 4.

| Variable | r   | p   | t   | p   |
|----------|-----|-----|-----|-----|
| F2L      | 0.98| 0.00| 0.95| 0.367|
| F2P      | 0.87| 0.001| -0.24| 0.815|
| F2M      | 0.93| 0.00| 1.05| 0.322|
| F2D      | 0.98| 0.00| 0.19| 0.858|
| F3L      | 0.98| 0.00| 0.68| 0.513|
| F3P      | 0.91| 0.00| 1.20| 0.262|
| F3M      | 0.95| 0.00| -0.60| 0.565|
| F3D      | 0.95| 0.00| -0.04| 0.970|
| F4L      | 0.95| 0.00| -1.71| 0.122|
| F4P      | 0.83| 0.003| -2.39| 0.040|
| F4M      | 0.68| 0.032| 1.51| 0.166|
| F4D      | 0.96| 0.00| 0.30| 0.772|
| F5L      | 0.97| 0.00| 0.75| 0.475|
| F5P      | 0.94| 0.00| 0.93| 0.375|
| F5M      | 0.84| 0.003| -0.28| 0.783|
| F5D      | 0.97| 0.00| 0.49| 0.635|
| RWW      | 0.94| 0.00| -0.60| 0.560|
| RtL      | 0.99| 0.00| 2.42| 0.039|
| RHW      | 0.99| 0.00| 4.44| 0.002|

Descriptive statistics for anthropometric measures of the Egyptian Hand

The mean and standard deviation of different measures grouped by gender are listed in table 5.

There were highly significant difference between both sex in all variables except F1P (Thumb Proximal phalanx) as presented in table 6.

The 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles are presented in tables 7 and 8 (appendix B and C) for males and females respectively.

Figures 5, 6, 7, and 8 shows the percentiles of females and males hand length, and width.
Table 5 Descriptive statistics for Hand Measurements by sex

| Measure | Males | | | Females | | |
|---------|-------|------|------|---------|------|------|
|         | Mean  | SD   | Mean  | SD      | Mean | SD   |
| F1L     | 69.96 | 7.59 | 59.87 | 6.68    |       |      |
| F1P     | 15.62 | 4.87 | 14.09 | 3.00    |       |      |
| F1M     | 23.21 | 5.87 | 19.59 | 3.49    |       |      |
| F1D     | 33.38 | 4.75 | 28.33 | 4.61    |       |      |
| F2L     | 75.50 | 8.92 | 67.84 | 6.59    |       |      |
| F2P     | 24.95 | 3.46 | 22.50 | 2.55    |       |      |
| F2M     | 24.08 | 3.26 | 21.69 | 2.36    |       |      |
| F2D     | 26.64 | 4.51 | 23.77 | 3.02    |       |      |
| F3L     | 83.31 | 10.29| 74.81 | 7.35    |       |      |
| F3P     | 28.17 | 4.43 | 25.30 | 3.31    |       |      |
| F3M     | 28.04 | 3.73 | 25.32 | 2.85    |       |      |
| F3D     | 27.22 | 4.51 | 24.33 | 3.31    |       |      |
| F4L     | 76.56 | 10.73| 68.39 | 6.86    |       |      |
| F4P     | 24.84 | 4.01 | 22.17 | 3.11    |       |      |
| F4M     | 25.13 | 3.40 | 22.73 | 2.80    |       |      |
| F4D     | 26.76 | 5.33 | 23.59 | 3.02    |       |      |
| F5L     | 62.47 | 8.59 | 54.36 | 6.45    |       |      |
| F5P     | 20.08 | 3.25 | 17.55 | 2.38    |       |      |
| F5M     | 18.03 | 2.54 | 15.56 | 2.37    |       |      |
| F5D     | 24.55 | 4.70 | 21.44 | 3.07    |       |      |
| RWW     | 64.67 | 6.97 | 56.82 | 4.51    |       |      |
| RLBL    | 41.29 | 7.80 | 35.03 | 5.61    |       |      |
| RMBL    | 76.39 | 9.40 | 66.70 | 8.90    |       |      |
| RL      | 193.70| 17.50| 169.39| 12.78   |       |      |
| RTHW    | 98.34 | 7.84 | 83.32 | 5.96    |       |      |

Table 6 Unpaired t test for testing the extent of sex difference among the variables

| Measure | t    | p    |
|---------|------|------|
| F1P     | 1.933| 0.056|
| F1M     | 3.828| 0.000|
| F1D     | 5.726| 0.000|
| F2L     | 5.229| 0.000|
| F2P     | 4.31 | 0.000|
| F2M     | 4.501| 0.000|
| F2D     | 3.999| 0.000|
| F3L     | 5.06 | 0.000|
| F3M     | 3.914| 0.000|
| F3D     | 4.401| 0.000|
| F4L     | 3.887| 0.000|
| F4P     | 4.859| 0.000|
| F4M     | 4.102| 0.000|
| F4D     | 3.927| 0.000|
| F5L     | 5.685| 0.000|
| F5P     | 4.731| 0.000|
| F5M     | 5.362| 0.000|
| F5D     | 4.206| 0.000|
| RWW     | 7.163| 0.000|
| RLBL    | 4.908| 0.000|
| RMBL    | 5.651| 0.000|
| RL      | 8.447| 0.000|
| RTHW    | 11.484| 0.000|

Figure 5 Right hand length percentile for females
Figure 6 Right hand width percentile for females

Figure 7 Right hand length percentile for males

Figure 8 Right hand width percentile for males
The percentile of the female hand length can be calculated by the following equation:

\[
\text{hand length percentile} = -0.0016859958x^3 + 0.8487333079x^2 - 139.5761816597x + 7538.2713558410
\]

where \(x\) represent the hand length, this polynomial model have an \(R^2\) value=0.9965 which is a very good value. While the female hand width can be calculates by the following equation:

\[
\text{hand width percentile} = -0.005853103546x^3 + 1.370127909123x^2 - 101.072872753908x + 2349.40250672925
\]

where \(x\) represent hand width, and \(R^2 = 0.9942\), which also have a good predictive values.

The equations for males are:

\[
\text{hand length percentile} = -0.000482750090x^3 + 0.268044692774x^2 - 47.229581905292x + 2652.51801666647 \quad (R^2=0.9957)
\]

\[
\text{hand width percentile} = -0.008354061576x^3 + 2.480003479265x^2 - 240.532057641213x + 7662.86856239361 \quad (R^2=0.9988)
\]

As an example suppose a female person have a hand length equal 180 mm, so

\[
\text{predicted percentile} =-0.0016859958(180)^3 + 0.8487333079(180)^2 - 139.5761816597(180) + 7538.2713558410 \approx 81^{\text{st}} \quad \text{percentile}
\]

**DISCUSSION**

Many studies on hand anthropometry were done either direct (Ching-yi & Deng-chuan, 2017), 2D (Akbarnejad, Osqueizadeh, Mokhtarinia, & Jafarpisheh, 2017), and 3D (Yu, Yick, Ng, & Yip, 2013) however, in this study, we introduced a two dimensional calibration method using spherical scale (ping pong ball) which minimize the magnification of the photos. Application of this new techniques of digital imaging in photo-anthropometry proved to be beneficial in getting absolute accurate measurements as the instrumental error after the 2D calibration was less than 0.4 %. The system is semi automated in the sense that after locating the landmarks the linear measurements are automatically calculated and saved to a database for further analysis, an important aspect in case of measurements of a large number of individuals. Another unique feature is the ability of the system to locate a derived points, as in our study the hand width was calculated between Right Mid Point of Medial Border (RtMBMP) and Right Mid Point of Lateral Border (RtLBMP), these points are automatically calculated. The 1st one was the midpoint between WMC (wrist medial crease) and RtMDB, while the 2nd point was the midpoint between RtLBP and RtLBD as shown in figure 9.

Figure 9: Measuring hand width, the two blue solid points are calculated points.
These techniques reduce inter-observer error as this measure depends on 4 simple easy identifiable landmarks.

Another feature is the speed as each hand need less than two minutes to get the 21 measurements, this parameter was not mentioned in all aforementioned studies.

However in spite of the aforementioned advantages there is an important limitation to the developed technique as measurements can be done in one plane only (Farkas, 1994) and our developed technique couldn’t overcome this limitation.

Comparing the hand length percentile of our study with US army (Thomas, 1991) showed that the overall average difference is about -1.95 mm, in which the 5-50 percentiles are bigger in US while 75-95 percentiles are smaller, as shown in Figure 10.

CONCLUSION

In this study we have introduced as new improved method for hand photanthropometry which is easier, faster and more accurate than other photanthropometric methods due to the two dimensional calibration. The scope of this new method is limited to the co-planner measurements (lie in one plane), so measurements such as circumferences can’t be measured.

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Figure 10 Male hand length percentile in US and Egypt
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### Appendix A

#### Table 3 Root square error for a set of hand measurements (1st, and 2nd)

|            | 1st Measurements | 2nd Measurements | Square difference | VSq Error |
|------------|------------------|------------------|-------------------|----------|
|            | Min Max Mean SD  | Min Max Mean SD  | Min Max Mean SD   |          |
| F2L        | 61.51 79.33 72.12 5.61 | 60.65 79.10 71.81 5.55 | 0.0 4.08 1.03 1.1 7 | 1.01     |
| F2P        | 17.50 27.00 22.65 3.00 | 17.80 26.44 22.77 2.40 | 0.0 8.76 1.99 2.8 1 | 1.41     |
| F2M        | 20.17 28.03 23.95 2.50 | 19.95 27.14 23.65 2.16 | 0.0 2.34 0.88 0.8 3 | 0.94     |
| F2D        | 22.23 29.34 25.68 2.26 | 21.94 30.52 25.65 2.65 | 0.0 1.39 0.35 0.4 7 | 0.60     |
| F3L        | 68.77 87.08 79.50 5.81 | 68.86 85.83 79.23 5.55 | 0.0 9.33 1.56 2.8 4 | 1.25     |
| F3P        | 20.44 30.33 25.84 2.75 | 21.49 28.91 25.40 2.64 | 0.0 3.27 1.38 1.2 9 | 1.17     |
| F3M        | 22.21 30.20 27.32 2.38 | 23.01 30.05 27.48 1.95 | 0.0 2.09 0.64 0.6 5 | 0.80     |
| F3D        | 22.77 32.03 26.39 2.72 | 23.10 29.90 26.40 2.15 | 0.0 4.56 0.82 1.4 1 | 0.91     |
| F4L        | 65.50 78.65 72.66 4.07 | 65.95 80.45 73.40 4.34 | 0.0 10.2 6 2.25 4.0 2 | 1.50     |
| F4P        | 18.54 28.24 22.40 2.77 | 18.43 28.28 23.64 2.80 | 0.0 16.0 2 4.00 6.1 5 | 2.00     |
| F4M        | 23.95 25.94 24.81 0.60 | 22.50 26.34 24.36 1.23 | 0.0 2.88 1.00 1.1 0 | 1.00     |
| F4D        | 21.67 30.34 25.58 2.42 | 22.16 30.44 25.52 2.43 | 0.0 2.36 0.48 0.7 2 | 0.69     |
| F5L        | 52.81 70.27 61.26 5.38 | 51.30 69.37 60.95 5.32 | 0.0 5.74 1.92 1.8 3 | 1.39     |
| F5P        | 14.31 25.37 19.64 3.02 | 13.35 23.34 19.34 2.95 | 0.0 4.13 1.00 1.3 2 | 1.00     |
| F5M        | 15.63 19.06 17.44 1.20 | 14.84 19.69 17.51 1.49 | 0.0 1.49 0.61 0.5 6 | 0.78     |
| F5D        | 18.58 30.39 24.33 3.11 | 19.32 28.53 24.19 2.55 | 0.0 3.43 0.77 1.0 6 | 0.88     |
| RW         | 56.64 71.51 65.92 4.66 | 56.59 71.14 66.21 4.56 | 0.0 7.05 2.23 2.2 7 | 1.49     |
| RL         | 172.5 205.2 188.4 10.8 | 170.7 200.8 186.9 10.2 | 0.0 23.1 5 5.56 8.2 8 | 2.36     |
| RTH        | 84.16 104.9 8 96.94 5.96 | 82.30 104.9 2 95.71 6.23 | 0.0 6.96 2.19 2.3 8 | 1.48     |
Appendix B

**Table 7** Percentiles for the anthropometric hand measurements for the Egyptian males

|     | 5   | 10  | 25  | 50  | 75  | 90  | 95  |
|-----|-----|-----|-----|-----|-----|-----|-----|
| F1L | 59.6| 62.2| 66.5| 70.2| 73.6| 79.8| 82.9|
| F1P | 9.0 | 10.6| 12.3| 14.5| 17.6| 23.4| 26.7|
| F1M | 12.3| 15.3| 20.5| 22.7| 26.3| 30.3| 35.9|
| F1D | 25.9| 27.4| 30.1| 33.4| 36.1| 39.0| 40.2|
| F2L | 61.3| 64.4| 69.7| 75.4| 82.1| 87.8| 91.8|
| F2P | 19.3| 20.3| 22.4| 24.4| 27.8| 29.9| 31.0|
| F2M | 19.2| 20.0| 21.1| 24.8| 26.4| 28.0| 29.0|
| F2D | 20.8| 21.2| 23.0| 26.7| 28.8| 33.9| 37.0|
| F3L | 69.1| 71.9| 76.6| 81.8| 90.5| 96.0| 102.2|
| F3P | 21.6| 23.6| 25.5| 27.8| 30.3| 33.0| 34.1|
| F3M | 22.2| 23.1| 25.6| 27.9| 31.1| 32.6| 36.2|
| F3D | 20.5| 21.7| 23.9| 27.3| 30.2| 33.5| 36.6|
| F4L | 62.0| 64.6| 69.2| 75.2| 83.9| 88.7| 94.1|
| F4P | 19.6| 20.8| 22.1| 24.6| 27.2| 29.8| 31.5|
| F4M | 20.4| 20.9| 22.4| 24.9| 28.2| 29.6| 31.8|
| F4D | 19.6| 20.4| 23.5| 25.8| 29.5| 33.9| 39.4|
| F5L | 48.9| 51.5| 57.4| 62.0| 68.2| 73.7| 79.1|
| F5P | 14.6| 15.9| 18.6| 20.2| 22.2| 24.4| 26.0|
| F5M | 14.6| 15.3| 16.5| 18.2| 19.3| 21.7| 24.4|
| F5D | 17.7| 18.6| 21.4| 24.1| 27.1| 31.5| 33.6|
| RWW | 52.1| 56.0| 60.1| 65.9| 70.1| 72.8| 75.2|
| RtLBL | 27.4| 32.2| 37.4| 41.2| 45.9| 51.1| 56.1|
| RtMBL | 65.5| 67.6| 70.8| 75.7| 82.2| 88.8| 96.8|
| RtL | 172.4| 175.9| 183.6| 191.0| 203.9| 215.9| 231.7|
| RtHW | 85.6| 88.6| 93.4| 99.2| 103.7| 109.0| 114.6|
Appendix C

**Table 8** Percentiles for the anthropometric hand measurements for the Egyptian females

|       | 5    | 10   | 25   | 50   | 75   | 90   | 95   |
|-------|------|------|------|------|------|------|------|
| F1L   | 51.3 | 53.3 | 54.7 | 60.0 | 64.3 | 69.5 | 75.7 |
| F1P   | 9.4  | 10.8 | 12.1 | 13.4 | 15.9 | 18.3 | 21.1 |
| F1M   | 12.1 | 16.0 | 18.0 | 19.6 | 21.7 | 23.3 | 26.0 |
| F1D   | 21.6 | 22.1 | 24.5 | 28.8 | 31.7 | 35.5 | 37.6 |
| F2L   | 56.8 | 59.3 | 63.6 | 66.7 | 71.7 | 77.4 | 79.5 |
| F2P   | 18.2 | 19.3 | 20.4 | 22.2 | 24.1 | 26.1 | 27.4 |
| F2M   | 16.3 | 18.1 | 20.2 | 21.2 | 23.1 | 25.0 | 25.6 |
| F2D   | 19.2 | 20.0 | 21.3 | 23.8 | 25.4 | 28.7 | 30.4 |
| F3L   | 62.2 | 65.4 | 68.4 | 73.7 | 80.3 | 83.5 | 87.7 |
| F3P   | 20.1 | 20.7 | 22.8 | 24.8 | 28.1 | 29.7 | 30.8 |
| F3M   | 20.1 | 21.6 | 23.1 | 24.9 | 27.7 | 29.4 | 30.8 |
| F3D   | 18.7 | 20.6 | 22.1 | 24.1 | 25.9 | 28.6 | 30.4 |
| F4L   | 59.0 | 60.3 | 62.1 | 67.0 | 72.7 | 78.3 | 82.4 |
| F4P   | 17.4 | 18.2 | 19.8 | 21.7 | 24.8 | 26.4 | 28.2 |
| F4M   | 18.2 | 19.3 | 20.9 | 22.3 | 24.0 | 26.9 | 29.7 |
| F4D   | 19.2 | 20.1 | 21.0 | 23.4 | 25.9 | 27.4 | 28.8 |
| F5L   | 44.1 | 46.0 | 48.6 | 54.0 | 58.2 | 63.8 | 68.3 |
| F5P   | 13.8 | 14.9 | 15.6 | 17.1 | 19.0 | 21.0 | 22.7 |
| F5M   | 11.6 | 12.2 | 13.7 | 15.4 | 16.8 | 18.5 | 19.7 |
| F5D   | 16.1 | 17.4 | 19.2 | 21.6 | 23.2 | 25.4 | 27.4 |
| RWW   | 48.7 | 50.8 | 54.2 | 56.9 | 59.6 | 62.3 | 63.6 |
| RtLBL | 24.1 | 27.6 | 31.0 | 34.8 | 38.2 | 43.1 | 45.3 |
| RtMBL | 54.2 | 55.8 | 59.4 | 65.7 | 73.3 | 82.3 | 84.4 |
| RtL   | 148.6 | 149.6 | 159.7 | 167.9 | 176.5 | 188.6 | 193.9 |
| RthW  | 74.3 | 76.2 | 78.4 | 81.8 | 88.4 | 91.5 | 96.1 |
الملخص العربي

القياسات الانثروبولوجيا لليد المصرية لدى الكبار من خلال الصور

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الأنثروبومترى هو فرع من العلوم الذي يختص بدراسة قياسات جسم الإنسان، حيث تعود جذوره إلى العصور القديمة ولمجال القياسات الانثروبومترية الكثير من التطبيقات في مجالات من بينها الطب والصناعة والعلوم الجنائية. تلعب القياسات البشرية للبيدين دوراً هاماً في التشخيص الطبي، وتصميم الأدوات اليدوية، وتحديد الهوية الشخصية. صممت هذه الدراسة لتقدم طريقة جديدة لقياسات اليد من خلال صورة فوتوغرافية.

و تعتبر هذه الطبقة الجديدة سهلة ودقيقة، حيث تم معالجة الصورة لتفادي مشكلة التكبير الشائعة في القياس الفوتوغرافي حيث كانت دقة القياسات 0.397٪. وتتميز هذه الطريقة الجديدة بمميزة فريدة حيث يمكن للنظام تحديد نقاط محسمة استناداً إلى نقاط بسيطة. من عيوب النظام أنه يعمل على القياسات في مستوى واحد.

تضمنت الدراسة تطبيق الطريقة الجديدة على 113 متطوع مصري بالغ (58 ذكر و 55 إناث) من ثلاثة مناطق جغرافية (كفر الشيخ، الجيزة، والفيوم). تم إجراء 32 قياسًا للبيدين، وتم تقديم المحكولات المتوية، بالإضافة إلى معادلتين متعددي الحدود لحساب ثماة لطول وعرض اليد، كما تم إلغاء الضوء على اختلاف القياسات بين الحالات من الجنسين ذكورًا و إناثًا.