Anthropometry of the Medan – North Sumatera Populations

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Abstract. This study was conducted on 780 students at a university in Medan, North Sumatra. The taken data is divided into two sub-groups, namely men and women, where the data of 343 men and women as many as 437 people. Taken anthropometry data is standing position, sitting position, hands, feet and body weight. This study presents statistical data in the form of standard deviation, average and percentiles. This research needs to be done because the population of the city of Medan is around 2,497,183 people, and Medan is the third largest city in Indonesia. The objectives this study is to collect the anthropometry data for ergonomics application and design product base on the customer need in Medan territory. Data retrieval is necessary because with this data is expected to be applied in the application of science of ergonomics, work station design, equipment design; tooling makes it convenient in everyday use.

Keywords: Anthropometry; Ergonomic; Body Weight; Medan; University Student

1. Introduction
Anthropometric measurements should be made to the application of ergonomic sciences, anthropometric measurements which can be used in designing tools or equipment so that users convenient in using tools or equipment. In addition, anthropometric measurements can be useful in terms of evaluating the existing work stations over the years, and through the evaluation will be carried out repairs of existing work stations so that workers or users more comfortable in work. Research on anthropometry in the Philippines which involves 1805 people working in 31 companies manufacturing industry, the research can be applied in the design of work stations, safety equipment works, tools, systems and methods of work, furnishings, increased productivity, and user-friendly workspaces [1].

Research in South Thailand conducted on 300 people, the sample measured data on weight, height, and other body dimensions. Then, this study compared the anthropometric data measurement results of anthropometric data in Thailand [2].

Other studies that have been done are anthropometry data measurement against university students in Singapore and Indonesia. This study aims to renew the anthropometric data that exist so far [3].

Anthropometric data samples used to determine the design of the user on the population of an area, so the data is considered important [4].
Related research about anthropometry in Indonesia is also a lot to do with design a specific tool, as well as design work station in the company of roof tiles, anthropometric data were measured based on anthropometric data in Sunda tribe, where the sample is taken as many as 660 samples [5]. In addition, another study conducted in Indonesia is the design tool of agricultural based anthropometric data conducted for Javanese and Madurese [6]. Then other studies, namely regarding the measurement of anthropometric data for the three largest ethnic Indonesia, the Minangkabau, Javanese and Sundanese [7]. Another study conducted in Indonesia is about inconvenience farmers in East Java in using the equipment [8].

So, the anthropometric data was very important for human life everyday in using the equipment to work. As in other studies which suggested that the use of anthropometric data on the comparison of the hand grip for the elderly in Malaysia, from the study cited differences between the age of hand grip strength is there, but this study focused on the elderly [9]. Other studies using anthropometric data like wheel chair design based on data from the population of Malaysia [10]. Then there are also studies that examined the design of work stations used by a multi-user [11]. There are also studies that differentiate the gender of anthropometry in Western Australia [12]. Likewise in South India which measures anthropometric and hamstring [13].

Thus the researchers conducted anthropometric measurements in Medan, considering the third largest city in Indonesia, with a population reaching 2,497,183 people with 265.10 km2 of land area and consist of various ethnic groups. Indonesia alone has about 255,993,674 people. It's the biggest number of people compared with other countries in the world. Therefore, anthropometric measurements are needed.

Through this research is expected the development and application of the science of ergonomics in the design tool, design tools, analysis methods of working, biomechanics measurement, or an increase in productivity in the manufacturing industry. This study also aims to update the existing data have been good in Indonesia, as well as in the city of Medan in particular.

2. Methods

Anthropometric history has identified useful in changing prosperity during the era of industrialization. In the industrialized world, a small market tends to affect superiority and human well-being, because people or farmers are unable to sell their products, it is because they consume their products [17]. Then a few cases it was found in Irish people is higher than the UK, and the average of American are shorter than the Southern Americans region. This is leading to self-sufficiency in producing equipment according to the needs and the suitability of the size of the human body.

In this study, the sample is as much as 760 samples taken from the 2010 to 2016. The sample was taken to distinguish between male and female categories. The anthropometric data measurement with age range 18-20 years. Sample was taken in the Laboratory Ergonomics and Statistical Laboratory at the Department of Industrial Engineering, University of North Sumatra.

Regarding of the sampling, according to the study, samples taken is sufficient to represent a population by Roscoe (1975), Uma Sekaran (2006) provides a common reference for determining the sample size:

- The sample size of more than 30 and less than 500 is appropriate for most research.
- If the sample is split into subsamples (male / female, junior / senior, etc.), the minimum sample size of 30 for each category is appropriate
- In multivariate research (including multiple regression analysis), the sample size should be 10 times greater than the number of variables in the study
- For a simple experimental research with strict control experimentation, research that success is possible with a small sample size between 10 to 20

An anthropometric measurement taken is standing, sitting, body circumference, strength grip, range of hands, chest circumference and weight Data anthropometry measured using a antropometer, meter, goniometric and callipers. Measurements were performed 3 times per the same person to make such
measurements more accurately. After the measurements the data is processed using Microsoft Excel 2007.

3. Research Result

Sample of this research are 780 people consisting of 343 men and 437 women. Average age of men and women is almost the same, where the average age of male is 19.2 years while the average age of women is 18.8 years. The average height of male is 165.93 cm with a standard deviation of 8.1 and average weight is 61.3 kg with a standard deviation of 1.34, while for women, the average height is 157.77 cm with a standard deviation of 7.86 and the average weight is 40.3 kg with a standard deviation of 1.56. For men the highest sample is 195 cm and the lowest is 148.7 cm. For women the highest sample is 178 cm and the lowest is 135 cm, while for men weight, the most severe is reached 100.2 kg and the lightest was 40.3 Kg. Most women's weight was 50.66 kg and the weight of the lightest was 35.7 Kg.

Table 1 shows the anthropometric data measurement male university students, while Table 2 shows the measurement of anthropometric data of women. This study uses 45 dimensional measurements of the human body.

**Table 1. Male Antropometric Measurement (343 people)**

| No | Dimension                     | 5 Percentiles | Mean   | 95 Percentiles | Modus | Standard Deviation |
|----|-------------------------------|---------------|--------|---------------|-------|-------------------|
| 1  | Sitting Upright Height        | 70.24         | 81.38  | 92.52         | 88    | 6.77              |
| 2  | Elbow Lounge Heigth           | 20.03         | 24.82  | 29.61         | 24    | 2.91              |
| 3  | Shoulder Sitting Height       | 55.08         | 61.03  | 66.98         | 61    | 3.62              |
| 4  | Sitting Eye Contact Height    | 62.06         | 75.43  | 88.8          | 73    | 8.13              |
| 5  | Thigh Thickness               | 9.4           | 14.02  | 18.64         | 13    | 2.81              |
| 6  | Polipteal Height              | 37.2          | 43.35  | 49.5          | 41    | 3.74              |
| 7  | Polipteal Bottom              | 40.78         | 46.85  | 52.92         | 46    | 3.69              |
| 8  | Bottom to Knee                | 46.82         | 55.77  | 64.72         | 56    | 5.44              |
| 9  | Hip Width                     | 26.72         | 32.54  | 38.36         | 32.5  | 3.54              |
| 10 | Shoulder Width                | 34.24         | 41.18  | 48.12         | 42    | 4.22              |
| 11 | Elbow Standing Height         | 91.52         | 104.29 | 117.06        | 104   | 7.76              |
| 12 | Under Forearm Length          | 22.23         | 26.66  | 31.09         | 26    | 2.69              |
| 13 | Standing Eye Contact Height   | 142.47        | 154.73 | 166.99        | 156   | 7.45              |
| 14 | Height                        | 152.61        | 165.93 | 179.25        | 168   | 8.1               |
| 15 | High Shoulder Stand           | 117.66        | 132.81 | 147.96        | 141   | 9.21              |
| 16 | Body Thickness                | 12.91         | 18.29  | 23.67         | 19    | 3.27              |
| 17 | Hand Reach                    | 65.37         | 77.64  | 89.91         | 73    | 7.46              |
| 18 | Spanning Hand                 | 154.45        | 169.81 | 185.17        | 173   | 9.34              |
| 19 | Feet Length                   | 21.82         | 24.63  | 27.44         | 25    | 1.71              |
| 20 | Leg Palms Length              | 15.15         | 18.01  | 20.87         | 18    | 1.74              |
| 21 | Leg until Pinkie Length       | 17.57         | 20.74  | 23.91         | 20    | 1.93              |
| 22 | Leg Width                     | 7.65          | 9.59   | 11.53         | 10    | 1.18              |
| 23 | Feet Limbs Width              | 4.24          | 6.05   | 7.86          | 6     | 1.1               |
| 24 | Ankle Heigth                  | 5.56          | 7.7    | 9.84          | 8     | 1.3               |
| No | Dimension                          | 5 Percentiles | Mean   | 95 Percentiles | Modus | Standard Deviation |
|----|------------------------------------|---------------|--------|----------------|-------|--------------------|
| 1  | Sitting Upright Height             | 76.34         | 82.74  | 89.14          | 81    | 3.89               |
| 2  | Elbow Lounge Height               | 19.14         | 24.17  | 29.2           | 23    | 3.06               |
| 3  | Shoulder Sitting Height           | 52.4          | 57.98  | 63.56          | 58    | 3.39               |
| 4  | Sitting Eye Contact Height        | 51.07         | 70     | 88.93          | 71.5  | 11.51              |
| 5  | Thigh Thickness                   | 9.81          | 13.74  | 17.67          | 13.5  | 2.39               |
| 6  | Polipteal Height                  | 35.29         | 42.08  | 48.87          | 40    | 4.13               |
| 7  | Polipteal Bottom                  | 40.43         | 45.48  | 50.53          | 46    | 3.07               |
| 8  | Bottom to Knee                    | 45.02         | 53.84  | 62.66          | 56    | 5.36               |
| 9  | Hip Width                         | 26.66         | 32.25  | 38.44          | 31    | 3.76               |
| 10 | Shoulder Width                    | 32.24         | 38.11  | 43.98          | 36    | 3.57               |
| 11 | Elbow Standing Height             | 90.54         | 99.01  | 107.48         | 97    | 5.15               |
| 12 | Under Forearm Length              | 21.21         | 24.99  | 28.77          | 25    | 2.3                |
| 13 | Standing Eye Contact Height       | 133           | 146.82 | 160.64         | 148.3 | 8.4                |
|   |                  |            |            |            |            |
|---|-----------------|------------|------------|------------|------------|
| 14| Height          | 144.84     | 157.77     | 170.7      | 154.5      | 7.86       |
| 15| High Shoulder Stand | 119.63    | 131.67     | 143.71     | 134        | 7.32       |
| 16| Body Thickness  | 15.08      | 20.74      | 26.4       | 19         | 3.44       |
| 17| Hand Reach      | 61.69      | 72.83      | 83.97      | 67         | 6.77       |
| 18| Spanning Hand   | 147.16     | 159.32     | 171.48     | 157        | 7.39       |
| 19| Feet Length     | 21.15      | 23.45      | 25.75      | 23         | 1.4        |
| 20| Leg Palms Length | 14.37     | 16.89      | 19.41      | 17         | 1.53       |
| 21| Leg until Pinkie Length | 16.37 | 19.23     | 22.09      | 19         | 1.74       |
| 22| Leg Width       | 7.5        | 9.16       | 10.82      | 9          | 1.01       |
| 23| Feet Limbs Width | 4.42      | 5.83       | 7.24       | 6          | 0.86       |
| 24| Ankle Height    | 5.4        | 7.18       | 8.96       | 7          | 1.08       |
| 25| Leg Midsection Height | 3.97   | 5.68       | 7.39       | 5          | 1.04       |
| 26| Horizontal Distance Stalk Ankle | 2.93   | 5.04       | 7.15       | 5          | 1.28       |
| 27| Finger Length 1 | 4.73       | 5.88       | 7.03       | 6          | 0.7        |
| 28| Finger Length 2 | 5.75       | 7.59       | 9.43       | 7.9        | 1.12       |
| 29| Finger Length 3 | 6.47       | 8.44       | 10.41      | 7.5        | 1.2        |
| 30| Finger Length 4 | 5.84       | 7.73       | 9.62       | 7.6        | 1.15       |
| 31| Finger Length 5 | 4.47       | 6.1        | 7.73       | 5.6        | 0.99       |
| 32| Base to Hand    | 6.23       | 8.19       | 10.15      | 9          | 1.19       |
| 33| Finger Width 2,3,4,5 | 5.56 | 6.81       | 8.06       | 7.3        | 0.76       |
| 34| Hand Width      | 7.36       | 8.64       | 9.92       | 8.7        | 0.78       |
| 35| Hand Length     | 7.97       | 17.97      | 27.97      | 17         | 6.08       |
| 36| Diameter Grip   | 2.64       | 4.61       | 6.58       | 4.4        | 1.2        |
| 37| Head Height     | 14.97      | 17.37      | 19.77      | 17.6       | 1.46       |
| 38| Head Width      | 13         | 14.81      | 16.62      | 14         | 1.1        |
| 39| Maximum Diameter from Chin | 21.17   | 23.39      | 25.61      | 24         | 1.35       |
| 40| Chin to Crown Head | 17.9       | 21.65      | 25.4       | 22         | 2.28       |
| 41| Ear to Crown Head | 12.4       | 14.8       | 17.2       | 14         | 1.46       |
| 42| Ear to Back Head | 11.89      | 13.78      | 15.67      | 14         | 1.15       |
| 43| Between two Ears | 11.66      | 13.58      | 15.5       | 14         | 1.17       |
| 44| Eye to Crown Head | 11.48      | 14.9       | 18.32      | 16         | 2.08       |
| 45| Body Weight     | 38.66      | 40.3       | 50.66      | 41         | 1.56       |

4. Discussion
The science of ergonomics growing fast, so is the anthropometric data, that is a resident of a population will change over time, changes can occur with a change in the physical size of the human body, so with that, through this study is expected to be a renewal of the data, so that this data can be used in further research. Research would be better to complement each other. With this research is expected anthropometric data for university students in the city of Medan can be used and become a reference in designing tools or equipment. For comparison, the anthropometric data is different than Indonesia anthropometry data. For the example is height, the 5 percentile for Indonesian height for
male is 157.72 but for Medan is 152.61. While the size of the other dimension is differences for another example on shoulder width for Indonesian anthropometry data using Mean is 31.74 but based on this measurement the dimension is 34.24. Almost the entire data is different compare to Indonesia Anthropometric data. Based on this situation, this data is needed for references and updating the data. The anthropometric data is very useful for many science, not only engineering, but also medical and the other field of research.

5. Conclusion
Anthropometric data is taken into the life of human productivity, so it can be used in working facilities design, equipment design, equipment and increased productivity in the manufacturing industry. Anthropometric data are data taken by the data by region in Indonesia such as Medan, so as to solve the existing problems at present is mainly related to this anthropometry. This can be important, comforting someone works it will be able to increase productivity and raise someone's job economic growth, minimal labour economics around neighbourhood.

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