An Ergonomics Approach of The Prayer Mat Size

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Abstract. Currently, Indonesia does not have a standard size for prayer mats. For this reason, the size of the prayer mat should be designed according to Islamic requirements and laws. This can be done by measuring the human body which is directly related to determining the dimensions of the prayer mat. The length and width of the prayer mat can be determined by knowing the length of the prostration and the width of the shoulders. This research was conducted using an ergonomic approach with anthropometric methods and the cosine formula. This study focuses on male and female adult prayer mats. This research resulted in the length of the prayer mats 1277.12 mm and 1229.1 mm, while the widths of the prayer mats were 805 mm and 744 mm.

Keywords: Prayer mats, Ergonomics, Anthropometry.

1. Introduction

The prayer mat has been used for centuries by millions of Muslims [2]. The function of the prayer mat is to pray. There are prayer mat for individual prayers, and there are prayer mat for congregations [1]. Prayer in language means prayer. Outward prayers are a number of utterances and sayings which start from takbir and end with greetings and fulfill the specified requirements [11]. Allah says in Al-Quran Surat An-Nisa verse 103, “When you pass (congregational) prayers, celebrate Allah’s praises, standing, sitting down, or lying down on your sides; but when you are free from danger, set up regular prayers: for such prayers are enjoined on believers at stated times.

Those who are Muslims are required by Islamic law to use prayer mats for prayer at least five times a day. Including the five obligatory prayers: sunset prayer (Maghrib) night prayer (Isha), Fajr prayer (Fajr), noon prayer (Zuhr), and afternoon prayer (Asr) [2,11]. Each of the five required prayers requires (1) Iquama steps, where the individual who prays initially stands at one end of the prayer mat, (2) Ruku steps, where the individual who prays bends at the waist and (3) Attayyat and Sujud steps, in which the person who is kneeling, performs two or more steps and then returns to a standing position. Every rakah involves touching the forehead of the person who prays twice to the opposite end of the mat [2].

Based on this, the prayer mat is a human need in carrying out the prayer either prayer alone or in congregation. Prayer needs must be designed based on science and technology. So we need to learn more about making prayer mat. This is because adult prayer mat on the market have different sizes (Table 1).

The diversity of the size of the prayer mat, it is necessary to uniform size based on the ergonomic approach. The science that needs to be discussed is related to Anthropometry Data. Anthropometric data which is used based on the activities of prayer activities. There are several studies that discuss the
application of ergonomics in designing a product, including ergonomic pillow design[3], ergonomic floor mats[4], and ergonomically contoured urinal floor mats[5]. So, in this study focuses on the ergonomic size of the prayer mat.

| Table 1. The size of prayer mat [10] |
|-------------------------------------|
| No | Length (cm) | Width (cm) |
|----|-------------|------------|
| 1  | 105         | 55         |
| 2  | 110         | 45         |
| 3  | 118         | 67         |
| 4  | 110         | 68         |
| 5  | 107         | 72         |
| 6  | 107         | 65         |
| 7  | 110         | 60         |
| 8  | 110         | 50         |
| 9  | 120         | -          |
| 10 | 115         | -          |
| 11 | 105         | -          |

2. Method
The methodology used in determining the area of the prayer mat for adult men and women is an ergonomic approach with the anthropometric method and the cosine formula.

2.1. Ergonomics
Ergonomics comes from the Greek word Ergo which means work and Nomos which means rule of law. Ergonomics has various meanings, in Indonesia, it is agreed that ergonomics is a science and its application that seeks to harmonize work and the environment to people or vice versa to archive the highest productivity and efficiency through optimal human utilization [9]. One part of ergonomics is the concept of anthropometry. The concept of Anthropometry The term anthropometry comes from "anthro" which means human and "metri" which means size. Anthropometry is the knowledge that involves measurements of the human body, especially body dimensions. Anthropometry will be widely used as an ergonomic consideration in the design process of products and work systems that will require human interaction.

| Table 2. The body shape and dimensions factors |
|-----------------------------------------------|
| No   | Specific                                      |
|------|-----------------------------------------------|
| 1    | Age                                           |
| 2    | Gender (sex)                                  |
| 3    | Ethnic groups                                 |
| 4    | Body position (posture and body position)     |
| 5    | Clothes                                       |
| 6    | Type of Work                                  |
| 7    | Pregnancy factors in women                    |
| 8    | Physical body defects                         |
Humans generally vary in terms of body shape and dimensions. Several factors affect the size of the human body (Table 2) [8]. This study focuses on 5 factors (1, 2, 3, 4, and 6). Age for adults, gender is distinguished between men and women. Indonesian ethnic community. Body position in a state of standing and Sujud. Type of work performing prayers.

Testing this Anthropometric Data will be possible if the available mean (average) and standard deviations from the normal distribution are available. To calculate the required data size, the Normality Test must be performed, the data uniformity test, and the data sufficiency test and percentile calculation [9]. However, this study does not focus on data normality test, data uniformity test and data adequacy test because it refers to secondary data from previous studies [7]. Therefore, the focus of his research is on the application of the dimensions of the human body which is a critical point in determining the length and width of the prayer mat.

2.2. Stand and Sujud in Prayer

“Guard strictly your (habit of) prayers, especially the middle prayer; and stand before Allah in a devout (frame of mind)” (Al-Baqarah: 238). Rasulullah SAW said: Meaning: "I was ordered to prostrate on seven limbs, namely the forehead, while the hands were on the nose, hands, toes." (Narrated by Imam Bukhari). “O you who believe! Bow down, prostrate yourselves, and adore your Allah; and do good; that you may prosper” (Al-Hajj: 77).

Determines the angle at each joint of the body during prostration. So it is necessary to know the correct way of prostrating based on the Prophet’s hadith and the opinions of the scholars. In general, the scholars have the same agreement when doing prostration. However, there are different parts regarding the position of the buttocks when doing prostration. Opinion (1) Syekh Muhammad Nawawi Banten explained in the Holy Prophet Only that a person who prostrates his buttocks should be higher than the position of the head and shoulders [11]. Meanwhile, the opinion (2) of Sheikh Muhammad ibn Shaleh Al-Uthaimin explained that what is meant when prostration is a stretch between the calf and thigh, and the stretch between the stomach and the thigh is about 90 degrees, but it should not be too much when stretching the calf and thigh. Thigh more than 90 degrees [12]. Responding to these differences of opinion, in this study two observations were made with the calculation of Pythagoras and cosines.

3. Results and Discussion

When someone is praying, the research looks at activities that determine the length and width of the prayer mat. Based on preliminary observations, it can be determined that the length of the prayer mat is determined by Sujud activities. While the width of the prayer mat is determined by the width of the shoulder. So, in this study determine the body dimension data involved in Sujud activities. The data used is based on secondary data from the results of the Indonesian Society Anthropometry Data and its Dimensions (Table 3) [7].

Opinion (2) The length of the prayer mat is determined by several body dimensions as in fig. 1. To determine the length of x and y using the calculation of Pythagorean [12]. Opinion (1) To determine the length of y using the cosine calculation [11]. This is supported by the vector theory of the angular prayer movement at the point of Sujud of 45° [6]. However, if you look at anthropometric data, it will produce a different Sujud position. And will produce a different length of the prayer mat. While the width of the prayer mat is determined by the dimensions of the body in fig. 2. For the length of the arm, the middle value is taken as a form of relaxation due to the individual prayer (Z), while for worship together, the symbol area is taken "E". The size of the prayer mat is based on the percentile (mm) (Table 4).
Table 3. The Indonesian Society Anthropometric Data (mm) [7]

| Symbol | Dimension                                                                 | Man 5th | Woman 5th | Man 95th | Woman 95th | S.D. | Man 50th | Woman 50th | S.D. |
|--------|---------------------------------------------------------------------------|---------|-----------|----------|------------|------|----------|------------|------|
| A      | long footwear                                                             | 165     | 178       | 191      | 8          | 158  | 171      | 184        | 8    |
| B      | Knee Height (popliteal)                                                   | 361     | 403       | 445      | 26         | 337  | 382      | 428        | 28   |
| C      | Distance from the knees (popliteal) to the buttocks                        | 405     | 450       | 495      | 27         | 488  | 537      | 586        | 30   |
| D      | Height in Sitting Position                                                 | 809     | 864       | 919      | 33         | 775  | 834      | 893        | 36   |
| E      | Shoulder Width (bideltoid)                                                | 382     | 424       | 466      | 26         | 342  | 385      | 428        | 26   |
| F      | Shoulder height in a sitting position                                     | 523     | 572       | 621      | 30         | 501  | 550      | 599        | 30   |
| G      | Elbow height in a sitting position                                        | 181     | 231       | 282      | 31         | 175  | 229      | 283        | 33   |

Figure 1. Sujud Position

Table 4. Size of the prayer mat is based on the percentile (mm)

| No | Size                                           | Man 5th | Woman 5th | Man 95th | Woman 95th |
|----|-----------------------------------------------|---------|-----------|----------|------------|
| 1  | Length (Opinion 1)                            | 1186.41 | 1277.12   | 1367.22  | 1057.73    |
|    | lenght (Opinion 2)                           |         |           |          |            |
|    | width (together)                             |         |           |          |            |
|    | width (Individual)                           |         |           |          |            |
| 2  | 1174.76                                      | 1274.75 | 1375.00   | 1120.06  | 1229.10    |
|    | 382                                          | 424     | 466       | 342      | 385        |
| 3  | 724                                          | 765     | 805       | 668      | 706        |
| 4  |                                              |         |           |          |            |
Determination of percentiles to be used as a reference, in determining the length and width of the prayer mat. Determination of the length of the prayer mat percentile. Because the position of prostration in prayer gives a number of concessions [11,12]. While at the width of the prayer mat (together), prayer in the congregation should be straight and close-knit [12]. At the width of the prayer mat (Individual), when prostration keeps the body's hand position [12] (Table 5).

### Table 5. Size of the prayer mat

| Size of the prayer mat | Percentile | Man (mm)  | Woman (mm) |
|------------------------|------------|-----------|------------|
| Length (Opinion 1)     | 50<sup>th</sup> | 1277.12   | 1150.71    |
| Length (Opinion 2)     | 50<sup>th</sup> | 1274.75   | 1229.10    |
| Width (together)       | 95<sup>th</sup> | 466       | 428        |
| Width (Individual)     | 95<sup>th</sup> | 805       | 744        |

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**Figure 2. Stand Position**

**Figure 3. Prayer Mat**
4. Summary
The prayer mat is usually around 1016 mm to 1270 mm long and around 508 mm to 990 inches wide [2]. Thus, in this study concluded the adult male prayer mat with a length of 1277.12 mm and adult female prayer mat 1229.10 mm. this is based on paying attention to people whose height is above the average of adult Indonesian society. With an area it can be seen in Table 5 and Fig. 3. This research has the advantage of comparing the opinions of scholars in determining a prayer mat area needed so that the resulting prayer mat area can facilitate all these differences of opinion. However, the anthropometric data used in this study is 1991 [7] data, this is due to pandemic conditions, so that data collection cannot be done directly in 2020. Further research can apply other aspects of ergonomics on the prayer mat.

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Acknowledgments
We would like to thanks Lembaga Penelitian dan Pengabdian Masyarakat, Institut Teknologi Kalimantan, Balikpapan, to give funding to this research.