

Design and analysis of wudu' (ablution) workstation for elderly in Malaysia

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Abstract. Wudu' (Ablution) workstation is one of the facilities used by most Muslims in all categories. At present, there are numbers of design guidelines for praying facilities but still lacking on wudu' (ablution) area specification especially or elderly. Thus, It is timely to develop an ergonomic wudu' workstation for elderly to perform ablution independently and confidently. This study was conducted to design an ergonomic ablution unit for the Muslim's elderly in Malaysia. An ablution workstation was designed based on elderly anthropometric dimensions and was then analyse using CATIA V5R21 for posture investigation using RULAs. The results of the study has identified significant anthropometric dimensions in designing wudu' (ablution) workstation for elderly people. This study can be considered as preliminary study for the development of an ergonomic ablution design for elderly. This effort will become one of the significant social contributions to our elderly population in developing our nation holistically.

1. Introduction

Malaysia population is facing a high rate of demo-graphic rate as in 2016; the population reached 32 million compared to 31 million in 2015 according to Malaysia Department of Statistic: Population Quick Info. High demographic rate not occurs only in Malaysia but this aging issue actually had become a global problem [1]. Malaysian population is projected to increase by 35% in 2040 but the annual growth rate is projected to decrease to 0.6% due to decrease in fertility rate and active international migration based on Department of Statistic at 2015. Elderly people commonly referred as population having one or more illnesses other than having movement or functional problem [2]. Improvement in health-care services results in existence of active elderly people which prefer to live independently [3], demands development of facilities which able to adapt to their capabilities and abilities also increasing to conduct their daily activity, including praying facilities.

As a Muslim, praying and ablution are considered as part of the daily activity that has to be conducted wherever they are. World Muslim population in the world is estimated to be around 20-25% of total world population. Majority of the Muslim residents is approximately in 40 countries including Malaysia and almost every country has small Muslim population [4]. In Malaysia, Selangor, Kuala Lumpur and Putrajaya themselves already had 645 and 144 mosques and musolla, registered with the government bodies. Prior to obligate five times praying every day, Muslims are required to perform ablution as a cleaning procedure for the Muslim [5]. In Malaysia, praying facilities equipped with



ablution area can be easily found around public places including shopping complex and highway rest area for the Muslim to pray.

Most of the existing praying facilities design guideline developed by some countries focus solely on the appearance of the praying facilities while ignoring proper design of supporting spaces such as toilet and ablution area [4]. In Malaysia, set of Malaysia Standard has been developed as a guideline for the developer and designer to build public facilities which can be accessible by the vulnerable group such as elderly and disabled population to provide design specification such as height of ramp and handrail, slope of ramp and finishing material. Therefore, it is necessary for praying facilities designer to promote an adequate environment for the elderly and disabled, considering their needs, capabilities, abilities and limitations.

Even though ablutions space is considered as one of the important public facilities especially in country with high Muslim population, there are numbers of design guideline for mosque but still lacking in guideline, research or document specifically on ablution area [6]. Most designer will neglect design of supporting area such as toilets and ablution space since most of them emphasized on aesthetic appearance of their design. As elderly population is increasing, their requirement should be taken into design consideration so that they will function with limited assistance from other people. Ergonomic aspect also should be taken into the consideration for safe and low risk environment. In Malaysia, research on anthropometric data is expanding which can be used to design an ergonomic ablution area at mosques for public use. Therefore, this study focused on designing and analysis of wudu' workstation for elderly in Malaysia.

2. Procedure

2.1 Subject

This study had been carried out in Malaysia which covers state of Kuala Lumpur, Selangor, Kelantan and Terengganu who met the following criteria: a) were able to understand or speak basic Bahasa Melayu and English, b) signed informed consent, c) aged between 60 years and above. Ethical approval for the study was obtained from the University of Malaya Medical Centre Ethics Committee. A total of 186 elderly participants involved in the survey.

2.2 Anthropometry Measurements

Anthropometry of the subjects was measured using a standard professional anthropometer (TTM Martin's Human Body Measuring Kit, Mentone Educational Centre, Carnegie, Vic., Australia), a sliding calliper, a weighing scale, a plastic measuring tape and an adjustable chair for sitting postures. The seat could be adjusted to different heights and acted as a reference point for the measurements in the sitting position. The measuring kit consisted of instruments for measurements of distances in straight lines, curves, circumferences, and thickness. The sliding calliper and spreading calliper were used to measure small breadths and depths of body segments. The plastic measuring tape was used to measure body circumferences. An adequate description of the human body may require over 300 dimensions [7], but the scope of this study was limited to measurement of body dimensions that were considered important to design the wudu' workstation design. Thus, 11 body dimensions were selected. All dimensions were as defined in the Malaysian Standard MS ISO 3638:1981: Size designation of clothes-definitions and body measurement procedure (Malaysia, Jabatan Standard, 2005).

2.3 Statistical Analysis

The IBM Statistical Package for Social Science (SPSS) for Windows version 23.0 (IBM SPSS Statistics for Windows Version 23.0, Armonk, NY: IBM Corp) was used in the following statistical analysis. Data was expressed as means \pm standard deviations (SD), and percentiles (5th and 95th) of the above measurements and were calculated for both the male and female subjects. Pearson's correlation coefficients were calculated and used to test the significance of the linear relationship among the variables.

2.4 Ablution Workstation Design Analysis- Rapid Upper Limb Assessment

RULA provides a quick analysis of demands on a person's musculoskeletal system when performing a specific task. It involves assessments on neck and upper limb loading in mainly sedentary tasks (repetitive tasks). The outcome of the analysis presents the exposure of individual workers to risks associated with work-related upper limb disorders. It examines risk factors such as number of movements, static muscle work, force, working posture, and time worked without a break. All these factors combine to provide a final score that ranges from 1(Good) to 7(Worse). In this study, the software used for RULA analysis was CATIA V5R21.

Parameters Used for RULA Analysis

- 1) Posture: Intermittent
- 2) Repeat Frequency: Fewer than 4 times per minute
- 3) Worker's posture:
 - A) Arms are working across midline: No
 - B) Check balance: No
- 4) Load: 0.
- 5) Manikin: Japanese (Asian, closely resembling to Malaysians (Not listed in software)), male, weight 69 kg and stature 159cm approximately.

According to above parameters, a manikin is built under human builder module in CATIA as shown in figure 1, figure 2 and figure 3. There is no load exerted because no lifting required.

3. Results and Discussion

3.1 The important Elderly anthropometric dimensions for wudu design

Table 1. Anthropometric data for elderly in Malaysia (all dimensions in cm)

		Male (N=91)					Female (N=96)				
		Mean	SD	5th	50th	95th	Mean	SD	5th	50th	95th
1	Stature	158.81	7.52	145.39	160.00	169.38	147.88	6.91	135.32	148.00	159.02
2	Shoulder height	132.37	6.09	121.53	133.35	141.94	121.81	5.75	111.64	121.60	129.70
3	Elbow height	100.40	9.74	89.48	98.90	115.10	91.36	5.23	83.00	91.40	99.34
4	Kneecap height	45.51	3.33	40.61	45.55	50.92	44.55	4.97	38.10	44.40	51.58
5	Span	160.02	16.35	135.69	163.05	174.02	148.68	10.87	132.00	150.10	163.90
6	Elbow span	81.96	6.05	69.07	83.05	91.05	73.29	7.47	59.72	74.40	82.30

7	Shoulder breadth	21.08	1.97	18.95	22.05	22.83	22.22	4.88	16.21	24.35	27.09
8	Arm reach forward	78.98	7.09	71.19	78.90	86.73	72.69	4.90	64.08	73.40	79.39
9	Forearm-hand length	43.70	4.13	35.73	44.50	47.92	40.46	5.48	26.02	41.70	45.70
10	Hand length	17.74	1.82	15.30	17.90	19.75	16.66	1.13	15.28	16.70	18.33
11	Foot length	23.83	1.30	21.54	24.00	26.22	22.11	1.33	19.64	22.10	24.30

Table 1 shows the dimensions of anthropometric data of elderly in Malaysia. There are 187 subjects involved in measuring the data which include 91 males and 96 females throughout Malaysia. 11 dimensions are selected which relate to the wudu' workstation out of 93 dimensions that have been taken. Some of the parts are clearly seen that male dominate the data while some parts such as shoulder breadth shows that female is bigger.

3.2 RULA Scores

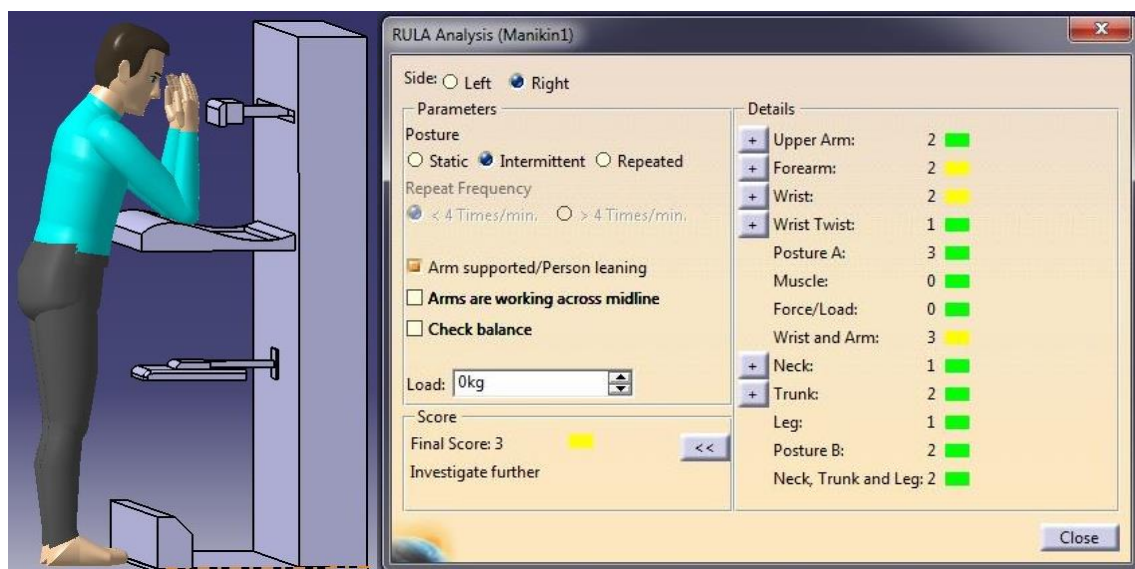


Figure 1. A Model posture attained while face cleaning

Figure 1 shows the posture of the step face cleaning in completing the ablution. The score is 3 and resulted in yellow colour that indicates further investigation is needed and changes may be required. The results show that the posture while performing the wudu' (ablution) is in good condition and further investigation is needed for any changes. The overall analysis indicated that the design is still acceptable but an investigation is needed to improve on the working posture to reduce any discomforts.

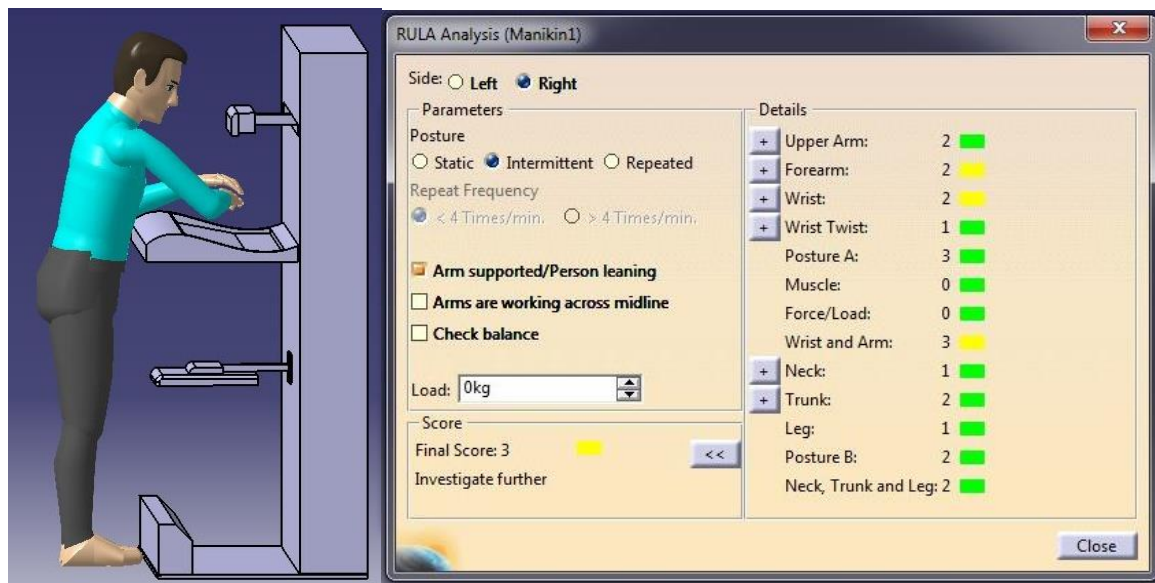


Figure 2. A Model posture attained while hands cleaning

Figure 2 presents the step for hands cleaning. The posture scores the same value, 3 and resulted in yellow colour. The posture will not cause any hazardous and there is no need for immediate investigations and changes. However, the results indicated that further investigation is needed to improve the posture and reduce difficulties for elderly to perform their ablution. The significant body parts that need to be improved are neck, trunk and leg. The results highlighted that the design of the workstation might be the reason of discomfort postures and the anthropometry dimensions should be taken into thorough consideration in planning to improve the design.

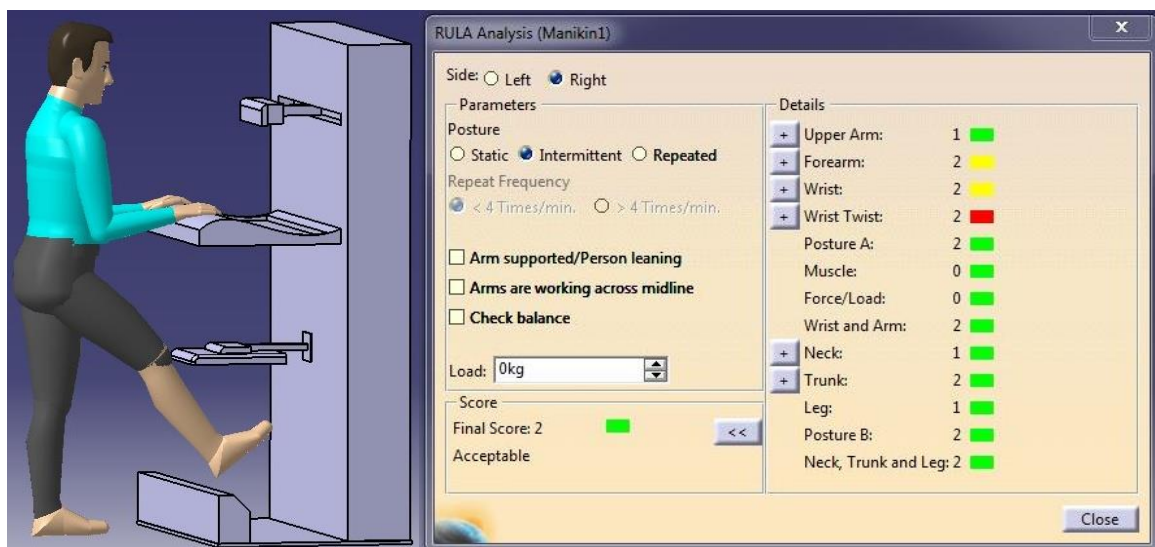


Figure 3. A Model posture attained while foot cleaning

Figure 3 illustrates the posture for foot cleaning in ablution. It scores 2 which resulted in green colour. The green colour indicates that the posture is acceptable. It can be maintained or repeated for long periods of time and no changes are required for improvements. This posture will avoid any discomfort of elderly in order for them to perform their ablution.

4. Conclusion

The results highlighted that the significant factors in designing wudu' (ablution) workstation are the right postures within the limitation and ability of the elderly pertinent to anthropometric dimensions. The significant body parts that related to the design of wudu' (ablution) that need to be improved are forearms, neck, trunk and leg. Therefore, it is hope that this effort will become one of the significant social contributions in developing our nation holistically.

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