Wudu' (Ablution) Workstation Design Analysis for Wheelchair User in Malaysia

Siti Zawiah Md Dawal
Department of Mechanical Engineering,
Faculty of Engineering, University of Malaya,
Kuala Lumpur, Malaysia
sitizawiahmd@um.edu.my

Nurul Izzah Abd Rahman
Department of Mechanical Engineering,
Faculty of Engineering, University of Malaya,
Kuala Lumpur, Malaysia
izzahrahman31@gmail.com

Atikah Aman
Department of Mechanical Engineering,
Faculty of Engineering, University of Malaya,
Kuala Lumpur, Malaysia
atikah_aman@yahoo.com

Abstract

How do wheel chair user perform their wudu' (ablution) especially in the mosque? This question is seldom asked even in the design, planning and development of the mosque. In Malaysia, set of Malaysian 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 disabled and elderly population. Existence of the Malaysian Standard 1331:2003 Code of Practice for Access of Disabled Persons Outside Buildings and Malaysian Standard MS 1184:2002, Code of Practice on Access for Disabled Persons to Public Buildings, design specification is provided for the disabled to ensure the public facilities is accessible by all population. However, none of standard developed solely mentioned on ablution workstation in detail for disabled populations. Therefore, the objective of this study is to analyze wudu' (ablution) workstation design for disabled population in Malaysia especially for wheel chair user. RULA analysis was carried out using CATIA V5R19 tested on available wudu' (ablution) design. The results highlighted that the significant factors in designing wudu' (ablution) workstation are the right postures within the limitation and ability of the disabled people especially the wheel chair user and pertinent anthropometric dimensions.

Keywords

Ablution, design, mosque, workstation, wheelchair user.

1. Introduction

Disability is defined as a physical or mental impairment experienced by an individual that substantially limits one or more major life activities (Fitzpatrick, 2013). A physical impairment is any disability which limits the

physical function of limbs or fine or gross motor ability. The Persons with Disabilities Act (2008) defines persons with disabilities as "Those who have long term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society." (Department of Social Welfare Malaysia, 2008). Malaysia has a total population of 29.9 million in May, 2014 and the number of persons with disabilities who are registered with the Malaysian Social Welfare Department is 301,346 (Department of Social Welfare Malaysia, 2013). 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 (Mynatt and Rogers, 2001). 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 (Mokhtar, 2003). 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 (Mynatt and Rogers, 2001). 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 (Besari et al, 2009). 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 disabled population is increasing, their requirement should be taken into design consideration so that they will function with limited assistance from other people. Therefore, this study focused on the design analysis on wudu' (ablution) workstation for wheelchair user in the mosque.

2. Procedure

2.1 Subjects

Data was collected from 25 male and 7 female wheelchair user, who met the following criteria: a) were able to understand or speak basic Bahasa Melayu and English, b) signed informed consent. Ethical approval for the study was obtained from the University of Malaya Medical Center Ethics Committee.

2.2 Measurements of Anthropometry

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 caliper, 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 caliper 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 (Pheasant, 1986), but the scope of this study was limited to measurement of body dimensions that were considered important to design the wudu' workstation design. Thus, 13 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 21.0, Armonk, NY: IBM Corp) was used in the following statistical analysis. Data was expressed as means ± 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)

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 V5R19 tested on available wudu' (ablution) design : industrial paten number MYIPO 14-01339-0101.

2.4.1 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
    B) Check balance
4) Load: 0.
5) Manikin: Taiwanese (Asian, closely resembling to Malaysians (Not listed in software)), male, weight 65 kg and sitting height 78 cm approximately.

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

3. Results and Discussion

3.1 The anthropometric data for the wheelchair user

Table 2: Anthropometric data for Malaysian wheelchair user (all dimensions in cm, body weight in kg).

No.	Dimension	Male				Female			
		Mean	SD	5th Percentile	95th Percentile	Mean	SD	5th Percentile	95th Percentile
1	Weight	65.6	19.6	41.6	97.4	62.0	15.1	44.0	79.0
2	Sitting height	77.9	6.0	66.1	86.2	74.4	10.4	62.3	88.6
3	Eye height, sitting	67.1	6.5	57.7	77.4	61.3	6.8	51.5	68.5
4	Shoulder height, sitting	52.2	6.8	43.8	60.7	47.8	7.1	38.4	56.5
5	Waist height, sitting	16.7	3.1	12.5	20.5	NA	NA	NA	NA
6	Thigh clearance	12.0	3.5	6.4	17.2	12.7	3.6	7.7	16.2
7	Sitting elbow height	19.9	4.9	14.0	24.4	17.0	4.5	11.0	21.9
8	Arm Reach upward	115.6	22.5	79.5	157.4	103.9	6.7	94.8	111.0
9	Knee height sitting	48.8	4.3	41.7	57.6	51.4	8.0	43.1	62.4
10	Popliteal height	39.4	4.2	34.2	46.9	40.9	9.5	31.4	54.0
11	Arm reach forward	80.7	4.8	71.7	86.4	75.1	4.7	70.2	81.1
12	Forearm-hand length	30.3	9.3	22.5	45.6	25.2	2.5	21.8	28.0
13	Elbow fingertip length	43.6	4.0	38.3	48.7	41.4	2.6	39.3	44.5

3.2 RULA scores

3.2.1 RULA Analysis for hands cleaning

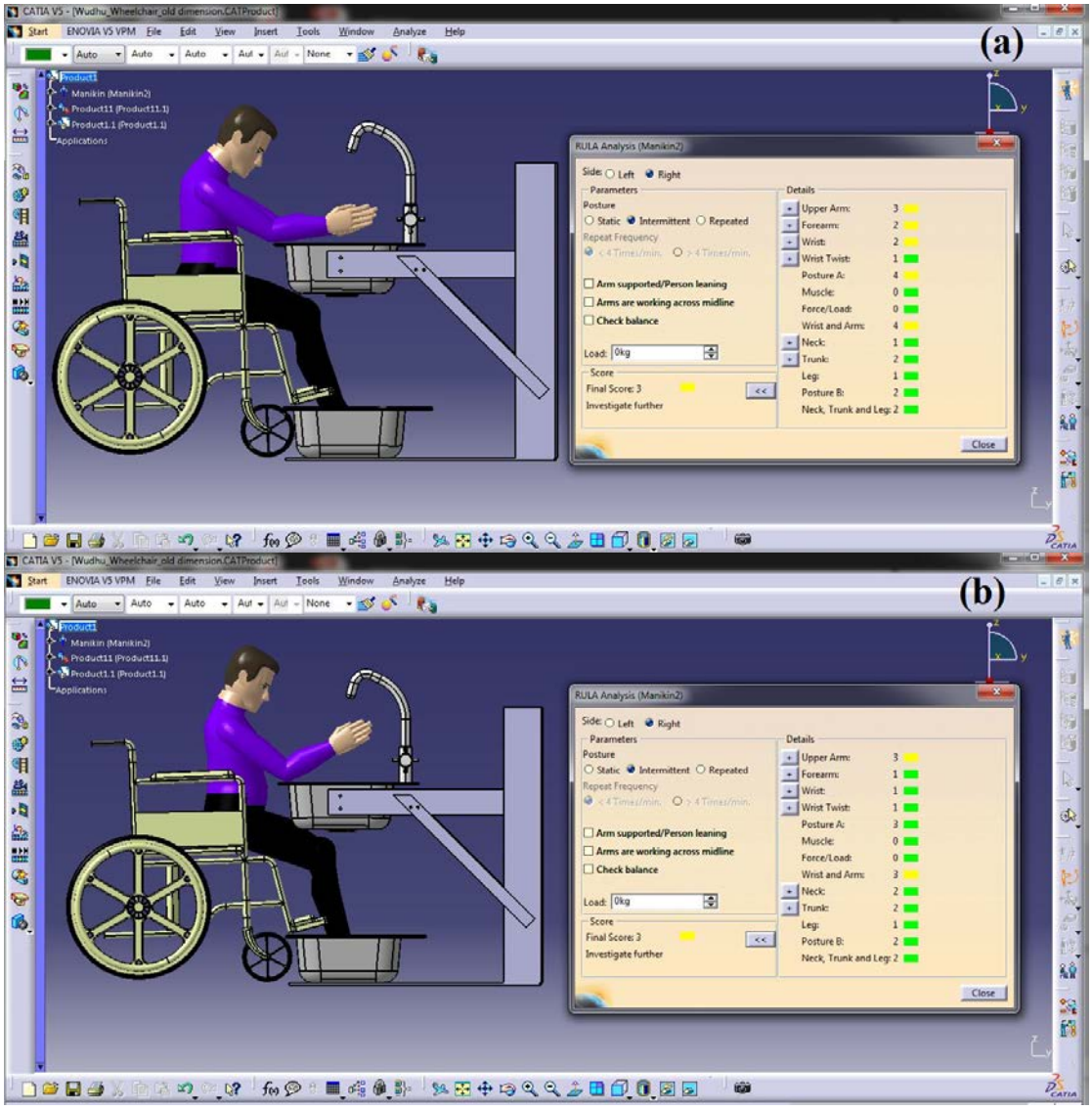

Figure 1 (a) and (b): Modelled postures attained while hands cleaning

Both postures (a) and (b) were used to perform wudu' (ablution) to complete hands cleaning. Both postures score 3 and resulting the yellow color that indicates that 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. Comfortable wudu' workstation is necessary to ensure the high degree of safety and accessibility for wheelchair user to facilitate the facility is acceptable (Dawal et al., 2016).

3.2.2 RULA Analysis for washing face

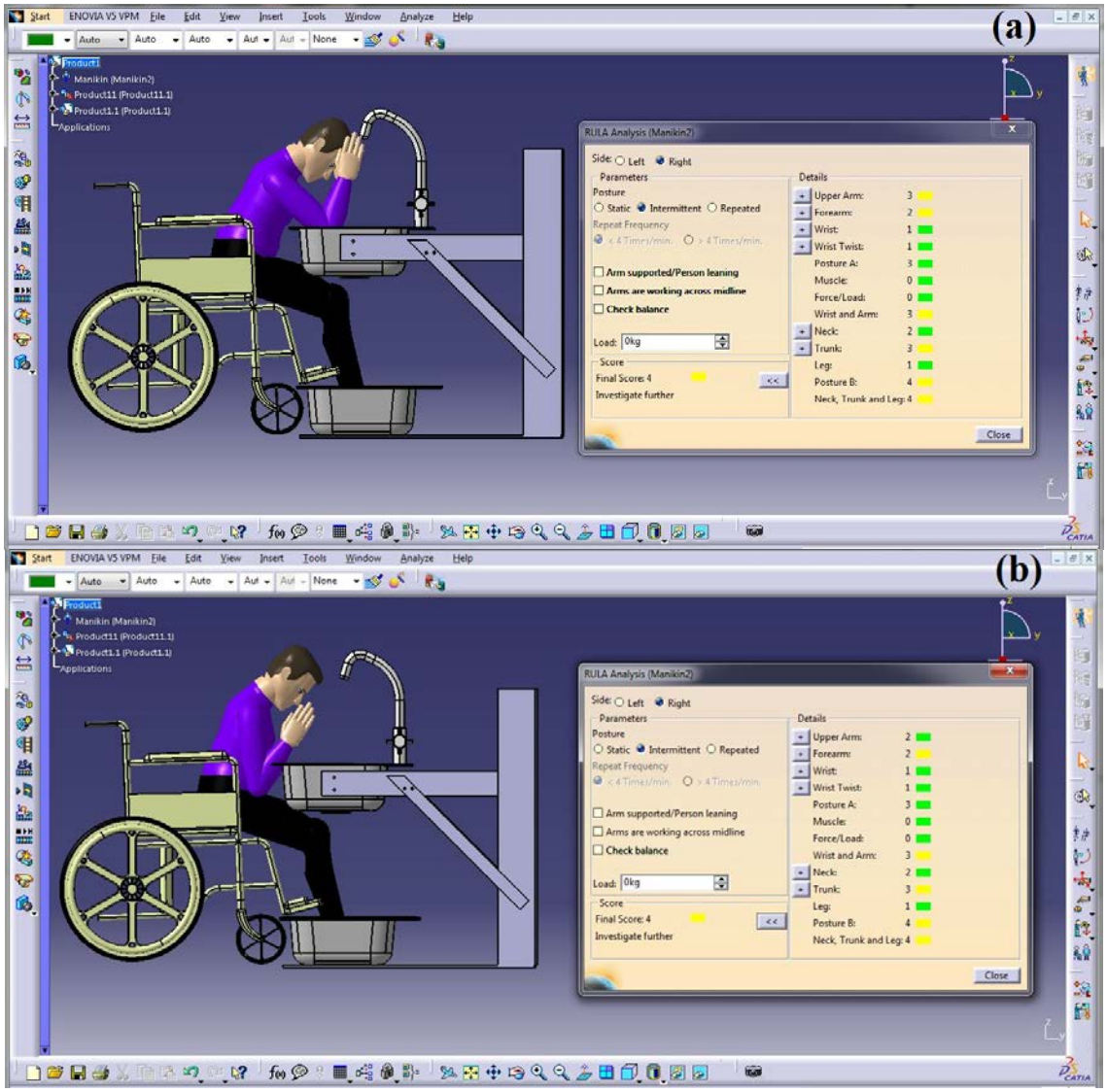

Figure 2 (a) and (b): Modelled postures attained while washing face

Posture (a) and (b) present the step for face cleaning. Both postures score the same value, 4 and resulted in yellow color. The postures 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 disable people to perform their ablution. The significant body parts that need to be improved are arms, 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.

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 disabled people especially the wheel chair user and pertinent anthropometric dimensions. The significant body parts that related to the design of wudu' (ablution) that need to be improved are arms, 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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Biography

Siti Zawiah Md Dawal is currently an Associate Professor, Coordinator of Master Engineering (Manufacturing) Programme at Faculty of Engineering and Head of ORKID Research Group (Design and Development for Disbaled and Elderly) at University of Malaya. She has published journal, international and national conference papers in the discipline of Ergonomics, Manufacturing System and Education. Dr Siti Zawiah has completed research on High Impact project with UM-MOSTI on Advanced manufacturing system for automotive industries and SME. She has carried out consultations with Standard Malaysia (SM), Board of Engineers Malaysia (BEM), Malaysian Palm Oil Board Malaysia (MPOB) and Proton Sdn Bhd Malaysia. Her research interests include Ergonomics design for disabled and elderly, Industrial Ergonomics and Advanced Manufacturing System. She is a member of Human Factor and Ergonomics Society Malaysia, BEM and MySET.

Nurul Izzah Abd Rahman is currently a PhD candidate of University Malaya under Department of Mechanical Engineering. Ms. Izzah holds a Bachelor of Manufacturing Engineering and Master of Engineering Science from University of Malaya. She is a Board Engineers Malaysia member over 6 years. She is also a member of ORKID Research Group which conducts researches on design and development for elderly and disabled people. Previously she works as a tutor who taught undergraduate students subjects such as Ergonomics, Thermodynamics and other subjects under Manufacturing field. Her current PhD study focuses more on the elderly and transportation field.

Atikah Aman is currently a Master's Degree student in Manufacturing Engineering at University of Malaya. Previously, she completed her Bachelor's Degree in Manufacturing Engineering from Faculty of Engineering, University of Malaya. She had started doing research in Ergonomics when she was working on her final year project about "Design an Individual Ergonomic Workstation for Autism Children in Their Learning Environment". Now she is one of the research assistant at Mechanical Engineering Department and focusing on the research in ergonomics for wudu' (ablution) workstation.