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Evaluation of adopted postures and the hardest part of the domestic laundry task

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Abstract

People experiencing difficulty when performing activities of daily living increases sharply as age increases, especially above 85 years (Wiener et al, 1990). As such an individual is no longer able to maintain an independent lifestyle (Lamton and Brody, 1969). Doing laundry is an essential part of any household and as such is defined within the instrumental activities of daily living (IADL) (Lamton and Brody, 1969). This study aims to use ergonomics tools from industry that identify task injury or strain risks; to assess a laundry task, in order to investigate the validity of using such a tool in a domestic environment. This study uses an ethnographical study to evaluate the postures adopted using three ergonomics techniques; Rapid Entire Body Assessment (REBA); Rapid Upper limb Assessment (RULA) and Postural Loading on Upper Body Assessment (LUBA). After dividing the task into five sub-tasks: gathering; sorting and pre-treatment; washing machine preparation; drying and folding clothes; a paper survey (60 respondents, 24 male, 36 female, 22-90 years) identified the perceived hardest part was the drying clothes sub-task, which requires physical effort (81% agreed) and is complex to perform (67% agreed). This study found that laundry did not pose a high risk of injury as the postures adopted during laundry were of short duration and repeated infrequently. Initial findings show an agreement with the survey with drying clothes sub-task scoring 8 (highest) in the REBA (indicating high risk). Whilst the study found that the ergonomics assessment tools were not sufficient on their own to analyse the domestic task, they did identify the hardest task through posture analysis. The study proposes that an ergonomics assessment method developed specifically for domestic tasks could have the potential to identify injury risks and hazards in the home and could be of use as a self-assessment tool for the elderly.

Keywords: Instrumental activities of Daily Living (IADL), Ergonomics, REBA, RULA, LUBA, laundry, fatigue

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Introduction

The integration of physical, social and economic wellbeing of our life determines our quality of life. However people will often experience illness or injury when they attempt tasks that are beyond their physical capability limits. As people get older these limits change and everyday tasks that previously did not cause pain or injury now may do so. Our lifestyle and the way we work dramatically affects our bodies; reducing our tolerance to stresses, illnesses and injuries especially as we get older. Activities which are essential to live independently, so called Activities of Daily Living (ADL); refer to those activities requiring the movement of the body in and around the home, such as bathing, dressing, homemaking, toileting, transferring, continence, and feeding (Wiener *et al*, 1990, MedicineNet.com, Nordenskiold, 1994). Lamton and Brody have presented another term IADL, which stands for "Instrumental Activities of daily Living" (Lamton and Brody, 1969) which is a progression of life functions essential for everybody to live an independent lifestyle. It includes handling personal finances, doing house work, using the telephone, and taking medicines (Wiener *et al*, 1990). Whilst younger people (below 40yrs) may have problems performing some ADL, the prevalence rate is significantly higher in the elderly (Wiener *et al*, 1990). The prevalence in people experiencing difficulty performing ADL increases sharply as age increases, especially for a person aged 85 and above (Rivlin *et al*, 1998). In addition evidence suggests that people adopting different postures in everyday activities and adopted poor postures can cause strain and lead to back pain (NHS Foundation Trust, 2011).

Ergonomics plays a vital role in our daily life, affecting both the working environment and the non-working (domestic) environment (Aksoy *et al*, 1977). It is fundamental to generating "tolerable" working conditions that do not pose known danger to human life or health (Kroemer *et al*, 1994). Therefore, researchers and practitioners aim to identify and alleviate those risks and stresses which produce adverse effects on a person's health (Tayyari and Smith, 2003). In ergonomics practice there are many tools used to evaluate the nature of tasks either safe or hazardous (AIHA Ergonomic Committee, 2011), this study focuses on three assessment tools, table 1 shows a brief explanation of each one. Each tool is used to assess the different postures adopted during a task and make recommendations to reduce injury or strain risk, this can be by adapting the environment or changing the postures used to complete a task (e.g. squatting to pick up a box). Previous literature has focused on work environments, such as agriculture, furniture and construction industries, in which guidelines were developed to encourage people to adopting stooping, squatting or kneeling postures to reduce the strain risk (Health Council of the Netherlands, 2011). However, little work has been focused on adopting these methods for everyday tasks.

This study aims to use an ethnographical study of a person doing laundry in his home to investigate the validity of using ergonomics assessment tools; REBA, RULA and LUBA, to assess the postures and nature of the domestic laundry task.

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Table 1 shows ergonomics assessment tools and their functions

Assessment Technique	Function	Exposure factors	Sources
RULA	Upper body and limb assessment	Posture, load/force and movement	(McAtamney and Corlett, 1993)
REBA	Entire body assessment for dynamic tasks	Posture, load/force, movement and others	(Hignett and McAtamney, 2000)
LUBA	Assessment of postural loading on the upper body and limb	Posture	(Kee and Karwowski, 2001)

Method

This ethnographical study, which was approved by the Ethical Committee of the University of Sheffield (Sheffield, UK), uses industrial ergonomics assessment methods REBA, RULA and LUBA to evaluate the postures adopted (e.g. stooping) during domestic laundry tasks. The laundry task has been divided into five sub-tasks: gathering; sorting and pre-treatment; washing machine preparation; drying and folding clothes. Figure 1 shows the typical sub-tasks involved in laundry and how they feed into one another.

A previous paper based survey by the authors (Zaheer *et al*, 2014) has been used to ascertain the hardest part of doing laundry and gathered information on perceived hardness, physical demand and complexity of different sub-tasks involved. The survey (60 respondents, 24 male, 36 female, age range: 22-90 years) identified the perceived hardest part was during the drying clothes sub-task, with results that it requires physical effort (81%) and is complex to perform (67%). Subjective scales are also used to record subjects' physical demand required, complexity of the task, perceived discomfort and fatigue level during laundry task.

The task was set up within the home environment of the subject, who was then asked to carry out the laundry in the way that they normally would. Two cameras were deployed to record the different postures adopted by the subject, along with a stop watch to record the duration of each sub-task. Prior to the task commencing the subject was shown a written questionnaire, detailing the laundry task divided into sub tasks. The questionnaire was similar to the one carried out previously (Zaheer *et al*, 2014) and in this case the subject was asked to not complete the questionnaire until after they had completed the task. The questionnaire included subjective scales to rate each of the sub-tasks. These are shown in figure 2.

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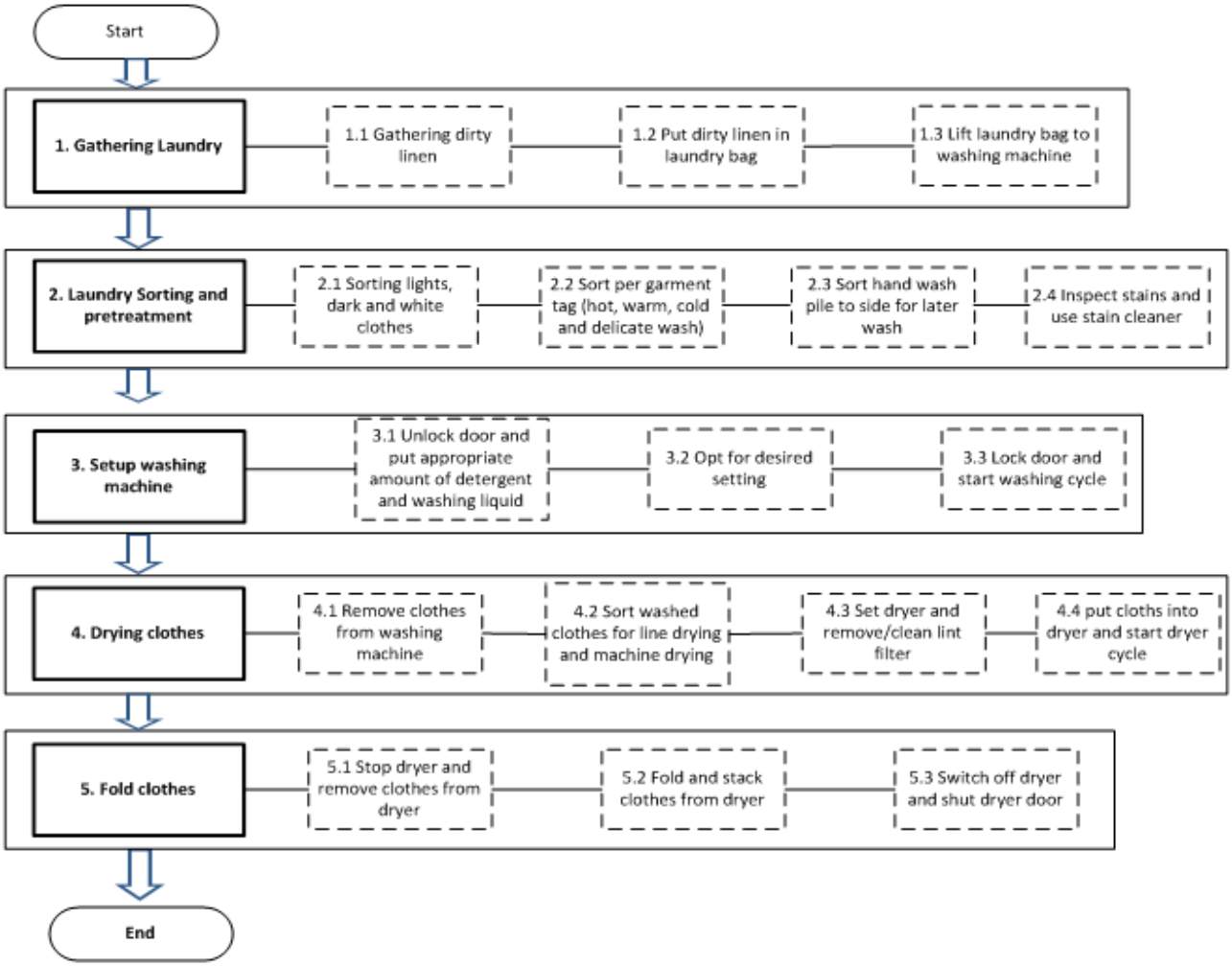

Figure 1 shows the typical sub-tasks involved in laundry and how they feed into one another

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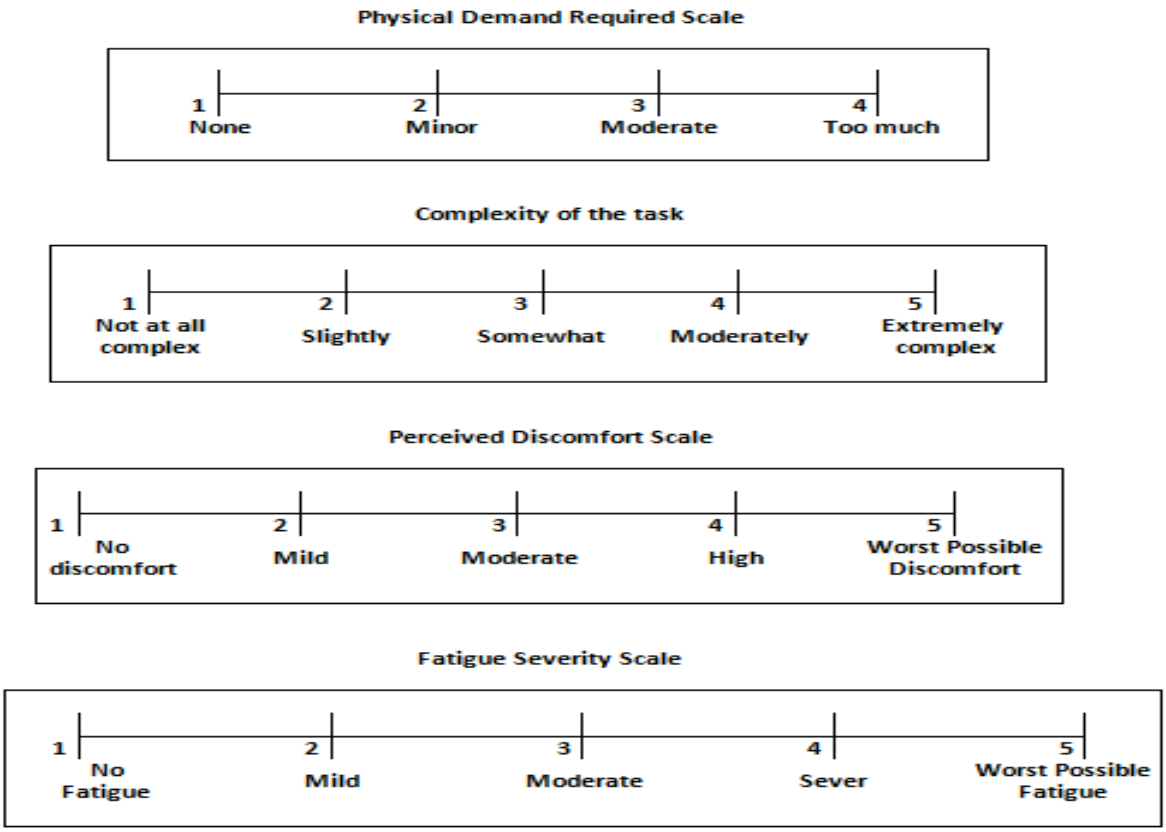

Figure 2 shows the subjective scales used in the study

Observations

The subject pushes a clothes bin out of the laundry room and gathers dirty clothes from different rooms of the house, going up and down stairs to do this. During the gathering process the subject bends at the waist and often reaches to the floor to grab dirty clothes. Once full the dirty laundry bins are emptied onto the floor in the laundry room. The subject bent at the waist and reached into the bin to grab pieces of loose laundry, then untangled them and threw into separate piles on the floor, sorting according to colours (light, dark and white) and washing requirements (hot, warm, cold and delicate). The sorted clothes were then loaded into the washing machine, with the subject then adding washing powder, closing the door and setting the cycle dial. Once the wash cycle was complete the subject emptied the machine. This involved bending at the waist and reaching into the washer drum to pull out the clean, wet laundry. It was then transferred to the dryer for a further cycle. Dried and clean laundry is emptied from dryer, put in the clean laundry bin and transferred to the folding area where it is sorted again into separate piles. Folding the clothing was time consuming because it involved sorting each household member's into a specific pile or bin. Sorted clothes were then ready for distribution to the household. Table 2 shows snapshots of the subject performing laundry.

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Table 2 shows snapshots of the subject performing laundry

(a) Gathering laundry

(b) Sorting and pre-treatment

(c) Washing machine preparation

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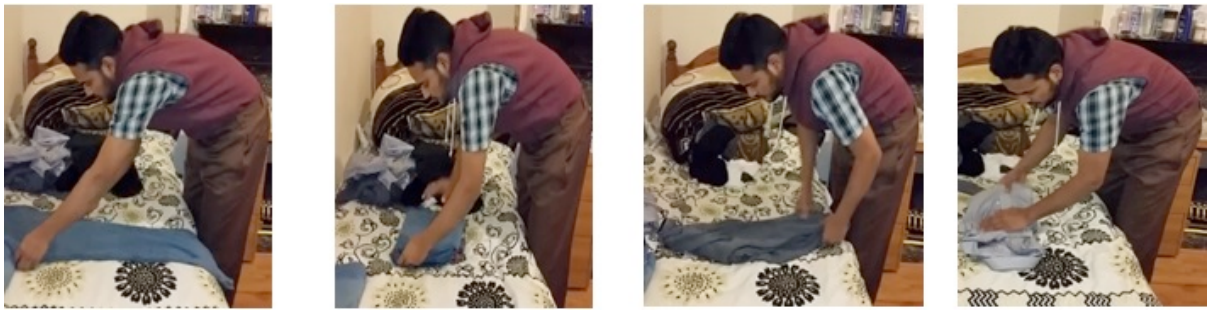
(d) Drying clothes



(e) Folding clothes

Results and discussion

The subject, person specific data was recorded in table 3, often adopted a stooping posture whilst performing the laundry task, which was then analysed using the ergonomics assessment methods REBA, RULA and LUBA according to their guidelines. The physical demand required, complexity of task, perceived discomfort and fatigue are measured by using subjective scales.

Table 4 shows the five sub-tasks involved in laundry as well as REBA, RULA and LUBA scores for each one. Table 5 shows duration, physical demand required, complexity of task, perceived discomfort and fatigue during laundry task.

Table 3 shows the subjects characteristics and anthropometrics.

Variables to measure	Subject adopted stooping posture

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Age	33
Gender	Male
Height (cm)	173
Weight(kg)	74
Lifestyle	Active

Table 4 shows the Ergonomic Analysis of performing the laundry task

	REBA Score					RULA Score				LUBA Postural load Score			
	1	2-3	4-7	8-10	11+	1-2	3-4	5-6	6+	1-5	5-10	10-15	15+
Gathering Laundry			4				3				7		
Laundry Sorting and Pre-treatment		3					3			5			
Setup washing machine			4				4				7		
Drying Clothes				8				5			8		
Folding Clothes			6					5			7		
Average			**5**				**4**				**7**		

Findings show that the doing laundry is considered as a short duration task (washing time excluded). It required an average of 2minutes 5secs to complete each sub-task (see table 5). The longest and shortest duration sub-tasks are drying and gathering clothes respectively. Average REBA, RULA and LUBA scores for the laundry task overall are shown in table 4, they suggest that domestic laundry is a medium risk task, having postural load of 7. This suggests the need for further investigation about the postures adopted because deviation of the posture from the neutral position when completing a task can result is significant stress on the body (Adams). The average perceived discomfort, fatigue and physical demand required for the laundry task is moderate and the complexity was considered somewhat complex.

Table 5 shows the subjective scale results for performing the laundry task

Sub-Task	Duration (sec)	Physical Demand Required	Complexity of Task	Perceived discomfort	Fatigue severity

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Gathering Laundry	90	Minor	Slightly	Mild	Mild
Laundry Sorting and Pre-treatment	125	Minor	Somewhat	Mild	Moderate
Setup washing machine	135	Minor	Slightly	Moderate	Mild
Drying Clothes	144	Moderate	Somewhat	High	Severe
Folding Clothes	129	Moderate	Somewhat	Moderate	Severe
Average	125	Moderate	Somewhat	Moderate	Moderate

The sub-task drying clothes was given the highest REBA score of 8 (indicating high risk), the RULA score of 5 (indicating moderate risk) and LUBA postural load score of 7 (indicating action is required). The difference in REBA and RULA scores is due to the targeted body parts of the body the assessments cover. REBA and RULA scores for sub-tasks drying and folding clothes indicate the urgency for further investigation and suggest that some changes are necessary. Similarly, LUBA scores for the drying clothes sub-task indicates the highest postural load of 8 (see table 4) seen during the task, this is in agreement with the highest perceived discomfort recorded. LUBA scores suggest further action is required to reduce the postural load demanded by the task. This is supported by further observations where other extreme non-neutral (stooped and bending) postures are adopted during the drying and folding sub-tasks, where they were held for a short period of time and repeated infrequently. This is reflected in the severe level of fatigue and high to moderate level of perceived discomfort responses for both tasks.

According to the research done by Fathallah, and Janowitz in 2004, extreme prolong stooped postures have been strongly associated with low back disorders (LBD) and onset for musculoskeletal disorders (MSDs) (Fathallah and Janowitz, 2004). Therefore, adopting neutral postures and sustained natural curves of our back and neck will enable us to perform daily activities effectively and helps reduce the stress placed on our back. In this study the adopted postures only last for a short period of the time and are repeated infrequently so did not pose high risk of injury. However, a person were to engage in other tasks (such as kitchen activities, ironing, hovering, polishing/ dusting, bed making, dressing, shaving, cleaning teeth, bathing, showering, washing hair, cleaning the bath, shopping, driving, gardening) and maintain this posture for a long duration then it could trigger more cause for concern which leads to high susceptibility of getting back injury or lower back disorders (LBD).

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Limitations

The limitations of the study are as follows:

1. This study only uses one domestic task, laundry, to analyse potential methods. More tasks may be required to generalize the results.

2. Only one subject is used in this ethnographic study. The results may vary with different subjects.

3. The study uses subjective measurements and assumed that subject answered honestly.

4. A goniometer is not used for measuring the postural angles due to the nature of the ethnographic study attempting to record natural domestic behaviour.

Conclusion

This study showed that the domestic laundry task is not easy to perform. During the laundry task, the subject adopted many non-neutral postures which are low to medium risk level on REBA and RULA scores. In particular the ergonomics tools highlighted that within the overall task, there is a sub-task, drying clothes, which scored, 8 in the REBA (indicating high risk) and therefore needed more consideration when performed. This result agreed with the previous paper based survey, where the drying clothes sub-task was identified. Showing that ergonomics assessment methods could potentially be used to assess ADL and IADL to identify particular tasks or sub-tasks that cause risk to individuals. Being able to identify these tasks that are potentially the hardest to perform and as such the first risk when it comes to losing independence could give insight into individual behaviour and the changes that can happen with age.

Whilst the study found that the ergonomics assessment tools were not sufficient on their own to analyse the domestic task, they did identify the hardest task through the posture analysis, and as such show the potential for such ergonomics tools to be adopted in domestic settings. Laundry did not pose a high risk of injury as the postures adopted during the task were of short duration and repeated infrequently. However, doing laundry combined with other IADL tasks that involve similar postures could trigger more cause for concern.

It is further concluded that similar assessment methods developed specifically for domestic tasks could have the potential to identify injury risks and hazards in the home and could be of use as a self-assessment tool for the elderly. Further study with more subjects and different tasks is also required for generalizing the results and thus generating recommended guidelines for good posture whilst completing domestic tasks.

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