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ABSTRACT

Malaysia is expected to become an aged society by year 2020, hence there is a need to prolong the independency of its senior citizens by improving their residential environment. This thesis aimed to increase elderly independency and their quality of life by ergonomic means to let them live independently as long as possible.

The main research question is; what is the role of ergonomics in enhancing comfort perception for improving residential built environment for the Malaysian elderly population? Besides this main research question, there are four sub-research questions in this study namely; what is the present state of living among elderly population in Malaysia, which ergonomic factors are affecting task performance of elderly population in their homes, what are the significant factors for enhancing comfort perception among elderly person when they perform their tasks, and what are the recommendations for ergonomic interventions that could enhance comfort perception for improving residential built environment for the elderly population.

From these research questions some construct descriptions were identified. They are elderly population, ergonomics, enhanced comfort perception, and improved residential built environment. From these constructs four research objectives were structured. They are; to understand the present state of living among elderly population in Malaysia, to identify significant ergonomic factors that affecting task performance of elderly population in their homes, to determine significant anthropometric dimensions that could enhanced comfort perception among elderly person when performing their task in the kitchen, and to develop anthropometric workstation design model that could enhance comfort perception for elderly in the kitchen. The main hypothesis was ‘Comfort Perception improved (when) Postural Measurement and Physiological Limitation matched with acceptable range during task performance’.

Chapter 1 is the introduction of the thesis. It consists of background study, issues relating to elderly in Malaysia, problem statements, research questions, research objectives, theoretical framework, inquiry strategy, expected findings, scope and limitation, significance of study, expected contribution and explains the organization of the thesis. Chapter 2 presents the literature review on ergonomics, enhance elderly comfort perception, task performance and improving residential built environment. Chapter 3 presents the method used, the subjects, apparatus and type of data. The eagle table research framework provides explicit information regarding the whole methodology of this study. This includes general survey, elderly critical task, major data acquisition, and validating elderly comfort perception. Chapter 4 explains the result of the study includes selection of subjects, elderly demography, results from the survey. It also presents the result of affecting factors against activity of frying such as postural assessment, physiology, anthropometry, kitchen environment and kitchen triangle distance. Chapter 5 explains the prototype fabrication and testing, setting-up the experiment, results of postural assessment and Rapid Entire Body Assessment (REBA), formulation to predict custom stove height and discussion on experiment. Chapter 6 explains ergonomic design criteria, proposed ergonomics design model, discussed on guidelines and challenges in elderly research. Chapter 7 summarizes the output and knowledge contribution of the study. This includes the key findings, limitation of the research and major contribution. Finally suggests what could be done for future work.

There are 30 subjects taking part in this study. They are aged between 60 to 83 years with the mean of age at 67.1 year. From the survey, frying was identified as most important and most tiring task. It was then selected to be the case study. Three environmental parameters obtained from the study were temperature (26.0°C), light (800 lux) and relative humidity (70.0%RH). Based on the findings ten kitchen triangle distances were exceeded 792cm (26’) of the National Kitchen and Bath Association (NKBA) guidelines. Volume of Oxygen (VO_2)

was used to measure physiological limitation. Based on the results, severity of five minutes frying task for Malaysian elderly could be classified as “Light Work”. However, eight elderly were found having higher volume of oxygen consumption. The anthropometry measurements were applied to estimate frying task envelope. The elbow height and elbow-thumb-tip length were used with the equation to predict individual stove height. Postural measurements were applied to evaluate armpit angle and elbow angle whilst performing frying task. It proved that many elderly having the wrong stove height that could cause fatigue. REBA score was done twice; observation on actual frying task in elderly’s kitchen (90% at medium risk) and observation on frying task using the adjustable table-top with their preferable height (0.07% at low risk and 99.93% safe). It proved by improving the elderly comfort perception could improve the frying task and increased their quality of life. Cornell body parts diagram was used with questionnaire to evaluate strain, pain and fatigue among the elderly upon frying. It was found upper arm, shoulder, neck and upper back, and lower back rated at ‘very fatigue’.

Results from this study shows that the most significant comfort perception factor was the stove height. It has relationships with anthropometry, task performance, strain and fatigue, physiological limitation and postural measurement. An adjustable table-top was designed and fabricated to test and validate the equations for setting individual stove height based on his/her anthropometry. It was found that the elderly preferable stove height were within the range of what was calculated by the equation. Therefore the equation could be used to predict individual stove height.

In conclusion, the increase in the aging population in Malaysia is inevitable. The aged population has its own unique problems and will generate new challenges and demands to designers, engineers and ergonomists. We will all age and we later on become independent and require the services for the aged at some point in time.

ABSTRAK

Malaysia dijangka akan menjadi negara tua pada tahun 2020, oleh itu terdapat keperluan untuk memanjangkan keupayaan berdikari di kalangan warga tua dengan meningkatkan kualiti persekitaran kediaman mereka. Tesis ini bertujuan untuk meningkatkan keupayaan berdikari di kalangan warga tua dan memperbaiki kualiti hidup mereka dengan pendekatan ergonomik untuk membolehkan mereka hidup berdikari selama mungkin.

Persoalan utama kajian adalah; apakah peranan ergonomik dalam meningkatkan persepsi keselesaan untuk meningkatkan persekitaran binaan bangunan bagi penduduk warga tua di Malaysia? Di samping persoalan utama kajian, terdapat empat sub-persoalan kajian dalam kajian ini iaitu; apakah taraf kehidupan semasa di kalangan penduduk warga tua di Malaysia, apakah faktor ergonomik yang boleh menjejaskan prestasi tugas penduduk warga tua di rumah mereka, apakah faktor-faktor yang penting bagi meningkatkan persepsi keselesaan di kalangan warga tua apabila mereka melaksanakan tugas-tugas harian, dan apakah cadangan pendekatan ergonomik yang boleh meningkatkan persepsi keselesaan untuk menambah baik persekitaran binaan kediaman untuk mereka.

Daripada soalan-soalan penyelidikan, beberapa penerangan konstruktif telah dikenal pasti. Ia adalah penduduk warga tua, ergonomik, meningkatkan persepsi keselesaan, dan memperbaiki persekitaran binaan kediaman. Dari situ, empat objektif kajian telah dibina. Objektif tersebut adalah; untuk memahami taraf hidup semasa di kalangan penduduk warga tua di Malaysia, untuk mengenal pasti faktor-faktor penting ergonomik yang menjejaskan prestasi tugas penduduk warga tua di rumah mereka, untuk menentukan dimensi utama antropometri yang boleh mempertingkatkan persepsi keselesaan di kalangan warga tua apabila melaksanakan tugas mereka di dapur, dan untuk membangunkan reka bentuk mejakerja berpandukan model

antropometri yang boleh meningkatkan persepsi keselesaan di kalangan mereka ketika bekerja di dapur.

Hipotesis utama dalam kajian ini ialah; Persepsi Keselesaan meningkat (apabila) pengukuran postur dan had fisiologi sepadan dengan julat yang boleh diterima ketika melaksanakan tugas.

Bab 1 merupakan pengenalan tesis. Ia terdiri daripada kajian latar belakang, isu-isu yang berkaitan dengan warga tua di Malaysia, pernyataan masalah, soalan kajian, objektif kajian, kerangka teori, strategi inkuiri, penemuan yang dijangkakan, skop dan had, kepentingan kajian, jangkaan sumbangan dan menerangkan organisasi tesis. Bab 2 membentangkan kesusasteraan tentang ergonomik, meningkatkan persepsi keselesaan warga tua, prestasi tugas dan menambah baik persekitaran binaan kediaman. Bab 3 membentangkan kaedah yang digunakan, peserta kajian, alat dan jenis data. 'Eagle table research framework' menyediakan maklumat jelas mengenai keseluruhan metodologi kajian ini. Ia termasuk kajian umum, tugas kritikal warga tua, pemerolehan data utama, dan mengesahkan persepsi keselesaan warga tua. Bab 4 menerangkan hasil kajian ini termasuk pemilihan peserta kajian dan demografi warga tua. Ia juga membentangkan hasil daripada faktor-faktor yang memberi kesan terhadap aktiviti menggoreng seperti penilaian postur, fisiologi, antropometri, persekitaran dapur dan jarak segitiga dapur. Bab 5 menjelaskan fabrikasi prototaip dan ujian, mengadakan ujian, keputusan penilaian postur dan REBA, penggunaan formula untuk meramalkan ketinggian dapur dan perbincangan mengenai eksperimen. Bab 6 menerangkan kriteria reka bentuk ergonomik, cadangan reka bentuk model ergonomik, membincangkan garis panduan dan cabaran dalam penyelidikan. Bab 7 adalah ringkasan sumbangan kepada ilmu pengetahuan. Ini termasuk penemuan penting, had penyelidikan dan sumbangan utama. Akhirnya mencadangkan apa yang boleh dilakukan untuk kerja-kerja akan datang. Seramait 30 orang warga tua telah mengambil bahagian dalam kajian ini. Mereka berusia antara 60 hingga 83 tahun dengan min umur pada 67.1 tahun.

Daripada kajian itu, menggoreng telah dikenalpasti sebagai tugas yang paling penting dan yang paling memenatkan. Ia kemudian dipilih menjadi kajian kes. Tiga parameter persekitaran yang diperoleh daripada kajian ini ialah suhu (26.0 ° C), cahaya (800 lux) dan kelembapan (70.0% RH). Berdasarkan dapatan jarak sepuluh segitiga dapur telah melebihi 792 sm (26') berbanding garis panduan yang dikeluarkan oleh NKBA.

Bagi mengukur had fisiologi warga tua ketika memasak, kandungan oksigen (VO_2) dalam pernafasan digunakan. Berpandukan keputusan kajian, tahap keterukan beban kerja untuk melaksanakan tugas menggoreng selama 5 minit di kalangan warga tua Malaysia boleh diklasifikasikan sebagai “Tugas Ringan”. Namun terdapat 8 orang warga tua yang mengambil kadar oksigen yang tinggi berbanding dengan yang lain.

Pengukuran antropometri telah digunakan untuk menganggar saiz ruang kerja ketika menggoreng. Ketinggian siku dan panjang siku ke hujung jari digunakan dengan ‘equation’ untuk meramalkan ketinggian dapur individu. Ukuran postur telah digunakan untuk menilai sudut ketiak dan sudut siku semasa menggoreng. Ia membuktikan bahawa ramai warga tua mempunyai ketinggian dapur yang salah di mana ia boleh meningkatkan tahap keletihan.

Skor REBA dilakukan sebanyak dua kali; iaitu pemerhatian sebenar ketika tugas menggoreng di dapur asal (90% berisiko sederhana) dan pemerhatian ketika tugas menggoreng menggunakan meja bolehlaras dengan ketinggian mereka (0.07% risiko terendah dan 99.93% memasak dengan tahap selamat). Ia terbukti dengan meningkatkan persepsi keselesaan warga tua boleh meningkatkan tugas menggoreng dan peningkatan kualiti hidup mereka. Rajah bahagian tubuh Cornell digunakan bersama soal selidik untuk menilai ketegangan, sakit dan keletihan di kalangan warga tua ketika menggoreng. Adalah didapati lengan, bahu, leher dan bahagian atas belakang dan bawah belakang dinilai sebagai 'sangat meletihkan’. Hasil daripada kajian ini menunjukkan bahawa faktor persepsi keselesaan yang paling penting ialah

ketinggian dapur. Ia mempunyai hubungan dengan antropometri, prestasi kerja, tekanan dan keletihan, had fisiologi dan pengukuran postur tubuh.

Satu meja bolehlaras telah direkabentuk dan dibina untuk menguji dan mengesahkan ‘equation’ penetapan keselesaan ketinggian dapur individu berdasarkan antropometri mereka. Adalah didapati bahawa keselesaan ketinggian dapur yang dipilih berada dalam julat yang sama dengan yang dikira menggunakan ‘equation’. Oleh itu ‘equation’ ini boleh digunakan untuk meramal ketinggian dapur individu.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

NOMENCLATURE

α	Cronbach alpha
bpm	beat per minute
°C	Temperature in Celsius
°F	Temperature in Fahrenheit
Fc	Footcandles
K	Kelvin
Lux	Unit of luminance (lux)
n	Sample size

LIST OF EQUATIONS

Equation 1	General equation to measuring the stove table-top height
Equation 2	Measuring stove table-top height when the angle is 20°
Equation 3	Measuring stove table-top height when the angle is 15°
Equation 4	Measuring stove table-top height when the angle is 10°
Equation 5	Measuring stove table-top height when the angle is 5°

LIST OF ABBRIVIATIONS

AARP	American Association of Retired Person
ADL	Activities of Daily Living
ASHRAE	American Society of Heating and Refrigerating Engineers
BADL	Basic Activities of Daily Living
CAD	Computer Aided Design
DHM	Digital Human Models
DVT	Digital Video Tape
EKG	Electrocardiogram (ECG)
HDD	Hard Disk Drivers
IADL	Instrumental Activities of Daily Living
IEA	International Ergonomics Association
NASA	National Aeronautics and Space Administration of America
NKBA	National Kitchen & Bath Association
O_2	Oxygen
OCD	Occupational Cervicobrachial Disorder
REBA	Rapid Entire Body Assessment
RH	Relative Humidity
RULA	Rapid Upper Limb Assessment
ULD	Upper Limb Disorder
VO_2	Volume of Oxygen
WRMSD	Work Related Musculoskeletal Disorder