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Original Article

A Physiological Study of the Elderly Whilst Frying

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Abstract

Background: The objective of this study was to determine the Heart Rate and Oxygen Consumption of the elderly whilst frying.

Methodology: In 2010, a total of 31 subjects (11 males and 20 females) from Sg. Merab, Selangor were participated in this study. They were aged between 60 to 83 years with a mean age of 67.06 years. They were asked to perform five minutes frying task and data were measured and recorded before and after performing the task. The variables investigated in this study were EKG to obtain heart rate readings and an Oxygen Gas Sensor to measure oxygen consumption. Collected data was statistically analysed.

Results: There was a 66.13% increase in oxygen consumption and 15.20% increment of heart rate after performing the task.

Conclusions: The high oxygen consumption and increasing heart rate show that frying could be an exhaustive or fatiguing task for the elderly.

Keywords: Ageing, Task performance, BADL and IADL, Independency, Heart rate, Oxygen consumption

Introduction

In Malaysia, an individual aged 60 years and over is categorised as an elderly person. This age threshold is adopted from the United Nation (UN) tariff and may differ from one country to another. Regardless of the definition, it is bounded by the ageing process. Physiology, psychology and pathology are three common changes in the ageing process. This includes some restricted movements of the legs, slowing down of directive functions, loss of alertness, loss of memory and reduced awareness. The normal effects of age are accomplished with varying frequency and to a varying extent by characteristic illness and infirmities (1).

Activities of Daily Living (ADLs) have been classified into two domains: Basic ADLs (BADLs) involved fewer complexes, implicitly learned activities, such as bathing, dressing, and eating (2). Meanwhile, instrumental ADLs (IADLs) involved more cognitively demanding tasks, such as managing money or medication (3). Functional impairment has frequently been assessed in self-report or caregiver report in these domains (4). Task performance is closely related to the physiological capabilities of an individual. As the elderly are susceptible to breakdown of functional impairments, their daily task performance is affected as the age increases.

There are two types of living category among the elderly. The elderly residing at the old folks home are categorised as *dependent living*. Many of them do

not actively perform IADL compared to those staying at their own houses. This may due to physical and cognitive abilities and safety regulations. They probably perform certain BADL since the meals are served and their garments are cleaned and dried by caregivers working at the premise. The cleanliness of the premise is also taken care of by the management. Other activities are planned for them and monitored. The second category is called *independent living*. This type of elderly performs BADL and IADL on their own. Most of them basically reside in their own homes and living in a community. They perform many tasks and activities inside and outside of their houses include socialising, visiting neighbours and relatives, shopping for groceries, attending invitation such as the wedding, taking part in a religious matter and so forth. They are the selected subjects for this study.

One of the most important tasks in BADL is meal preparation. It involves issues on nature of the task and the instrument used in performing the task. From a previous survey, it was found that this crucial task is so tiring since there are pre and post activities involved in the whole process. More than 20% of the elderly require assistance due to their limitations. The selected case study is frying. It is the most popular method among Malaysian elderly population compared to roasting, steaming, or boiling. Meal preparation is also the main measurement of elderly independence level.

The human heart rate depicts the pumping function of the heart. This cardiac cycle is divided into 3 principle stages, known as *atrial systole, ventricular systole* and *diastole*. Through these stages, the heart forces oxygenated blood from the lungs throughout the body and send the de-oxygenated blood to the lungs to get oxygenated (5). The heart rate at rest and the heart rate after performing a task are indicators of an elderly physiological state. It must be noted that the normal heart rate varies with the activity being perform.

The respiratory function includes both oxygen uptake and excretion of carbon dioxide through the lungs (6). While work is performed, the oxygen consumption (along with CO2 release) is a measure of metabolic energy production, which can be assessed with a variety of instruments (7). Longer observation period (at least 5 minutes) could be a reliable assessment of the metabolic processes. But in this study, there is no intention of measuring the metabolic processes which involve energy conversion to kcal/L O2. The level of cardiorespiratory fitness is a powerful predictor of morbidity and cardiovascular mortality (8). Therefore measuring the heart rate and oxygen consumption is significant to assess the elderly capability in performing BADL tasks.

This paper presents the results of a study carried out to measure physiological limitations of the elderly in frying task.

Materials and Methods

This paper focuses on 2 physiological variables of the elderly whilst performing a given task; heart rate and oxygen consumption. In 2010, thirty-one subjects (11 males and 20 females) participated in this study. They were from Kampung Sungai Merab, in the district of Kajang and in the state of Selangor, Malaysia (2° 95'N, 101° 79'E). Their ages ranged between 60 to 83 years old with a mean age of 67.06 years and are healthy. They live independently in a community and stayed at their own home. Although Malaysia is a multi-racial country but the ethnic origin and religious conviction of its citizen are not included in this study. These variables are excluded as their physical anthropometrics have not much difference and there is nothing to relate between believes and physiology. There were two variables measured. Both types of data (heart rate and oxygen consumption) were collected before and immediately after a 5 minutes frying session to compare any differences. Data acquisition was started within the first 15 seconds after performing the task in accordance with the data acquisition protocol. The study is conducted based on a door-to-door visit and data was collected at the subject's actual kitchen setting. Subjects voluntarily participated as agreed in the earlier letter of intent and the visits are based on appointment. They were briefed on the data acquisition protocol, equipment to use, type of task they should perform and time estimated to finish.

SPSS statistical software was used for data analysis. The result was then compared with previous findings.

Instruments

The main equipment for both data acquisition is VernierLabPro. The heart rate reading was collected using a Vernier EKG (Electrocardiogram or ECG) and VernierLabQuest Mini software running on a laptop computer. Three electrodes are used on the cleaned subject's hand skin. The first electrode (reference-black) was pasted on the right wrist. The second electrode (negative-green) was pasted on the inside of the right elbow. The third electrode (positive-red) was pasted on the inside of the left elbow. All cables from the EKG sensor were linked to the electrodes patches using mini alligator clips. The other cable links the EKG sensor to the computer interface. To start collecting data, the software has to be activated. The data was processed and saved in the software and then analysed using SPSS software. To measure the gas pressure, VernierLabPro with Logger Pro V3.6 software was used. Oxygen Gas Sensor respiratory equipment was linked to the computer interface to measure oxygen from the collected expired air. The subject was required to take a deep breath and blow the expired air into a rubber balloon. The balloon was then carefully fitted to the sensor head. The software was then activated to record the gas pressure (O2) reading for a duration of one minute. The result is then analysed.

Results

Statistics on Gender and Age

Table 1 shows the number of male and female subjects participated in the study.

Statistics on EKG and O2

Table 2 shows the age, EKG and Oxygen readings. The data presented was the difference between minimum and maximum of both variables from 54-64 beats per minute (before performing the task) and 68-86 beats per minute (after performing the task). Although it does not show great differences and the frequency remains near the resting level but there were changes after task performed. There were two affecting factors that may contribute to the results. First, the given task was of a 'light work type'. Secondly, the subjects were elderly people who experiencing the ageing process and exposed to frailty. A decrease in heart rate variability (HRV) was observed with increasing age.

Table 1: Statistics on gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	11	35.5	35.5	35.5
	Female	20	64.5	64.5	100.0
	Total	31	100.0	100.0	

Table 2: Age, EKG readings and O2 readings

		Age	Min.EKG	Max.EKG	Min.O2	Max.O2
N	Valid	31	31	31	31	31
	Missing	0	0	0	0	0
Mean		67.0645	.6506	2.4917	17.8726	19.4887
Std. Deviation		4.59663	.17315	.51022	1.76992	1.35800
Minimum		60.00	.20	1.24	9.80	14.82
Maximum		83.00	.85	3.38	20.08	23.68

Data Distribution

Both heart rate and oxygen consumption data were found to be normally distributed. The EKG that measures maximum heart rate was shown in Fig. 1. Meanwhile Fig. 2 shows the maximum oxygen consumption. Both minimal heart rate and oxygen consumption data were based on the readings at rest.

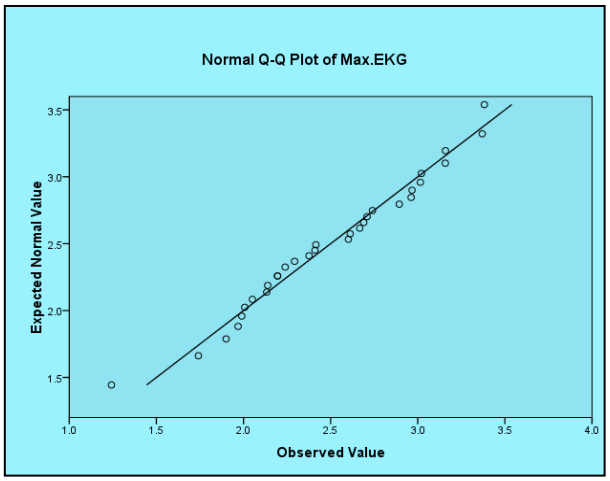

Fig. 1: Maximum Heart Rate data distribution

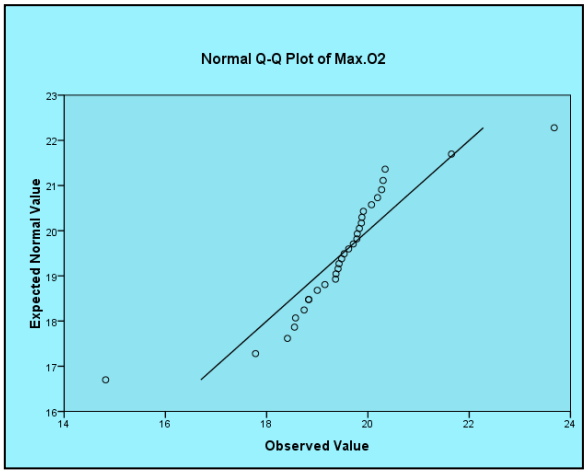

Fig. 2: Maximum O2 Consumption data distribution

Figure 3 shows the descending value of oxygen demand recorded immediately after 5 minutes task performing for the duration of 1 minute. At the end of 1 minute, we can see the oxygen demand was getting back to normal as the subject cooling down from the recovery state. After a few minutes, the subject's oxygen consumption settles at the normal state.

Figure 4 shows the heart rate graph. The same protocol as the oxygen consumption data acquisition was applied to this variable. The heart beat per minute also shows a descending pattern.

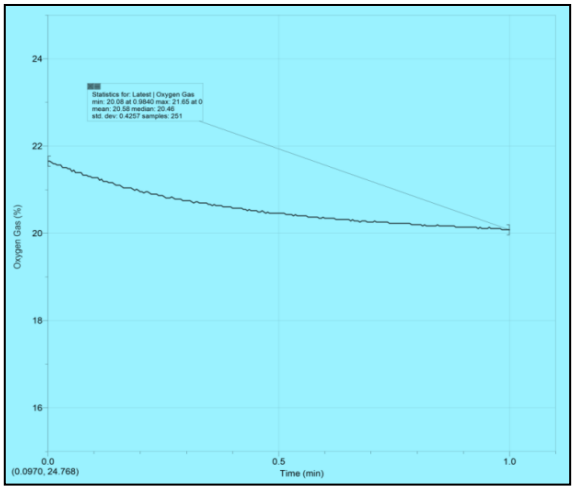

Fig. 3: Example of oxygen consumption graph

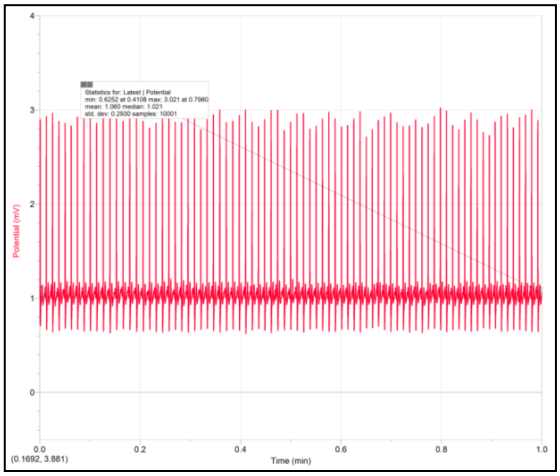

Fig. 4: Example of EKG graph on the heart rate

Statistics on Heart Rate and Oxygen Consumption

One heart cycle is represented by a group of waveforms beginning with the P wave, followed by the QRS wave complex, and ending with the T

wave. The normal heart rate is between 70-80 beats per minute[1] at rest. The previous study by Kilbom and Astrand stated the heart rate of female subjects during cooking, ranges between 82 and 116 beats per minute, compared with 69 to 79 when they were at rest. In most individuals, the breathing mixtures are less than 60% oxygen. Prolonged breathing of 100% oxygen is harmful otherwise; we are at the altitudes of 6000 meters high and over. Table 2 shows the differences in their heart rate before and after performing the task. Table 3 shows the differences in oxygen consumption before and after performing the given task. There were significant differences between the level of heart rate and oxygen consumption among the elderly before and after performing the given task.

Discussions

Heart rate comparison with previous findings

The results of both oxygen intakes *before* and *after* performing the frying task show positive increment of oxygen consumption. And this shows that there was an increase in energy expenditure during the experiment. The minimum oxygen reading *before* performing the task was 66.13% lower than *after* performing the task. The maximum oxygen reading also shows the same pattern with an increment of up to 15.20% after performing the task.

The findings also show that the elderly had a lower heart beat both *before* and *after* the frying task activity compared to Kilbom and Astrand (10). But the trend of incremental heart beat readings remains happened. This shows that there was a significant difference between the elderly and adult physiological capability thus accepting the research hypothesis. Table 3 shows the differences between both research findings.

Pulse rates during household tasks could be used to measure the difficulty of the task and level of body stress. Normal resting heart rate for an adult is within 70-80 beats per minute. Values above 100 beats per minute are considered a fatiguing task. Therefore, the heart rate is a valid measurement of stress. The results show frying tasks performed in the kitchen have a significant impact on elderly physiology.

Table 3: Different findings on heart rate reading on frying task

	Kilbom and Astrand (1969) Female Adult	**Taha, Z and S. Ruhaizin (2010) Malaysian Elderly**
Heart rate before performing task	69-79 beats m^{-1}	54-64 beats m^{-1}
Heart rate after performing task	82-116 beats m^{-1}	68-86 beats m^{-1}

Recommendation

First, future research should focus on investigating the elderly physiological limitations on other BADLs and IADLs tasks. By identifying their stamina or endurance when performing several tasks, one could clarify their levels of capabilities and classify them for future references. These references are very useful for task and instruments design. Second, the study should also combine the improvement of task envelope, friendly designed stove and comfortable environment where the tasks were normally performed. Finally, well-designed task performing utensils should be produced for the benefit of the elderly population. These initiatives hopefully could prolong elderly independency in managing themselves.

Conclusion

Elderly are exposed to frailty which is a late-life syndrome of vulnerability to adverse health outcomes and mortality. The physiological study is a

way to translate the capabilities and limitations of the body when performing a task. The more strenuous the activity, the more oxygen consumption will be needed by the body. Therefore identifying elderly physiological limitations could help increase their independency and well-being. It is hoped that the findings of this study will generate awareness among ergonomists on the elderly capability to perform everyday tasks and redesign tasks that suit elderly physiological limitations. For designers, the ergonomic design criteria should be taken into consideration during the design process to suit the subject's capability whilst performing a certain task. By designing ergonomic utensils could increase elderly independency.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

The authors declare that there is no conflict of interest.

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