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# Correlates of Physical Activity Level among Hemodialysis Patients in Selangor, Malaysia

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## ABSTRACT

**Introduction**: There is mounting evidence demonstrating the importance of adequate physical activity to promote better well-being among hemodialysis patients. Available data pertaining to the levels of physical activity and its determinants among hemodialysis patients is, however, scarce in Malaysia. The objectives of this study are hence to determine the levels of physical activity and it associated factors among hemodialysis patients. **Methodology**: A total of 70 subjects were recruited from three dialysis centres in Selangor. A face-to-face interview was conducted to obtain socio-demographic data and subjects' knowledge on dietary sources. Medical history, biochemical parameters and weight status were obtained from medical records. Physical activity level (PAL) was assessed using the Global Physical Activity Questionnaire (GPAQ). **Results**: A total of 81.4% and 18.6% of the respondents had low and moderate PALs, respectively. Thus, none of the respondents had high PAL. Serum creatinine, education level, personal income and knowledge score on potassium-related medical complications were factors found to correlate significantly with PAL. Multiple linear regression analysis showed that higher PAL was predicted by a lower knowledge score on dietary sodium source, higher education and higher serum creatinine. **Conclusion**: Despite consistent documentation of the potential positive impact of physical exercise on hemodialysis outcomes, the level of physical activity remains low among these patients. It is hoped that these findings can add to the existing body of knowledge and serve as a supporting document for the formulation of appropriate interventions to improve the status of physical activity among hemodialysis patients in Malaysia.

**Keywords:** Determinants, hemodialysis patients, physical activity

## INTRODUCTION

The prevalence rate of end-stage renal disease (ESRD) has seen a continuous increase globally. According to the National Renal Registry of Malaysia, the numbers of ESRD patients requiring renal replacement therapy increased rapidly from 59 in 1980 to almost 15,000 in 2006 and this number is expected to increase from year to year (Lim & Lim, 2008). This increasing trend is partly attributed to the tremendous increase in the

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incidences of diabetes mellitus and hypertension, which are the primary causes of ESRD in Malaysia. Despite the advancement in dialysis procedures and a wider use of hormone erythopoeitin which have generally extended the lifespan of patients with ESRD, the rates of mortality and morbidity remain high while impairment of quality of life has been frequently reported among the dialysis population (Cheema & Fiatatone Singh, 2005).

While rehabilitation in the context of physical, social and vocational is important in dialysis patients (Lo *et al*., 2000), reduced exercise capacity has often been reported as an obstacle in this population (Painter, Nelson-Worel & Hill, 1986), which can be overcome with appropriate exercise programs (Lo *et al*., 2000). Several pioneer studies have shown that higher levels of physical activity improves cardiovascular risk (Stack & Murthy, 2008), physical function (Painter *et al*., 2000), psychological status (Suh *et al*., 2002) and health-related quality of life (Cheema *et al*., 2007). Despite the overwhelming reported benefits, the implementation of exercise programs is not commonly advocated in most countries. This could be partly attributed to the misconception that these patients are viewed as being too ill to perform exercise (Painter *et al*., 2004), lack of motivation (Painter *et al*., 2004) and increased perceived risk by health care professionals (Painter & Johansen, 2006).

The National Health and Morbidity Survey (III) of Malaysia (2006) identified some 30% of the general population as physically inactive. However, such data is not available among the hemodialysis population and this is an important missing piece of information without which it is difficult to develop an effective and standardised exercise guideline for this population. Hence, the aims of the present study are to determine the level of physical activity among the hemodialysis patients in Malaysia and to identify factors determining their levels of physical activity.

## METHODOLOGY

### Study design and instrumentation

This was a cross-sectional study where a total of 70 subjects from three hemodialysis centres located in Kajang, Selangor were enrolled in the study. Inclusion criteria were adult population aged 20 and above, had received hemodialysis treatment at least three months prior to study enrolment and consented to participate voluntarily. Patients who had impaired physical functioning ability, dementia, were unconscious, diagnosed with hepatitis infection and were hospitalised during the study period were excluded from the study. Ethical approval to carry out the study was obtained from the Medical Research Ethics Committee of Faculty of Medicine and Health Sciences, Universiti Putra Malaysia. Subject information sheet was given to all subjects and written informed consent was obtained from subjects prior to study enrolment.

A structured questionnaire was developed and validated to ascertain information on patients' demographic characteristics and knowledge on important issues in end-stage kidney disease care including dietary aspects and medical complications associated with non-compliance. The medical history, presence of co-morbidities and biochemical measurements were retrieved from the medical reports. Routine anthropometry data such as weight and interdialytic weight gain (IDWG) were collected from medical records as secondary data. Height was obtained using SECA body metre 208 and recorded to the nearest 0.1cm. Other anthropometric measurements including triceps skinfold thickness (TSF) and mid-upper-arm circumference (MUAC) were taken after the termination of dialysis treatment, according to standard techniques.

The physical activity level (PAL) of the subjects was determined by using Global Physical Activity Questionnaire (GPAQ), which was developed by the World Health

Organization (WHO, 2009) as a population surveillance tool to measure participation in physical activity. The subjects were interviewed on the number of days and duration spent on physical activities in a typical week. All activities performed by the subjects including occupation activities (which included all activities involved in job or workplace, unpaid work, study or training and household chores), travel to and from places and recreational activities were ascertained. These activities were further classified as vigorous-intensity activities (defined as activities that require hard physical effort and cause large increases in breathing or heart rate) or moderate-intensity activities (defined as activities that require moderate physical effort and cause small increases in breathing or heart rate). Status of sedentary behaviour of subjects was ascertained as well.

Two types of scores, namely continuous score and categorical score, were computed. For the continuous score, total physical activity (MET-minutes / week) was determined as the sum of vigorous, moderate and sitting activities performed by the subjects, with MET defined as the energy cost of sitting quietly, and is equivalent to a calorie consumption of 1 Kcal / kg / hour. The GPAQ Analysis Guide (WHO, 2009) was used to quantify the level of physical activity of the subjects. Subject's PAL was further classified as low, moderate, or high according to this guide.

## Data analysis

Statistical analyses were performed using the SPSS Windows Version 18 (Chicago, IL). Unless otherwise specified, continuous variables are presented as mean ± standard deviation. Pearson's product moment correlation coefficients were computed to determine the associations between physical activity and variables while stepwise multivariate linear regression analysis was performed to identify variables that predict the level of physical activity of subjects. Statistical significance was defined at $p < 0.05$.

## RESULTS

Characteristics of study subjects are presented in Table 1. A total of 58.6% respondents were male and 41.4 % were female. Mean age of subjects was 57 ± 12.5 years. Most of the participants had a low level of education, with 12.9 % of the respondents having no formal education while 30% of respondents had attended primary school. Slightly more than half (51.4%) reported a monthly income of less than RM1000.

The mean duration on dialysis treatment was 2.3 ± 1.7 years. Diabetes Mellitus (58.6%) was the major cause for kidney failure followed by hypertension (47.1%). Mean IDWG which is a generally acceptable indicator for fluid compliance of the subjects was 2.7 ± 1.0 kg, with 15.7% of them having excess IDWG (defined as > 5.7% of dry weight). Mean body mass index (BMI) of the subjects was 23.9 ± 4.3 kg / m$^2$. A total of 52.9% of the subjects had BMI $\leq$24 kg / m$^2$ and were underweight according to K / DOQI guideline. There were 3.4% and 7.1% with TSF and MUAC below the 5$^{th}$ percentile, respectively. The means of serum albumin, creatinine and hemoglobin were 34.0±4.7 g / L, 746.0±270.5 $\mu$mol / L and 98.3±21.3 g / dL, respectively. A total of 50% and 92.9% of the subjects had low serum albumin and hemoglobin levels and all of the respondents had elevated serum creatinine.

According to the classifications of physical activity level using WHO GPAQ guideline, a total of 81.4% subjects were inactive, 18.6% were moderately active while none of them had a high level of physical activity (Table 2). This corresponded to the fact that transport-related walking and household chores were the dominant types of physical activities performed by the subjects, while involvement in leisure time exercise was very limited. Comparison of

**Table 1.** Demographic characteristics among respondents (n=70)

| | *Mean ± SD* | *n (%)* |
|---|---|---|
| Gender | | |
| Male | | 41 (58.6) |
| Female | | 29 (41.4) |
| Age (years) | 57 ± 12.5 | |
| ≤ 40 | | 8 (11.4) |
| 41 – 60 | | 31 (44.3) |
| > 60 | | 31 (44.3) |
| Educational Level | | |
| No formal education | | 9 (12.9) |
| Primary school | | 21 (30) |
| Secondary school | | 28 (40) |
| Tertiary | | 12 (17.1) |
| Employment Status | | |
| Working | | 18 (25.7) |
| Not working | | 52 (74.3) |
| Etiology of kidney disease* | | |
| Diabetes mellitus | | 41 (58.6) |
| Hypertension | | 33 (47.1) |
| Unknown | | 17 (24.3) |
| Kidney stone | | 3 (4.3) |
| Polycystic kidney disease | | 2 (2.9) |
| Systemic Lupus Erythematous (SLE) | | 1 (1.4) |
| Body Mass Index ($kgm^{-2}$) | 23.9 ± 4.3 | |
| Interdialytic weight gain (kg) | 2.7 ± 1.0 | |
| Dry Weight (kg) | 61.1 ± 12.6 | |
| TSF (cm)MUAC (cm) | 28.9 ± 10.5 | |
| MUAC (cm) | 29.7 ± 4.3 | |
| Serum albumin (g/L) | 34.0 ± 4.7 | |
| Serum creatinine (μmol/L) | 746.0 ± 270.5 | |
| Serum hemoglobin (g/dL) | 98.3 ± 21.3 | |

* Multiple responses
TSF: Tricep skinfold thickness
MUAC: Mid-upper arm circumference

**Table 2**. Levels of physical activity in different age and sex groups

| *Variables* | *Categories of physical activity** | | *Difference* | *Statistical value, p* |
|---|---|---|---|---|
| | *Low* | *Moderate* | | |
| Age group (years) | | | $\chi 2 = 15.114$ | .001 |
| ≤ 40 | 6 (8.6) | 2 (2.8) | | |
| 41 – 60 | 24 (34.3) | 7 (10.0) | | |
| > 60 | 27 (38.6) | 4 (5.7) | | |
| Sex | | | $\chi 2 = 2.057$ | 0.151 |
| Male | 36 (51.4) | 5 (7.1) | | |
| Female | 21 (30) | 8 (11.4) | | |

* None of the subjects had a high level of physical activity
Data are expressed as number and percentage

physical activity by gender shows that 87.8% and 72.4% of the male and female respondents had low PAL, respectively. This corresponded to a higher mean duration of time spend by the female respondents in occupational travelling and recreational activities, together with a shorter mean duration of time spent in sitting and reclining activities. Despite these, as shown in Tables 2 and 3, there was no significant difference in the level of physical activity ($\chi^2$ = 2.507, p>0.05) or energy expenditure (expressed as MET count) (t = 0.209, $p$>0.05) between gender. A low level of physical activity was documented in 76.9% of subjects below 60 years of age while among those aged 60 years and above, 87.1% had low level of physical activity. A significant difference between level of physical activity and age group, with younger subjects most likely to have a higher level of physical activity was documented ($\chi^2$= 15.114, $p$=0.001).

As shown in Table 4, higher education and personal income were associated with higher levels of physical activity. Higher serum creatinine was also found to be associated with greater PAL. There were no significant associations between level of physical activity and age, gender, working status or biochemical measures (hemoglobin, hematocrit, albumin). There were also no significant associations between anthropometric measures (IDWG, BMI, dry weight or body composition) and level of physical activity. While higher knowledge score on the medical complications of potassium non-compliance was associated with a higher level of physical activity, knowledge scores on the other medical complications of non-compliance (phosphate, sodium and fluid) remain non-significant.

Stepwise multivariate linear regression analysis was performed to identify variables that predict level of physical activity. The regression model predicting level of physical activity is summarised in Table 5. A higher level of physical activity was predicted by a combination of three factors, namely a lower knowledge score of dietary sodium sources ($\beta$ = -0.434, $p$ < 0.05), higher education level ($\beta$ = 0.362, $p$< 0.01) and higher serum

**Table 3**. Distribution of time spent in physical activities and energy expenditure according to gender

| *Categories of activity* | *Male* | *Female* |
|---|---|---|
| Activity at work | | |
| Duration | 13.4 ± 56.7 | 15.7 ± 22.7 |
| Energy expenditure | 302.4 ± 1226.5 | 303.5 ± 437.5 |
| Activity in recreational | | |
| Duration | 9.9 ± 21.4 | 12.9 ± 30.4 |
| Energy expenditure | 215.1 ± 521.2 | 295.9 ± 706.7 |
| Sitting / Reclining | | |
| Duration | 772.6 ± 133.9 | 704.0 ± 192.8 |
| Energy expenditure | 5228.4 ± 1190.2 | 4971.4 ± 1203.1 |
| Travel to and from places | | |
| Duration | 4.3 ± 11.2 | 5.2 ± 14.1 |
| Energy expenditure | 66.8 ± 153.7 | 46.9 ± 121.8 |
| **Total Energy Expenditure** | 584.4 ± 1425.6 | 646.2 ± 845.9* |

The measurement unit for duration and energy expenditure of activities are minutes and MET count, respectively
* $p$>0.05

**Table 4**. Correlation coefficients between selected variables and level of physical activity

| *Variable* | *Coefficient* | *P value* |
|---|---|---|
| Age (years) | 0.071 | - 0.217 |
| Education level | 0.362 | 0.002 * |
| Income | 0.327 | 0.006 * |
| Sex | -0.081 | 0.506 |
| Working status | 0.164 | 0.176 |
| IDWG | 0.029 | 0.814 |
| BMI | 0.598 | - 0.064 |
| MAC | 0.580 | 0.632 |
| Triceps | 0.105 | 0.389 |
| Hemoglobin | 0.135 | 0.265 |
| PCV (Hematocrit) | 0.125 | 0.301 |
| Creatinine | 0.34 | 0.004 * |
| Albumin | 0.229 | 0.057 |
| **Knowledge score on diet sources** | | |
| Potassium | 0.232 | 0.054 |
| Phosphate | 0.191 | 0.113 |
| Sodium | 0.014 | 0.910 |
| Fluid | 0.104 | 0.391 |
| **Knowledge score on medical complications of dietary non-compliance** | | |
| Potassium | 0.262 | 0.029* |
| Phosphate | 0.201 | 0.096 |
| Sodium | 0.148 | 0.220 |
| Fluid | 0.168 | 0.164 |

* $p < 0.05$, significant correlation

**Table 5**. Multiple linear regression model predicting level of physical activity

| *Predicting Variables*[1] | *Standardised coefficients (β)* | *P value* |
|---|---|---|
| Sodium food compliance | -0.434 | 0.017* |
| Education level | 0.362 | 0.008* |
| Serum creatinine | 0.268 | 0.024* |
| Fluid compliance | 0.285 | -33.057 |
| BMI | -20.262 | 1.396 |
| Serum haemoglobin | 6.855 | 0.761 |
| Serum albumin | 36.833 | 0.896 |

[1]Predictor variables listed were selected using enter mode in standard mode of multiple regression model*
$p < 0.05$, significant correlation

creatinine level ($\beta = 0.268$, $p < 0.05$). These variables explained 28.7% of the variance in the level of physical activity.

## DISCUSSION

The prevalence of physical inactivity was high in this cross-sectional study, with over 80% of the subjects reporting low PAL. Although these findings were not unexpected, we still find the percentage of our subjects that were physically active relatively lower compared to other published studies in the United States (Elder *et al*., 2005; Stack & Murthy, 2008), Japan and the European countries (Elder *et al*., 2005). There are many potential causes of low PAL among hemodialysis patients. The dialysis procedure itself may lead to fatigue and low PAL among the respondents while the presence of uremia may decrease the skeletal muscle function of the subjects (Johansen *et al*., 2000). Mental and social changes, accelerated ageing, unemployment, and decreased quality of life may also contribute to lower levels of physical activity in dialysis patients (Gariballa & Sinclair, 1998).

In the absence of healthy control subjects, we compared our data to the local National Health and Morbidity Survey III (NHMS III) (2006) and Malaysia Non-Communicable Disease Surveillance-1 (MyNCDS-1) (NCD, 2006) findings. We found that the percentage of subjects who were physically active in our study was much lower than the non-dialysis population. This is undoubtedly reasonable as dialysis patients spent long hours for dialysis treatment and they tend to be more sedentary than the normal healthy population. These findings are congruent with an abundance of evidence confirming lower PAL among hemodialysis patients (Johansen *et al*., 2010a; Zamojska *et al*., 2006).

Patients' characteristics associated with levels of physical activity were congruent with the findings of Johansen *et al* (2010a) where higher physical activity levels were found among those better educated and with higher creatinine level. Serum creatinine is a well-known surrogate for nutritional and inflammation status (Lowrie & Lew, 1990; Kaysen *et al*., 2001). Patients with higher serum creatinine may have better nutritional status, lower rates of inflammation and a better general well-being, which allow them to engage more regularly in physical activities. On the other hand, regular participation in physical activities may also improve muscle mass and hence serum creatinine level. Although the nature of this cross-sectional study precludes determination of causality and the exact etiology of the direct association between serum creatinine and PAL is not clear, in view of the significant interactions between higher serum creatinine with lower mortality risk (Lowrie & Lew, 1990), it is believed that exercise would be of great benefit for dialysis patients. In contrast, hemoglobin concentration was not associated with physical activity level in our subjects which was consistent with Johansen *et al*. (2010a). Recent findings show that although severe anemia may limit exercise capacity and physical functioning, low haemoglobin is not the sole factor determining level of physical activity among hemodialysis patients (Johansen *et al*., 2010b; Gandra *et al*., 2010).

Age was not a determinant of PAL in our study, which was not consistent with other studies (Johansen *et al*., 2000; Johansen *et al*., 2010a). A majority of our subjects were between 55 and 64 years old, which failed to represent a more heterogenous group and may mask the effects of age. The lack of a significant association between weight status and levels of physical activity was unexpected and is not consistent with earlier studies (Cupisti *et al*., 2011; Zamojska *et al*., 2006). The relatively small sample of subjects in our study may explain the discrepancy in results. Our findings showed that a higher knowledge score does not guarantee a higher level of physical activity. Indeed, the presence of a trend towards lower physical activity in subjects with higher knowledge scores on dietary sodium suggests that the challenges of promoting higher level of physical activity may transcend parameters including health literacy.

One of the important findings of our study showed that the highest involvement of activity of subjects was sitting / reclining, which was highly related to the need to receive twice weekly hemodialysis treatment for about four hours per session. On the other hand, most of these subjects were reluctant to exercise during their leisure time regardless of dialysis or non-dialysis days. This gives us an insight to suggest that exercise interventions planned for the dialysis population may be best conducted during the dialysis sessions (intradialytic exercise). Similar intervention programs had indeed reported success stories in Hong Kong (Lo *et al*., 2000), Taiwan (Chang *et al*., 2010), Australia (Koh *et al*., 2010) and Spain (Segura-Orti, Kouidi & Liœon, 2009). A recent systematic review by Segura-Orti (2010) also confirmed intradialytic exercise promotes a higher compliance rate. Exercise during hemodialysis sessions is recognised as time-efficient (Chang *et al*., 2010) and should be considered as part of the standard dialysis prescription.

## CONCLUSION

The majority of the hemodialysis patients were sedentary, with only a small percentage having a moderate level of physical activity. Although it is reasonable that poor clinical conditions may limit hemodialysis patients' physical activity performance, the promotion of physical activity among them should not be neglected since various health benefits for hemodialysis patients have been identified. Women tend to be slightly more active compared to men. However, the difference was not significant, possibly due to insufficient sample size. On the other hand, to the best of our knowledge, this is the first study that used GPAQ to determine the PAL among the hemodialysis patients. This instrument broadens the assessment of physical activity level by attempting to assess the subjects' involvement on activities besides recreational activities. Such activities might be considered as sedentary or moderate for the general population but might be vigorous enough for hemodialysis population due to fatigue and very low levels of exercise capacity.

Although direct evidence that physical activity can improve functioning or survival is lacking, in view of the abundant evidence speculating the beneficial effect on metabolic and hemodynamic, health-related quality of life, and improvement on frailty and functional capacity, appropriate strategies should be formulated to enhance participation in physical activity among the dialysis population, especially among those vulnerable groups including the less educated population. The exercise programme should however be individualised as a large proportion of the dialysis population may have significant co-morbid conditions that may reduce their exercise capacity. Although we acknowledge that the number of subjects in our sample is small, we hope that the findings from our study helps to create higher awareness among the health authorities and researchers that more work is needed to promote a higher physical activity level among the hemodialysis population.

Our study has several limitations. This was a cross-sectional study with a relatively small sample size which could limit the cause-effect interpretation and generalisation of findings. Selection bias is also possible that only healthier or more health conscious hemodialysis patients were more likely to consent to participate. This may lead to over-representation of healthier hemodialysis patients and weaken the internal and external validity. Despite such limitations, we have highlighted several important points that require further investigations.

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