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Relationship between Physical Performance and Cognitive Function in Malaysian Older Persons

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Abstract

It is inevitable for older persons to experience a loss in physical performance and cognitive function because of the ageing process. The reduction of muscle mass that comes with ageing is linked to a decrease in physical performance. Ageing has also been associated with a decline in cognitive function. Multiple studies have found a relationship between physical performance deterioration and cognitive function deterioration. This research aims to see if there's a link between demographic characteristics, physical performance assessments, and cognitive function among Malaysian older persons. A cross-sectional study was conducted among 37 community-dwelling older persons aged 60 years old and above. Written consents were collected from participants. Demographic information, physical performance test and cognitive function test were collected. Using SPSS® version 28, the data was analysed using Spearman's Rho, and One Way ANOVA. The Timed Up Go test (TUG) and Mini-Mental State Examination (MMSE) were strongly associated. HGT, on the other hand, shows no link between MMSE and HGT. There is statistically significant, indicating that cognitive levels were influenced by the level of education level, $F(2,34) = 6.45$, $p = 0.004$. More tests that demonstrate the link between physical performance and cognitive function should be included. This will provide healthcare providers with a variety of choices in selecting the best outcome measure for evaluating an older person`s physical and cognitive function. Early diagnosis of physical and cognitive function levels will further empower early intervention in the older person.

Keywords: Older Person, Physical Performance, Cognitive Function, Timed Up Go, Mini-Mental State Examination

Introduction
It is inevitable for older persons to experience a loss in physical performance and cognitive function as a result of the ageing process (Eshkoor et al., 2015; Mendonca et al., 2017). The ageing process causes a loss of muscle mass and strength (Beaudart et al., 2016; Keller & Engelhardt, 2013). The loss in muscular strength indicates to be a predictor of a decrease in physical performance (Beaudart et al., 2016). The reduction of muscle mass that comes with ageing is linked to a decrease in physical performance (Bettio et al., 2017). A prevalence survey, indicates an average of 20% of older persons aged 60 and above indicate a decline in cognitive function (Busse et al., 2006; Di Carlo et al., 2007; Ronald, 2016).

Physical activity that targets modifiable risk factors and neuroprotective mechanisms in older persons is a nonpharmacological method of decreasing age-related decline and minimising disease-related cognitive impairment (Kirk-Sanchez & McGough, 2013). According to a study on physical activity guidelines, older persons should engage in 150 minutes of moderate to strenuous physical activity every week to maintain optimal physical performance (Spartano et al., 2019). Gait speed, timed up and go, self-reported physical function, sit to stand five times, standing balance, short physical performance, battery test (SPPB), stair climb, and a 3-D accelerometer are examples of common physical performance tests (Beaudart et al., 2016). The aforementioned tests have also been shown to be valid, reliable, and feasible to employ among older persons in identifying accurate physical status (Beaudart et al., 2016; Freiberger et al., 2012; Mijnarends et al., 2013).

Multiple studies indicate that there is a significant link between decreased physical performance and a decline in cognitive function (Kennedy et al., 2016; Kirk-Sanchez & McGough, 2013; Tieland et al., 2018; Won et al., 2014). Furthermore, certain demographic features have been linked to a deterioration in physical performance and cognitive function (Baumgart et al., 2015; Trombetti et al., 2016). To date, there are no current studies in Malaysia that research physical performance and cognitive function among older persons. For that, this research aims to identify a relationship between demographic characteristics, physical performance assessments, and cognitive function among Malaysian older persons. An examination of the criteria may aid in determining the likely association between the variables and provide a foundation for future research in this area, particularly among Malaysian older person.

Methodology
Design and Participation
This cross-sectional study was conducted in a senior citizen club in Ipoh, Malaysia, with a total of 37 community-dwelling older persons aged 60 years old and above. This study has been approved by Pusat Aktiviti Warga Emas (PAWE) UTC Ipoh Committee and UniKL Royal College of Medicine Perak SDCL ethical committee.

There were inclusion and exclusion criteria in conducting this study. The inclusion conditions that must be met by the participants are: 1) Capable of communicating, reading, and writing in either Malay or English language, 2) Possess the ability to follow simple instructions, 3) able to walk for at least 7 meters with minimal supervision. Meanwhile, the exclusion are 1) Vision, hearing, and severe speech difficulties, 2) Severe medical conditions such as unstable heart

condition, and 3) Participants who are using antipsychotic, antidepressant, or dopaminergic medications may have an impact on the test results.
As shown in the data collection flow chart (Figure 1), informed consent was obtained after delivering verbal and written information to the potential participants. Participants were interviewed for sociodemographic and cognitive status. There were 30 minutes resting period before the physical performance test was assessed which was conducted by final-year undergraduate physiotherapy students.

Demographic Information
Age, gender, race, degree of education, medical condition, blood pressure (systolic & diastolic), Body Mass Index (BMI), glucose, and retrospective falls recalled are collected for the demographic information section. Information regarding existing medical conditions was collected through self-reported based on their medical diagnosis. An average of 10 minutes were spent collecting the information from the selected participants.

Cognitive Status
The Mini-Mental State Examination (MMSE) was used to determine the cognitive state. The Mini-Mental State Examination (MMSE), formerly known as the Mini-Mental State (MMS), is made up of 11 items that assess cognitive orientation, memory, attention, arithmetic, language, registration, and visuospatial organization (Folstein et al., 1975; Tsai et al., 2016).
The test takes about 5 to 10 minutes to complete and has a maximum score (Folstein et al., 1975). In identifying mild cognitive impairment (MCI), the MMSE has a high to moderate sensitivity of 0.88 and specificity of 0.70 (Tsai et al., 2016). The MMSE has also been shown to provide quick and accurate cognitive impairment screening for healthcare professionals (Tsai et al., 2016).

Physical Performance Test
The Timed Up Go test (TUG) is a physical performance test for measuring lower limb mobility function in older persons (Coelho-Junior et al., 2018). In previous investigations, the exam had also been used to estimate the risk of falling (Ibrahim et al., 2017; Park, 2018). The test is administered by taking the time when participants rose from an armless chair with a height of roughly 47cm, walked for 3m at an average pace, turned and walked back to the chair and sat down (Ibrahim, Singh, Shahar, et al., 2017). According to previous research, the Timed Up Go test has a high test-retest reliability (ICC 0.98-0.99) (Podsiadlo & Richardson, 1991; Shumway-Cook et al., 2000).
Another physical performance is the handgrip test (HGT). The handgrip test was found to be highly reliable with an intra-class correlation coefficient (ICC > 0.9) (Reuter et al., 2011). It is used to determine the risk of sarcopenia, the indication of frailty, functional ability limitation and impairments in an older person (Manini & Clark, 2012; Rantanen et al., 2010; Takahashi et al., 2017). The handgrip strength of both arms was measured twice using the Jamar® Hand Dynamometer's standards (Lafayette Instrument, 2004).

Statistical Analysis
Following that, all the data collected from the participants were analysed using Statistical Package for the Social Sciences (SPSS®) version 28. Sociodemographic information and cognitive and physical performance tests were analysed using descriptive by reporting the mean and standard deviation for continuous variables, and frequencies for categorical

variables. The examination of the relationship between the variables using Spearman's Rho correlation coefficient respectively. Further analysis using multiple regression for the relationship between physical performance and cognitive function. In addition, One Way ANOVA was conducted to identify whether education level affects cognitive function in the older person.

Results

The study was conducted among 37 Malaysian older person with an average age of 69 years old. Most of the participant were female which makes up more than a quarter of the population and more than half of them were Chinese descendants. Participants mostly had secondary education level and participants with tertiary level education were less than three percent. The average mean of the participant was categorised as having a healthy body mass index (BMI) of 22.5 kg/m^2. Approximately half of the participants had at least one medical condition and a quarter of them reported having no existing medical condition. The average mean results of physical performance tests such as TUG were less than 11 seconds and the HGT with an average mean of 15kg. Besides that, the cognitive function test of MMSE indicates a mean score of 25. The socio-demographic information is shown in Table 1.
The relationship between physical performance and cognitive function was analysed using spearman's rho in Table 2. There was a significant relationship between TUG and MMSE. However, HGT indicate no significant relationship with MMSE. The analysis also indicates a significant correlation between left and right HGT. Further analysis, using multiple regression to identify regression coefficient for predicting cognitive level as indicated in Table 3. TUG is the only physical performance test that indicates a significant predictor of cognitive level. The unstandardized coefficient for TUG is -2.441, as a 1 SD increase in TUG will result in -2.441 SD in cognitive level. In addition, analysis of variance (ANOVA), to identify the relationship between education level with cognitive function as indicated in Table 4. The analysis was statistically significant, indicating that cognitive levels were influenced by the level of education level, $F(2,34) = 6.45$, $p = 0.004$.

Discussion

The purpose of this study was to learn more about the relationship between physical performance and cognitive abilities among Malaysian older persons. Findings indicate a significant relationship between TUG with MMSE. In addition, TUG is also shown to have the predictive ability at the cognitive level. Past research has found a link between physical performance and cognition, with lower physical performance being linked to cognitive decline (Best et al., 2015; Schumacher & Bruin, 2015). The TUG test was discovered to be a good predictor of physical ability, as well as general physiological health (Ibrahim, Singh, & Shahar, 2017). The result is a longitudinal study also suggests that physical activity as simple HGT does influence cognitive functioning in an older person (Sternäng et al., 2016). However, there is no significant correlation between HGT and cognitive function in this study.

During active physical activity, one requires keeping track of their movements, which demand necessitates attention, working memory, and task-switching abilities (Best et al., 2015; Schumacher & Bruin, 2015). To preserve their current degree of independence, the older person must increase their physical activity while also improving their cognitive functioning (Best et al., 2015). Physical activity such as strength and coordination training results in increased hemodynamic brain activity and activation of certain brain networks that support or improve their cognitive performance (Schumacher & Bruin, 2015). Other studies also indicate that physically inactive older person have poor maintenance of their brain volume and neural integrity. The sedentary lifestyle has led to the deterioration of cognitive function in the older person (Cheng, 2016).

TUG is the only physical performance test that is positively correlated with cognitive function in this study. This is because TUG access the comprehensive aspect of basic physical mobility and positively correlates with physical performance attributes such as balance, gait speed and functional ability (Podsiadlo & Richardson, 1991) as compared to the HGT which measures hand skeletal muscle strength and has also been associated with peripheral strength and exercise capacity (Reuter et al., 2011).

Further analysis indicates a significant influence between education level and cognitive in this study. The findings supported in the past study on the level of education and changes in cognitive function indicate that person with fewer formal education level tends to have higher cognitive declines (Evans et al., 1993). Investigation of the effect of education level on cognitive function at the cellular level also indicates that education does influence individual general cognitive function (Elkins et al., 2006). In addition, a study indicates that secondary memory and language functions were found to be more resistant to decrease in those with a high education level. However, attention, implicit memory, and visuospatial skills were found to decline regardless of education level (Leibovici et al., 1996).

Conclusion

In conclusion, multiple tests that demonstrate the link between physical performance and cognitive function should be included. This will provide healthcare providers with a variety of choices in selecting the best outcome measure for evaluating an older person`s physical and cognitive function. Early diagnosis of physical and cognitive function levels will further empower early intervention in older persons.

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Figures and Tables

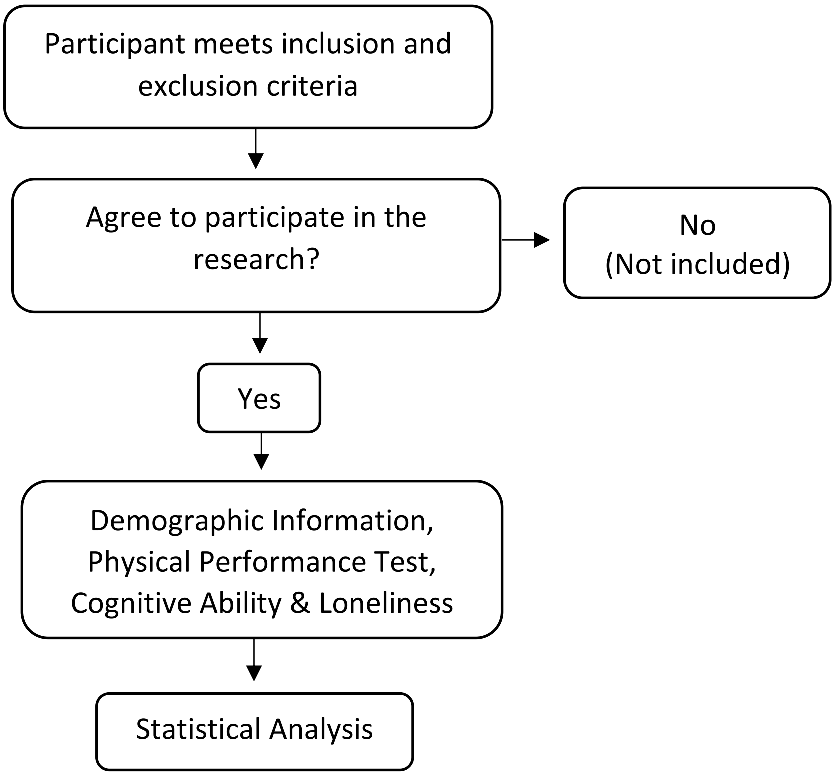

Figure 1. Flow Chart for Data Collection

Table 1
Sociodemographic Information

Variables	**Mean or % (n=37)**	**Standard Deviation**
Age	69.4	6.0
Gender		
Male	18.9	
Female	81.1	
Race		
Malay	8.1	
Chinese	64.9	
Indian	27.0	
Level of Education		
No Education	24.3	
Primary	10.8	
Secondary	62.2	
Tertiary	2.7	
Hypertension	30.6	
Body Mass Index kg/m^2	22.5	10.7
No of Comorbid		
0	24.1	

1 **2** **≥ 3**	48.3 13.8 13.8	
Physical Performance Test		
Timed Up Go	10.5	2.4
Left Handgrip	15.1	5.5
Right Handgrip	16.2	5.0
Cognitive Function **Mini-Mental State Examination (MMSE)**	24.9	8.2

Table 2
Relationship between the variables (Spearman's Rho)

Variables	M	SD	1	2	3	4
1.MMSE_Group				-0.476**	0.02	0.056
2. TUG	11.109	1.827	-0.476**		-0.74	-0.41
3.Rt. Handgrip	16.11	4.92	0.02	-0.740		0.863**
4.Lt. Handgrip	15.08	5.428	0.056	-0.41	0.863**	

Note. *indicates p < 0.05; **indicates p < 0.01. M and SD were used to represent mean and standard deviation, respectively. Correlation using Spearman's Rho analysis.

Table 3
Relationship between the variables (Multiple Regression)

Variable	B	95% CI	β	t	p
1. TUG	-2.441	[36.517,71.689]	-0.554	-3.778	0.001**
2.Rt. Handgrip	-0.183	[-3.756, -1.127]	-0.112	-0.343	0.734
3.Lt. Handgrip	0.06	[-1.267,0.901]	0.041	0.125	0.901

Note. *indicates p < 0.05; **indicates p < 0.01, CI=confidence interval.
Regression coefficient for predicting cognitive level.

Table 4
Relationship between education level with cognitive function (ANOVA)

	SS	df	Mean Square	F	p
Between Groups	643.148	2	321.574	6.451	0.004**
Within Group	1694.744	34	49.845		
Total	2337.892	36			

Note. *indicates p < 0.05; **indicates p < 0.01, ss=sum of squares, ci=confidence interval, f=f-ratio analysis of variance (ANOVA), the relationship between education level with cognitive function.