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Kertas Asli/*Original Articles*

Gender-Specific Age-Related Changes in Physical Performance, Physical Activity And Anthropometry Status Among Community-Dwelling Older Persons With And Without Mild Cognitive Impairment: A Prospective Study

(Perubahan Berkaitan Dengan Usia Berdasarkan Jantina yang Berhubung Dengan Antropometri, Prestasi Fungsi Fizikal dan Aktiviti Fizikal dalam Kalangan Warga Emas di Komuniti dengan dan tanpa Kecelaan Kognitif Ringan)

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ABSTRACT

In this study, we aimed to determine gender specific age-related decline in anthropometry status, physical performance (PP) and physical activity (PA) in older persons with and without mild cognitive impairment (MCI) prospectively over 3 years. Within-group changes across three time points (baseline-Wave 1, 18 months-Wave 2, 36 months-Wave 3) based on gender and cognitive status were determined. Data was collected at Wave 3 of a longitudinal study: "Neuroprotective Model for Health Longevity among Elderly". Secondary data from Wave 1 and 2 was obtained for analysis. Older persons with MCI were categorised to have subjective memory problems (answered 'yes' on item 10 of Geriatric Depression Scale), scored at least 1.5 SD below mean average on Rey Auditory Verbal Learning Test and Digit Span, no dementia, no problems with activities in daily living, intact global cognition (>19/30: Mini Mental State Examination) and without depression (Geriatric Depression Scale 15-items,≤4). Anthropometry measurements and a battery of PP tests were performed. PA was measured using Physical Activity Scale for the Elderly questionnaire. Data from 779 older persons (67.7 ± 5.3 years) consisting of 372 men (68.0 ± 5.2 years) and 407 women (67.4 ± 5.4) who completed all tests from Wave 1 to Wave 3 were analysed. There was a decline in PP (-0.7% to -14.1% per year), PA levels (-0.7% to -14.1% per year) and anthropometry status (-0.1% to -6.3% per year), except for percentage body fat (+9.9% per year) with advancing age. Within-group changes over the three years showed significant differences (p<0.05) in height and PA in non-MCI and MCI men and lower body flexibility in non-MCI and MCI women. Specifically, tailored physical and nutritional health prevention and promotion strategies for older persons based on gender and cognitive status may be beneficial to support person-centered care.

Keywords: aged, ageing, cognition, cognitive dysfunction, physical performance impairment

ABSTRAK

Tujuan kajian ini adalah untuk menentukan perubahan berkaitan dengan usia berdasarkan jantina yang berhubung dengan antropometri, prestasi fizikal (PP) dan aktiviti fizikal (PA) dalam kalangan warga emas dengan dan tanpa kecelaan kognitif ringan (MCI). Perubahan kumpulan di tiga titik masa (di peringkat awal - Gelombang 1, 18 bulan – Gelombang 2 dan 36 bulan- Gelombang 3) berdasarkan jantina dan status kognitif juga telah ditentukan. Data telah dikumpul pada Gelombang 3 kajian longitudinal "Neuroprotective Model for Health Longevity among Elderly" (LGRS-TUA). Data retrospektif dari Gelombang 1 dan Gelombang 2 kajian diperolehi untuk dianalisis. Warga emas dengan MCI dikategorikan mempunyai masalah ingatan subjektif (menjawab 'ya' pada item 10 Skala Kemurungan Geriatrik), mempunyai sekurang-kurangnya 1.5 SD di bawah purata pada Rey Auditory Verbal Learning Test (RAVLT) dan Digit Span, tiada dementia, tiada masalah dengan aktiviti dalam kehidupan seharian (ADL), mempunyai kognitif global yang utuh (menjaring >19 pada Mini Mental Status Examination; MMSE) dan tanpa kemurungan (diukur menggunakan Skala Depresi Geriatrik 15-item, ≤4). Pengukuran antropometri dan siri ujian PP juga telah dilaksanakan. PA telah diukur menggunakan soal selidik Physical Activity Scale for the Elderly (PASE). Data dari 779 warga emas (67.7 ± 5.3 tahun) yang terdiri daripada 372 lelaki (68.0 ± 5.2 tahun) dan 407 wanita (67.4 ± 5.4), yang telah menyelesaikan semua *ujian dari Wave 1 hingga Wave 3 dianalisis. Terdapat penurunan kadar PA dan PP (-0.7% hingga -14.1% setahun) dan status antropometri (-0.1% hingga -6.3% setahun), kecuali peratusan lemak badan (+ 9.4% setahun) dengan peningkatan usia. Perubahan dalam kumpulan selama tiga tahun menunjukkan perbezaan yang signifikan (p <0.05) untuk ketinggian dan PA dalam lelaki bukan MCI dan MCI serta keregangan anggota bawah dalam wanita bukan MCI dan MCI. Adalah penting untuk menggalakkan intervensi kesihatan fizikal yang bertambah baik berkhususkan status kognitif dan jantina untuk melambatkan penurunan berkaitan usia berhubung status fizikal dan kognitif dalam kalangan warga emas.*

Kata kunci: kecelaan kognitif, kognitif, penuaan, prestasi fungsi fizikal, tua

INTRODUCTION

The number of older persons is expected to rise rapidly, reaching 2 trillion worldwide by 2050, with 50% living in Asia (Jhansi & Mishra 2014). Ageing is associated with decline in physical and cognitive status. The literature indicates that physical performance (Abe et al. 2017; Buracchio et al. 2010; Mielke et al. 2013; Payette et al. 2011), cognitive impairment (albeit mild) (Veronese et al. 2016), changes in anthropometry status (Katzman et al. 2013) and declined physical activity can lead to debilitating consequences for older persons.

Lung capacity reduces by 1% annually, as is evidenced by a decrease in maximum oxygen uptake (VO2 max), starting from the third decade of life, with rapid increase after the seventh decade of life (Jones & Carter 2000). Muscle strength stays intact for the first five decades of life and declines by 1 to 5% annually thereafter (Tieland, Trouwborst & Clark 2017; Milanovic et al. 2013). While, muscle power decline is reported to be more pronounced compared to muscle strength, due to loss of type IIa fast twitch fibers (Reid & Fielding 2012). More than half of the fast twitch muscle fibers are lost by the age of 75 years (Bongard et al. 2007). Muscle strength loss in older persons is mainly associated with loss of muscle mass known as sarcopenia (Reid & Fielding 2012). In addition, advancing age causes loss of motor units, muscle atrophy and increase in fat mass, partly due to a reduction in anabolic hormones (Volpi et al. 2004). Existing co-morbidities, such as hypertension and diabetes, intensify age-related decline (Morisawa et al. 2017).

Reduction in both aerobic and anaerobic capacity alters speed and stability in older persons (Krasovsky et al. 2014; Buchner et al.1996). Postural control reduction affects motor coordination (Remaud et al. 2016). In addition, decline in neurogenesis and afferent synapses reduces reaction time and speed (Veronica & Kunlin 2007), and this is reflected in walking speed (Lenardt et al. 2015). These age-related physiological changes have a negative effect on activities of daily living and quality of life in older persons (Keller & Engelhardt 2013).

Mild cognitive impairment (MCI) is defined as an intermediate state between cognitive normalcy and dementia (Petersen et al. 2014). Individuals with MCI have some degree of measurable cognitive deterioration which affects daily functions but can still perform physical activities normally (Lee et al. 2012). To date, 5-36.7% older persons worldwide (Sachdev et al. 2015) and 5.7%-22% older persons in Malaysia (Ibrahim, Singh & Shahar 2017; Vanoh et al. 2017) are reported to have MCI. Older persons with MCI are known to have accelerated cerebral pathology, including reduced cerebral blood volume, loss of grey matter in frontal and medial temporal lobe that are related to memory and motor task functioning (Makizako et al. 2013).

As a consequent, the combination of these effects brought about by advancing age and cognitive decline over time may impair physical function. Physical function described as the ability of an individual to perform movements which enable them to carry out activities of daily living (ADL) is necessary for older persons to be independent. Some of the many pre-requisites of physical function include components of physical performance (mobility, strength, agility, balance, flexibility, speed and endurance) as well as physical activity (van Lummel et al. 2015).Longitudinal findings have shown a -3.6 to -10.7% decline in strength, mobility and balance components in healthy older persons (Abe et al. 2017) with lower scores annually by 20-25% in MCI groups (Veronese et al. 2016). Comparison of rates of change for physical performance and activity in older persons with and without MCI in longitudinal studies are limited. It was found that there was a 16% (0.13 meter per second) decline in mobility in older persons with MCI, compared to only a 6% (0.05 meter per second, m/s) decline in those without MCI (Veronese et al. 2016). Gait speed was reported to decline at a rate of 0.02m/s per year for 12 years prior to MCI diagnosis in older persons. In older persons with MCI, this decline further increased (0.01m/s yearly) (Buracchio et al. 2010).

As for anthropometry measurements, unintentional weight loss of -0.5 kg per year was associated with an increase in 2.4% chances of developing MCI (Alhurani et al. 2016). Decline in height up to -7.16% with advancing age was noted in a huge population study involving older women and this was related to increased thoracic curvatures (kyphosis) (Katzman et al. 2013). A greater decline in arm circumference (AC) was noted in older women (-0.06% to -0.38% per year) compared to men (-0.06% to -0.26 per year) (Almeida et al. 2013; Gavriilidou et al. 2015). Greater waist circumferences (WC) of 5.3% to 9.7% was noted among older men in comparison to women (Logan et al. 2013; Nam et al. 2012). However, smaller calf circumference (CC) associated with poor cognitive status was only found in older men with frailty, but not in older women [OR: 10.94, CI, 2.87-41.68] (Kim et al. 2018). In addition, men without MCI had significantly greater appendicular skeletal mass (0.06%) compared to men with MCI (Auyeung et al. 2008). Meanwhile, decrease of one standard deviation of abdominal fat was associated with increased likelihood of dementia in women (Spauwen et al. 2017).

Quantitative information of body composition (anthropometry) that include muscles are useful markers for physical performance (Casadei & Kiel, 2021). There is some information about age-related changes in regard to anthropometry and physical status in older persons with and without MCI in cross sectional studies (Tseng, Cullum & Zhang 2014; Lee et al. 2016). However, there are limited studies examining anthropometry as well as comprehensive components of physical performance namely, strength, mobility, flexibility, balance, agility, and physical activity in a longitudinal manner. Specifically, information pertaining to age related changes in flexibility, balance and physical activity is still limited in older persons.

The purpose of our study was to examine gender-specific age-related changes in anthropometry status, physical performance, and physical activity levels over three years in community-dwelling older persons with and without MCI in Malaysia.

MATERIAL AND METHODS

This study is part of a large-scale longitudinal study on healthy longevity "TUA (Towards useful ageing) – A Neuroprotective Model for Healthy Longevity among Malaysian Older Adults". Wave 1 was conducted from May 2012 to February 2013, Wave 2: November 2014 - August 2015 (18 months follow-up) and Wave 3: March 2016 - September 2016 (36 months follow-up). Sampling was conducted by the Malaysian Statistics Department using multistage random sampling method. Ethical approval was obtained from the Medical Research and Ethics Committee of Universiti Kebangsaan Malaysia (UKM 1.5.3.5/244/NN-060-2013).

Community-dwelling older persons between 60-90 years old were recruited. Prior to data collection, all participants provided informed written consent. Detailed sampling is available in prior literature (Shahar et al. 2015).

MCI categorization was in accordance with previous studies (Petersen et al. 2014, Shahar et al. 2015) based on a multicomponent framework which included: subjective memory complaints (answered 'yes' on item 10 of Geriatric Depression Scale); objective memory impairment (scored at least 1.5 SD below mean average on Rey Auditory Verbal Learning Test [RAVLT] and Digit Span), absence of dementia confirmed by physician, no problems with activities in daily living (ADL) and intact global cognition (scored >19/30 on Malay version of Mini Mental Status Examination; MMSE).

An interview using a structured questionnaire was conducted to obtain socio-demographic data as age, gender, race and self-reported medical conditions (hypertension, diabetes, heart disease, cataract/ glaucoma/ joint pain, gout, hearing and vision problems, urinary incontinence, falls history in past 18 months). Anthropometric measurements including weight, height, body mass index (BMI) and circumference of arm, hip, waist and calf were taken using the standard method as reported in the study by Shahar et al. (2015). Participants were allowed to drink plain water during the fasting period but were advised to limit the intake.

Height was measured (in centimetres) using SECA 206 portable body meter (Seca, Hamburg, Germany) in standing position without shoes. Body weight was measured (in kilogrammes, kg) using Tanita digital lithium weighing scale (Tanita, Tokyo, Japan) in light clothing without shoes. Body mass index (BMI) was calculated using the following formula: BMI = Weight / (Height) 2. Arm, waist and hip circumferences were taken in standing position, while calf circumference was measured (in centimetres, cm) in sitting position using a universal measuring tape. After anthropometry measurements, information on percentage body fat (PBF) and skeletal muscle mass were obtained using Inbody S10 (Biospace CO, Ltd, Korea) with the participant in a supine lying position. All the procedures were standardised between participants.

Participants were required to perform physical performance tests as per outlined in the study by Rikli and Jones (2013) and Rikli and Jones (1999) : 2 Minutes step test (2MST), dominant hand grip test (HG), 30 seconds chair stand test (CS), sit and reach test (SR), timed up and go test (TUG), back scratch test (BS) and 6 meter gait speed test (GS).

For 2MST, participants marched continuously for 2 minutes with knees and hips flexed to 90 degrees. Digital Hand Dynamometer (Jamar Plus +, SI Instruments Pty Ltd SA, Australia) was used to measure hand grip of dominant hand in sitting, with shoulders abducted 10-15 degrees, elbows flexed 90 degrees, neutral wrist position and ulnar deviation 0-15 degrees. Participants were instructed to grip the dynamometer as hard as possible with a sustained pressure for 3-5 seconds. This test has a high inter-reliability rate of 0.876 (Bhattacharya et al. 2015).

For CS, participants were instructed to rise and sit as fast and as many times as possible from a standard chair (46 cm in height). The number of completed stands were counted. A stand more than halfway at the end of the 30 seconds was counted as one stand (Milanovic et al. 2013). This test has a high inter-reliability rate of 0.93 (Mijnarends et al. 2013).

For SR, in sitting position, participants bent forward with arms maximally outstretched, both legs straightened forward and toes pointing upwards. The distance between tip of the middle finger to tip of big toe was measured using a universal measuring tape. Positive measurement was indicated when participant was able to cross the tip of the middle finger over the big toe. Bhattacharya et al. (2015) noted a high inter-reliability rate of 0.967 for this test.

For TUG, participants performed sit to stand from a standard chair, walk 3 meters, turn around, walk back and sit back at a normal pace. Time was measured from when participants get up from the chair to when they were seated again. Chen (2013) reported high test-retest reliability for the TUG with an intraclass correlation coefficient (ICC) of 0.95-0.99.

For BS, participants had to stretch one arm above the shoulder and touch midline of the back. The other arm was placed below the shoulder to touch midline of the back, both with fingers straight. The distance between the tips of the middle fingers of both hands was measured. Positive measurement was indicated if both middle fingers touched each other. Bhattacharya et al. (2015) reported an excellent inter-reliability rate of 0.977 for this test.

For the GS, participants were required to walk at a comfortable pace on a marked 6-meter pathway. Using a stopwatch, time was recorded (in seconds) from start of walk to crossing the finishing line. There is a high inter-reliability rate of 0.906 for this test (Bhattacharya et al. 2015).

All PP tests, except 2MST, were repeated twice with a rest in between. The mean of the repeated tests was calculated. Only for HG, the higher score was taken as the result. These tests were conducted by physiotherapists.

PA was measured using the Physical Activity Scale for the Elderly (PASE) questionnaire, which records data pertaining to the frequency, duration, and intensity of 12 different activities carried out over 7 days. We used the PASE-M (Malay version) and this questionnaire (Ismail et al. 2015) has high validity and reliable among Malaysian older adults (Singh et al. 2018).

STATISTICAL ANALYSIS

Only participants with complete data from all three waves were analysed based on 2 levels of stratification comprising of gender and cognitive status. The annual mean change is reported in means, using the formula (Wave 3 - Wave 1) / 3) for all parameters except GS and PASE (Wave 3 - Wave 1) / 1.5) [Unavailable Wave 1 data]. Percentage annual change was calculated based on [(Mean change between Wave 1 to Wave 3 / Baseline score) x 100]. Independent t-test was used to examine significant differences between MCI and non-MCI groups for mean and percentage annual change for each parameter.

Table 1. Participants' sociodemographic characteristics at Wave 1

Variables	Men			Women		
	Without MCI (n= 313)	With MCI (n= 59)	Total (n= 372)	Without MCI (n= 348)	With MCI (n= 59)	Total (n= 407)
Age groups [n (%)]						
60-64	96 (30.7)	19 (32.2)	115 (30.9)	138 (39.7)	15 (25.4)	153 (37.6)
65-74	177 (56.6)	31 (52.5)	208 (55.9)	175 (50.3)	34 (57.6)	209 (51.4)
75-90	40 (12.8)	9 (15.3)	49 (13.2)	35 (10.1)	10 (16.9)	45 (11.1)
Age (Mean ± SD)	67.9 ± 5.2	68.6 ± 5.2	68.0 ± 5.2	67.2 ± 5.4	68.9 ± 5.0	67.4 ± 5.4
Ethnicity [n (%)]						
Malay	223 (71.2)	33 (55.9)	256 (68.8)	216 (62.1)	22 (37.3)	238 (58.5)
Indian	15 (4.8)	2 (3.4)	17 (4.6)	13 (3.7)	1 (1.7)	14 (3.4)

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Chinese	75 (24.0)	24 (40.7)	99 (26.6)	119 (34.2)	36 (61.0)	155 (38.1)
Educational level [n (%)]						
Primary	197 (62.9)	45 (76.3)	242 (65.1)	193 (55.5)	37 (62.7)	230 (56.5)
Secondary	80 (25.6)	12 (20.3)	92 (24.7)	63 (18.1)	3 (5.1)	66 (16.2)
Tertiary	11 (3.5)	0 (0)	11 (3.0)	2 (0.6)	0 (0)	2 (0.5)
No formal education	25 (8.0)	2 (3.4)	27 (7.3)	90 (25.9)	19 (32.2)	109 (26.8)
Marital status [n (%)]						
Single	11 (3.5)	1 (1.7)	12 (3.2)	6 (1.7)	0 (0)	6 (1.5)
Married	213 (68.1)	34 (57.6)	247 (66.4)	246 (70.7)	36 (61.0)	282 (69.3)
Divorced/ Separated	9 (2.9)	4 (6.8)	13 (3.5)	6 (1.7)	2 (3.4)	8 (2.0)
Widow/ Widower	80 (25.6)	20 (33.9)	100 (26.9)	90 (25.9)	21 (35.6)	111 (27.3)
Smoking habits [n (%)]						
Smoker	46 (14.7)	11 (18.6)	57 (15.3)	67 (19.3)	11 (18.6)	78 (19.2)
Ex-smoker	35 (11.2)	6 (10.2)	41 (11.0)	40 (11.5)	7 (11.9)	47 (11.5)
Non-smoker	232 (74.1)	42 (71.2)	274 (73.7)	241 (69.3)	41 (69.5)	282 (69.3)
Past medical history [n (%)]						
Hypertension	148 (47.3)	30 (50.8)	178 (47.8)	171 (49.1)	28 (47.5)	199 (48.9)
Hypercholesterolemia	102 (32.6)	15 (25.4)	117 (31.5)	99 (28.4)	15 (25.4)	114 (28.0)
Diabetes	79 (25.2)	13 (22.0)	92 (24.7)	81 (23.3)	15 (25.4)	96 (23.6)
Heart problems	31 (9.9)	5 (8.5)	36 (9.7)	36 (10.3)	4 (6.8)	40 (9.8)
Cataract/ Glaucoma	33 (10.5)	6 (10.2)	39 (10.5)	29 (8.3)	5 (8.5)	34 (8.4)
Joint pain (OA, OP)	76 (24.3)	12 (20.3)	88 (23.7)	101 (29.0)	20 (33.9)	121 (29.7)
Gout	23 (7.3)	0 (0)	23 (6.2)	5 (1.4)	1 (1.7)	6 (1.5)
Falls history [n (%)]						
Faller	49 (15.7)	8 (13.6)	57 (15.3)	70 (20.1)	11 (18.6)	81 (19.9)
Non faller	264 (84.3)	51 (86.4)	315 (84.7)	278 (79.9)	48 (81.4)	326 (80.1)
Body Mass Index (BMI) (kg/m^2)						
BMI (Means ± SD)	26.9 ± 5.6	26.2 ± 4.9	26.8 ± 5.5	23.9 ± 5.4	24.1 ± 5.3	23.9 ± 5.4
BMI Range (kg/m^2)						
<18.5 (underweight)	16 (5.1)	1 (1.7)	17 (4.6)	57 (16.4)	10 (16.9)	67 (16.5)
18.5-24.9 (healthy weight)	107 (34.2)	24 (40.7)	131 (35.2)	148 (42.5)	22 (37.3)	170 (41.8)
>25.0 (overweight)	190 (60.7)	34 (57.6)	224 (60.2)	143 (41.1)	27 (45.8)	170 (41.8)

Abbreviations: OA- Osteoarthritis, OP- Osteopenia

Repeated measures analysis (SPANOVA) was performed to determine within-group changes for in men and women, taking cognition effect into account. Means from all 3 Waves were used in a 3 levels repeated measure analysis, except for GS and PASE, which used 2 levels of repeated measures.

RESULTS AND DISCUSSION

A total of 779 community dwelling older persons were followed up in all 3 waves (Table 1). 16.4% of participants were categorized as MCI based on Petersen's classification (Petersen et al. 2014) that has been outlined in the methodology. Participants with MCI were older by approximately 10 and 12 months in men and women respectively compared to their non-MCI counterparts. Almost half of the participants had hypertension, followed by hypercholesterolemia and diabetes. About 29% older men and 22% older women were classified as overweight.

Table 2 shows the means and standard deviations (SD) of measured parameters at Wave 1 for participants with complete data from all 3 waves. In men, non-MCI group scored significantly ($p<0.05$) higher in 2MST, CS and PASE. Only in men, the non-MCI group scored significantly ($p<0.05$) higher in PBF, 2MST, CS and PASE.

Table 2. Anthropometry Parameters, Physical Performance and Physical Activity Levels based on Gender and Cognitive Status at Baseline (Wave 1) for participants followed-up in all 3 waves [Mean (SD)]

Variables [Mean (SD)]	Men (n= 372)			Women (n= 407)		
	Without MCI (n= 313)	With MCI (n= 59)	Independent t-test for men	Without MCI (n= 348)	With MCI (n= 59)	Independent t-test for women
Anthropometry parameters						
Weight (kg)	64.74 (11.97)	64.62 (10.35)	0.94	57.43 (11.39)	57.96 (10.57)	0.74
Height (cm)	155.86 (8.13)	157.55 (8.56)	0.15	155.73 (7.98)	155.86 (8.44)	0.92
BMI (kg/m^{2})	26.87 (5.64)	26.23 (4.89)	0.42	23.88 (5.36)	24.13 (5.33)	0.74
Arm circumference (cm)	28.78 (3.15)	28.56 (2.62)	0.62	28.27 (3.96)	28.44 (3.40)	0.75
Waist circumference (cm)	89.01 (10.69)	88.59 (9.49)	0.78	86.27 (11.14)	86.67 (12.61)	0.80
Hip circumference (cm)	95.13 (8.05)	95.08 (7.00)	0.96	97.09 (9.95)	97.95 (9.80)	0.54
Calf circumference (cm)	33.99 (3.51)	34.23 (2.89)	0.62	33.05 (4.08)	33.17 (3.68)	0.83
Skeletal muscle mass (%)	22.22 (4.26)	23.04 (4.14)	0.18	16.78 (3.00)	17.09 (3.59)	0.48
Percentage body fat (%)	35.36 (9.95)	32.27 (9.43)	0.03**	42.93 (9.10)	43.12 (8.55)	0.88
Physical Performance parameters						
2 Minutes step test (no. of reps)	78.00 (19.58)	72.14 (22.02)	0.039*	73.66 (21.37)	74.75 (22.28)	0.72
Hand grip (kg)	28.03 (6.45)	28.26 (6.06)	0.80	18.46 (4.35)	17.66 (5.28)	0.21
Chair stand (no. of reps)	10.79 (2.84)	9.69 (2.48)	0.006*	9.81 (2.62)	10.34 (2.73)	0.16
Sit and reach (cm)	1.56 (9.93)	-1.00 (9.30)	0.07	0.25 (8.22)	0.64 (7.79)	0.74
Time up and go (s)	10.21 (2.21)	10.76 (2.18)	0.08	11.09 (2.62)	11.05 (2.34)	0.91
Back scratch (cm)	-15.17 (11.57)	-18.30 (12.07)	0.06	-12.27 (11.17)	-14.59 (10.64)	0.14
Gait speed# (s)	6.53 (1.30)	6.66 (1.37)	0.48	6.98 (1.61)	7.15 (1.66)	0.50
Physical Activity Parameter						
PASE#	118.70 (54.69)	101.74 (53.43)	0.03*	102.47 (42.31)	98.09 (33.64)	0.45

#Initial measurement taken at 18 months (wave 2). Data not available at Wave 1
* Significant difference at p<0.05 (95%CI)

As shown in Figure 1(a) to 1(i), there is a decline in weight, height, body mass index, skeletal muscle mass, as well as arm, waist, hip and calf circumferences from Wave 1 to Wave 3. In contrast, there is an increase in percentage body fat which indicates increase in body fat over time. As for physical performance and activity [Figure 2(a) to 2(h)], there is a decline for all parameters except for CS and TUG in both MCI and non-MCI and gender groups. For CS, increase in scores from Wave 2 to Wave 3 suggests better outcomes. Meanwhile, throughout the 36 months, more time is required to complete the TUG test. Regardless of gender and cognition, participants took longer over time, indicating decreasing GS with increasing age. Based on gender, men performed better than women in most tests, except for BS and SR, which indicates lower flexibility in men compared to women.

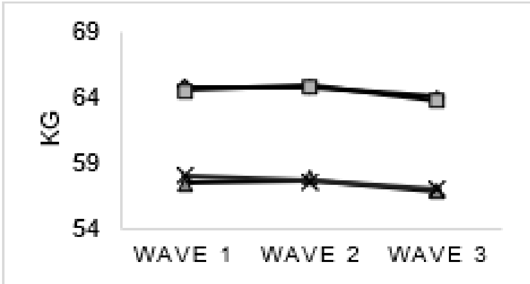

Figure 1(a): Mean changes of Weight

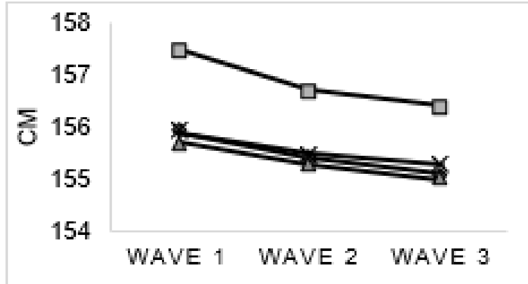

Figure 1(b): Mean changes of Height

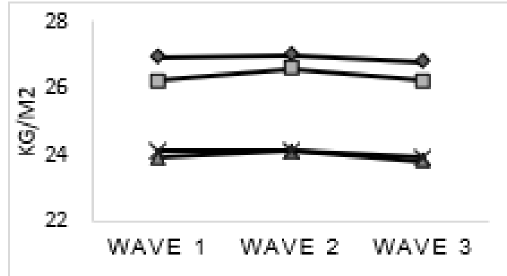

Figure 1(c): Mean changes of Body Mass Index

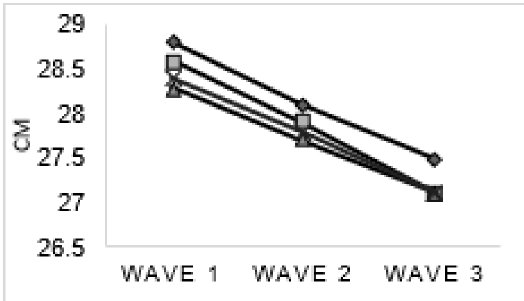

Figure 1(d): Mean changes of Arm Circumference

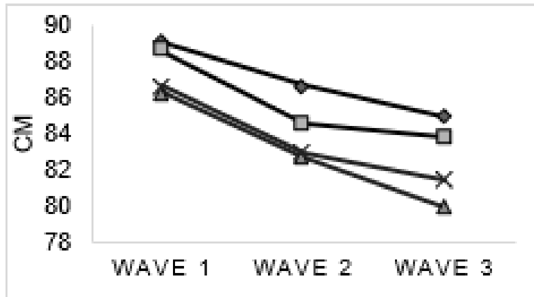

Figure 1(e): Mean changes of Waist Circumference

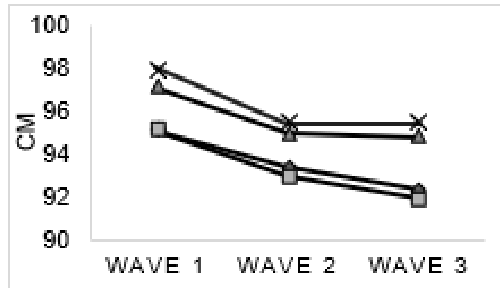

Figure 1(f): Mean changes of Hip Circumference

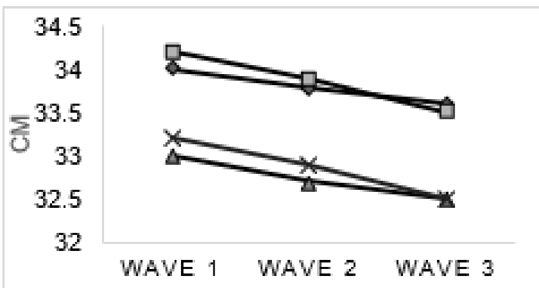

Figure 1(g): Mean changes of Calf Circumference

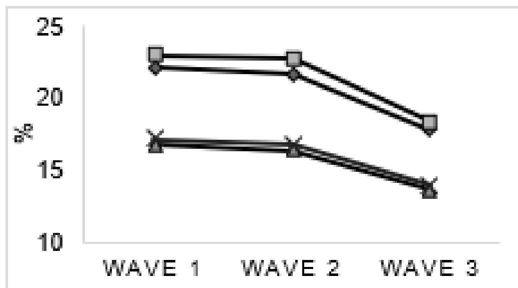

Figure 1(h): Mean changes of Skeletal Muscle Mass

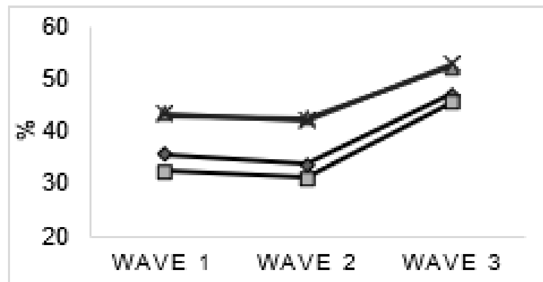

Figure 1(i): Mean changes of Percentage Body Fat

Legend: ◆ Men non-MCI ■ Men MCI ▲ Women non-MCI X Women MCI

Figure 1(a) to 1(i) Mean (SD) Changes for Anthropometry Parameters based on Gender and Cognition Status over 36 months.

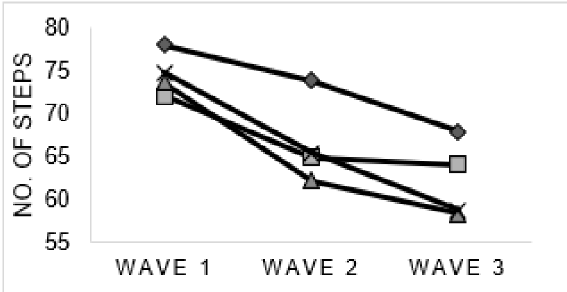

Figure 2(a): Mean changes for 2 Minutes Step test

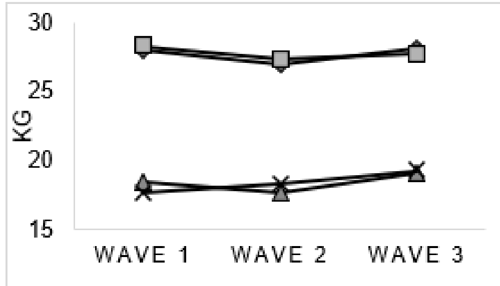

Figure 2(b): Mean changes for Hand Grip test

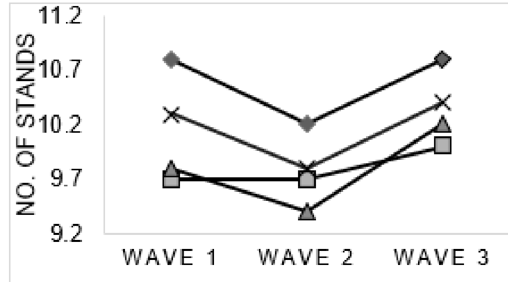

Figure 2(c): Mean changes for Chair Stand test

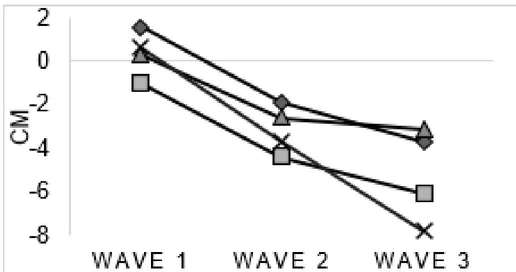

Figure 2(d): Mean changes for Sit & Reach test

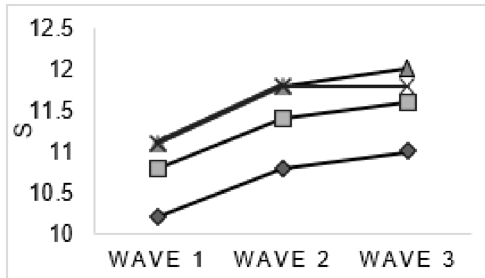

Figure 2(e): Mean changes for Timed Up and Go test

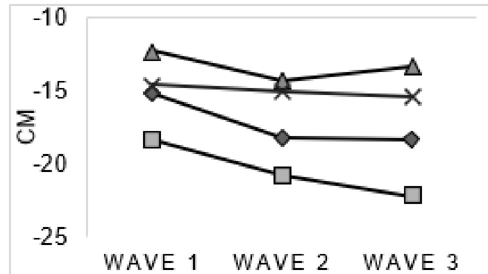

Figure 2(f): Mean changes for Back Scratch test

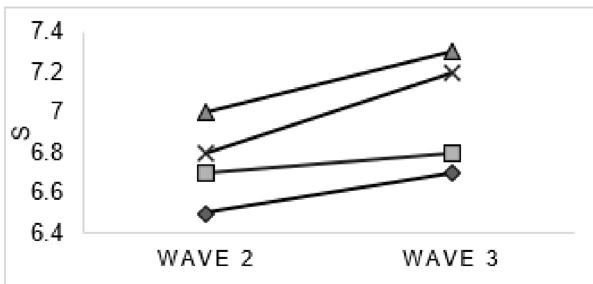

Figure 2(g): Mean changes for Gait Speed

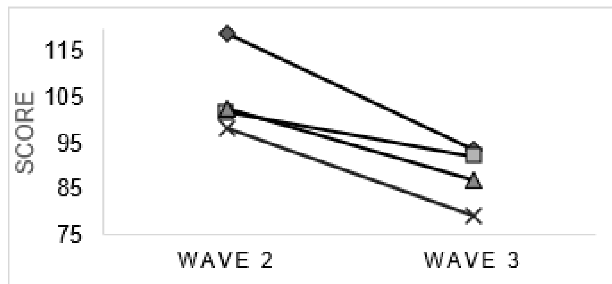

Figure 2(h): Mean changes for PASE

Legend: Men non-MCI Men MCI Women non-MCI X Women MCI

Table 3 shows annual mean change of anthropometry, PP and PA, taking into consideration score differences from Wave 1 to 3. Only scores for SR were found to be significantly different ($p<0.01$) between MCI and non-MCI group in women (Cohen's d: medium effect size of 0.45). For men with MCI, there was greater decline for HG, CS, BS and GS. Meanwhile, there was greater decline in 2MST, SR and PASE for women in the MCI group compared to their non-MCI counterpart. Considering all parameters, men in the non-MCI group showed the highest decline in PASE scores, 2.5 times more than men in the MCI group.

Table 3. Annual Mean Change for Anthropometry, Physical Performance and Physical Activity based on Gender and Cognitive Status

Variables (Mean)	Annual mean change for men [%]			Annual mean change for women [%]		
	Without MCI (n= 313)	With MCI (n= 59)	p-value	Without MCI (n= 348)	With MCI (n= 59)	p-value
Anthropometry parameters						
Weight (kg)	-0.25 [-0.4]	-0.36 [-0.6]	0.613	-0.26 [-0.5]	-0.32 [-0.6]	0.682
Height (cm)	-0.25 [-0.2]	-0.39 [-0.3]	0.11##	-0.26 [-0.2]	-0.20 [-0.1]	0.171
BMI (kg/m^{2})	-0.01 [-0.04]	-0.002 [-0.008]	0.929	-0.02 [-0.1]	-0.06 [-0.3]	0.549
Arm circumference (cm)	-0.44 [-1.5]	-0.49 [-1.7]	0.188	-0.40 [-1.4]	-0.46 [-1.6]	0.107
Waist circumference (cm)	-1.37 [-1.5]	-1.59 [-1.8]	0.432	-2.13 [-2.5]	-1.75 [-2.0]	0.294
Hip circumference (cm)	-0.92 [-1.0]	-1.07 [-1.1]	0.419	-0.77 [-0.8]	-0.85 [-0.9]	0.685
Calf circumference (cm)	-0.13 [-0.4]	-0.25 [-0.7]	0.148	-0.18 [-0.5]	-0.21 [-0.6]	0.771
Skeletal muscle mass (%)	-1.47 [-6.6]	-1.58 [-6.9]	0.512	-1.05 [-6.2]	-1.07 [-6.3]	0.887
Percentage body fat (%)	4.0 [+11.3]	4.40 [+13.6]	0.395	3.15 [+7.3]	3.18 [+7.4]	0.939
Physical Performance Parameters						
2 Minutes step test (no. of reps)	-3.37 [-4.3]	-2.72 [-3.8]	0.503	-5.08 [-6.9]	-5.36 [-7.2]	0.787
Hand grip test (kg)	0.03 [+0.1]	-0.19 [-0.7]	0.335	0.22 [+1.2]	0.56 [+3.2]	0.18##
Chair stand test (no. of reps)	0.01 [+0.1]	0.10 [+0.1]	0.35##	0.12 [+1.2]	0.03 [+0.3]	0.397
Sit and reach test (cm)	-1.76 [-112.8]	-1.71 [-171.0]	0.919	-1.11 [-444.0]	-2.80 [-437.5]	0.003*
TUG (s)	0.28 [+2.7]	0.26 [+2.4]	0.898	0.30 [+2.7]	0.26 [+2.4]	0.727
Back scratch test (cm)	-1.09 [-7.2]	-1.31 [-7.2]	0.712	-0.37 [-3.0]	-0.27 [-1.9]	0.838
Gait speed (s) #	0.10 [+1.5]	0.07 [+1.1]	0.866	0.19 [+2.7]	0.22 [+2.7]	0.860
Physical Activity Parameter						
PASE #	-16.69 [-14.1]	-6.35 [-6.3]	0.059	-10.44 [-10.2]	-12.58 [-12.8]	0.644

Annual mean change calculated based on [(Phase 3 - Phase 1) / 3]
Annual mean change calculated based on [(Phase 3 - Phase 1) / 1.5]#
Percentage mean change (%) calculated based on [(Mean change/ baseline score) x 100]
*Significant difference at $p<0.05$ (95%CI) with Independent t-test
Equal variance not assumed as Homogeneity of variance violated with Levene's test ($p<0.05$)
Negative value denotes decline of scores over time (except Gait speed and TUG)

SPANOVA analysis of anthropometry levels, PP and PA levels for within-groups based on cognitive status in men and women from baseline to 36 months are per Table 4. Men MCI and non-MCI groups had significantly different scores ($p<0.05$) in height and PASE. SR scores were found to be significantly different ($p<0.05$) only in women in the non-MCI and MCI groups.

Table 4. Gender-specific Within-group Difference for Cognition based on Repeated Measures for Anthropometry, Physical Performance and Physical Activity at Baseline (Wave 1), 18 months (Wave 2) and 36 months (Wave 3)

Variables	Men			Women		
	p	ηp^2	Observed Power	p	ηp^2	Observed Power
Anthropometry levels						
Weight	0.573*	0.001	0.126	0.369***	0.003	0.225
Height	**0.017****	0.013	0.694	0.154*	0.005	0.366
Body Mass Index	0.730*	0.001	0.088	0.286*	0.003	0.274
Arm circumference	0.146*	0.006	0.378	0.272*	0.003	0.256
Waist circumference	0.056***	0.008	0.567	0.643***	0.001	0.122
Hip circumference	0.686*	0.001	0.107	0.809*	<0.001	0.079
Calf circumference	0.387***	0.003	0.215	0.813***	0.001	0.082
Skeletal muscle mass	0.409*	0.002	0.179	0.907*	<0.001	0.059
Percentage body fat	0.668*	0.001	0.116	0.670*	0.001	0.114
Physical Performance Parameters						
2 Minutes step test	0.232*	0.004	0.304	0.479*	0.002	0.164
Hand grip test	0.389***	0.003	0.215	0.061*	0.007	0.553
Chair Stand test	0.189*	0.005	0.350	0.917*	<0.001	0.062
Sit and reach test	0.839*	<0.001	0.075	**0.004***	0.015	0.845
TUG	0.983*	<0.001	0.053	0.760*	0.001	0.094
Back scratch test	0.819*	0.001	0.081	0.429*	0.002	0.195
Gait speed	0.460***	0.002	0.114	0.995***	<0.001	0.050
Physical Activity Parameter						
PASE	**0.028*****	0.013	0.596	0.456***	0.001	0.116

* p- value based on Huynd-Feldt values (Epsilon value more than 0.75)
** p-value based on Greenhouse-Geisser (Epsilon value less than 0.75)
*** p-value based on Sphericity Assumed
Significant difference at $p<0.05$ (95%CI) for figures in Bold

SPANOVA analysis conducted based on controlling covariates of age at Wave 1, ethnicity, educational level, marital status, smoking habits and past medical history [hypertension, hypercholesterolemia, diabetes, heart problems, cataract/ glaucoma, joint pain (osteoarthritis, osteoporosis), gout and falls history].

To the best of our knowledge, this is the first study to report comprehensive gender specific age-related decline regarding anthropometry status, PA and PP levels among older persons based on cognitive status.

Among all the anthropometry measurements, only percentage body fat (PBF) was significantly different between non-MCI and MCI men, but not in women at baseline of our study. While further cross sectional studies showed conflicting results for differences of PBF between MCI and non-MCI groups (Lee et al. 2016; Vanoh et al. 2017), women were noted to have higher risk of MCI with increasing body fats (Willers et al. 2018). Although not significant, lower body fat mass has been noted in MCI men as compared to men without MCI (Willers et al. 2018), which is in accordance to our findings. Further reasoning to this can be due to differences in PA levels between MCI and non-MCI men. Age-related changes noted in other anthropometry parameters may be related to reduction in skeletal muscle mass (Walston 2012) and peripheral fats in older persons (Almeida et al. 2013).

In our study, the annual mean increase of PBF was twice higher in men (11.3% & 13.6% per year for with and without MCI respectively) compared to women (7.3% & 7.4% per year for with and without MCI respectively), regardless of their cognitive status. Regardless of gender, a simultaneous mechanism of increase in fat mass and decrease in fat-free mass result in an overall net increase in body fats in older persons (Coin et al. 2006). Ageing, together with such factors as inflammation and increased leptin resistance, result in the rearrangement of fats from superficial to visceral level (Holden et al. 2009). The duration of our study may have not been long enough to detect significant annual changes in PBF. However, our findings are consistent with another study (Delmonico et al. 2009) which demonstrated a two fold increase in inter-muscular fats in older men (+3.1cm2) when compared to women (+1.7cm2) in a 5 year long longitudinal study. While, cross sectional studies showed conflicting results for differences of PBF between MCI and non MCI groups (Lee et al. 2016; Vanoh et al. 2017), women were noted to have higher risk of MCI with increasing body fats (Willers et al. 2018).

A significant and greater decline of height in men (-0.32cm per year, -0.21% per year) compared to women (-0.23cm per year, -0.15% per year) was shown in our study. In contrast, a greater decline of height in women (-0.32cm per year, -0.21% per year) compared to men (-0.21cm per year, -0.12% per year) was reported in an earlier U.S. study (Sorkin et al. 1999). Significant annual age-related height decline in men (-0.16 cm) and women (-0.2 cm) were demonstrated in a longer follow up study (Dey et al. 1999). An association between height and cognitive function has been reported in men (OR, 4.20; CI,1.02-17.36) but not in women (OR,1.65; CI,0.62- 4.40) (Quan et al. 2013). These findings are consistent with our study findings. Generally, the reduction in height in older men and women may be due to age-related changes in musculoskeletal structures including osteoporosis (Ginaldi et al. 2005), spinal vertebral compressions (Xu et al. 2011), paravertebral muscular atrophy (Kim et al. 2013), spinal disc degeneration (Akeda et al. 2015), sarcopenia (Meng et al. 2015) and increased thoracic curvatures (Katzman et al. 2013).

The only physical function components which differed significantly at baseline between men with and without MCI were endurance, lower extremity strength and PA but not between non-MCI and MCI women. This difference could probably due to men having a drastic change in lifestyle towards sedentarism after retirement (Chung et al. 2009). Whereas, women still continued performing their routine chores especially related to household tasks and caretaking of family (Wen et al. 2013). This also explains higher percentage decline (-14% per year) in PA scores among men as compared to women (-10% per year) in the non-MCI group. The highest proportion of PA consisted of housework activities in a local study which supports our explanation of gender differences (Singh et al. 2018). Fundamentally, higher levels of PA in older persons have been shown to safeguard long term memory by enhancing neural processing and dopamine levels which aids neuroprotective mechanism against MCI (Ottenbacher et al. 2014).

Men were more likely to engage in high intensity activities as compared to medium and low intensity activities in women (Moschny et al. 2011) which explains higher endurance and lower extremity strength in men. However, general decline trend in both genders can be due to reduced lung function, arterial elasticity, cardiac wall integrity contributing to decreased VO2 max (Jakovljevic 2017). Correspondingly, lower scores in MCI men in our study can be linked to high prevalence of obesity with men accounting for 60.2% vs 42% in women. An association between excessive weight and endurance, exacerbated by increasing age has been reported (Jerome et al. 2016).

In women, although with MCI, marginally better scores were demonstrated in endurance and lower extremity strength in comparison to their non-MCI counterparts. This can be due to cognitive reserves whereby older persons with MCI intentionally increase their physical threshold to compensate for physiological deficits which has been documented (Callisaya et al. 2017). The endurance test was rather difficult for older persons due to longer completion time, being tedious and repetitive in nature. We found older persons reached fatigue faster for 2 Minutes step test (2MST) and some even during 30 seconds chair stand test (CS). Owing to the high physical demands of these measurements, detectable differences were noted between MCI and non-MCI groups in men. Likewise, better aerobic capacity in older persons was linked with perseverance of cerebral grey matter responsible for neural activities (Makizako et al. 2013).

Our findings showed significant 4 times more decline in women versus 1.5 times in men for lower body flexibility. There is limited information pertaining to age-related decline in relation to flexibility. However, a correlation between advancing age with lower body flexibility among healthy older persons has been reported (Stathokostas et al. 2013).

No association between cognition and lower body flexibility was shown in other recent Asian studies (Lee et al. 2016; Lau et al. 2017). In contrast, lower body flexibility correlated with working memory (digit span test, r= 0.301) and fluid cognition (matrix reasoning test, r= 251) (Won et al. 2014). We can assume predominance of floor culture to be similar across Asian countries. This entails sitting on floor for activities such as religious worship, eating, sleeping, usage of Asian sitting toilets and specific household chores (cooking, cleaning, laundry). Depending on the type and duration of floor activity, most require lower body flexibility with some degree of hip and lumbar flexion.

The probable reason for greater decline in flexibility among women in our study may be due to parallel decline in PA, heighten by presence of MCI. Based on predominance of gender roles, we assume that women with MCI have less involvement related to floor household related chores and overall PA. Notwithstanding this, lower mortality risk by 34% in women who were physically active has been shown previously (Oguma et al. 2002). This may be due to the kinematic demand of SR test as a well preserved test measurement, linked to well-maintained physical functioning in older persons (Lau et al. 2017).

Age-related decline in lower body flexibility in our study could be attributed to physiological changes associated with ageing which includes reduced rates of myogenesis, wear and tear effects of joints from overuse, reduced contractility in actin and myosin protein in sarcomere and decline in elasticity of collagen fibers in joints (Aalami et al. 2003). Greater decline of lower flexibility in women with MCI in our study is supported by a previous study (Stathokostas et al. 2013) reporting greater hip flexion decline in women with a 0.6% per year (0.7 degrees per year) as compared to 0.5% per year (0.6 degrees per year) in men. Decreased flexibility in dorsiflexors (Tainaka et al. 2009) and lumbar extensors (Milanovic et al. 2013) in older persons have also been demonstrated previously.

Although not significant, there was a decline in BS test scores in our participants. These are consistent with the findings of another study that showed lower upper body flexibility in old (aged 70-80) compared to younger older persons (aged 60-69) (Milanovic et al. 2013). Even then, women reported lesser decline of -2.9% per year than men (-7.2% per year) in our study. This can be due to the dressing needs in women such as combing and tying hair, buckling of undergarments, and installing head scarfs (predominantly in Malay women) which involve increased scapular movements in comparison to men.

Muscle flexibility is a perquisite in performing many daily activities effectively such as reaching, bending and in preserving normal gait patterns (Stathokostas et al. 2013). Majority of our participants consist of Malay ethnic group who perform prayer rituals involving kneeling, squatting, and bending. These movements when repeated several times in a day could have assisted in maintaining muscle and ligament extensibility, especially in the spine and lower limbs. Hence, muscle flexibility is an essential gauge of physical independence in older persons (Lau et al. 2017). In comparison to other parameters, lower body flexibility is the only parameter that showed significant changes over 3 time points in women (annual mean decline). We deduce that lower body flexibility could be one of the first aspects of physical performance to decline in older women, subsequently followed by others such as mobility, strength, balance, and agility.

Unexpectedly, mobility scores in our study showed no significant differences between gender or cognition groups. We postulate that a longer distance walking test may provide better accuracy to detect minimal changes. Overall decline in mobility scores in our study can be reflected by ageing physiology related to reduced energy expenditure (Schrack et al. 2016). Another possibility could be due to presence of gait abnormalities involving difficulty in foot clearance, increased step width, reduced stride length and step length (Allali et al. 2017) as well as altered kinematics of hip and knee joints (Ko et al. 2010) with advancing age. Also, age associated deterioration in vision (Singh 1997) and lower limb strength (Eggermont et al. 2010) which are prerequisites to perform walking activities are known factors in poorer mobility scores. Findings from longitudinal studies linked to mobility decline with regards to cognitive status are not readily available. However, a majority of cross sectional findings showed a significant difference between groups for cognitive status in regard to TUG (Ibrahim et al. 2017; Lee et al. 2016; Rolenz & Reneker 2016; Tseng, Cullum & Zhang 2014).

Altered balance in older population with MCI has been deduced to be caused by slower turning (Borges et al. 2016; Mirelman et al. 2014) during TUG performance. Although TUG and gait speed tests are considered quick and straightforward, it encompasses a combination of movements that include sit to stand, vertical acceleration, turning sequence, deceleration, precise stepping and stabilisation (Herman et al. 2011). The ability to perform these tests entails some degree of executive function of planning, orientation and configuration which stresses cognitive abilities, hence requires unimpaired cognitive function for ideal test scores (Pettersson et al. 2005). Whereas, a lower decline in mobility and lack of differences between MCI and non-MCI groups in our findings may be attributed to practice and anticipatory effects among participants. It is noteworthy that we measured dominant hand grip strength to measure upper limb strength in high functioning older persons. It is possible that our participants have maintained dominant upper limb muscle strength for the past three years, which explains absence of notable mean annual and within-group changes in our study. Also, chair stand is a functional activity performed several times daily and it is easily executed in high functioning older persons as in our study.

One of the strengths of our study is the representative multistage sampling. Our study sample also included a sub-population of older persons aged between 60-64 years of age. In addition, older persons were recruited from a range of urban, suburban and rural areas, providing a good representation of Malaysian older population.

However, our study results are limited to a follow up to 36 months. Three years follow up can be considered a fairly short time to detect age-related decline for anthropometry, strength and mobility components. Furthermore, participants with MCI were smaller in the sample size, compared to those without MCI. Homogenous sample size may generate better results for between group differences.

CONCLUSION

There was a decline in PA (ranging from -0.7% to -14.1% per year) and PP levels (ranging from -0.7% to -14.1% per year) as well as anthropometry status (ranging from -0.1% to -6.3% per year), except for percentage body fat (+9.9% per year) with advancing age. Our study adds to the existing body of literature about age-related changes in anthropometry, PP and PA in older persons. The findings from this study about age-related changes in anthropometry and physical performance in community dwelling older adults could be used as a reference for comparison in older adults with impairments. It was shown that older women experienced decline in lower body flexibility, while older men, showed significant decline in height and PA scores, all of which were associated with MCI. Specifically tailored physical and nutritional health prevention and promotion strategies for older persons based on gender and cognitive status may be beneficial to support person-centered care.

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REFERENCES

Aalami, O.O., Fang, T.D. & Song, H.J.M. 2003. Physiological feature of aging persons. *Surgery* 183: 1068–1078. https://jamanetwork.com/journals/jamasurgery/fullarticle/395665#27436187.

Abe, T., Soma, Y., Kitano, N., Jindo, T., Sato, A., Tsunoda, K., Tsuji, T. & Okura, T. 2017. Change in hand dexterity and habitual gait speed reflects cognitive decline over time in healthy older adults : a longitudinal study. *The Journal of Physical Therapy Sciences* 1737–1741. https://doi.org/10.1589/jpts.29.1737.

Akeda, K., Yamada, T., Inoue, N., Nishimura, A. & Sudo, A. 2015. Risk factors for lumbar intervertebral disc height narrowing: A population-based longitudinal study in the elderly Epidemiology of musculoskeletal disorders. *BMC Musculoskeletal Disorders* 16(1): 1–9. http://dx.doi.org/10.1186/s12891-015-0798-5.

Alhurani, R.E., Vassilaki, M., Aakre, J., Mielke, M.M., Kremers, W.K., Machulda, M.M., Geda, Y.E., Knopman, D.S., Peterson, R.C. & Roberts, R.O. 2016. Decline in Weight and Incident Mild Cognitive Impairment: Mayo Clinic Study of Aging 73(4): 439–446. https://doi.org/10.1001/jamaneurol.2015.4756.

Allali, G., Launay, C.P., Blumen, H.M., Callisaya, M.L., Cock, A.-M. De, Kressig, R.W., Srikanth, V., Steinmetz, J.-P., Verghese, J. & Beauchet, O. 2017. Falls, Cognitive Impairment, and Gait Performance: Results From the GOOD Initiative 18(4): 335–340. https://doi.org/10.1016/j.jamda.2016.10.008.

Almeida, M.F.D., Marucci, M.D.F.N., Gobbo, L.A., Ferreira, L.S., Dourado, D.A.Q.S., Duarte, Y.A.D.O. & Lebrão, M.L. 2013. Anthropometric changes in the brazilian cohort of older adults: SABE survey (Health, Well-Being, and Aging). *Journal of Obesity* 2013. https://www.hindawi.com/journals/jobe/2013/695496/.

Auyeung, T.W., Kwok, T., Lee, J., Leung, P.C., Leung, J. & Woo, J. 2008. Functional decline in cognitive impairment - The relationship between physical and cognitive function. *Neuroepidemiology* 31(3): 167–173. https://doi.org/10.1159/000154929.

Bhattacharya, P., Deka, K. & Roy, A. 2015. A community-based study to assess test-retest reliability of senior fitness test in the geriatric population in a northeastern Indian city. *International Journal of Medical Science and Public Health 5*(08): 1. http://www.scopemed.org/?mno=208690.

Bongard, V., McDermott, A.Y., Dallal, G.E. & Schaefer, E.J. 2007. Effects of age and gender on physical performance. *Age* 29(2–3): 77–85. https://doi.org/10.1007/s11357-007-9034-z.

Borges, A.P.O., Carneiro, J.A.O., Zaia, J.E., Carneiro, A.A.O. & Takayanagui, O.M. 2016. Evaluation of postural balance in mild cognitive impairment through a three-dimensional electromagnetic system. *Brazilian Journal of Otorhinolaryngology* 82(4): 433–441. http://dx.doi.org/10.1016/j.bjorl.2015.08.023.

Buchner, D.M., Cress. M.E., Esselman, P.C., Margherita, A.J., de Lateur, B.J., Campbell, A.J., and Wagner, E.H. 1996. Factors associated with changes in gait speed in older adults. *Journal of Gerontology and Medical Sciences* 51A(6): M297–M302. https://pubmed.ncbi.nlm.nih.gov/8914502/.

Buracchio, T., Dodge, H.H., Howieson, D., Wasserman, D. & Kaye, J. 2010. The Trajectory of Gait Speed Preceding Mild Cognitive Impairment. *Archives of Neurology* 67(8): 980–6. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2921227&tool=pmcentrez&rendertype=abstract.

Callisaya, M.L., Launay, C.P., Srikanth, V.K., Verghese, J., Allali, G. & Beauchet, O. 2017. Cognitive status, fast walking speed and walking speed reserve—the Gait and Alzheimer Interactions Tracking (GAIT) study. *GeroScience* 39(2): 231–239. https://doi.org/10.1007/s11357-017-9973-y.

Casedei, K. & Kiel, J. 2021. Anthropometric Measurements.https://www.ncbi.nlm.nih.gov/books/NBK537315/ [17 October 2021].

Chen, H. 2013. Reliability and Minimal Detectable Change of Single- and Dual-Tasking Timed Up & Go Tests. Chung San Medical Journal (24): 9–17. *https://www.semanticscholar.org/paper/Reliability-and-Minimal-Detectable-Change-of-Single-Chen/1a8835f5ba04ebbf21f5cab8523faae4f6ec8139*

Chung, S., Domino, M.E., Stearns, S.C. & Popkin, B.M. 2009. Retirement and Physical Activity. Analyses by Occupation and Wealth. *American Journal of Preventive Medicine* 36(5): 422–428. http://dx.doi.org/10.1016/j.amepre.2009.01.026.

Coin, A., Sergi, G., Inelmen, E.M. & Enzi, G. 2006. Pathophysiology of Body Composition Changes in Elderly People. *Cachexia and Wasting: A Modern Approach* 369–375. http://www.springerlink.com/index/10.1007/978-88-470-0552-5_36.

Delmonico, M.J., Harris, T.B., Visser, M., Park, S.W., Conroy, M.B., Velasquez-Mieyer, P., Boudreau, R., Manini, T.M., Nevitt, M., Newman, A.B. & Goodpaster, B.H. 2009. Longitudinal study of muscle strength, quality, and adipose tissue infiltration123. *The American Journal of Clinical Nutrition* 90(6): 1579–1585. https://doi.org/10.3945/ajcn.2009.28047.INTRODUCTION.

Dey, D., Rothenberg, E., Sundh, V., Bosaeus, I. & Steen, B. 1999. Height and body weight in the elderly. I. A 25 year longitudinal study of a population aged 70 to 95 years. *European Journal of Clinical Nutrition* 53: 905–914. https://www.nature.com/articles/1600852.

Eggermont, L.H., Gavett, B.E., Volkers, K.M., Blankevoort, C.G., Scherder, E.J., Jefferson, A.L., Steinberg, E., Nair, A., Green, R.C. & Stern, R.A. 2010. Lower-Extremity Function in Cognitively Healthy Aging, Mild Cognitive Impairment, and Alzheimer's Disease. *Archives of Physical Medicine and Rehabilitation* 91(4): 584–588. http://dx.doi.org/10.1016/j.apmr.2009.11.020.

Gavriilidou, N.N., Pihlsgard, M. & Elmståhl, S. 2015. Anthropometric reference data for elderly Swedes and its disease-related pattern. *European Journal of Clinical Nutrition* 69(9): 1066–1075. https://doi.org/10.1038/ejcn.2015.73.

Ginaldi, L., Benedetto, M.C. Di & Martinis, M. De. 2005. Osteoporosis, inflammation and ageing. *Immunity & Ageing* 2(1): 14. http://immunityageing.biomedcentral.com/articles/10.1186/1742-4933-2-14.

Herman, T., Giladi, N. & Hausdorff, J.M. 2011. Properties of the "Timed Up and Go" test: More than meets the eye. *Gerontology* 57(3): 203–210. https://doi.org/10.1159/000314963.

Holden, K.F., Lindquist, K., Tylavsky, F.A., Rosano, C., Harris, T.B. & Yaffe, K. 2009. Serum leptin level and cognition in the elderly: Findings from the Health ABC Study 30(9): 1483–

Ibrahim, A., Ajit, D.K.S., Shahar, S. & Omar, M.A. 2017. Timed up and go test combined with self-rated multifactorial questionnaire on falls risk and sociodemographic factors predicts falls among community-dwelling older adults better than the timed up and go test on its own. *Journal of Multidisciplinary Healthcare* 10: 409–416. https://doi.org/10.2147/JMDH.S142520.

Ibrahim, A., Singh, D.K.A. & Shahar, S. 2017. 'Timed Up and Go' test: Age, gender and cognitive impairment stratified normative values of older adults. *PLoS ONE* 12(10): 1–14. https://doi.org/10.1371/journal.pone.0185641.

Ismail, N., Hairi, F., Choo, W.Y., Hairi, N.N., Peramalah, D. & Bulgiba, A. 2015. The Physical Activity Scale for the Elderly (PASE). *Asia Pacific Journal of Public Health* 27(8_suppl): 62S-72S. http://journals.sagepub.com/doi/10.1177/1010539515590179.

Jakovljevic, D.G. 2017. Physical activity and cardiovascular aging: Physiological and molecular insights. *Experimental Gerontology* http://dx.doi.org/10.1016/j.exger.2017.05.016.

Jerome, G.J., Ko, S.U., Chiles Shaffer, N.S., Studenski, S.A., Ferrucci, L. & Simonsick, E.M. 2016. Cross-sectional and longitudinal associations between adiposity and walking endurance in adults age 60-79. *Journals of Gerontology - Series A Biological Sciences and Medical Sciences* 71(12): 1661–1666. https://doi.org/10.1093/gerona/glw054.

Jhansi, S.C. & Mishra, S.K. 2014. Ageing Population and Gender Issues in Asia-Pacific Region. *Carribean Educational Research Journal* 2(2): 61–73. https://www.cavehill.uwi.edu/fhe/education/publications/past-issues/volume-2-number-2-september-2014/articles/article-5-s-c-jhansi,-s-mishra.aspx.

Jones, A.M. & Carter, H. 2000. The effect of endurance training on parameters of aerobic fitness. *Sports medicine* 29(6): 373–386. https://doi.

org/10.2165/00007256-200029060-00001.

Katzman, W.B., Huang, M., Lane, N.E., Ensrud, K.E. & Kado, D.M. 2013. Kyphosis and Decline in Physical Function Over 15 Years in Older Community-Dwelling Women : The Study of Osteoporotic Fractures 68(8): 976–983. https://doi.org/10.1093/gerona/glt009.

Keller, K. & Engelhardt, M. 2013. Strength and muscle mass loss with aging process. Age and strength loss. *Muscles, Ligaments and Tendons Journal* 3(4): 346–350. https://doi.org/10.11138/mltj/2013.3.4.346.

Kim, J.Y., Chae, S.U., Kim, G.D. & Cha, M.S. 2013. Changes of Paraspinal Muscles in Postmenopausal Osteoporotic Spinal Compression Fractures: Magnetic Resonance Imaging Study. *Journal of Bone Metabolism* 20(2): 75. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3910309&tool=pmcentrez&rendertype=abstract%5Cnhttp://synapse.koreamed.org/DOIx.php?id=10.11005/jbm.2013.20.2.75.

Kim, M., Jeong, M., Yoo, J., Song, D. & Won, C. 2018. Calf Circumference as a Screening Tool for Cognitive Frailty in Community-Dwelling Older Adults: The Korean Frailty and Aging Cohort Study (KFACS). *Journal of Clinical Medicine* 7(10): 332. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6210081/.

Ko, S.U., Hausdorff, J.M. & Ferrucci, L. 2010. Age-associated differences in the gait pattern changes of older adults during fast-speed and fatigue conditions: Results from the Baltimore longitudinal study of ageing. *Age and Ageing* 39(6): 688–694. https://doi.org/10.1093/ageing/afq113.

Krasovsky, T., Lamontagne, A., Feldman, A.G. & Levin, M.F. 2014. Effects of walking speed on gait stability and interlimb coordination in younger and older adults. *Gait and Posture* 39(1): 378–385. http://dx.doi.org/10.1016/j.gaitpost.2013.08.011.

Lau, H., Ludin, A.F.M., Rajab, N.F. & Shahar, S. 2017. The Association between Physical Fitness with Successful Ageing and Risk of Cognitive Impairment among Malaysian Older Adults. *Malaysian Journal of Health Sciences* 15(2): 97–102. http://journalarticle.ukm.my/11480/1/16774-56217-1-PB.pdf.

Lee, L.K., Shahar, S., Chin, A.V., Mohd Yusoff, N.A., Rajab, N. & Aziz, S.A. 2012. Prevalence of gender disparities and predictors affecting the occurrence of mild cognitive impairment (MCI). *Archives of Gerontology and Geriatrics* 54(1): 185–191. http://dx.doi.org/10.1016/j.archger.2011.03.015.

Lee, S., Han, J., Jin, Y., Lee, I., Hong, H. & Kang, H. 2016. Poor physical fitness is independently associated with mild cognitive impairment in elderly Koreans. *Biology of Sport* 33(1): 57–62. https://doi.org/10.5604/20831862.1185889

Lenardt, M.H., Sousa, J.A.V. de, Grden, C.R.B., Betiolli, S.E., Carneiro, N.H.K. & Ribeiro, D.K. de M.N. 2015. Gait speed and cognitive score in elderly users of the primary care service. *Revista brasileira de enfermagem* 68(6): 1163–1168. http://www.ncbi.nlm.nih.gov/pubmed/26676441.

Logan, S.L., Gottlieb, B.H., Maitl, S.B., Meegan, D. & Spriet, L.L. 2013. The physical activity scale for the elderly (PASE) questionnaire; Does it predict physical health? *International Journal of Environmental Research and Public Health* 10(9): 3967–3986. https://doi.org/10.3390/ijerph10093967.

Makizako, H., Shimada, H., Doi, T., Park, H., Yoshida, D. & Suzuki, T. 2013. Six-Minute Walking Distance Correlated with Memory and Brain Volume in Older Adults with Mild Cognitive Impairment: A Voxel-Based Morphometry Study. *Dementia and Geriatric Cognitive Disorders Extra* 3(1): 223–232. http://www.karger.com?doi=10.1159/000354189.

Meng, N.H., Li, C.I., Liu, C.S., Lin, C.H., Lin, W.Y., Chang, C.K., Li, T.C. & Lin, C.C. 2015. Comparison of height- and weight-adjusted sarcopenia in a Taiwanese metropolitan older population. *Geriatrics and Gerontology International* 15(1): 45–53. https://doi.org/10.1111/ggi.12227.

Mielke, M.M., Roberts, R.O., Savica, R., Cha, R., Drubach, D.I., Christianson, T., Pankratz, V.S., Geda, Y.E., Machulda, M.M., Ivnik, R.J., Knopman, D.S., Boeve, B.F., Rocca, W.A. & Petersen, R.C. 2013. Assessing the temporal relationship between cognition and gait: Slow gait predicts cognitive decline in the mayo clinic study of aging. *Journals of Gerontology - Series A Biological Sciences and Medical Sciences* 68(8): 929–937. https://doi.org/10.1093/gerona/gls256.

Mijnarends, D.M., Meijers, J.M.M., Halfens, R.J.G., Ter Borg, S., Luiking, Y.C., Verlaan, S., Schoberer, D., Cruz Jentoft, A.J., Van Loon, L.J.C. & Schols, J.M.G.A. 2013. Validity and Reliability of Tools to Measure Muscle Mass, Strength, and Physical Performance in Community-Dwelling Older People: A Systematic Review. *Journal of the American Medical Directors Association 14*(3): 170–178. http://dx.doi.org/10.1016/j.jamda.2012.10.009.

Milanovic, Z., Pantelic, S., Trajkovic, N., Sporis, G., Kostic, R. & James, N. 2013. Age-related decrease in physical activity and functional fitness among elderly men and women. *Clinical Interventions in Aging* 8: 549–556. https://pubmed.ncbi.nlm.nih.gov/23723694/.

Mirelman, A., Weiss, A., Buchman, A.S., Bennett, D.A., Giladi, N. & Hausdorff, J.M. 2014. Association between performance on timed up and go subtasks and mild cognitive impairment: Further insights into the links between cognitive and motor function. *Journal of the American Geriatrics Society* 62(4): 673–678. https://doi.org/10.1111/jgs.12734.

Morisawa, T., Tamaki, A., Nagai, K., Tsukagoshi, R., Nozaki, S., Miyamoto, T., Mori, A., Kaya, M. &

Fujioka, H. 2017. Effects of increased physical activity on body composition, physical functions, vascular functions, HR-QOL, and self-efficacy in community-dwelling elderly people. *Journal of Physical Therapy Science* 29(1): 152–157. https://www.jstage.jst.go.jp/article/jpts/29/1/29_jpts-2016-830/_article.

Moschny, A., Platen, P., Klaaßen-Mielke, R., Trampisch, U. & Hinrichs, T. 2011. Physical activity patterns in older men and women in Germany: A cross-sectional study. *BMC Public Health* 11(1): 559. http://www.biomedcentral.com/1471-2458/11/559.

Nam, S., Kuo, Y.-F., Markides, K.S. & Snih, S. Al. 2012. Waist circumference, body mass index, and disability among older adults in Latin American and the Caribbean Sanggon 55(2): e40–e47. https://doi.org/10.1016/j.pmrj.2014.02.014.Lumbar.

Oguma, Y., Sesso, H.D., Jr, R.S.P. & Lee, I.-M. 2002. Physical activity and all cause mortality in women: a review of the evidence. *British Journal of Sports Medicine* 36: 162–172. https://pubmed.ncbi.nlm.nih.gov/12055109/.

Ottenbacher, A.J., Snih, S. Al, Bindawas, S.M., Markides, K.S., Graham, J.E., Samper-Ternent, R., Raji, M. & Ottenbacher, K.J. 2014. Role of physical activity in reducing cognitive decline in older mexican-american adults. *Journal of the American Geriatrics Society* 62(9): 1786–1791. https://doi.org/10.1111/jgs.12978.

Payette, H., Gueye, N.R., Gaudreau, P., Morais, J.A., Shatenstein, B. & Gray-Donald, K. 2011. Trajectories of physical function decline and psychological functioning: the Quebec longitudinal study on nutrition and successful aging (NuAge). *The journals of gerontology. Series B, Psychological sciences and social sciences 66 Suppl* 1: i82-90. http://www.ncbi.nlm.nih.gov/pubmed/21135071.

Petersen, R.C., Caracciolo, B., Brayne, C., Gauthier, S., Jelic, V. & Fratiglioni, L. 2014. Mild cognitive impairment: A concept in evolution. *Journal of Internal Medicine* 275(3): 214–228. https://doi.org/10.1111/joim.12190.

Pettersson, A.F., Olsson, E. & Wahlund, L.O. 2005. Motor function in subjects with mild cognitive impairment and early Alzheimer's disease. *Dementia and Geriatric Cognitive Disorders* 19(5–6): 299–304. https://doi.org/10.1159/000084555.

Quan, S.A., Jeong, J. & Kim, D. 2013. The Relationship between Height and Cognitive Function among Community-dwelling Elderly: Hallym Aging Study. *Epidemiology and health* 35: e2013002. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3654091&tool=pmcentrez&rendertype=abstract.

Reid, K.F. & Fielding, R.A. 2012. Skeletal Muscle Power: A Critical Determinant of Physical Functioning in Older Adults. *Exercise & Sport Sciences Reviews* 40(1): 4–12. http://search.ebscohost.com/login.aspx?direct=true&db=sph&AN=70928790&site=ehost-live.

Remaud, A., Thuong-Cong, C. & Bilodeau, M. 2016. Age-related changes in dynamic postural control and attentional demands are minimally affected by local muscle fatigue. *Frontiers in Aging Neuroscience* 7(JAN): 1–13. https://doi.org/10.3389/fnagi.2015.00257.

Rikli, R.E. & Jones, C.J. 1999. Development and Validation of a Functional Fitness test for Community-Residing Older Adults. *Journal of Ageing and Physical Activity* 7(162-181). https://doi.org/10.1123/japa.7.2.162

Rikli, R.E. & Jones, C.J. 2013. Development and validation of criterion-referenced clinically relevant fitness standards for maintaining physical independence in later years. *Gerontologist* 53(2): 255–267. https://pubmed.ncbi.nlm.nih.gov/22613940/

Rolenz, E. & Reneker, J.C. 2016. Validity of the 8-Foot Up and Go, Timed Up and Go, and Activities-Specific Balance Confidence scale in older adults with and without cognitive impairment. *Journal of Rehabilitation Research and Development* 53(4): 511–518. https://doi.org/10.1682/JRRD.2015.03.0042.

Sachdev, P.S., Lipnicki, D.M., Kochan, N.A., Crawford, J.D., Thalamuthu, A., Andrews, G., Brayne, C., Matthews, F.E., Stephan, B.C.M., Lipton, R.B., Katz, M.J., Ritchie, K., Carrière, I., Ancelin, M.L., Lam, L.C.W., Wong, C.H.Y., Fung, A.W.T., Guaita, A., Vaccaro, R., Davin, A., Ganguli, M., Dodge, H., Hughes, T., Anstey, K.J., Cherbuin, N., Butterworth, P., Ng, T.P., Gao, Q., Reppermund, S., Brodaty, H., Schupf, N., Manly, J., Stern, Y., Lobo, A., Lopez-Anton, R., Santabárbara, J., Zimmerman, M., Derby, C., Leung, G.T.Y., Chan, W.C., Polito, L., Abbondanza, S., Valle, E., Colombo, M., Vitali, S.F., Fossi, S., Zaccaria, D., Forloni, G., Villani, S., Christensen, H., MacKinnon, A., Easteal, S., Jacomb, T., Maxwell, K., Bowman, A., Burns, K., Broe, A., Dekker, J., Dooley, L., De Permentier, M., Fairjones, S., Fletcher, J., French, T., Foster, C., Nugent-Cleary-Fox, E., Gooi, C., Harvey, E., Helyer, R., Hsieh, S., Hughes, L., Jacek, S., Johnston, M., McCade, D., Meeth, S., Milne, E., Moir, A., O'Grady, R., Pfaeffli, K., Pose, C., Reuser, L., Rose, A., Schofield, P., Shahnawaz, Z., Sharpley, A., Thompson, C., Queisser, W., Wong, S., Mayeux, R., Brickman, A., Luchsinger, J., Sanchez, D., Tang, M.X., Andrews, H., Marcos, G., De-La-Cámara, C., Saz, P., Ventura, T., Quintanilla, M.A. & Lobo, E. 2015. The prevalence of mild cognitive impairment in diverse geographical and ethnocultural regions: The COSMIC Collaboration. *PLoS ONE* 10(11): 1–19. https://doi.org/10.1371/journal.pone.0142388.

Schrack, J.A., Zipunnikov, V., Simonsick, E.M., Studenski, S. & Ferrucci, L. 2016. Rising energetic cost of walking predicts gait speed decline with aging. *Journals of Gerontology - Series A Biological Sciences and Medical Sciences* 71(7): 947–953. https://doi.org/10.1093/gerona/glw002.

Shahar, S., Omar, A., Vanoh, D., Hamid, T.A., Mukari, S.Z.M.S., Din, N.C., Rajab, N.F., Mohammed, Z., Ibrahim, R., Loo, W.H., Meramat, A., Kamaruddin, M.Z.A., Bagat, M.F. & Razali, R. 2015. Approaches in methodology for population-based longitudinal study on neuroprotective model for healthy longevity (TUA) among Malaysian Older Adults. *Aging Clinical and Experimental Research* 28(6): 1089-1104. https://doi.org/10.1007/s40520-015-0511-4.

Singh, D.K.A., Rahman, N.N.A.A., Rajaratnam, B.S., Yi, T.C. & Shahar, S. 2018. Validity and Reliability of Physical Activity Scale for Elderly in Malay Language (Pase-M) (1): 116–123. https://www.mjphm.org.my/mjphm/journals/2018%20-%20Special%20Volume%20(1)/VALIDITY%20AND%20RELIABILITY%20OF%20PHYSICAL%20ACTIVITY%20SCALE%20FOR%20ELDERLY%20IN%20MALAY%20LANGUAGE%20(PASE-M).pdf

Singh, P. 1997. Ophthalmic problems among the elderly in Malaysia. *Medical Journal of Malaysia* 52(3): 213–216. http://www.e-mjm.org/1997/v52n3/Ophthalmic_Problems.pdf/

Sorkin, J.D., Muller, D.C. & Andres, R. 1999. Longitudinal Change in Height of Men and Women: Implications for Interpretation of the Body Mass Index: The Baltimore Longitudinal Study of Aging. *American Journal of Epidemiology* 150(9): 969–977. https://academic.oup.com/aje/article-lookup/doi/10.1093/oxfordjournals.aje.a010106.

Spauwen, P.J.J., Murphy, R.A., Jónsson, P. V., Sigurdsson, S., Garcia, M.E., Eiriksdottir, G., Van Boxtel, M.P.J., Lopez, O.L., Gudnason, V., Harris, T.B. & Launer, L.J. 2017. Associations of fat and muscle tissue with cognitive status in older adults: The AGES-Reykjavik Study. *Age and Ageing* 46(2): 250–257. https://doi.org/10.1093/ageing/afw219.

Stathokostas, L., Mcdonald, M.W., Little, R.M.D. & Paterson, D.H. 2013. Clinical Study Flexibility of Older Adults Aged 55 – 86 Years and the Influence of Physical Activity. *Journal of Aging Research* 2013: 1–8. https://www.hindawi.com/journals/jar/2013/743843/.

Tainaka, K., Takizawa, T., Katamoto, S. & Aoki, J. 2009. Six-year prospective study of physical fitness and incidence of disability among community-dwelling Japanese elderly women. *Geriatrics and Gerontology International* 9(1): 21–28. https://doi.org/10.1111/j.1447-0594.2008.00492.x.

Tieland, M., Trouwborst, I. & Clark, B.C. 2018. Skeletal muscle performance and ageing. *Journal of Cachexia, Sarcopenia and Muscle* 9(1): 3–19. https://onlinelibrary.wiley.com/doi/10.1002/jcsm.12238

Tseng, B., Cullum, C. & Zhang, R. 2014. Older Adults with Amnestic Mild Cognitive Impairment Exhibit Exacerbated Gait Slowing under Dual-Task Challenges. *Current Alzheimer Research* 11(5): 494–500. http://www.eurekaselect.com/openurl/content.php?genre=article&issn=1567-2050&volume=11&issue=5&spage=494. https://doi.org/10.2174/1567205011666140505110828.

van Lummel, R.C., Walgaard, S., Pijnappels, M., Elders, P.J.M., Garcia-Aymerich, J., van Dieën, J.H. & Beek, P.J. 2015. Physical Performance and Physical Activity in Older Adults: Associated but Separate Domains of Physical Function in Old Age. *Plos One* 10(12): e0144048. http://dx.plos.org/10.1371/journal.pone.0144048.

Vanoh, D., Shahar, S., Din, N.C., Omar, A., Vyrn, C.A., Razali, R., Ibrahim, R. & Hamid, T.A. 2017. Predictors of poor cognitive status among older Malaysian adults: baseline findings from the LRGS TUA cohort study. *Aging Clinical and Experimental Research* 29(2): 173–182. https://pubmed.ncbi.nlm.nih.gov/26980453/

Veronese, N., Stubbs, B., Trevisan, C., Bolzetta, F., De Rui, M., Solmi, M., Sartori, L., Musacchio, E., Zambon, S., Perissinotto, E., Crepaldi, G., Manzato, E. & Sergi, G. 2016. What physical performance measures predict incident cognitive decline among intact older adults? A 4.4 year follow up study. *Experimental Gerontology* 81: 110–118. http://dx.doi.org/10.1016/j.exger.2016.05.008.

Veronica, G. & Kunlin, J. 2007. Neurogenesis in the aging brain. *Clinical Interventions in Aging* 2(4): 605–610. https://doi.org/10.1016/j.bcp.2017.06.116.

Volpi, E., Nazemi, R. & Fujita, S. 2004. Muscle tissue changes with aging. *Current opinion in clinical nutrition and metabolic care* 7(4): 405–410. https://doi.org/10.1097/01.mco.0000134362.76653.b2.

Walston, J.D. 2012. Sarcopenia in older adults. *Current Opinion in Rheumatology* 24(6): 623–627. https://doi.org/10.1097/BOR.0b013e328358d59b.

Wen, X., Liang, Y., Zhu, J. & Wu, T. 2013. The Effects of Housework on the Health of Retired Older Adults : A Preliminary Investigation from the Tongji- 8(3): 1–6. https://doi.org/10.1093/ije/dys053.

Willers, J., Hahn, A., Gellert, S., Witte, V., Tesky, V., Pantel, J. & Schuchardt, J.P. 2018. Poor Body Composition in Patients with Mild Cognitive Impairment Compapred to Healthy Older Controls. *Journal of Aging Research and Clinical Practice* 7(8): 37–41. https://www.jarlife.net/3743-poor-body-composition-in-patients-with-mild-cognitive-impairment-compared-to-healthy-older-controls.html.

Won, H., Singh, D.K.A., Din, N.C., Badrasawi, M., Manaf, Z.A., Tan, S.T., Tai, C.C. & Shahar, S. 2014. Relationship between physical performance and cognitive performance measures among community-

dwelling older adults. *Clinical Epidemiology* 6: 343–350. https://doi.org/10.2147/CLEP.S62392.
Xu, W., Perera, S., Medich, D., Fiofito, G., Wagner, J., K.Berger, L. & Greenspan, S.L. 2011. Height Loss, Vertebral Fractures, and the Misclassification of Osteoporosis. *Bone* 48(2): 307–311. https://doi.org/:10.1016/j.bone.2010.09.027.

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