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Sarcopenia and Its Impact on Health: Do They Have Significant Associations?

(Sarkopenia dan Kesannya ke Atas Kesihatan: Adakah Terdapat Sebarang Hubung Kait?)

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ABSTRACT

A cross sectional study was conducted to determine the prevalence of Sarcopenia and its association with health profiles and oxidative stress among multiethnic older adults in an urban area of Malaysia. Sarcopenia was assessed using Bioimpedance analysis (BIA) and the associations between demography, socioeconomic status, lifestyle practices, health risk factors and blood profile were examined on 388 apparently healthy subjects aged 60 years and above. Prevalence of sarcopenia was 89.0% in men and 40.3% in women with the overall prevalence of 59.8%. It was found that prevalence of severe sarcopenia was 13.9% and sarcopenia obese was 23.5%. Binary logistic regression showed that there was no predictor found in men or women. However, a decline in muscle mass was observed in sarcopenic as compared with normal subjects. Sarcopenia is prevalent and there is a need to implement interventional strategies to prevent sarcopenia and its associated comorbidities.

Keywords: Elderly people; Malaysia; muscle mass; oxidative stress; sarcopenia

ABSTRAK

Satu kajian keratan lintang telah dijalankan bagi menentukan prevalens sarkopenia dan hubungannya dengan profil kesihatan dan tekanan oksidatif dalam kalangan warga tua multietnik di sebuah kawasan bandar di Malaysia. Sarkopenia dinilai menggunakan analisis bioimpedans (BIA) dan hubungannya dengan demografi, status sosioekonomi, amalan gaya hidup, faktor risiko kesihatan dan profil darah telah ditentukan dalam kalangan 388 subjek berusia 60 tahun dan ke atas yang kelihatan sihat. Prevalens sarkopenia adalah 89.0% dalam kalangan lelaki dan 40.3% dalam kalangan wanita, dengan prevalens keseluruhan adalah 59.8%. Didapati bahawa prevalens sarkopenia teruk adalah 13.9% dan sarkopenia obes adalah 23.5%. Analisis regresi logistik binari menunjukkan tiada prediktor yang dijumpai bagi lelaki atau wanita. Walau bagaimanapun, penurunan jisim otot berlaku dalam kalangan subjek sarkopenia berbanding subjek normal. Sarkopenia adalah prevalens dan terdapat keperluan bagi implementasi strategi pencelahan bagi mencegah sarkopenia dan komorbiditi berkaitannya.

Kata kunci: Jisim otot; Malaysia; sarkopenia; tekanan oksidatif; warga tua

INTRODUCTION

Sarcopenia is increasingly recognized as a health problem among older persons (Baumgartner et al. 1998; Lau et al. 2005; Melton et al. 2000) and it is one of the major determinant factors in frailty (Baumgartner et al. 1998; Melton et al. 2000; Newman 2003). Losses of more than 40% muscle mass as frequently seen in elderly people with sarcopenia are associated with morbidity and diminished strength due to a reduction in physical activity and aerobic capacity. The relatively low muscle mass may already adversely affect quality of life and functional abilities (Baumgartner et al. 1998). Physical disability and functional limitations are common among older people, leading to adverse consequences such as dependency and institutionalization. Older people's ability to function independently is important, as physical disability and functional limitation have profound public health implications with increased utilization of health care and a need for supportive services and long term care (Baumgartner et al. 1998; Morley et al. 2001).

The prevalence of sarcopenia among older adults in western countries ranged from 8.8% to 17.5% with its prevalence increasing with ageing. For example, in the New Mexico Elder Health Survey involving 426 men and 382 women, the prevalence of sarcopenia varied from 13% to 24% among subjects under 70 years old to more than 50% among those aged 80 years and above (Baumgartner et al. 1998). The magnitude of sarcopenia among Asian elderly people in Hong Kong was 7.2% in men and 6.1% in women (Sowers et al. 2005). The discrepancy of the prevalence of sarcopenia might not only be due to differences in body composition across ethnic groups but also depends on the diagnostic criteria and techniques utilised. Furthermore, since body composition varies among ethnic groups, the cut off points of health risk may differ across different populations (Tanko et al. 2002).

Cigarette smoking, poor health, low body mass index (BMI) and low testosterone levels in men were several of the associated factors identified in the western population (Baumgartner et al. 1998). However, there is a paucity

of literature regarding risk factors of sarcopenia amongst Asians.

Accumulation of reactive oxygen species throughout life is known to influence the ageing process. The mechanism by which reactive oxygen species accumulate and contribute to the aging of muscles involves the insufficient function of the respiratory chain, as well as mutations in mitochondrial DNA (Lau et al. 2005). The oxidative capacity of human muscles have been characterized between younger and older adults and is shown to decrease with age and muscle mass (Janssen et al. 2002). Previous studies, however, have not shown the relationship between hand grip strength and protein carbonyl levels in human plasma. In humans, elevated serum protein carbonyls levels have been described in the elderly compared to younger adults (Tanko et al. 2002). Indicators of oxidative damage to lipids and proteins could complement these investigations. However, very few studies have explored the influences of oxidative stress on sarcopenia. Therefore, this study aimed to investigate the magnitude of sarcopenia among Malaysian elderly and its association with health factors including oxidative stress and food intake.

METHODOLOGY

STUDY DESIGN AND PARTICIPANTS

This is a cross-sectional study that was carried out from December 2008 until early May 2009. A total of 388 subjects (39.9% men and 60% women) residing at 15 low cost flats and houses managed by Kuala Lumpur City Hall, Cheras, Kuala Lumpur, Malaysia participated in this study through convenient sampling. The subjects were recruited with the help of the Housing Management Officer, residential representative, as well as through information from using posters, banners, invitation letters and informational lectures. The inclusion criteria also included individuals aged 60 years old and above, subjects with at least a duration of permanent residence of one year prior to the study with no terminal or mental illness. Written informed consent was obtained from all subjects. This study has been approved by the Medical Research and Ethics Committee of Universiti Kebangsaan Malaysia.

DEMOGRAPHY, LIFESTYLE AND ANTHROPOMETRY

The subjects were gathered at community halls for anthropometry measurement, body composition and also interviewed for socio-demography and health profile. Screening questionnaires on demography details included gender, age, ethnics, marital status, education level, employment status and monthly household income. For lifestyle assessment, questions on smoking and self-reported exercise practices were obtained. Assessment of food intake (Dietary Habits Questionaires) as well as appetite was assessed using CNAQ questionnaires. Handgrip strength using handgrip Dynamometer JAMAR 7498-05 (JAMAR Sammons Preston, Inc, UK) to the nearest 0.1 kg was used. Anthropometry parameters were measured using TANITA digital lithium scale HD319, (TANITA Corporation, Japan) for body weight, using SECA Leicester Portable Height Measure (SECA, German) for height and waist circumference using SECA measuring tape (SECA, German). Maltron Bio-Scan 916 (Maltron International Ltd, UK) was used for estimation of body composition using bio-impedance analysis method.

DETERMINATION OF SARCOPENIA

Subjects were categorized as sarcopenia when the skeletal muscle mass index = (total skeletal muscle (kg) / height (m^2)) value was below – 2 SD compared with young adults. The cut off points for Asian population that was used to classify sarcopenia is less than 10.75 kg/m^2 in men and 6.75 kg/m^2 in women (Janssen et al. 2002). For moderate sarcopenia, the cut-off point is between 8.51 and 10.75 kg/m^2 in men and 5.76 and 6.75 kg/m^2 in women. However, for severe sarcopenia the cut-off point for men is <8.50 kg/m^2 and <5.75 kg/m^2 for women.

CLINICAL AND LABORATORY EXAMINATION

Clinical evaluation for hypertension and diabetes mellitus was conducted and the presence of chronic diseases was confirmed (self-reported, diagnosed by physician and identified current medication). A total of 10 mL venous blood sample was drawn from the antecubital vein in a seated position after an overnight fast. The samples were centrifuged at 28000 g for 5 min at 4°C and the clear supernatants were collected and stored at –30°C for plasma separation. Plasma was transferred in Eppendorf tubes and used for the oxidative stress markers determination of superoxide dismutase enzyme (Bayer & Fridovich 1987) and protein carbonyl (Buss et al. 1997). Lipid hydroperoxide was determined using kits by Cayman Chemicals (USA). Blood samples were stored in multiple aliquots at –30°C and thawed only once prior to analysis. Another portion of blood (10 mL) was collected in plain tubes, left on ice for 20 min to clot and then centrifuged at 1500 g for 10 min at 4°C for serum separation. Serum was sent to the Gribbles Pathology Department for analysis of homocysteine, total cholesterol, HDL, LDL and glucose analysis using automated ADVIA 2400 from Siemens (USA).

STATISTICAL ANALYSIS

Statistical package for Social Sciences version 17 (SPSS, Inc, Chicago, IL) was used to analyze the data collected. Descriptive analyses were performed on demography, clinical and laboratory examinations. The prevalence of Sarcopenia between genders was presented in percentage. Pearson's correlation test was carried out to compare the differences in the frequency of Sarcopenia among genders. Binary logistic regression analysis was used to simultaneously examine the relative predictors for

Sarcopenia among men and women. All tests were 2-tailed at a probability level of 0.05.

Results

General

The mean age of subjects were 66.4±5.7 years old with no differences between men (66.56±5.55 years) and women (66.7±6.24 years) ranging from 60 to 86 years. The prevalence of sarcopenia was 89.0% in men and 40.3% in women with the overall prevalence of 59.8% (Figure 1). Most of the subjects were categorized as moderate sarcopenia with 72.9% prevalence in men and 27.9% in women. On one hand, severe sarcopenia in men was 16.1% and 12.4% in women. On the other hand, sarcopenia was categorized as sarcopenia lean with prevalence in men was 47.4% and 24.5% in women. Proportion of sarcopenia obese was 42.2% in men and 15.8% in women.

Factors associated with sarcopenia incidence between gender

The results from χ^2 analyses to investigate the association between various independent variables and the incidence of sarcopenia between genders are shown in Table 1. The results indicated, that Diabetes and HDL were significantly associated with incidence of sarcopenia in men ($p<0.05$). For women, those who are more than 70 years (41.6% > 70 years, 26.9% 60-70 years,) (Crude Odd Ratio (OR) 1.937); a 95% confidence interval (CI) 1.097-3.421; $p=0.023$) was found to be associated with women. Overall, age group more than 70 years (36.6% more than 70 years, 26.7% age between 60 and 70 years) (Crude OR 1.588; 95% CI 1.010-2.497; $p=0.045$), being married (66.4% married, 33.6% single/widow) (Crude OR 1.876; 95% CI 1.238-2.842; $p=0.003$), hypercholesterolemia (66.3% high, 33.7% normal) (Crude OR 0.523; 95% CI 0.305-0.896; $p=0.017$) and hyperhomocysteine (52.5% hyperhomocysteine, 31.9% normal) (Crude OR 1.930; 95% CI 1.190 – 3.129; $p=0.007$). However, binary logistic regression (Table 3) demonstrated an absence of predictors among men and women in this study.

Body composition, oxidative stress and biochemical parameters for men and women

The results showed that there were reductions in weight (men: 64.7±11.2; women: 52.3±10.99), BMI (men: 24.8±3.8; women: 23.9±6.1) and waist circumference (men: 87.9±11.9; women: 79.7±13.7) in sarcopenic subjects compared with non sarcopenic subjects in both men and women ($p<0.05$). Sarcopenic subjects in both men and women have lower SMI (9.24 ± 0.99 in men and 5.98 ± 0.65 in women, $p<0.05$) than the non sarcopenic (Table 2). The women also showed a lower level of fat free mass

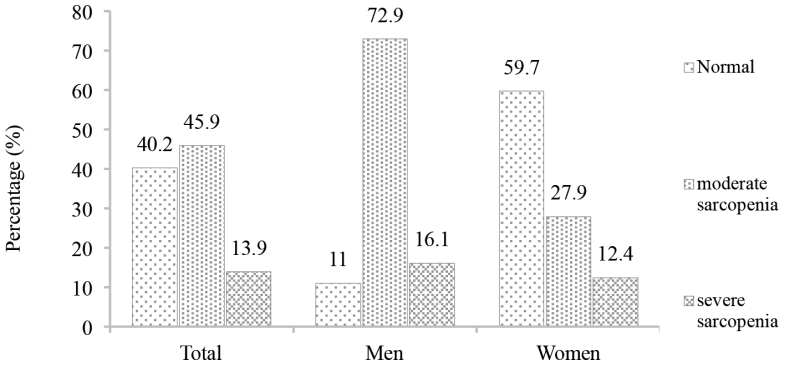

FIGURE 1. Prevalence of moderate and severe sarcopenia according to gender

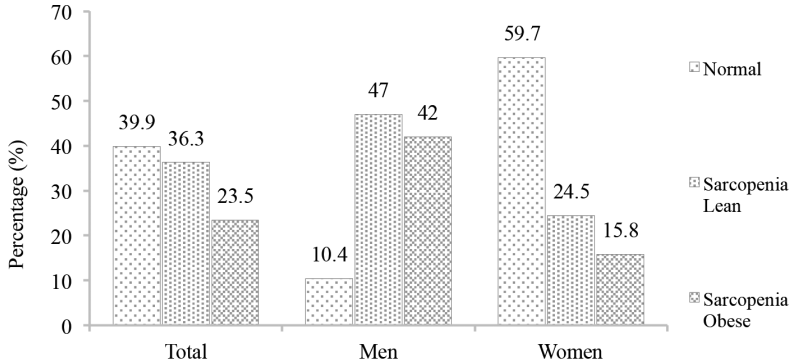

FIGURE 2. Prevalence of obese and lean sarcopenia according to gender

TABLE 1. Associations between demographic profile and biochemical indicator with sarcopenia according to gender

Factor	Men (*n*=155)						Women (*n*=233)						Total (*n*=388)				
	n	Normal	Sarcopenia	Crude OR	95% CI	P [a]	*n*	Normal	Sarcopenia	Crude OR	95% CI	P [a]	Normal	Sarcopenia	Crude OR	95% CI	P [a]
Ethnic																	
Malay	116	15 (88.2)	101(73.2)	NA	NA	NA	164	108 (78.3)	58(61.7)	NA	NA	NA	123(79.4)	159(68.5)	NA	NA	NA
Chinese	37	2(11.8)	35 (25.4)				50	25(18.1)	25 (26.6)				27(17.4)	60(25.9)			
Indian	2	0 (0)	2 (1.4)				16	5 (3.6)	11 (11.7)				5(3.2)	13(5.6)			
Age																	
60- 70 years	102	12(75.0)	90(66.7)	1.500	0.458 –	0.501	150	98(73.1)	52(58.4)	1.937	1.097 –	0.023[b]	110(73.3)	142(63.4)	1.588	1.010 –	0.045
≥ 70 years	49	4 (25.0)	45 (33.3)		4.915		73	36 (26.9)	37(41.6)		3.421		40(26.7)	82(36.6)		2.497	
Marital status																	
Single/	20	2(11.8)	18(90.0)	1.125	0.237 –	0.882	134	74(53.2)	60 (63.8)	1.550	0.906 –	0.109	76(48.7)	78(33.6)	1.876	1.238 –	0.003[b]
Widow/widower					5.334						2.651					2.842	
Married	135	15(88.2)	120(88.9)				99	65(46.8)	34(36.2)				80(51.3)	154(66.4)			
Employment																	
Retired	144	16(94.1)	128(92.8)	1.250	0.150 –	0.837	15	130(93.5)	88(93.6)	0.985	0.339 –	0.978	146(93.6)	216(93.1)	1.081	0.478 –	0.851
Employed	11	1(5.9)	10(7.2)		10.417		218	9(6.5)	6(6.4)		2.865		10(6.4)	16(6.9)		2.449	
Household income																	
Low	93	12(75.0)	81(63.3)	1.741	0.531 –	0.355	173	99(75.0)	74(80.4)	0.730	0.382 –	0.341	111(75.0)	155(70.5)	1.258	0.785 –	0.325
Moderate to high	51	4(25.0)	47(36.7)		5.706		51	33(25.0)	18(19.6)		1.396		37(25.0)	65(29.5)		2.016	
Education																	
Non formal	11	0(0)	11(8.0)	NA	NA	NA	57	28(20.1)	29(30.9)	0.565	0.309 –	0.064	28(17.9)	40(17.2)	1.050	0.617 –	0.857
Formal	144	17(100))	127(92.6)				176	111(79.9)	65(69.1)		1.033		128(82.1)	192(82.8)		1.788	
Activity physical																	
Low	120	15(100.0)	105(83.3)	NA	NA	NA	171	107(85.6)	76(88.4)	1.279	0.559 –	0.560	122(87.1)	181(85.4)	0.861	0.461 –	0.640
Moderate/high	21	0(0)	21(16.7)				28	18(14.4)	10(11.6)		2.923		18(12.9)	31(14.6)		1.609	

(continue)

Continued (TABLE 1)

Factor	Men (*n*=155)						Women (*n*=233)						Total (*n*=388)				
	n	Normal	Sarcopenia	Crude OR	95% CI	P [a]	*n*	Normal	Sarcopenia	Crude OR	95% CI	P [a]	Normal	Sarcopenia	Crude OR	95% CI	P [a]
Smoking habit																	
No	98	12(70.6)	86(62.3)	0.689	0.230 –	0.506	226	137(98.6)	89(94.7)	0.260	0.049 –	0.089	149(95.5)	175(75.4)	0.144	0.064 –	0.101
Yes	57	5(29.4)	52(37.7)		2.067		7	2(1.4)	5(5.3)		1.369		7(4.5)	57(24.6)		0.326	
History of falls																	
No	133	14(82.4)	119(89.5)	1.821	0.465 –	0.389	189	114(82.6)	75(80.6)	0.877	0.446 –	0.704	128(82.6)	194(85.8)	1.279	0.731 –	0.388
Yes	17	3(17.6)	14(10.5)		7.128		42	24(17.4)	18(19.4)		1.726		27(17.4)	32(14.2)		2.236	
Hypertension (mmHg)																	
No	129	12(75.0)	117(88.6)	0.385	0.110 –	0.135	195	116(84.1)	79(87.8)	0.734	0.337–	0.435	128(83.1)	196(88.3)	0.653	0.363 –	0.155
Yes	19	4(25.0)	15(11.4)		1.346		33	22(15.9)	11(12.2)		1.599		26(16.9)	26(11.7)		1.175	
Diabetes																	
No	109	9(52.9)	100(76.9)	2.963	1.051 –	0.034[b]	157	92(70.8)	65(73.0)	0.894	0.490 –	0.715	101(68.7)	165(75.3)	0.719	0.451 –	0.163
Yes	38	8(47.1)	30(23.1)		8.350		62	38(29.2)	24(27.0)		1.632		46(31.3)	54(24.7)		1.144	
Appetite																	
Low	86	10(66.7)	76(60.3)	0.760	0.245 –	0.634	112	92(73.6)	20 (33.3)	1.184	0.625 –	0.605	102 (72.9)	142(67.0)	0.756	0.472 –	0.243
Normal	55	5(33.3)	50(39.7)		2.356		99	33(26.4)	66(76.7)		2.243		38(27.1)	70(33.0)		1.209	
Exercise																	
No	83	11(13.3)	68(86.7)	0.721	0.246 –	0.550	148	84(45.7)	64(43.0)	1.397	0.805 –	0.235	77(38.3)	124(61.7)	1.055	0.620 –	0.892
Yes	72	12(16.7)	60(83.3)		2.110		85	55(64.7)	30(35.3)		2.424		63(42.3)	86(57.7)		1.793	
Total Chol																	
Normal (<5.2 mmol/l)	46	2(18.2)	44(40.4)	0.328	0.068 – 1.593	0.149	40	23(21.3)	17(23.6)	0.875	0.429 – 1.786	0.714	25(21.0)	61(33.7)	0.523	0.305 – 0.896	0.017[b]
High (>5.2 mmol/l)	74	9(81.8)	65(59.6)				140	85(78.7)	55(76.4)				94(79.0)	120(66.3)			

(continue)

Continued (TABLE 1)

Factor	Men (*n*=155)						Women (*n*=233)						Total (*n*=388)				
	n	Normal	Sarcopenia	Crude OR	95% CI	P [a]	*n*	Normal	Sarcopenia	Crude OR	95% CI	P [a]	Normal	Sarcopenia	Crude OR	95% CI	P [a]
LDL																	
Normal (<2.58 mmol/l)	15	1(10.0)	14(13.0)	0.746	0.088 – 6.347	0.789	16	10(9.3)	6(8.5)	1.105	0.383 – 3.189	0.853	11(9.3)	20(11.2)	0.817	0.376 – 1.775	0.610
High (>2.58 mmol/l)	103	9(90.0)	94(87.0)				163	98(90.7)	65(91.5)				107(90.7)	159(88.8)			
HDL																	
Normal (>1.03 mmol/L)	89	5(45.5)	84(77.1)	0.248	0.071 – 0.881	0.031 [b]	165	99(91.7)	66(91.7)	1.00	0.340 – 2.942	1.000	104(87.4)	150(82.9)	1.433	0.288 – 2.787	0.737
Low (<1.03 mmol/L)	31	6(54.5)	25(22.9)				15	9(8.3)	6(8.3)				15(12.6)	31(17.1)			
Glucose																	
Normal (3.9-5.5 mmo/l)	62	4(36.4)	58 (53.2)	0.502	0.139 – 0.816	0.294	98	59(57.3)	39(55.7)	0.849	0.464 – 1.553	0.595	63(55.5)	98(54.1)	1.091	0.528 – 1.750	0.680
High (>5.5 mmo/l)	58	7(63.6)	51(46.8)				75	44(42.7)	31(44.3)				51(43.7)	82(45.3)			
HBA1C																	
Normal	57	5(45.5)	52(47.7)	0.913	0.263 – 3.172	0.887	98	59(57.3)	39(55.7)	1.066	0.578 – 1.966	0.838	63(52.9)	93(51.7)	1.052	0.662 – 1.673	0.829
Diabetes	63	6(54.5)	57(52.3)				75	44(42.7)	31(44.3)				56(47.1)	87(48.3)			
Homocysteine																	
Normal (5-20 mmol/l)	62	7(63.6)	55(50.5)	1.718	0.476 – 6.208	0.405	114	74(68.5)	40(55.6)	1.741	0.939 – 3.228	0.078	81(68.1)	86(47.5)	1.930	1.190 – 3.129	0.007 [b]
High (>20 mmol/l)	58	4(36.4)	54(49.5)				66	34(31.5)	32(44.4)				38(31.9)	95(52.5)			

[a] χ^2 – Test was used
[b] Significant at $p<0.05$

TABLE 2. Predictors of Sarcopenia by gender

Predictor	Adjusted OR	95% CI	β	P[a]
Men				
Diabetes	0.614	0.118– 3.183	-0.488	0.561
HDL	4.535	1.252 - 16.424	1.512	0.121
Women				
More than 70 years	0.470	0.204-1.803	-0.755	0.076
Overall				
Married	0.539	0.280 -1.040	-0.618	0.539
More than 70 years	1.973	0.992 – 3.921	0.679	0.053
Hypercholesterolemia	0.778	0.367 – 1.648	- 0.252	0.511
Hyperhomocysteine	1.536	0.794 – 2.973	0.429	0.203

[a] Data were analyzed using binary logistic regression
[b] significant differences at $p< 0.05$

(FFM) among sarcopenic subjects (45.54±9.47), rather than non sarcopenic (51.56±15.23) ($p<0.05$). A similar trend was noted for the women where sarcopenic subjects (32.76±5.20) have lower levels of FFM compared with non sarcopenic subjects (36.43±9.36) ($p<0.05$). In relation to muscle mass, a decline was noted among sarcopenic subjects in both men and women ($p<0.05$). There was no difference observed for handgrip strength for both men and women in sarcopenic subjects ($p>0.05$).

Table 3 also showed that there was no significant differences in measures oxidative parameters which consists of superoxide dismutase, protein carbonyl, lipid hydroperoxide and glutathione ($p>0.05$). Women also showed similar results as men ($p>0.05$) according to sarcopenia status in both men and women.

FOOD INTAKE IN MEN AND WOMEN

With respect to nutrient intake, Table 4 shows all subjects regardless of their gender or sarcopenia status, did not meet the recommended nutrient intake for energy. A similar trend was noted for carbohydrate, thiamin, riboflavin, zinc and calcium. However, protein and iron intake was satisfactory. For men, it was also noted that there was a decline in carbohydrate intake in sarcopenic subjects as compared with normal subjects ($p<0.05$). For both men and women, energy and protein intake were also lower in the sarcopenic lean subjects. However, the differences were not significant.

DISCUSSION

This present study apparently revealed that the prevalence of sarcopenia among elderly Malaysians was significantly higher than those documented in the west and other Asians countries. A study done by (Tanko et al. 2002) showed that there was a prevalence of 24% in women. For the Hispanic population, the prevalence was 18.3% in men and 35.1% in women. In contrast with non-Hispanic population, the prevalence was 19.8% in men and 33.3% in women (Baumgartner et al. 1998). For the Chinese population, it was found that the prevalence was 7.19% in men and 6.05% in women (Sowers et al. 2005). The large differences in values for sarcopenia incidence could be due to the variability in study design, sample size, geographical boundaries, background of subjects, method for assessing the skeletal muscle mass and different cut-off points used for the determination of sarcopenia. In Australia, the low prevalence of sarcopenia in men increased with age from 14% in those aged 70 to 74 to 58% in those aged 90 and older was observed. In this study, muscle mass was measured using dual X-ray absorptiometry (DXA) and was defined as appendicular lean mass relative to height (aLM/height^2) (Hairi et al. 2010). On the other hand, most of the other studies have used the cut-off points suggested by Baumgartner et al. (1998), which defined sarcopenia as having a relative skeletal muscle mass (RSMI) of less than 2.0 standard deviations below the young references group or less than 7.26 kg/m in men and less than 5.45 kg/m^2 in women.

However, this current study has employed the cut-off points used by Janssen et al. (2002), which considered the presence of moderate to high degree of Sarcopenia as that within the SMI values of <10.75 kg/m^2 in men and <6.75 kg/m^2 in women was used. For moderate sarcopenia the cut-off points between 8.51 and 10.75 kg/m^2 in men and 5.76 and 6.75 kg/m^2 in women. However, for severe sarcopenia the cut-off points for men was <8.50 kg/m^2 and for women was <5.75 kg/m^2. These cut-off points have been used because they were associated with elevated physical disability risk. These cut-off values derived in the present study is whole body muscle mass, which can be estimated using a variety techniques that included magnetic resonance imaging, total body potassium counting, bioimpedance analysis and anthropometry. It is also noted that the skeletal muscle mass cut-off points determined using this current cut-off points are similar to the arbitrary cut-off points determined in previous studies (Janssen et al. 2002).

The prevalence of sarcopenia in this study was 89.0% in men and 40.3% in women with the overall prevalence

TABLE 3. Differences in anthropometry, body composition, functional status and biochemical indicators in men and women according to sarcopenia status

	Men			Women		
	Normal	Sarcopenia	*P* [a]	Normal	Sarcopenia	*P* [a]
Number	17	138		139	94	
Weight (kg)	86.95 ± 24.1	64.74 ± 11.29	0.000 [b]	63.91 ± 10.66	52.28 ± 10.99	0.000 [b]
BMI (kg/m^2)	31.76 ± 4.40	24.81 ± 3.79	0.000 [b]	28.62 ± 4.43	23.94 ± 6.08	0.000 [b]
Waist Circumference (cm)	102.267 ± 9.60	87.99 ±11.89	0.000 [b]	89.21 ± 9.16	79.69 ±13.69	0.000 [b]
Fat Free Mass (kg)	51.56 ± 15.23	45.54 ± 9.47	0.027 [b]	36.43 ±9.36	32.76 ± 5.20	0.001 [b]
% Fat	34.13 ± 11.08	29.58 ± 5.85	0.000 [b]	38.25 ±11.91	36.02 ± 10.10	0.137
Muscle (kg)	25.03 ± 7.56	21.41 ± 5.42	0.017 [b]	15.70 ± 4.78	14.14 ± 2.66	0.004 [b]
ECW (kg)	19.93 ± 4.49	16.79 ± 4.30	0.011 [b]	16.95 ± 1.64	12.47 ± 1.31	0.025 [b]
ICW (kg)	24.5 ± 5.88	19 .11 ± 3.95	0.000 [b]	19.93 ± 2.55	14.67 ±2.20	0.089
Handgrip (kg)	20.94 ± 7.90	19.77 ± 7.98	0.578	13.27 ± 6.90	14.38 ± 1.67	0.479
SMI (kg/m^2)	11.86 ± 2.61	9.24 ± 0.99	0.000 [b]	8.24 ±3.74	5.98 ± 0.65	0.000 [b]
Number	11	109		108	72	
SOD (specific activity)	1.73 ± 1.15	1.74 ± 0.94	0.962	1.86 ± 0.99	1.77 ± 0.72	0.515
Protein Carbonyl (nmol/L)	1.28 ± 0.69	1.20 ± 0.52	0.661	1.37 ± 1.00	1.41 ± 1.23	0.786
LPO (pg/mL)	3.80 ± 1.19	3.58 ±1.07	0.468	4.59 ± 4.65	3.96 ± 1.54	0.253
Glutathione(μmol/L)	1.09 ± 0.64	1.00 ± 0.48	0.592	1.07 ±0.52	0.99 ± 0.45	0.355
Homocysteine (μmol/L)	19.71 ± 4.20	22.02 ± 6.33	0.226	19.71 ± 6.87	20.88 ± 6.59	0.260
Total cholesterol (mmol/L)	5.67 ± 1.13	5.53 ± 0.99	0.042 [b]	5.99 ± 1.12	6.01 ± 1.16	0.917
HDL (mmol/L)	1.09 ± 0.19	2.39±12.04	0.723	1.44 ± 0.32	1.57 ± 0.45	0.020 [b]
LDL (mmol/L)	3.47 ± 0.86	3.60 ± 0.87	0.652	3.83 ± 0.99	3.83 ±1.07	0.942
Glucose (mmol/L)	6.05 ± 1.64	6.70 ± 3.21	0.508	6.19 ± 2.28	6.24 ± 2.55	0.888
HBA1C(%)	6.81 ± 1.86	6.45 ± 1.47	0.455	6.42 ± 1.56	6.32 ± 1.45	0.654

[a] independent sample t-test

[b] significant differences between normal and sarcopenic subjects (p<0.05). BMI = Body Mass Index, ECW =Extracellular water, ICW =Intracellular Water, SMI = Relative Skeletal Muscle Index , SOD = Superoxide dismutase enzyme, LPO = Lipid hydroperoxide

of 59.8%. The prevalence of moderate sarcopenia was 72.9% and severe sarcopenia was only 16.1% in men while in women moderate sarcopenia was 27.9% and severe sarcopenia was 12.4%. Sarcopenia lean was 47.4% in men and 24.5% in women, while sarcopenia obese in men was 42.2% and 15.8% in women. As compared with the study by Janssen et al. (2002), the prevalence in the current study was higher in both moderate and severe sarcopenia. However, a similar trend was found in this study where men showed the higher prevalence compared to women.

In terms of gender, the current study revealed for those who are more than 70 years old there are differences in its association with sarcopenia. This is in line with previous studies which found that sarcopenia prevalence for less than 70 years was 13 to 28% and more than 70 years old was over 50% (Timothy 2003). A similar trend was found by Morley et al. (2001) who observed that in women, the percentage of subjects with sarcopenia increased from 8.8% in those less than 70 years to about 16% in those older than 70 years. A person's marital status was also observed to be associated with the incidence of sarcopenia. Sarcopenic subjects without spouse are deemed to be deficient of companionship, are discouraged from participating in extraneous activities and are lack perceived social support especially in doing exercise or any physical activities (Lee et al. 2012). The current study also observed an association between hypercholesterolemia and hyperhomocysteinemia and with the occurrence of sarcopenia in the population regardless of gender. However, the mechanism underlying the possible role of cholesterol and homocysteine with the occurrence of sarcopenia remain unknown. Further research may attempt to investigate the possible mechanism of cholesterol and homocysteine in accelerating sarcopenia in elderly people. This study also found decline in level of muscle mass and FFM in sarcopenic subjects as compared with normal subjects, thereby supporting the fact that there will be decreased in muscle mass and muscle strength with ageing. The loss of muscle mass with age may be attributed to the loss of anabolic factors such as neural growth factors,

TABLE 4. Macro and micronutrient intake according to gender and sarcopenia status

	Men			Women		
	Normal (n=14)	Sarcopenia lean (n=117)	P value	Normal (n= 118)	Sarcopenia lean (n=84)	P value
Calorie (g/day)	1444.50±289.49	1396.45±381.7	0.683	1243.44±340.49	1209.55±306.16	0.441
%RNI	71.9%	69.5%		69.9%	68%	
Protein (g/day)	62.36±17.97	57.85±13.57	0.263	51.07±15.37	49.40±13.15	0.383
% Kcal	17.17±3.02	16.08±2.52	0.139	15.94±3.26	16.21±2.86	0.552
%RNI	105.7%	98.1%		99.9%	96.9%	
Fat(g/day)	47.59±19.35	46.37±14.45	0.777	41.69±12.84	38.81±13.47	0.113
% Kcal	28.92±6.11	28.67±5.55	0.875	29.26±5.72	28.11±6.39	0.182
%RNI	105.8%	103.0%		104.2%	97.0%	
CHO (g/day)	177.70±50.73	198.21±42.30	0.097	174.31±41.56	169.95±39.86	0.419
%Kcal	55.25±14.32	55.09±6.10	0.022[a]	54.86±6.56	55.91±6.32	0.251
% RNI	88.9%	99.1%		96.8%	94.4%	
Thiamine(mg/day)	0.68±0.18	0.80±0.37	0.235	0.74±0.31	0.70±0.35	0.336
%RNI	56.7%	66.7%		67.3%	51.8%	
Riboflavin(mg/day)	1.19±0.48	1.09±0.37	0.363	1.11±0.56	1.04±0.43	0.342
%RNI	91.5%	83.8%		100.1%	94.5%	
Niacin(mg NE)	17.97±4.30	18.13±4.89	0.906	15.94±4.80	15.35±4.40	0.342
%RNI	112.3%	113.3%		113.9%	109.6%	
Vitamin C(mg/day)	89.31±45.63	98.94±118.76	0.764	80.71±51.72	89.47±52.86	0.249
%RNI	127.6%	141.3%		115.3%	127.8%	
Vitamin A(μg/day)	807.08±376.96	785.70±344.36	0.830	658.83±275.46	730.79±378.46	0.129
%RNI	134.5%	131.0%		131.8%	146.2%	
Iron(mg/day)	11.23±4.16	11.35±4.64	0.932	19.95±3.71	25.43±142.99	0.241
%RNI	80.2%	81.1%		181.4%	231.2%	
Zinc(mg/day)	0.20±0.19	0.50±0.76	0.401	0.36±0.46	0.28±0.30	0.387
%RNI	3.2%	8.1%		8.4%	6.5%	
Calcium(mg/day)	441.39±202.39	391.42±150.28	0.261	396.41±214.61	371.43±169.57	0.375
%RNI	44.1%	39.1%		39.6%	37.1%	

[a]significant differences between normal and sarcopenic subjects (p<0.05)

growth hormones, physical activity and inflammation of cytokines. Meanwhile, a decline in protein synthesis and mitochondrial dysfunction might reduce endurance capacity and possibly loss of strength in elderly related to aging. In this study, a decline in FFM and an increase in fat mass can lead to the incidence of sarcopenic obesity in the population. However, it was found that prevalence of sarcopenic lean was higher. This finding might be due to the fact that sarcopenic obese subjects had difficulty in attending the screening phase at the community hall as it was on a voluntary basis.

As expected, we found a totally different conceptual factor to predict sarcopenia occurrence. Among men and women, there were no statistically significant associations between any of the variables and sarcopenia. The current study is in contrast to Lee et al. (2007), which found an association between underweight and sarcopenia incidence. However, in a study by Noran et al. (2010), it was found that high body fat and high BMI values were associated with a greater likelihood of functional limitation in a population of elderly women. These differences may be due to significant cultural and socioeconomic differences between the study populations.

In addition, this current study revealed that the body weight, BMI and waist circumference was lower among sarcopenic as compared with normal subjects in both men and women. The loss of muscle mass in tandem with weight loss in the elderly will cause serious functional disabilities and limitations in their daily lives'. Muscle strength and muscle mass both deteriorate with age (Zamboni et al. 2007). However, the causes of these decreases in muscle strength and mass are not well documented and will need further clarification.

In the human skeletal muscle, proteins, DNA and lipids are damaged by reactive oxygen species during oxidative stress. The levels of these damaged macromolecules and lipids increase with age. Protein carbonyls are known markers of oxidative stress and accumulate with ageing. Protein carbonylation leads to cellular dysfunction and a decline in tissue function and is involved in the pathogenesis of sarcopenia (Sowers et al. 2005). Although oxidative stress has been implicated in the pathogenesis of sarcopenia, the relationship between oxidative stress and physical performance has not been well documented. Hence, this current study observed the associations between oxidative stress and incidence of sarcopenia. However, there were no significant differences observed between the sarcopenia incidences with the oxidative parameters. The finding of nutrient intake in this current study showed that level of antioxidant intake, mainly Vitamin C, meets the RNI in this population. There were no significant difference for both normal and sarcopenic subjects. This antioxidant intake may play a major role as a scavenger for free radical attack and may prevent lipid and protein oxidation. These finding were contrary to Semba et al. (2007), which showed there was a relationship between protein carbonyl and severe walking disability which are closely related with sarcopenia. Hence, in relation to the oxidative stress the findings showed that it may increase the risk of sarcopenia incidence. The differences may be due to the background of population which is more than 65 years old and the difference in cut-off points of subjects. Data regarding oxidative stress and sarcopenia are limited and the mechanisms underlying this remains controversial. However, initial evidence stating that excessive oxidative stress is involved in the pathogenesis of age-related sarcopenia and subsequent decrease of strength and mobility should be further investigated.

There are several mechanisms underlying sarcopenia problems such as poor nutrition and physical inactivity in this population. The level of physical activity in this population study was not much different between sarcopenic and normal subjects. However, it was observed that the energy intake for this population did not meet the requirement for RNI for all subjects and this may accelerate the process of sarcopenia.

The present work has several strengths. First, it is the first study to specifically investigate the influence of gender disparities to predict the occurrence of Sarcopenia among multiethnic elderly population, thereby bridging the research gap in the pool of currently available data. Second, the participants were non-institutionalized, which allows direct extrapolation to older persons of the population at large with investigation of various potential risk factors (ranging from socio-demographic background, lifestyle practices, health status and clinical aspects). These volunteers who are living independently were interested in this study and may represent those who were more educated and healthier within the general population. However, the major limitation in the present study is that it was cross sectional and therefore cannot provide evidence for a causal relationship between predictors and Sarcopenia. The validity and reliability of the self-reported variables for socioeconomics, diseases, smoking, physical activities, food intake are not known. The self-reported data may be subject to significant cultural and socioeconomic influences, which might also influence the findings of this study. Finally, bioelectrical impedance analysis has been employed to estimate muscle mass and previous studies have noted inaccuracies in its use to assess lean body mass in the elderly, which may in part be caused by changes in the hydration of lean mass and the cylindrical shape of the appendicular muscles.

Conclusion

In summary, the present work documents at high prevalence (59.8%) of sarcopenia among elderly people in Malaysia with the highest incidence of moderate sarcopenia in both men and women. The findings revealed no absence of predictor in men and women. However, decline in body weight, muscle mass and FFM were observed among sarcopenic subjects. This could imply that in our population, further investigations should be

done to confirm the controversial issue of the occurrence of sarcopenia in both men and women. The clinical significance of these predictors as well as pathophysiology of the skeletal muscle and inflammatory mediators among the Malaysian elderly will need further investigations. Possibly, a physical therapy intervention may help improve muscle strength among this affected group and thus assist towards improvement of functional performance in activities of daily living as well as their quality of life.

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