International Journal of Gerontology 15 (2021) 324–329
https://doi.org/10.6890/IJGE.202110_15(4).0006

International Journal of Gerontology

journal homepage: http://www.sgecm.org.tw/ijge/

Original Article

Sarcopenia and Associated Factors among Thai Community-Dwelling Older Adults

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ARTICLE INFO

Accepted 23 June 2021

Keywords:
community,
risk factors,
older adults,
sarcopenia,
Thailand

SUMMARY

Background: Older people suffer the greatest number of fatal falls worldwide. Sarcopenia is one of the geriatric syndromes that increases risk of falls. However, there are limited studies among Thai older adults which address risk factors for this condition. Here we evaluate the prevalence of sarcopenia, and measure associations with risk factors among Thai community-dwelling older adults.
Methods: This cross-sectional study collected information on socio-demography, physical activity, and anthropometry as well as a semi-food frequency questionnaire. Sarcopenia was defined using the criteria of Asian Working Group for Sarcopenia (AWGS) consensus. Muscle mass, muscle strength, and physical performance were determined using bioelectrical impedance analyzer, handgrip dynamometer, and 6-meter usual gait speed respectively. Factors that were associated with sarcopenia were analyzed using multiple logistic regression.
Results: Of the 510 participants, mean age was 69.1 (SD = 6.7) years. The majority were female (67.3%) and 44.3% had insufficient daily dietary protein intake. The prevalence of sarcopenia was 5.3%. Factors associated with sarcopenia were male sex (adjusted OR = 5.35; 95% CI: 1.68–17.00), increased body mass index (BMI) (adjusted OR = 0.52; 95% CI: 0.39–0.70) and increased calf circumference (CC) (adjusted OR = 0.67; 95% CI: 0.54–0.84).
Conclusion: The prevalence of sarcopenia among Thai community-dwelling older adults using the AWGS consensus was quite low. Every one unit increase in BMI and CC reduced the chance of having sarcopenia. Thus, the issue of underweight status among older Thais is crucial for reducing sarcopenia and associated injury risks.

1. Introduction

Sarcopenia is a condition characterized by loss of muscle mass and decreased muscle strength and/or physical performance.[1] Sarcopenia significantly increases the risk of dysphagia, cognitive impairment, fractures, falls, hospitalization, and all-cause mortality in elderly populations.[2] A recent systematic review had shown that sarcopenic individuals had a significantly higher risk of falls and fractures compared with non-sarcopenic individuals.[3] Older people are the population group at risk of sarcopenia, as well as having the highest risk of fall-related injury.[4]

In 2010, the European Working Group on Sarcopenia in Older People (EWGSOP) recommended using the presence of both low muscle mass and low muscle function (strength or performance) as diagnostic criteria for sarcopenia.[5] In 2014, the Asian Working Group for Sarcopenia (AWGS) proposed a similar definition for sarcopenia but they recommended measuring both muscle strength and physical performance as the screening test and using the cut-off values for Asian populations based on evidence derived from research in Asia.[6] In 2020, AWGS published a consensus update on sarcopenia diagnosis, treatment, and introduced the category of "possible sarcopenia", defined by low muscle strength with or without reduced physical performance and presented new cut-off points for Asian countries.[7] The prevalence of sarcopenia in Asian countries that used the AWGS 2014 criteria ranged from 5.5% to 25.7%.[7] Thailand has recognized sarcopenia as a geriatric syndromes and has agreed to use AWGS diagnostic criteria.[7]

Sarcopenia in older adults can be classified as either primary or secondary sarcopenia. Primary sarcopenia refer to age related sarcopenia, resulting from pathophysiology changes such as sex hormones, muscle apoptosis, and mitochondrial dysfunction. Secondary sarcopenia is (a) activity related such as physical inactivity and sedentary lifestyle, (b) nutrition related such as inadequate dietary intake, insufficient dietary energy and protein intake, and vitamin D insufficiency that cause anorexia, (c) endocrine disorder related such as obesity, insulin resistance, and inflammatory cytokine, (d) neurodegenerative disorder related and (e) chronic disease related.[8,9]

There are few studies of sarcopenia prevalence among Thai older adults. Previous studies which follow the AWGS criteria reported that the prevalence of sarcopenia were 30.5% in community-dwelling elderly,[10] 27.3% in chronic kidney disease participants,[11] and 1.3% in older people with type 2 diabetes.[12] The factors associated with sarcopenia in older people were age, body mass index

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(BMI), and quadriceps strength.[10] However, these studies of sarcopenia among the Thai elderly were not comprehensive and dietary factors have not been studied. Therefore, the objectives of this study were to determine the prevalence of sarcopenia using the AWGS consensus, and to determine factors that associated with sarcopenia in Thai community-dwelling older adults. This study provides information to guide the direction of health care services in Thailand.

2. Methods

2.1. Study design

This is a cross-sectional study which was conducted in Northeast Thailand between June 2020 to October 2020. The setting was an urban area (Mueang district), a semi-urban area (Nampong district), and rural areas (Chonnabot district), Khon Kaen Province.

2.2. Participants

A total of 510 participants, aged 60 years and over were included in the study using multi-stage random sampling from among people living in Khon Kaen province. The sampling process is shown in Figure 1. The inclusion criteria were as follows: 1) living in Khon Kaen province at least 1 year; 2) able to communicate with interviewers; 3) able to walk, sit, and stand independently without a walking device or any support. The participants who had pain around hand to arm were excluded. All of those invited were willing to participate in this study.

2.3. Main outcome and independent variables

The data were collected via face-to-face interview by trained interviewers through a health promoting hospital using a structured questionnaire for all demographic characteristics developed by the study's researchers, and case record forms for anthropometric measurements. Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ). This questionnaire collects detailed information on participants' physical activity, in terms of frequency and intensity across a range of domains including 1) daily work; 2) travel or commuting; 3) recreational activities and 4) amount of sedentary time. Physical activity levels were categorized into 3 groups by metabolic equivalent (MET) calculation. We calculated the number of instances of each type of physical activity and multiplied this number by the corresponding MET value which were low (MET < 600), moderate (MET ≥ 600–1500), and high (MET ≥ 1500) respectively.[13] A semi-food frequency questionnaire (semi-FFQ) was used for assessing dietary frequency and daily protein intake. Daily protein intake was calculated using the Thai food exchange list.[14] Insufficient dietary protein intake per day was < 1 gram/body weight/day.[15] Anthropometric measurements including body weight (BW), height, middle-arm circumference (MAC), waist circumference (WC), and calf circumference (CC) were also collected. Body mass index (BMI) using Asian cut-offs was calculated by weight in kilograms divided by height squared in meters and was categorized into 3 groups including underweight (< 18.5 kg/m^2), normal (18.5–22.9 kg/m^2), and overweight (≥ 23.0 kg/m^2).[16] MAC, WC, and CC were measured with an anthropometric tape and categorized into 2

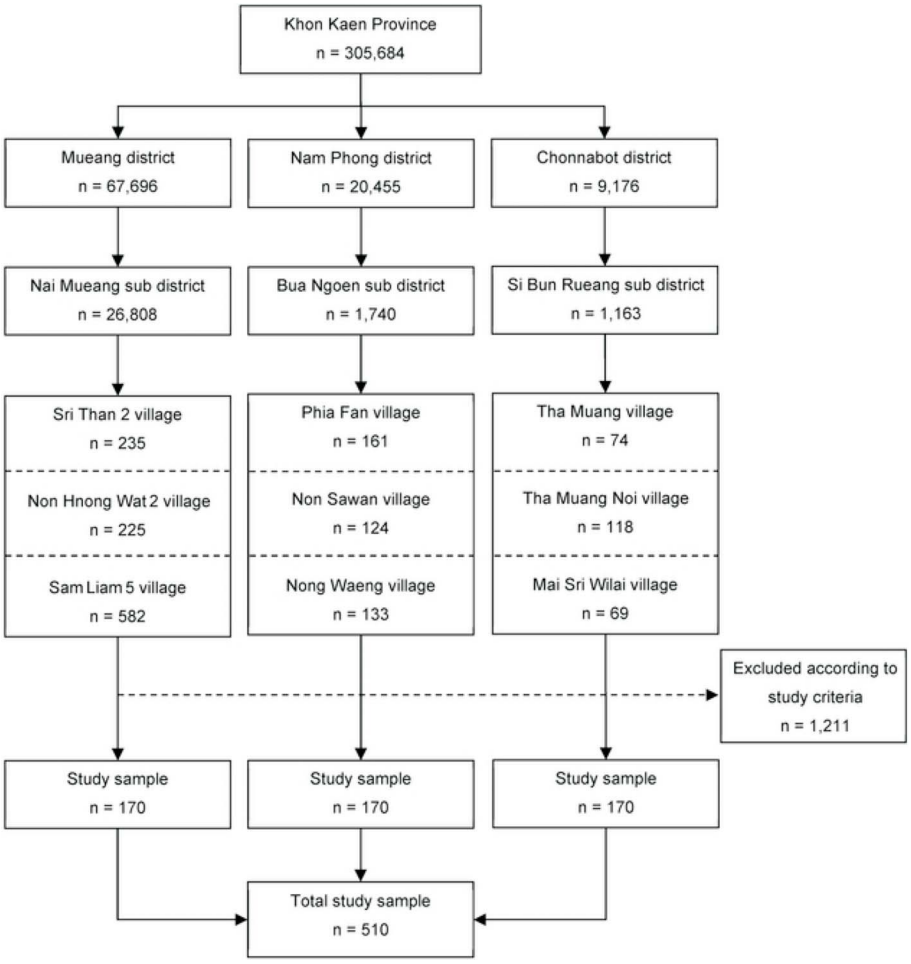

Figure 1. Sample selection process.

groups. The cut-off point of MAC was lower than 29.3 centimeters in males and 28.5 centimeters in females.[17] The cut-off point of WC was higher than 90.0 centimeters in males and 80.0 centimeters in females.[18] The cut-off point of CC was lower than 34.0 centimeters in males and 33.0 centimeters in females.[7]

2.4. Assessment of sarcopenia

According to the diagnostic algorithm of AWGS, participants with low muscle mass as well as low muscle strength and/or physical performance were considered to have sarcopenia.[7]

Muscle mass was measured by bioelectrical impedance analyzer (BIA) using a ACCUNIQ BC300 (SELVAS Healthcare, Daejeon, Republic of Korea). Low muscle mass was defined as a relative appendicular skeletal muscle mass (RASM), which was calculated by summing the lean mass of the arms and legs (appendicular skeletal mass; ASM) divided by height^2, of < 7.0 kg/m^2 in males and < 5.7 kg/m^2 in females.[7] Muscle strength was measured using a handgrip dynamometer (Takei Digital Hand Grip Dynamometer, Japan). Low muscle strength was defined as < 28 kilograms in males and < 18 kilograms in females.[7] Physical performance was assessed by the 6-meter usual gait speed, asking to walk 10-meter at usual gait speed. Time was recorded from the 2-meter to 8-meter marker. Then, the gait speed was calculated from time using in 6-meter.[10] Low physical performance was defined as < 1.0 m/s.[7]

2.5. Statistical analyses

Demographic characteristics were summarized using frequencies and percentages for categorical data. Continuous data were summarized by their mean, standard deviation (SD), median, minimum and maximum range.

The prevalence percentage was calculated using number of cases as the numerator and the total number of participants as the denominator. Bivariate and multivariable analysis using simple and multiple logistic regression respectively were performed to investigate the associations between the potential risk factors and sarcopenia. These were determined by crude odds ratios (OR) and OR adjusted for independent variables include gender, age, BMI, and CC together with their 95% confidence intervals (CI) for bivariate and multivariable analysis, respectively.

For bivariate analysis, OR and 95% CI were used to consider the strength of association between factors associated with sarcopenia. Factors with a p-value < 0.25 or clinical significance in literature review were then entered into a multiple logistic regression model. A p-value of < 0.05 was considered to indicate statistically significant differences, and adjusted OR and their 95% CI were reported to consider the strength of association. All statistical analyses were performed using Stata version 15 (StataCorp, College Station, TX).

2.6. Ethics approval

The research protocol was approved by the Khon Kaen University Ethics Committee for Human Research, reference number HE632051. All participants gave written informed consent to participate in the study.

3. Results

3.1. Baseline characteristics of studied participants

Baseline characteristics for the 510 elderly Thais included in the study are shown in Table 1. The mean age was 69.1 years. Around two-thirds (67.3%) were females and reported high physical activity levels (65.3%). Most participants were non-smokers (84.3%) and more than half (56.7%) were overweight. The mean values of components of sarcopenia for males and females are shown in Table 2. Males had significantly higher values than females in all variables except in low gait speed (p-value = 0.343).

Table 1
Socio-demographic, dietary and physical characteristics of participants.

Participant characteristic	Number (%)
Gender	
Male	167 (32.7)
Female	343 (67.3)
Age group (year)	
60–64	159 (31.2)
65–69	120 (23.5)
70–74	116 (22.8)
75–79	69 (13.5)
≥ 80	46 (9.0)
Mean ± SD	69.1 ± 6.7
Median (minimum:maximum)	68 (60:92)
Smoking status	
Never smoking	430 (84.3)
Ex-smoker	33 (6.5)
Current smoker	47 (9.2)
Physical activity levels	
Low (MET < 600)	79 (15.5)
Moderate (MET ≥ 600–1500)	98 (19.2)
High (MET ≥ 1500)	333 (65.3)
Mean ± SD	4050.9 ± 5420.5
Median (minimum:maximum)	2280 (0:37680)
History of fall within 1 year	
0	372 (72.9)
≥ 1	138 (27.1)
Fish consumption	
< 4 times per week	173 (33.9)
≥ 4 times per week	337 (66.1)
Vegetable consumption	
Not everyday	200 (39.2)
Everyday	310 (60.8)
Dietary protein intake per day	
Insufficient (< 1 g/BW)	226 (44.3)
Sufficient (≥ 1 g/BW)	284 (55.7)
Mean ± SD	1.3 ± 0.8
Median (minimum:maximum)	1.1 (0.1:5.1)
Body mass index	
Underweight (< 18.5 kg/m^2)	47 (9.2)
Normal (18.5–22.9 kg/m^2)	174 (34.1)
Overweight (≥ 23.0 kg/m^2)	289 (56.7)
Mean ± SD	23.9 ± 4.3
Median (minimum:maximum)	23.8 (15.3:39.6)
Middle-arm circumference	
Normal	151 (29.6)
Low (M < 29.3 cm, F < 28.5 cm)	359 (70.4)
Mean ± SD	27.2 ± 3.3
Median (minimum:maximum)	27.0 (13.0:37.5)
Waist circumference	
Normal	194 (38.0)
High (M > 90.0 cm, F > 80.0 cm)	316 (62.0)
Mean ± SD	87.8 ± 11.1
Median (minimum:maximum)	87.0 (62.5:87.8)
Calf circumference	
Normal	264 (51.8)
Low (M < 34.0 cm, F < 33.0 cm)	246 (48.2)
Mean ± SD	33.3 ± 3.6
Median (minimum:maximum)	33.0 (23.0:44.0)

BW: body weight; F: females; M: males; MET: metabolic equivalent; SD: standard deviation.

Table 2
Comparing mean values of components of sarcopenia between males and females.

Component of sarcopenia	Number (%)	Mean ± SD			p-value*
		Total	Male	Female	
Muscle mass					
Normal	478 (93.7)	7.7 ± 1.0	8.3 ± 0.9	7.4 ± 0.9	< 0.001
Low (M < 7.0 kg/m^2, F < 5.7 kg/m^2)	32 (6.3)	6.1 ± 0.6	6.6 ± 0.3	5.4 ± 0.2	< 0.001
Muscle strength					
Normal	230 (45.1)	25.5 ± 6.3	33.8 ± 4.5	22.2 ± 3.1	< 0.001
Low (M < 28 kg, F < 18 kg)	280 (54.9)	16.8 ± 5.1	21.9 ± 4.1	13.9 ± 2.8	< 0.001
Physical performance					
Normal	217 (42.5)	1.0 ± 0.2	1.2 ± 0.2	1.1 ± 0.1	< 0.001
Low (< 10 m/s)	293 (57.5)	0.6 ± 0.1	0.8 ± 0.1	0.8 ± 0.1	0.343

M: males; F: females; SD: standard deviation.
* p-value from student t-test.

The overall prevalence of sarcopenia was 5.3% and the percentage having sarcopenia among males and females according to age group is shown in Figure 2. Comparison of the prevalence of sarcopenia according to anthropometric variables, and for males and females according to body mass index groups are demonstrated in Table 3 and Figure 3, respectively. Males were more likely to have sarcopenia than females and the elderly in the underweight group had the highest prevalence (40.4%).

3.2. Factors associated with sarcopenia using bivariate and multivariate analysis

Factors that were associated with sarcopenia from bivariate analysis using simple logistic regression were male sex, increasing age, current or previous smoking, low vegetable consumption, BMI, MAC, WC, and CC (Table 4).

Multivariable analysis used multiple logistic regression, after controlling for the effect of factors including gender, age in years, BMI, and CC. The result showed that male sex, BMI, and CC were associated with sarcopenia (Table 5). The result showed that males were 5.35 times (95% CI: 1.68–17.00; p-value = 0.004) more likely to have sarcopenia than females, and for every 1 kg/m^2 increase in BMI, the chance of having sarcopenia was reduced by 48% (adjusted OR = 0.52; 95% CI: 0.39–0.70; p-value < 0.001) (Table 5).

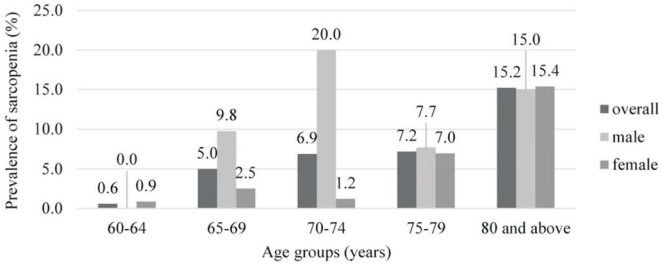

Figure 2. Prevalence of sarcopenia for males and females according to age groups.

Table 3
Prevalence of sarcopenia by anthropometric variables.

Anthropometric variables	Number	% sarcopenia	p-value*
Overall	510	5.3	
Body mass index			< 0.001
Underweight	47	40.4	
Normal	174	4.0	
Overweight	289	0.3	
Middle-arm circumference			0.002
Normal	151	0.7	
Low	359	7.2	
Waist circumference			< 0.001
Normal	194	12.4	
High	316	0.9	
Calf circumference			< 0.001
Normal	264	1.5	
Low	246	9.3	

* p-value from Chi-square test.

4. Discussion

This study offers information to guide the direction of health care services in Thailand, in regards to the prevalence and risk factors for sarcopenia. This study's findings are the first to assess sarcopenia in Thailand, a rapidly ageing society, using the Asian Working Group for Sarcopenia (AWGS) consensus.

The overall prevalence of sarcopenia in this study was 5.3%. This prevalence in our study was in accordance with studies among community-dwelling Chinese elderly by Wang et al. in 2018 which reported sarcopenia prevalence of 7.1%, and Hai et al. in 2017 who reported prevalence of 10.6%.[19,20] Our results are also in line with the study of Kuo et al. in year 2019 which was performed among community-dwelling older adults in Taiwan, and presented sarcopenia prevalence at 6.8%.[21] Our prevalence was somewhat lower than some other studies and this may be because the majority of the participants were females whereas sarcopenia is generally more prevalent in males. Recently, epidemiological studies from Asian countries reported that the prevalence of sarcopenia ranged from 5.5% to 25.7% with male dominance.[7]

Concerning the factors related to sarcopenia, this study found that gender, increased age, body mass index (BMI) and calf circumference (CC) were associated with sarcopenia. Males compared to females and every 5 years increase in age increased the chance of having sarcopenia. On the other hand, every 1 kg/m^2 increase in BMI and 1 centimeter increase in CC decreased the chance of having sarcopenia.

Our findings regarding male sex associating with sarcopenia risk

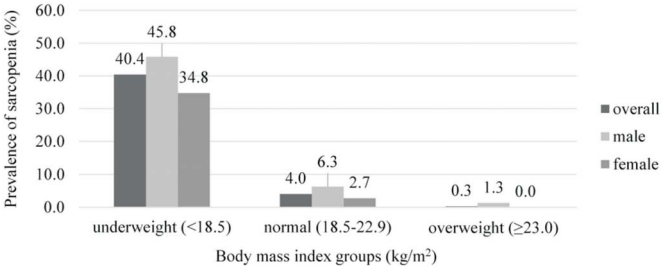

Figure 3. Prevalence of sarcopenia for males and females according to body mass index groups.

Table 4
Factors related to sarcopenia in univariable analysis by logistic regression.

Factor	Number	% sarcopenia	Crude OR	95% CI	p-value
Gender					0.004
Females	343	3.2	1		
Males	167	9.6	3.20	1.45–7.06	
Age (every 5 years increase)	510	NA	1.86	1.40–2.48	< 0.001
Smoking status					0.003
No smoking	430	3.9	1		
Yes (previous and/or current)	80	12.5	3.47	1.53–7.89	
Vegetable consumption					0.033
Not everyday	200	8.0	1		
Everyday	301	3.5	0.42	0.19–0.93	
BMI (every 1 kg/m^2 increase)	510	NA	0.47	0.37–0.60	< 0.001
MAC (every 1 cm increase)	510	NA	0.62	0.52–0.74	< 0.001
WC (every 1 cm increase)	510	NA	0.87	0.83–0.92	< 0.001
CC (every 1 cm increase)	510	NA	0.59	0.49–0.69	< 0.001

BMI: body mass index; CC: calf circumference; CI: confidence interval; MAC: middle-arm circumference; NA: not available; OR: odd ratios; WC: waist circumference.

Table 5
Multivariable analysis of factors that were associated with sarcopenia using multiple logistic regression.

Factors	Crude OR	Adjusted OR	95% CI[a]	p-value[b]
Gender				0.004
Females	1	1		
Males	3.20	5.35	1.68–17.00	
Age (every 5 years increase)	1.86	1.47	0.99–2.17	0.055
Body mass index (every 1 kg/m^2 increase)	0.47	0.52	0.39–0.70	< 0.001
Calf circumference (every 1 cm increase)	0.59	0.67	0.54–0.84	< 0.001

CI: confidence interval; OR: odd ratios.
[a] 95% confidence interval of adjusted odd ratios; [b] p-value of adjusted odd ratios.

is similar to the findings of a study by Nasimi et al. in year 2019 that found among community-dwelling older adults in Iran, males had higher risk of sarcopenia (adjusted OR = 3.13; 95% CI: 1.23–7.98).[22] As well our findings are consistent with those of Kuo et al. in year 2019 which found the prevalence of sarcopenia in Taiwan community-dwelling older adults was 9.3% in males and 4.1% in females.[21] On the other hand, Wang et al. in year 2018 studied community-dwelling older Chinese people and found the prevalence of sarcopenia was 7.5% in females and 6.6% in males.[19]

As well as having a higher risk of sarcopenia, males had higher values in almost all the components of sarcopenia than females. This was in line with a study performed among community dwelling older adults in Singapore by Tey et al. in 2019 which found the females had significantly lower muscle mass than males.[23] Also, Khongsri et al. in year 2016 performed a study of community-dwelling Thai elderly and reported that males had significantly higher values in muscle mass, grip strength, and gait speed than females.[10] Tay et al. in year 2015 studied the clinical and biological correlates of sarcopenia in Singapore community-dwelling older adults and discovered that sarcopenia appears to be driven by the catabolic influence of myostatin in males and anabolic decline represented by reduced IGF-1 potentially contributing to sarcopenia in females.[24]

Increased BMI and increased CC decreased the chance of having sarcopenia. This was in line with the other studies such as Khongsri et al. in year 2016 which reported that low BMI was associated with sarcopenia among community-dwelling elderly Thai.[10] Also, the study of Nasimi et al. in year 2019 carried out with Iranian community-dwelling older adults found that low BMI and high CC were associated with sarcopenia, namely decreased BMI was a higher risk whereas higher CC reduced risk of sarcopenia.[22]

Previous studies of associations with muscle mass also support our finding as muscle mass was the main diagnostic algorithm used in the Asia consensus to consider sarcopenia. For example, Tey et al. in year 2019 studied Singapore community-dwelling older adults and concluded that BMI and CC were positively associated with muscle mass.[23] Likewise, the study from Kawakami et al. in year 2015 also found CC was positively correlated with appendicular skeletal muscle mass and skeletal muscle index in Japanese elderly.[25] In addition, the study from Xu et al. in year 2019 also reported that higher BMI was associated with high muscle mass in older Chinese people.[26]

Low BMI has been commonly recognized as a marker for malnutrition. The cohort study of Beaudart et al. in year 2019 concluded that malnutrition was found to be a strong predictor of sarcopenia and severe sarcopenia during a four-year follow-up in Belgian people which were diagnosed with malnutrition having a BMI < 18.5 kg/m^2 and having sarcopenia diagnosed using the Europe consensus,[27] while CC was used for sarcopenia case finding and screening as AWGS 2019 recommends.[7]

Every 5 years increase in age in our study associated with an increase in the chance of having sarcopenia (adjusted OR = 1.47; 95% CI: 0.99–2.17; p-value = 0.055), aging was the primary cause of sarcopenia (age-related sarcopenia). Older age related with a risk of sarcopenia consistent with the studies of Khongsri et al. in year 2016, Xu et al. in year 2019, and Nasimi et al. in year 2019, conducted in Thai, China, and Iran respectively.[10,22,26] Beside, Tey SL et al. in year 2019 concluded that muscle mass was the mechanism for a strong inverse association between age of community-dwelling older adults in Singapore.[23]

Our results may be driven by the particular age distribution of our participants, the majority of whom were aged 60–70 years. Pongchaiyakul et al. in year 2013 suggested that sarcopenia prevalence will increase dramatically in the next one to two decades in Thailand, as the Thai population proportion aged over 60 is rapidly rising.[28] Moreover, ages between 40 and 70 years are associated

with age-related loss of muscle mass of approximately 8% per decade accerlerating to about 15% per decade after age of 70 years.[29]

This study presents novel results in Thailand with important clinical and public health implications. There were however some limitations. First, this study was conducted only in the community of some areas in the Northeastern part of Thailand. This might not generalize to different settings. Second, the prevalence of sarcopenia was quite low which could affect the study results and limit the numbers of factors that could be introduced into the model. Third, the continuous variables that had associations with sarcopenia could not be grouped because the numbers of those with sarcopenia in each group were too small (less than 10 events). Finally, the proportion of females in this study (67.3%) was higher than the general population. Generalizability of the result might be effected. Given the generally observed higher prevalence of sarcopenia in males, this higher female proportion is likely to mean overall sarcopenia prevalence is underestimated. Further study with more representative populations are needed to verify external validity.

5. Conclusion

Our study reveals that the prevalence of sarcopenia was highest among underweight Thai elderly. The factors that increase the chance of having sarcopenia were gender, BMI, and CC while factors that decrease the chance of having sarcopenia were increasing of BMI and CC in every 1 unit. The underweight elderly is a serious issue in Thailand and consumption behavior must be addressed in this group. Furthermore, sarcopenia screening should be applied in older adults using BMI and CC measurement in primary health care. Importantly, the already high incidence of fall and injuries amongst the elderly in Thailand can be addressed through a further concentration on screening for sarcopenia.

6. Recommendation

Increasing the number of participants is recommended for further study as well as longitudinal studies which address the development of risk factors over the life course. The study should be repeated in other settings where different lifestyle, particularly consumption behavior, could lead to difference in body composition which directly affect sarcopenia-risk.

Conflict of interest

There is no conflict of interest involve with this study.

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