Sarcopenia in Asia: Consensus Report of the Asian Working Group for Sarcopenia

Liang-Kung Chen MD, PhD a,*, Li-Kuo Liu MD, PhD a, Jean Woo MD b, Prasert Assantachai MD, PhD c, Tung-Wai Auyeung MD b, Kamaruzzaman Shahrul Bahyah MD d, Ming-Yueh Chou MD e, Liang-Yu Chen MD a, Pi-Shan Hsu MD f, Orapitchaya Krairit MD g, Jenny S.W. Lee MD b, Wei-Ju Lee MD, MSc h, Yunhwan Lee MD, PhD i, Chih-Kuang Liang MD e, Panita Limpawattana MD, PhD j, Chu-Sheng Lin MD k, Li-Ning Peng MD, MSc a, Shosuke Satake MD, PhD l, Takao Suzuki MD, PhD m, Chang Won Won MD, PhD n, Chih-Hsing Wu MD o, Si-Nan Wu MD p, Teimei Zhang MD, PhD p, Ping Zeng MD p, Masahiro Akishita MD, PhD q, Hidenori Arai MD, PhD r,*

a Center for Geriatrics and Gerontology, Taipei Veterans General Hospital, Taipei, Taiwan
b The S H Ho Centre for Gerontology and Geriatrics, The Chinese University of Hong Kong, Hong Kong, China
c Department of Preventive and Social Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand
d Department of Medicine, University of Malaya, Kuala Lumpur, Malaysia
e Geriatric Medicine Center, Koahsiung Veterans General Hospital, Kaohsiung, Taiwan
f Department of Family Medicine, Taichung Hospital, Ministry of Health and Welfare, Taichung, Taiwan
g Department of Internal Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand
h Department of Family Medicine, Taipei Veterans General Hospital Yuanshan Branch, I-Land, Taiwan
i Department of Preventive Medicine and Public Health, Ajou University School of Medicine, Suwon, South Korea
j Department of Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand
k Center for Geriatrics and Gerontology, Taichung Veterans General Hospital, Taichung, Taiwan
l Department of Comprehensive Geriatric Medicine, National Center for Geriatrics and Gerontology, Obu, Japan
m Research Institute, National Center for Geriatrics and Gerontology, Obu, Japan
n Department of Family Medicine, Kyung Hee University School of Medicine, Seoul, South Korea
o Department of Family Medicine, National Cheng Kung University Hospital and College of Medicine, Tainan, Taiwan
p Beijing Institute of Geriatrics, Beijing Hospital, Ministry of Health, Beijing, China
q Department of Human Health Sciences, Kyoto University Graduate School of Medicine, Kyoto, Japan
r Department of Geriatric Medicine, Graduate School of Medicine, University of Tokyo, Tokyo, Japan

A B S T R A C T

Sarcopenia, a newly recognized geriatric syndrome, is characterized by age-related decline of skeletal muscle plus low muscle strength and/or physical performance. Previous studies have confirmed the association of sarcopenia and adverse health outcomes, such as falls, disability, hospital admission, long term care placement, poorer quality of life, and mortality, which denotes the importance of sarcopenia in the health care for older people. Despite the clinical significance of sarcopenia, the operational definition of sarcopenia and standardized intervention programs are still lacking. It is generally agreed by the different working groups for sarcopenia in the world that sarcopenia should be defined through a combined approach of muscle mass and muscle quality, however, selecting appropriate diagnostic cutoff values for all the measurements in Asian populations is challenging. Asia is a rapidly aging region with a huge population, so the impact of sarcopenia to this region is estimated to be huge as well. Asian Working Group for Sarcopenia (AWGS) aimed to promote sarcopenia research in Asia, and we collected the best available evidences of sarcopenia researches from Asian countries to establish the consensus for sarcopenia diagnosis. AWGS has agreed with the previous reports that sarcopenia should be described as

The authors declare no conflicts of interest.

* Address correspondence to Liang-Kung Chen, MD, PhD, Center for Geriatrics and Gerontology, Taipei Veterans General Hospital, No. 201, Sec 2, Shihpai Road, Taipei, Taiwan; or Hidenori Arai, MD, PhD, Department of Human Health Sciences, Kyoto University Graduate School of Medicine, 53 Kawahara-cho, Shogoin, Sakyoku 606-8507, Kyoto, Japan.

E-mail addresses: lkchen2@vghtpe.gov.tw (L.-K. Chen), harai@kuhp.kyoto-u.ac.jp (H. Arai).

1525-8610/ - see front matter © 2014 - American Medical Directors Association, Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jamda.2013.11.025
Sarcopenia has been accepted as a new geriatric syndrome, and the knowledge related to sarcopenia is growing rapidly worldwide. Over the past 20 years of sarcopenia research after the first introduction by Rosenberg et al., the etiology, pathophysiology, risk factors, and consequences of sarcopenia have gradually become clearer. Moreover, a number of therapeutic approaches and clinical trials have been developed and are still evolving. Most importantly, the association of sarcopenia with poorer health status and adverse outcomes had triggered a new approach for health promotion and health care of older people. The escalation of elderly population worldwide further strengthened the clinical importance of sarcopenia, which is even more significant in Asia because of the rapid demographic transition in this highly populated continent.

Sarcopenia has been described as an age-related decline in skeletal muscle mass as well as muscle function (defined by muscle strength or physical performance), which may result in reduced physical capability, poorer quality of life, impaired cardiopulmonary performance, unfavorable metabolic effects, falls, disability, and mortality in older people, as well as high health care expenditure. Furthermore, sarcopenia is also associated with multimorbidity, cigarette smoking, low body mass index, underweight, physical inactivity, and low serum levels of testosterone in men. In general, the association between sarcopenia and functional decline is more significant in men than in women, which deserves further research for therapeutic consideration. Since Asia is the most populated and fastest aging region in the world, sarcopenia will pose great impacts to Asian populations in the near future. Therefore, experts and researchers of sarcopenia from China, Hong Kong, Japan, South Korea, Malaysia, Taiwan, and Thailand organized the Asian Working Group for Sarcopenia (AWGS) and had several meetings in Taipei, Seoul, and Kyoto to promote further research development of sarcopenia in Asia since March 2013. This article will focus on the epidemiology of sarcopenia in Asian countries and to propose a diagnostic algorithm based on currently available evidence in Asia.

### Diagnosis of Sarcopenia and Its Impact to Asia

Asia is a huge and densely populated continent with a wide range of ethnicities, cultural, social, religious backgrounds, and lifestyles. Because of the rapid population aging and the population size, the impact of sarcopenia in Asia may be stronger than in other continents. However, the status of population aging and economic development varies extensively in different Asian countries. Therefore, developing a consensus for sarcopenia diagnosis and clinical approaches based on available evidence is of great importance for sarcopenia research in the future.

In 2010, European Working Group on Sarcopenia in Older People (EWGSOP) proposed an operational definition and diagnostic strategy for sarcopenia that had become the most widely used in the world. The EWGSOP definition required measurements of muscle mass, muscle strength, and physical performance for the diagnosis of sarcopenia, which is compatible with current understanding about sarcopenia. Based on the discussion of the AWGS meetings, we decided to take similar approaches for sarcopenia diagnosis, but unlike EWGSOP, we recommended measuring both muscle strength (handgrip strength) and physical performance (usual gait speed) as the screening test (Figure 1). Although the recommended approaches for measurements of muscle mass, muscle strength, and physical performance by AWGS were similar to the EWGSOP definition, the cutoff values of these measurements in Asian populations may differ from those in Caucasians because of ethnicities, body size, lifestyles, and cultural backgrounds. Therefore, developing an Asian consensus in sarcopenia diagnosis based on the evidence derived from Asian populations is essential for research and therapeutic approaches to sarcopenia in Asia.

### Strategy for Sarcopenia Screening and Assessment

In principle, AWGS followed the diagnostic approach of EWGSOP, and we added some Asian perspectives in sarcopenia diagnosis and research. In the previous studies from Western countries, the prevalence of sarcopenia in older people was around 20% among people aged 65 years and older and may reach 50–60% in octogenarians. EWGSOP recommends routine screening for sarcopenia among community-dwelling people aged 65 years and older. On the other hand, the International Working Group on Sarcopenia (IWGS) specifies certain conditions for sarcopenia assessment, including (1) noted decline in function, strength, health status, (2) self-reported mobility-related difficulty, (3) history of recurrent falls, (4) recent unintentional weight loss (>5%), (5) post-hospitalization, and (6) other chronic conditions (e.g., type 2 diabetes, chronic heart failure, obstructive pulmonary disease, chronic kidney disease, rheumatoid arthritis, and cancer). Moreover, IWGS recommends assessing patients with reduced physical functioning (or weakness) or patients with habitual gait speed <1.0 m/s (by 4-m course) to assess body composition by dual x-ray absorptiometry (DXA). Nonambulatory patients or those who cannot rise from a chair unassisted should be considered to be sarcopenic without DXA measurements. Since sarcopenia is defined as an age-related condition, assessment of sarcopenia is limited to people aged 65 years and older only in the...
EWGSOP criteria, but IWGS does not specify the age for sarcopenia diagnosis. In Asia, because of the different states of aging, not all countries use the same age cutoff to define elderly populations. Therefore, AWGS recommends using 60 or 65 years as the age for sarcopenia diagnosis according to the definitions of elderly in each country. Although muscle aging is a continuous process, most previous studies supported the idea that loss of muscle mass and muscle strength becomes pronounced around the age of 50,36 progresses faster after the age of 60,37 and accelerates even faster after the age of 75.38 The overall benefits of sarcopenia screening or assessment programs are dependent on the outcomes of effective intervention programs. AWGS emphasizes the benefits of intervention programs in addition to sarcopenia screening and assessment; therefore, we recommend screening for sarcopenia among community-dwelling older people as well as older people with certain clinical conditions in all healthcare settings. Table 1 summarized the recommended strategy for sarcopenia screening and assessment of AWGS by dividing cases into 2 categories (ie, community settings and specific chronic conditions in all healthcare settings). From the perspective of public health, sarcopenia screening for community-dwelling older people would facilitate health promotion and disability prevention in their communities, and the assessment of sarcopenia in clinical settings would facilitate strategies for the intervention in clinical practice. AWGS would like to emphasize the prognostic significance of sarcopenia in clinical practice through assessment under certain clinical conditions. However, the benefits of identification of and interventions for sarcopenia remain to be determined.

Suggested Outcome Indicators in Sarcopenia Research

The EWGSOP definition suggests using physical performance, muscle strength, and muscle mass as the primary treatment outcome indicators for sarcopenia intervention trials, whereas activities of daily living, quality of life, metabolic and biochemical markers, inflammatory markers, global impression of change by subject or physician, falls, admission to nursing home or hospital, social support, and mortality as secondary outcome indicators.33 While most epidemiologic studies in sarcopenia research to date have taken a static approach, the state of sarcopenia may change over time and this dynamic approach may provide different considerations in developing sarcopenia intervention programs. Therefore, AWGS also recommends a dynamic approach for sarcopenia research by measuring changes in (1) muscle mass, strength, and function, (2) physical performance, (3) frailty status, (4) instrumental activities of daily living, and (5) basic activities of daily living over a given period of time as outcome indicators for sarcopenia research. In addition to the above-mentioned outcome indicators, AWGS also recommends using fear of falling and incontinence as outcome indicators for sarcopenia research (Table 2).

Assessment Techniques and Suggested Cutoff Values

Assessment of sarcopenia in Asian populations presents a great challenge because of the lack of outcome-based studies. However, determining appropriate cutoff values for sarcopenia diagnosis in Asia is critical to promote further sarcopenia research and treatment in Asia. Consequently, AWGS focused on the best available evidence to determine cutoff values for the diagnosis of sarcopenia in Asia. If, however, no outcome-based data are available, AWGS would recommend standardized approaches for cutoff value determination.
are highly associated with that measured using DXA among elderly

ment. Results of multiple segment fat-free mass estimation using BIA

processing, noninvasiveness, radiation-free functions, and conve-

sarcopenia diagnosis and evaluation of the effect of

community-based screening programs. Therefore, AWGS supports

may be considered the main approach in sarcopenia assessment in

Asian populations. Strasser et al46 proposed measurement of

changes in Asia in recent decades. Older Asian people today may have

walked and performed more physical activities because of the un-
derdevelopment of public transportation and living conditions since

their early adulthood, so their muscle mass may be maintained better

than that of the younger generation. On the other hand, because of

the relatively higher adiposity of Asian people in comparison with

Caucasians, appendicular muscle mass may be overestimated by DXA.

Overall, AWGS recommends using 2 standard deviations below the

mean muscle mass of young reference group or the lower quintile as

the cutoff value determination. Moreover, AWGS recommends using

height-adjusted skeletal muscle mass instead of weight-adjusted

skeletal muscle mass, and the suggested cutoff values were 7.0 kg/m²

in men and 5.4 kg/m² in women by using DXA. By using BIA, the

suggested cutoff values were 7.0 kg/m² in men and 5.7 kg/m² in

women, defined by appendicular skeletal muscle mass/height².

Muscle Mass

EWGSOP recommends DXA, computed tomography (CT), mag-
netic resonance imaging (MRI), and bioimpedance analysis (BIA) for

sarcopenia research. Currently, the precision of DXA, CT, and MRI has

been well recognized, but the precision of BIA in measuring muscle

mass is controversial. BIA was developed to estimate the volume of

body fat and lean body mass, but not appendicular muscle mass.

Although the accuracy of BIA in sarcopenia diagnosis has been

validated,39–41 it is heavily dependent on the accuracy of the equation

of the equipment and the conditions of assessments, eg, temperature,

humidity, skin condition, etc. Nevertheless, the high cost, CT-gen-
erated radiation exposure, and inconvenience for community

screening have limited the applications of CT and MRI despite both CT

and MRI have both been considered gold standards for evaluation of

body composition. On the other hand, DXA is also considered an

appropriate alternative approach to distinguish between fat, bone

mineral, and lean tissues. Currently, DXA may be the most widely

used method for muscle mass measurement in sarcopenia research.

Despite the minimal radiation exposure from DXA, using DXA in

community screening of sarcopenia is still difficult. Newly developed

models of BIA equipment may obtain measurements of appendicular

muscle mass with precision.43,44 Portability, reasonable cost, fast

processing, noninvasiveness, radiation-free functions, and conven-

ience of use made BIA suitable for community sarcopenia assess-

ment. Results of multiple segment fat-free mass estimation using BIA

are highly associated with that measured using DXA among elderly

Taiwanese.45 Although using BIA equipment with validated equations

is recommended for sarcopenia research in EWGSOP criteria, the

equations of BIA equipment in Western countries are not derived

from Asian populations. Strasser et al46 proposed measurement of

muscle thickness, especially of musculus vastus medialis, by muscu-

loskeletal ultrasound to be a reliable method for the estimation of

sarcopenia, which deserves further research for applications in Asian

studies. In current Asian studies, the most commonly used BIA ma-

chines were manufactured by only 2 companies, and the results were

quite consistent. Because of its portability and reasonable cost, BIA

may be considered the main approach in sarcopenia assessment in

community-based screening programs. Therefore, AWGS supports

using BIA for sarcopenia diagnosis and evaluation of the effect of

intervention programs, but AWGS suggests researchers to provide

coefficient of variance, inter- and intra-examiner reliability whenever

possible to facilitate subsequent international comparisons.

In terms of cutoff value determination, most current Asian studies

have adopted the classical approach for muscle mass measurement

(i.e., below 2 standard deviations of the mean muscle mass of young

adults). However, Asian studies reported an extremely low preva-

lence of sarcopenia through this approach, especially in older

women.26,47,48 Lau et al26 also found that the relative total skeletal

muscle of Hong Kong Chinese (total skeletal muscle/height²) was 17% lower among young Chinese men than that of Caucasian men.26

A potential cohort effect may exist in this approach since younger

people in Asia today leading a westernized or more urbanized life-

style while older Asian people have carried out a traditional lifestyle

since adulthood. This cohort effect may be derived from the economic
development, urbanization, and development of public transporta-

tion in Asia in recent decades. Older Asian people today may have

walked and performed more physical activities because of the un-
derdevelopment of public transportation and living conditions since

their early adulthood, so their muscle mass may be maintained better

than that of the younger generation. On the other hand, because of

the relatively higher adiposity of Asian people in comparison with

Caucasians, appendicular muscle mass may be overestimated by DXA.

Overall, AWGS recommends using 2 standard deviations below the

mean muscle mass of young reference group or the lower quintile as

the cutoff value determination. Moreover, AWGS recommends using

height-adjusted skeletal muscle mass instead of weight-adjusted

skeletal muscle mass, and the suggested cutoff values were 7.0 kg/m²

in men and 5.4 kg/m² in women by using DXA. By using BIA, the

suggested cutoff values were 7.0 kg/m² in men and 5.7 kg/m² in

women, defined by appendicular skeletal muscle mass/height².

Muscle Strength

Measuring handgrip strength is considered a feasible and conve-

nient measure of muscle strength because of cost, availability, ease of

use, and its association with leg strength. Wu et al49 presented the

norm of handgrip strength in Taiwan, which disclosed that the mean

grip strength of the study sample in Taiwan was significantly lower

(male 25%, female 27%) than consolidated norms derived from largely

Caucasian populations. Although some papers published in Taiwan

using this adjusted cutoff value based on EWGSOP definition for

sarcopenia research,49 some unpublished papers from Japan, Hong

Kong, and China recommended using 25 kg for men and 18 or 16 kg

for women as the cutoff values for handgrip strength. Currently,

handgrip strength is the most widely used measure for muscle

strength in Asian sarcopenia research (Table 3), and AWGS also rec-

ommends using it for the measurement of muscle strength. Although

knee flexion/extension and peak expiratory flow are also re-

commended for sarcopenia research in EWGSOP criteria, they are less

commonly used. In Thailand, the cutoff points of quadriceps strength

had been defined based on the outcome of mobility decline. The

cutoff points of <18 kg in men and <16 kg in women can discriminate

those had normal and abnormal various sarcopenia-related variables.

Because of the lack of outcome-based cutoff values, AWGS recom-

mends using the lower 20th percentile of handgrip strength of the

study population as the cutoff value for low muscle strength before

outcome-based data is available. Low handgrip strength is suggested

to be defined as <26 kg for men and <18 kg for women by AWGS.

Physical Performance

A wide range of tests for physical performance are recommended

in EWGSOP criteria, including the Short Physical Performance Battery

(SPPB), usual gait speed, the 6-minute walk test, the stair climb power

test, and the timed-up-and-go test (TUG).51 Timed usual gait is highly

predictive for the onset of disability,52 and other adverse health

Table 2

Outcome Indicators for Sarcopenia Research Recommended by AWGS

<table>
<thead>
<tr>
<th>Static Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities of daily living</td>
</tr>
<tr>
<td>Quality of life</td>
</tr>
<tr>
<td>Inflammatory markers</td>
</tr>
<tr>
<td>Falls</td>
</tr>
<tr>
<td>Frailty status</td>
</tr>
<tr>
<td>Mobility disorders</td>
</tr>
<tr>
<td>Admission to hospitals</td>
</tr>
<tr>
<td>Admission to long term care facilities</td>
</tr>
<tr>
<td>Mortality</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Dynamic Approach</td>
</tr>
<tr>
<td>Changes in muscle mass</td>
</tr>
<tr>
<td>Changes in muscle strength</td>
</tr>
<tr>
<td>Changes in physical performance</td>
</tr>
<tr>
<td>Changes in frailty status</td>
</tr>
<tr>
<td>Changes in instrumental activities of daily living</td>
</tr>
<tr>
<td>Changes in activities of daily living</td>
</tr>
</tbody>
</table>

AWGS, Asian Working Group for Sarcopenia.
events like severe mobility limitation and mortality. TUG is an assessment of ambulation and dynamic balance. Poorer TUG has been demonstrated to be associated with poorer physical and mental function and mood status, as well as low fat-free mass by BIA measurements. Although TUG has been proposed as a suitable measurement for physical performance in EWGSOP, abnormal TUG may result from a great variety of underlying conditions. AWGS is more conservative in the use of TUG as a measurement for physical performance in EWGSOP, abnormal TUG based on the lower 20% of study group, obtained from the middle 5 m of a total of 11 m walking.

Table 3
Measurable Variables and Cutoff Points in Asian Populations

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Measurement Method</th>
<th>Cutoff Points by Sex</th>
<th>Reference Group Definition</th>
<th>Prevalence of Sarcopenia</th>
<th>Country/ Ethnicity</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle mass</td>
<td>DXA</td>
<td>ASM/height&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Based on values 1 and 2 SD below the sex-specific means of the study reference data (n = 529)</td>
<td>Class 1 and class 2 sarcopenia in subjects 70–85 years of age: Men: 6.7%, 56.7% Women: 6.3%, 33.6%</td>
<td>Japan</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Men: 7.77 and 6.87 kg/m&lt;sup&gt;2&lt;/sup&gt; Women: 6.12 and 5.46 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Men: 7.50 and 6.58 kg/m&lt;sup&gt;2&lt;/sup&gt; Women: 5.38 and 4.59 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>In older Chinese ≥70 years of age: Men: 12.3% Women: 7.6%</td>
<td>Chinese</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASM/height&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Based on 2 SD below the sex-specific mean of a younger population (n = 145)</td>
<td>In older subjects ≥ 60 years of age: Men: 6.3% Women: 4.1%</td>
<td>Korea</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Men: &lt;6.72 kg/m&lt;sup&gt;2&lt;/sup&gt; Women: &lt;5.82 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Men: 32.2% and 29.1% Women: 25.6% and 23.0%</td>
<td>Men: 15.4% Women: 22.3%</td>
<td>China</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASM/body weight (%)</td>
<td>Based on 2 SD below the sex-specific mean of a younger population (n = 145)</td>
<td>Corean</td>
<td>Korea</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Men: 7.40 kg/m&lt;sup&gt;2&lt;/sup&gt; Women: 5.14 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Men: 29.5% and 23.0% Women: 29.3%</td>
<td>Men: 29.5% and 22.3%</td>
<td>China</td>
<td>48</td>
</tr>
<tr>
<td>SMI (%)</td>
<td></td>
<td>Men: 35.71% Women: 30.70%</td>
<td>Based on 2 SD below the sex-specific mean of a younger population (n = 145)</td>
<td>Sarcopenia class I, II</td>
<td>Thailand</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>Using the residuals method</td>
<td></td>
<td></td>
<td>Men: 29.5% and 9.7% Women: 30.3% and 11.8%</td>
<td>Korea</td>
<td>48</td>
</tr>
<tr>
<td>ASM/height&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Based on 1 and 2 SD below the mean of young adults in study (n = 2513)</td>
<td>Class I and class II sarcopenia</td>
<td>Based on 2 SD below the sex-specific mean of a younger population (n = 145)</td>
<td>Men: 29.5% and 9.7% Women: 30.3% and 11.8%</td>
<td>Korea</td>
<td>48</td>
</tr>
<tr>
<td>Men: 7.50 and 6.58 kg/m&lt;sup&gt;2&lt;/sup&gt; Women: 5.38 and 4.59 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>Class I and class II sarcopenia</td>
<td>In older Chinese ≥70 years of age: Men: 12.3% Women: 7.6%</td>
<td>Japan</td>
<td>69</td>
</tr>
<tr>
<td>ASM/height&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Based on 1 and 2 SD below the mean of young adults in study</td>
<td></td>
<td></td>
<td>In older Chinese ≥70 years of age: Men: 12.3% Women: 7.6%</td>
<td>China</td>
<td>26</td>
</tr>
<tr>
<td>Men: &lt;6.72 kg/m&lt;sup&gt;2&lt;/sup&gt; Women: &lt;5.82 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>Class I and class II sarcopenia</td>
<td>In older subjects ≥ 60 years of age: Men: 6.3% Women: 4.1%</td>
<td>Korea</td>
<td>70</td>
</tr>
<tr>
<td>ASM/body weight (%)</td>
<td>Based on 2 SD below the sex-specific mean of a younger population (n = 145)</td>
<td>Based on 2 SD below the sex-specific mean of a younger population (n = 145)</td>
<td>Based on 2 SD below the mean of young adults in study</td>
<td>Men: 29.5% and 9.7% Women: 30.3% and 11.8%</td>
<td>Korea</td>
<td>48</td>
</tr>
<tr>
<td>Men: 32.2% and 29.1% Women: 25.6% and 23.0%</td>
<td></td>
<td></td>
<td>Class I and class II sarcopenia</td>
<td>In older Chinese ≥70 years of age: Men: 12.3% Women: 7.6%</td>
<td>Japan</td>
<td>69</td>
</tr>
<tr>
<td>ASM/body weight (%)&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Based on 2 SD of sex-specific young normal people</td>
<td>Corean</td>
<td>Sarcopenia class I, II, overall</td>
<td>Men: 32.5%, 15.7%, 35.33 % Women: 30.5%, 10%, 34.74 %</td>
<td>Korea</td>
<td>48</td>
</tr>
<tr>
<td>Men: 7.27 kg/m&lt;sup&gt;2&lt;/sup&gt; Women: 5.44 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>Sarcopenia class I, II</td>
<td>Sarcopenia class I, II, overall</td>
<td>Men: 32.5%, 15.7%, 35.33 % Women: 30.5%, 10%, 34.74 %</td>
<td>Korea</td>
<td>48</td>
</tr>
<tr>
<td>SMI (% of skeletal muscle mass index)</td>
<td>Based on the lower 20% of study group</td>
<td></td>
<td></td>
<td>Men: 10.8% Women: 3.7%</td>
<td>Taiwan</td>
<td>47</td>
</tr>
<tr>
<td>Men: 37.4% Women: 28.0%</td>
<td></td>
<td></td>
<td>Based on the lower 20% of study group</td>
<td>Based on values 1 and 2 SD below the normal sex-specific mean for young people</td>
<td>Taiwan</td>
<td>40</td>
</tr>
<tr>
<td>BIA</td>
<td>SMI</td>
<td>Men: &lt;8.87 kg/m&lt;sup&gt;2&lt;/sup&gt; Women: &lt;6.42 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Based on 2 SD below the normal sex-specific mean for young people</td>
<td>Based on EWGSOP recommendation and adjusted according to Asian data&lt;sup&gt;59&lt;/sup&gt;</td>
<td>Korea/Health ABC data</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Men: &lt;7.0 kg/m&lt;sup&gt;2&lt;/sup&gt; Women: &lt;5.8 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Based on 2 SD below the normal sex-specific mean for young people</td>
<td>Based on EWGSOP recommendation and adjusted according to Asian data&lt;sup&gt;59&lt;/sup&gt;</td>
<td>Korea/Health ABC data</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Men: &lt;6.42 kg/m&lt;sup&gt;2&lt;/sup&gt; Women: &lt;5.82 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Based on 2 SD below the normal sex-specific mean for young people</td>
<td>Based on EWGSOP recommendation and adjusted according to Asian data&lt;sup&gt;59&lt;/sup&gt;</td>
<td>Korea/Health ABC data</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Men: &lt;6.75 kg/m&lt;sup&gt;2&lt;/sup&gt; Women: &lt;5.07 kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Based on 2 SD below the normal sex-specific mean for young people</td>
<td>Based on EWGSOP recommendation and adjusted according to Asian data&lt;sup&gt;59&lt;/sup&gt;</td>
<td>Korea/Health ABC data</td>
<td>15</td>
</tr>
<tr>
<td>Muscle strength</td>
<td>Handgrip strength</td>
<td>Men: 30.3 kg Women: 19.3 kg Men: &lt;22.4 kg Women: &lt;14.3 kg</td>
<td>Based on the lowest quartile of study group based on EWGSOP criteria</td>
<td>Based on EWGSOP recommendation and adjusted according to Asian data&lt;sup&gt;59&lt;/sup&gt;</td>
<td>Korea/Health ABC data</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Knee extension gait speed</td>
<td>Women: ≤1.01 Nm/kg</td>
<td>Based on the lowest quartile of study group, gait speed obtained from the middle 5 m of a total of 11 m walking</td>
<td>Based on the lowest quartile of study group</td>
<td>Japan</td>
<td>13</td>
</tr>
<tr>
<td>Physical performance</td>
<td>Gait speed</td>
<td>Men: &lt;1.27 m/s Women: &lt;1.19 m/s</td>
<td>Based on the lowest quartile of study group, gait speed obtained from the middle 5 m of a total of 11 m walking</td>
<td>Based on the lowest quartile of study group</td>
<td>Japan</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gait speed ≤ 1 m/s Gait speed ≤ 1.22 m/s SPPB scores ≤ 9</td>
<td>Based on the lowest quartile of study group, gait speed obtained from the middle 5 m of a total of 11 m walking</td>
<td>Based on the lowest quartile of study group</td>
<td>Japan</td>
<td>13</td>
</tr>
<tr>
<td>SPPB</td>
<td></td>
<td></td>
<td></td>
<td>Men: 11.3% Women: 10.7% using EWGSOP criteria</td>
<td>Japan</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Men: 12.1% Women: 11% using EWGSOP criteria</td>
<td>Japan</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Men: 11.3% Women: 10.7% using EWGSOP criteria</td>
<td>Japan</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Men: 12.1% Women: 11% using EWGSOP criteria</td>
<td>Japan</td>
<td>13</td>
</tr>
</tbody>
</table>

ASM, appendicular skeletal muscle mass; BIA, bioimpedance analysis; DXA, dual x-ray absorptiometry; EWGSOP, European Working Group on Sarcopenia in Older People; Health ABC, The Health Aging and Body Composition Study; RASM, relative appendicular skeletal muscle; SD, standard deviation; SPPB, Short Physical Performance Battery; SMI, skeletal muscle mass index.

<sup>1</sup>SMI (%) = total skeletal muscle mass (kg)/weight (kg) × 100.

<sup>2</sup>The author also named it modified skeletal muscle mass index (SMI).
performance, and we recommend using 6-meter usual gait speed for measurement of physical performance.

Ideally, determination of the cutoff values of these measurements should be based on longitudinal outcome-based studies instead of a simply statistical approach.\textsuperscript{55} Although the association between sarcopenia and functional decline or even mortality has been established,\textsuperscript{56} selection of universal outcome indicators in subsequent research may facilitate international comparisons. Table 3 summarized the epidemiology and proposed cut-off points in different cases of Asian sarcopenia research. EWGSOP has developed a suggested algorithm based on gait speed measurement with a cutoff point of <0.8 m/s.\textsuperscript{33} The association of slow usual gait speed in the elderly with adverse clinical outcomes has been reported extensively, but the application was also dependent on the determination of appropriate cutoff points. Meanwhile, the prevalence of low muscle mass in the Asian population as determined using the classical approach is very low, which is confusing. The potential cohort effect may partially explain the phenomenon of older people today engaging in more physical activities than younger people, which made the prevalence of sarcopenia lower than expected. Specific consideration of this potential cohort effect deserves further attention in the diagnosis of sarcopenia in Asia. Although there is a potential gender difference in the cutoff value of usual gait speed and a wide range of walking speed (from 0.6 to 1.2 m/s) being reported in this special issue, AWGS suggested using <0.8 m/s as the cutoff for low physical performance after extensive consideration of data available in Asian studies.

Therapeutic Implications

Physical activities, including aerobics, endurance exercise,\textsuperscript{37} and resistance exercise training,\textsuperscript{58,59} have been demonstrated to significantly increase muscle mass and strength in sarcopenic older people. Although the recommended frequency of exercise training to improve muscle strength and functional performance has been shown,\textsuperscript{60} a consensus has not yet been reached concerning the content of the prescribed exercise and the most optimal frequency and intensity. Inappropriate exercise training in the elderly may result in unfavorable adverse outcomes such as musculoskeletal complaints.\textsuperscript{61} which is not uncommon. Further research should be focused on the development of suitable exercise prescription, especially for older people at risk of functional decline or sarcopenia. The Society for Sarcopenia, Cachexia, and Wasting Disease developed nutritional recommendations for the prevention and management of sarcopenia, which combined exercise with adequate protein and energy intake.\textsuperscript{62} A leucine-enriched balanced essential amino acid or balanced amino acid supplementation is suggested for sarcopenia. Recently, Kim et al\textsuperscript{63} demonstrated that exercise and amino acid supplementation (3 g of a leucine-rich essential amino acid mixture twice a day) together may actually be effective in enhancing muscle strength, variables of muscle mass, and walking speed in sarcopenic women. Aside from exercise and nutritional supplementation, the pharmaceutical approach to sarcopenia is still under development. Growth hormone replacement was not successful because the effect of increased muscle mass by growth hormone replacement was not associated with the improvement of muscle performance.\textsuperscript{53―56} unless it is used for growth hormone deficiency patients for a period longer than 12 months.\textsuperscript{66―68} In addition, the effects of antimyostatin antibodies on sarcopenia have been demonstrated and may be marketed in a few years. Therefore, sarcopenia should be treated through a multi-level approach employing combined physical activities and nutritional supplementation. Currently, there is no well-established evidence for pharmaceutical approach for sarcopenia intervention, but a few agents may be available in future.

Future Challenge and Conclusion

Sarcopenia significantly impacts daily activities, functional status, disability, and quality of life in older populations. Although Asian populations are rapidly ageing, from the clinical practice or public health points of view, the understanding of and preparation for sarcopenia remain inadequate. Hence, this consensus collected as many Asian studies as possible and offers a working diagnosis of sarcopenia for Asian people. The main aims of AWGS were to promote sarcopenia research in Asian countries through providing recommended diagnostic strategies and cutoff values based on Asian studies, and to foster the importance of implementing sarcopenia in clinical practice and in community health promotion programs.

References


