

Unit 1: From Lifespan to Healthspan

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ABSTRACT

Singapore is a super-aged society; residents live for roughly a decade of their lives in poor health. Narrowing the gap between lifespan and healthspan is therefore a priority for primary care, so that older adults can maintain function and quality of life. This article describes the shift in healthcare delivery from a reactive to a proactive approach, summarises the WHO concepts of healthy ageing, intrinsic capacity, and functional ability, and reviews preventive interventions across the life course. It then offers practical guidance for Family Physicians within the Healthier SG framework: goal setting, brief screening for functional decline, targeted interventions, attention to social context and safety, and structured follow-up.

Keywords: Healthy Ageing, Healthspan, Prevention, Primary Care

INTRODUCTION

Human life expectancy has risen from approximately 47 years in 1900 to more than 80 years in many high-income countries.¹ Singapore has among the highest life expectancies in the world. According to World Health Organization (WHO) estimates, life expectancy at birth for Singapore residents is approximately 84 years, while healthy life expectancy is approximately 74 years, indicating about 10 years lived with illness, disability, and dependence.² A similar gap is seen in other developed countries, such as Japan, the United Kingdom, and the United States.² Years spent in poor health are associated with greater healthcare utilisation and expenditure, and strain the sustainability of a nation's health system.^{3,4}

Our population is also ageing rapidly. In 2026, 21.4 percent of Singaporeans were aged 65 years or older, crossing the 21 percent threshold that defines a super-aged society.⁵ The number of citizens aged 80 years and above has also risen by 60 percent, from 95,000 in 2016 to 152,000 in 2026.⁵

These trends have direct implications for primary care, which is best placed to deliver preventive care by virtue of its continuity of care, long-term patient relationships, and proximity to the community. Longitudinal, holistic care focused on health promotion, disease prevention, and patient empowerment is provided most efficiently and cost-effectively by a strong primary care sector.⁴ This imperative is further underscored by Healthier SG, the national health reform launched in July 2023.⁶ Family Physicians will increasingly care for patients who live longer and expect to remain active and independent. This paper considers what can be done within routine primary care consultations to narrow the gap between lifespan and healthspan.

A SHIFT IN APPROACH: FROM REACTIVE TO PROACTIVE CARE

Healthcare has traditionally operated reactively, responding to illness once symptoms or complications develop, and has been organised around acute illness and single-disease management. This model is poorly suited to an ageing population, in whom multiple concurrent chronic conditions are common³ and who prioritise outcomes such as functional mobility, independence, and the ability to remain in their own homes. A proactive approach instead seeks to identify risk and early functional decline before disability is established, and

to intervene while capacity can still be preserved or improved. Healthy longevity medicine, an emerging field that targets the biological processes of ageing, is similarly framed as a paradigm shift from reactive to proactive healthcare.⁷

This conceptual shift is reflected in global and local policy. The UN Decade of Healthy Ageing (2021 to 2030) emphasises age-friendly environments, integrated care, long-term care, and the reduction of ageism.⁸ In Singapore, the Action Plan for Successful Ageing, Age Well SG, and Healthier SG put these priorities into practice,⁹ consistent with the Ministry of Health's Three Beyonds framework of moving beyond healthcare to health, beyond hospital to community, and beyond quality to value.⁴ Healthier SG in particular is a multi-year strategy that moves the emphasis from caring reactively for those who are already ill to proactively preventing illness, anchoring preventive care in the enrolled patient's Family Physician, and a personalised health plan.^{6,10}

HEALTHY AGEING: PREVENTION ACROSS THE LIFE COURSE

Lifespan denotes the chronological duration of life from birth to death.¹ Healthspan, by contrast, is conceptually complex and lacks a uniform definition. It is often described as the period of life spent in "good health", free from major chronic disease or significant functional decline.^{1,11} At the population level, healthy life expectancy—which subtracts years lived with disability from total life expectancy—serves as a surrogate marker.¹²

The WHO defines healthy ageing as the process of developing and maintaining the functional ability that enables well-being in older age.¹³ This definition rests on three linked concepts:

- **Intrinsic capacity** refers to all the physical and mental capacities that a person can draw on, including locomotor capacity (physical movement), sensory capacity (hearing and vision), vitality (energy and balance), cognition, and psychological capacity.
- **Environment** comprises all the factors in the home, community, and broader physical and social surroundings that interact with an individual's capacities.
- **Functional ability** combines the intrinsic capacity of the individual, the environment a person lives in, and how they interact with their environment.

This framework has two key implications. First, declines in capacity may be slowed and, in some cases, partially reversed.¹³ Second, where capacity cannot be restored, function may still be preserved through modification of the environment, which provides the rationale for community resources and social prescribing.

A life-course perspective is equally important. Intrinsic capacity is accrued in childhood, peaks in early adulthood, and then declines at a rate shaped by cumulative exposures and behaviours.¹³ Healthy ageing therefore does not begin at 60. Younger adults with chronic conditions, declining physical activity, or sedentary occupations are the group in whom primary care interventions may most effectively alter later trajectories. The interventions with the strongest supporting evidence are summarised in the table below.

Evidence-based interventions across the life course
1. Physical activity, including resistance and balance training
2. Cardiometabolic control (blood pressure, lipids, glycaemic control, weight)
3. Smoking cessation and alcohol reduction
4. Vaccinations
5. Cancer screening (breast, cervical, colorectal)
6. Hearing and vision correction
7. Bone health and falls prevention

8. Nutrition, including adequate protein intake
9. Sleep, mood, and loneliness
10. Cognitive engagement and social participation

WHAT CAN BE DONE IN THE PRIMARY CARE SETTING

Current health systems are often better designed to respond to episodic health needs than to the complex, chronic needs that arise with age. There is an urgent need for coordinated primary healthcare approaches that prevent, slow, or reverse declines in intrinsic capacity, and that help older adults compensate when decline is unavoidable. The steps below set out how this can be done in practice.

Exploring and Establishing Goals

The Healthier SG enrolment and annual health plan reviews offer an opportune window to shift consultations away from isolated disease markers towards patient-centred functional goals.⁶ Eliciting priorities in the patient's own terms, such as maintaining independent travel, preserving the ability to cook, or avoiding dependence on caregivers, helps anchor subsequent clinical decisions, improves concordance, and strengthens the patient-physician relationship.

Screening for Decline

A brief screen for functional decline can be performed using the WHO ICOPE framework,¹⁵ which examines cognition, mobility, nutrition, vision, hearing, and mood. Positive screens can then be followed by in-depth assessment. Suggested instruments are shown in the table below.

Domain	Suggested Screen
Mobility and falls	Gait speed or five-repetition chair stand; questions on a fall in the past year, unsteadiness and fear of falling
Nutrition	Unintentional weight loss and reduced appetite
Cognition	Mini-Cog or another validated brief test, prompted by patient or family concern
Vision and hearing	Visual acuity chart; whispered-voice test or hearing questionnaire
Mood	PHQ-2, followed by PHQ-9 if positive
Frailty	FRAIL scale or Clinical Frailty Scale
Social connection	Brief loneliness question or three-item loneliness scale

Intervene on Modifiable Domains

Exercise. Older adults are recommended to undertake at least 150 to 300 minutes of moderate-intensity aerobic activity per week, muscle-strengthening activities on at least two days per week and, for those at risk of falls, multicomponent balance and functional training on at least three days per week.¹⁶

Nutrition. Adequate protein intake, approximately 1.0 to 1.2 g per kg body weight per day in healthy older adults and higher in acute or chronic illness,¹⁷ supports muscle mass and function. Unintentional weight loss warrants further review and referral to a dietitian.

Medication review. Polypharmacy and potentially inappropriate medications are important and modifiable contributors to falls, confusion, and hospital admission. An annual medication

review using validated tools such as the STOPP/START or Beers criteria^{18,19} is recommended, with particular attention to sedative, anticholinergic, and hypotensive agents. Deprescribing should be undertaken through shared decision-making, with monitoring after each change.

Vaccination and screening. Vaccination status and participation in national cancer screening programmes should be reviewed at chronic disease visits.

Address Social Determinants of Health

Social determinants influence health outcomes to a degree comparable with clinical factors. Useful screening questions address living arrangements, ability to manage medications and associated costs, frequency of leaving the home, and experience of loneliness. Social prescribing helps link patients to community programmes, such as those supported by the Health Promotion Board, and involving the Integrated Community Care Provider (ICCP) network of Active Ageing Centres, Senior Care Centres, enhanced Home Personal Care, and Home Therapy.

Follow-up and Reassessment

Positive screens should lead to a defined action and a review date, recorded in the health plan. Reassessment is also indicated after an acute illness or hospitalisation and when the patient's social role or living situation changes.¹⁵

NAVIGATING POTENTIAL BARRIERS

Implementing preventive care requires navigating several operational hurdles. Single-handed and small group private practices may lack the scale to manage patients with complex needs, and sharing of information across providers remains difficult⁴; Healthier SG seeks to address this.⁶ Time constraints can be mitigated through interprofessional, team-based care in which nurses, allied health professionals, and community partners take on tasks such as baseline frailty screening, balance checks, and lifestyle counselling, and repeated short contacts are likely to be more effective than a single extended consultation. Health literacy and language also influence how well patients understand advice.⁷ Finally, ageism, including clinicians' assumptions that decline is inevitable or that older patients are unlikely to change their behaviour, may limit the care offered.

CONCLUSION

The focus of healthy ageing is not to prolong life irrespective of its quality, but to extend the period lived in good health. Singapore possesses the demographic imperative and has the support of the policy framework through Healthier SG to promote health prevention in the primary care setting with individualised health plans. Narrowing the gap between lifespan and healthspan is best placed in the primary care setting.

Learning Points

- Most residents live the last decade of life in poor health; narrowing the gap between lifespan and health span is a priority to allow maintenance of function and quality of life in old age.
- Primary care, supported by Healthier SG, is best placed to support the ageing population through a shift from reactive to proactive care.
- Practical actions include establishing goals, screening intrinsic capacity using the WHO ICOPE domains, exercise prescription, reviewing medications, and linking patients to community programmes.
- Time constraints and other potential barriers can be mitigated through team-based care, repeated short contacts, and a shared health plan.

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Unit 2: Frailty and Sarcopenia: Clinical Consequences and Windows for Prevention

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ABSTRACT

Sarcopenia is an age-related progressive and generalised skeletal muscle disorder involving loss of muscle mass and strength, leading to reduced physical function. It is the antecedent cause of physical frailty, with both sharing similar clinical features, adverse outcomes and intervention strategies. Muscle health plays an important role in locomotor capacity, one of the domains of intrinsic capacity that is essential for healthy ageing. Recognising that muscle health starts to decline in midlife, with potential for reversibility with earlier recognition and intervention, the Asian Working Group for Sarcopenia (AWGS) 2025 consensus was updated to reflect sarcopenia management in the context of improving muscle healthspan across the life course. The AWGS 2025 update expands case-finding to at-risk older adults aged 50–64 years. Diagnosis of sarcopenia was revised to include presence of low muscle mass and strength, with physical performance as an outcome measure. Resistance exercise and quality nutrition with adequate protein intake remain the pillars of sarcopenia and frailty management. This article summarises how the key AWGS 2025 recommendations can be contextualised to our clinical practice locally, alongside existing guidelines for sarcopenia and frailty management.

Keywords: sarcopenia, frailty, intrinsic capacity, locomotor capacity, diagnosis, treatment, prevention, Singapore, Asia

INTRODUCTION

Frailty is a clinical syndrome describing the increased vulnerability of individuals to adverse outcomes from health-related stressors, as a result of reduced physiological reserves.¹ Faced with an ageing world demographic, the World Health Organisation introduced the term “intrinsic capacity” in 2015 to promote a function-centred approach to healthy ageing.^{2,3} Optimisation of intrinsic capacity—the composite of all physical and mental capabilities that an individual can draw upon throughout life—can delay onset of frailty and its attendant consequences, including functional decline and mortality.⁴ Intrinsic capacity has been shown to be related to and predictive of frailty risk, with impaired locomotion, impaired vitality, and a greater number of impaired domains associated with greater risk.^{5,6}

Muscle health is integral to maintaining locomotor capacity, one of the domains of intrinsic capacity. Measures of muscle strength and function have been shown to be predictive of important clinical outcomes.⁷ Sarcopenia is an age-related progressive and generalised skeletal muscle disorder involving loss of muscle mass and strength,

leading to reduced physical function.^{8,9} While muscle mass and strength peak in young adulthood, the decline begins in midlife around age 30, with strength affected more than mass, then accelerates further beyond age 60.^{10,11} Sarcopenia has often been described as the antecedent cause of physical frailty, with both sharing similar manifestations of weakness and slowness, and leading to common outcomes including falls, functional decline, disability, hospitalisation, increased healthcare costs, institutionalisation, and mortality.¹²

PREVALENCE OF SARCOPENIA AND FRAILITY

Commensurate with the rapidly ageing population, both sarcopenia and frailty are growing problems. Using the Asia Working Group for Sarcopenia (AWGS) 2014 criteria, the prevalence of sarcopenia was 5.5 to 25.7 percent in Asia.¹³ Locally, sarcopenia prevalence varies from 6.1 to 44.3 percent depending on study setting, diagnostic criteria, and cutoffs applied.¹⁴ In the community, 27 to 32.2 percent of older Singaporeans, predominantly men, have sarcopenia.^{15,16}

As for frailty, the prevalence ranges between 3.5 to 27 percent in Asia Pacific, comparable to Europe and America.¹⁷ The local prevalence ranges from 5.7 to 6.2 percent among older adults.¹⁸ The Singapore Longitudinal Ageing Study found 32.5 percent of community-dwelling older adults were found to be pre-frail.¹⁹

Sarcopenia and Frailty Transitions

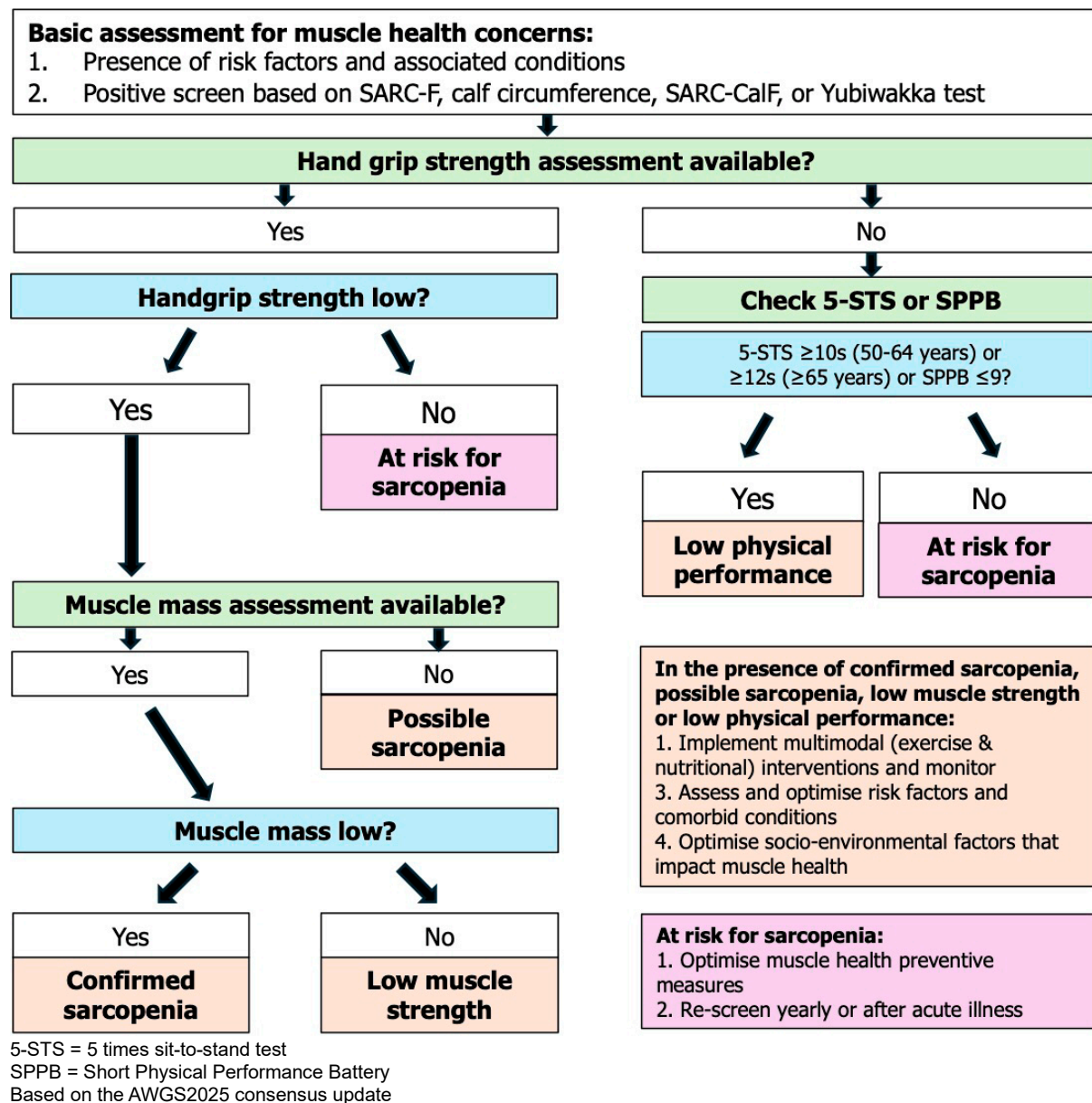
Fortunately, there is potential for reversal from sarcopenia, pre-frailty, and early frailty to non-sarcopenic and robust states.^{20–23} This bidirectional transition emphasises the importance of early detection and intervention for older adults at risk, and the need to shift in favour of a preventative life-course approach towards muscle health in order to safeguard our population against the cascade of adverse health outcomes related to sarcopenia and frailty.

ASIAN WORKING GROUP FOR SARCOPENIA 2025 CONSENSUS UPDATE

The Singapore Clinical Practice Guidelines (CPG) for sarcopenia were developed in 2022, drawing upon the AWGS 2019 consensus as well as supportive evidence based on local studies until 31 Dec 2020, providing contextualised recommendations to facilitate adoption of the AWGS 2019 consensus in our local practice.¹⁴

Recognising the need to expand sarcopenia management across the life course, the AWGS consensus was updated in 2025 to: 1) include middle-aged adults (50–64 years) in the target population for diagnosis; 2) update existing AWGS 2019 diagnostic algorithms to align with the Global Leadership Initiative in Sarcopenia (GLIS) recommendations; and 3) introduce an enhanced muscle health framework, integrated within the WHO Integrated Care for Older People (ICOPE) framework used for intrinsic capacity assessment (refer to **Figure 1**).⁹

Figure 1. Enhanced framework for muscle health assessment and management (AWGS-2025 consensus)



This article aims to summarise how the key AWGS 2025 recommendations can be contextualised to our current practice, alongside our local CPG for sarcopenia management as well as recommendations for frailty management based on the Asia-Clinical Practice Guidelines for the Management of Frailty and National Frailty Consensus Discussion.^{18,24}

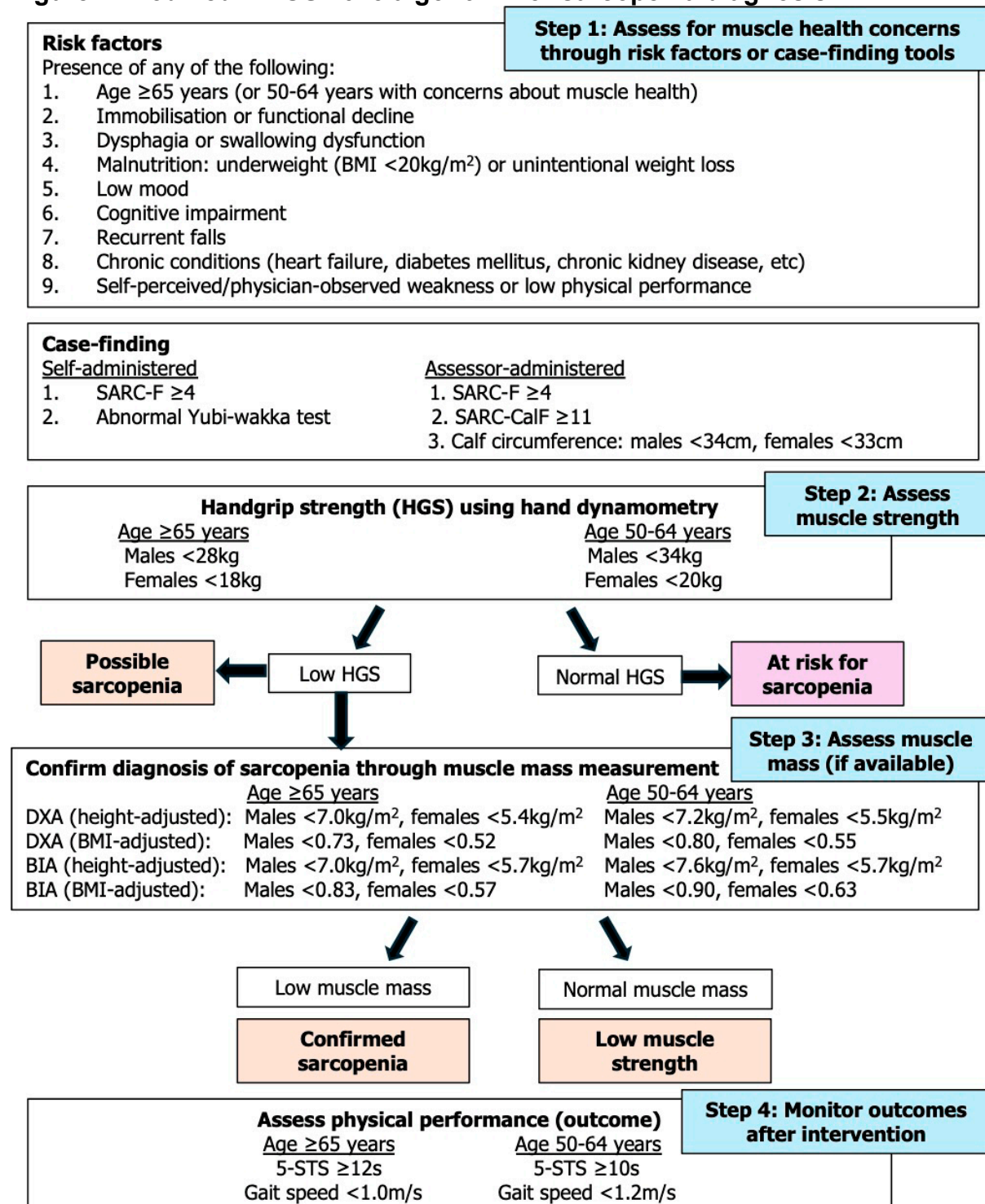
SARCOPENIA CASE-FINDING

A. Risk Factor Assessment

Similar to AWGS-2019 and Singapore CPG, the AWGS 2025 consensus recommends a case-finding approach for older adults aged 65 years and above, but also includes those aged 50–64 years who have muscle health concerns, with risk factors including functional decline, dysphagia, malnutrition risk, comorbidities (such as chronic heart, lung, kidney, liver disease, diabetes mellitus, etc), weakness or low physical performance, or concomitant geriatric syndromes such as cognitive impairment, low mood, and falls risk (refer to **Figure 2**). Opportunistic screening is also recommended

following acute hospitalisation, illness or other significant health events that may accelerate muscle loss, or in care settings with an expected higher prevalence of sarcopenia such as rehabilitation or long-term care settings.²⁵

Figure 2. Modified AWGS 2025 algorithm for sarcopenia diagnosis



5-STST = 5 times sit-to-stand test
BIA = Bioelectrical impedance analysis
BMI = Body mass index
DXA = Dual-energy X-ray absorptiometry
SPPB = Short Physical Performance Battery
Based on the AWGS2025 consensus update

B. Case-Finding Tools

Recommended case-finding tools are: SARC-F, calf circumference (CC), SARC-CalF, and Yubi-wakka test. It is important to note that current assessment cutoffs are validated only in older adults aged 65 and above. The SARC-F is a self-reported 5-item questionnaire that assesses strength, assistance in walking, ability to rise from a chair, climb stairs, and history of falls (refer to **Table 1**).²⁶ A SARC-F cutoff of ≥ 4 has low-moderate sensitivity and moderate-high specificity for sarcopenia diagnosis in the community and outpatient clinic setting.²⁷ If there is a high index of suspicion for sarcopenia and SARC-F score is between 2 to 4, further assessment and intervention is warranted given increased sensitivity for sarcopenia at this lower cutoff.^{28,29}

Table 1. SARC-F Screening for Sarcopenia

Component	Question	Scoring
Strength	How much difficulty do you have in lifting and carrying 10 lb (4.5 kg)?	None = 0 Some = 1 A lot or unable = 2
Assistance in walking	How much difficulty do you have walking across a room?	None = 0 Some = 1 A lot, use aids, or unable = 2
Rising from a chair	How much difficulty do you have transferring from a chair or bed?	None = 0 Some = 1 A lot or unable without help = 2
Climbing stairs	How much difficulty do you have climbing a flight of 10 stairs?	None = 0 Some = 1 A lot or unable = 2
Falls	How many times have you fallen in the past year?	None = 0 1–3 falls = 1 ≥ 4 falls = 2
		Total score : _____ ≥ 4 indicates sarcopenia

CC has moderate-to-high sensitivity and specificity in predicting sarcopenia or low skeletal muscle mass.¹³ Recommended cutoffs are CC < 34 cm for men and < 33 cm for women. As there is systematic overestimation of sitting over standing measurements by 0.7 cm leading to under-detection in the sitting position, CC should be measured in the standing position using a nonelastic tape and hence is preferably administered by an assessor rather than self-administered. Diagnostic performance of CC can be attenuated in sarcopenic obesity due to decreased sensitivity with under-detection in women.³⁰ SARC-CalF combines both CC and SARC-F, improving the sensitivity of SARC-F for case-finding by adding CC, with a score of ≥ 11 indicating sarcopenia.³¹ Similar to CC, the diagnostic performance of SARC-CalF is attenuated by obesity with under-detection of sarcopenic obesity in both older men and women.³²

The Yubi-wakka test is a self-administered screening test of muscle mass loss by assessing one's ability to surround the calf muscle using a ring formed with both thumbs and index fingers around the largest part of the calf.³³ A gap between the finger-ring and calf muscle suggests possible muscle loss. While it is easily administered and shown to have predictive validity in Japanese populations, a local

study highlighted limitations in its diagnostic performance for case-detection of sarcopenia in the community, particularly in obese individuals.³⁴ This suggests that anthropometric differences can contribute to heterogeneity in diagnostic accuracy across Asian populations.

C. Determining Presence of Possible Sarcopenia or Sarcopenia at Risk

In the absence of further muscle mass assessment, middle-aged or older adults who screen positive for risk factors or on the case-finding tools should be evaluated for “possible sarcopenia” based on handgrip strength assessment. Those with low handgrip strength (i.e., possible sarcopenia) should undergo further evaluation for underlying causes (including drugs, diabetes mellitus, disease, deficiency) (refer to **Table 2**). Those with normal muscle strength are considered “at risk for sarcopenia” and should be re-assessed annually.

Table 2. 4Ds Mnemonic: Underlying causes of Sarcopenia

1. <u>D</u>rugs <i>Common</i> • Statins • Fibrates • Steroids • Alcohol <i>Less common</i> • Chloroquine • Colchicine • Antiretroviral drugs, e.g., lamivudine, zidovudine • Chemotherapy medications 2. <u>D</u>iabetes Mellitus 3. <u>O</u>ther <u>D</u>iseases • Chronic lung, kidney, liver, or heart disease • Osteoporosis • Knee Osteoarthritis • Neurological diseases • Cancer • Cognitive impairment, depression 4. <u>D</u>eficiency • Vitamin D deficiency • Caloric or protein deficiency <i>Risk factors for under-nutrition:</i> • Dentition or oral health problems • Dysgeusia (loss of taste) • Dysphagia • Diseases/drugs causing anorexia or malabsorption • Deprivation (Socioeconomic factors affecting access to food)
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D. Addressing Underlying Causes

Both individuals with “possible sarcopenia” and “at risk for sarcopenia” should be advised accordingly on nutritional and exercise interventions to improve muscle health, namely adequate caloric and protein intake, and regular resistance-based exercise and multi-component physical activity. Suitable cases, with diagnostic and/or management challenges, can be considered for referral to tertiary settings for further evaluation of underlying causes, muscle mass assessment, and tailored multidisciplinary intervention as needed.

SARCOPENIA DIAGNOSIS

The AWGS 2025 consensus refines previous AWGS 2019 criteria by requiring both low muscle mass and low muscle strength for sarcopenia diagnosis, shifting low physical performance to an outcome measure rather than as part of the diagnostic criteria. Cutoffs for muscle mass and strength are age- and gender-specific and dependent on measurement method (refer to **Figure 2**).

A. Skeletal Muscle Mass Measurement

A diagnosis of “possible sarcopenia” or “sarcopenia at risk” is usually sufficient for primary care or community preventive health settings to recommend interventions for muscle health. In cases where confirmatory muscle mass measurement is necessary, dual-energy X-ray absorptiometry (DXA) is still recommended as the imaging modality. Readings of lean mass from the four limbs are summed and divided by height-squared to yield the height-adjusted appendicular lean mass. However, as DXA measures lean mass rather than muscle mass per se, limitations include: 1) potential misclassification of body composition in individuals with high levels of water and fibrous tissue; 2) weak association between DXA-measured muscle mass and adverse health outcomes; and 3) lack of information about muscle quality.

Bioelectrical impedance analysis (BIA) is not routinely recommended for use in clinical care in view of the need for population- and device-specific equations and cutoffs. A validated multi-frequency device is preferred as there is better correlation with DXA-measured appendicular skeletal mass.³⁵ BIA readings can be affected by factors such as hydration status and obesity, and is contraindicated in those with pacemakers or cardiac devices.

Height-adjusted appendicular lean mass cutoffs may under-detect low muscle mass in individuals with sarcopenic obesity. BMI adjusted cutoffs for both DXA and BIA have been recognised for this purpose and validated to be comparable to height-adjusted cutoffs for clinical outcomes in the AWGS 2025 consensus update.^{36–38}

B. Muscle Strength Measurement

Consistency in the type of dynamometer used and adherence to measurement protocol are important in ensuring the validity of handgrip strength measurement in assessing muscle strength in clinical practice. The recommended positions for measuring handgrip strength are sitting with 90° elbow flexion for the Jamar (hydraulic) dynamometer and standing with full elbow extension for the Smedley dynamometer, respectively; the protocol for Smedley dynamometer also permits sitting for those who are unable to stand unassisted.³⁹ In addition, handgrip strength results of dynamometers are not interchangeable, with Smedley dynamometers having systemically lower readings compared to the Jamar.⁴⁰ Where possible, local validation

studies of other hand dynamometers should be carried out to determine the presence of systematic or proportional bias relative to the Jamar or Smedley.

The AWGS 2025 cutoffs for low handgrip strength are <28.0 kg in men and <18.0 kg in women aged 65 and above, and <34.0 kg in men and <20.0 kg in women aged 50–64 years. The maximum reading of at least two trials using the dominant hand in a maximum-effort isometric contraction has better predictive validity for poor physical performance at two years.⁴¹

C. Role of Physical Performance Measurement

While physical performance has been designated as an outcome measure of sarcopenia in the AWGS 2025 consensus, the 5-time sit-to-stand test (5-STST) and Short Physical Performance Battery (SPPB) remain clinically relevant as screening tools for physical function in clinical practice. Notably, they have also been recommended as feasible and valid assessments for locomotor capacity and physical function under the ICOPE framework. The 5-STST involves asking the participant to stand up from a chair and sit back down as quickly as possible five times. The SPPB assesses lower limb function in the three domains of balance, gait speed, and 5-STST. Each of the three subtests is scored from 0 to 4, and summing the three subtests yields the total score (range: 0–12). If 5-STST time is prolonged by ≥12 s (for older adults ≥65 years and above) or by ≥10 s (for adults aged 50–64 years old) or SPPB ≤9, it can indicate sarcopenia risk that necessitates further evaluation, particularly in primary care or community settings without access to muscle strength or mass measurement.^{7,9} Either the stand or sit stop can be used, as long as the same protocol is consistently used.⁴²

FRAILTY SCREENING

Based on the Asia-Pacific Clinical Practice Guidelines for the Management of Frailty, it is recommended that adults more than 70 years of age or those who have unintentionally lost >5 percent of their body weight in the previous year be screened for frailty.²⁴

Frailty screening tools differ based on their underlying theoretical framework. The predominant models of classification are: 1) the physical phenotype model (e.g., Fried's frailty phenotype with the key features of involuntary weight loss, exhaustion, muscle weakness, slow gait speed, low physical activity)⁴³; 2) the deficit accumulation model (e.g., Frailty Index); and 3) mixed physical and psychosocial models (e.g., Edmonton Frailty Scale).

The FRAIL scale is based on the physical phenotype model and consists of self-reported assessment of five components: **F**atigue, **R**esistance (ability to climb one flight of stairs), **A**bility to walk one block, presence of >5 **I**llness, and **L**oss of weight >5 percent from baseline.⁴⁴ A score of 1–2 is pre-frail, and ≥3 is frail (refer to **Table 3**).

Table 3. FRAIL instrument

Symptom/Sign	Assessment
Fatigue	Are you fatigued?
Resistance	Can you walk up one flight of stairs?
Ambulation	Can you walk one block?
Illness	Do you have more than five illnesses?

Loss of weight	Have you lost more than 5% of your weight in the last six months?
≥ 3 = Frail 1–2 = Prefrail 0 = Robust	

Another commonly used frailty screening tool for older adults, which functions as a global synthesis assessment tool using clinical descriptors and pictures, is the Clinical Frailty Scale (CFS). The CFS has been shown to predict institutionalisation and mortality risk in older adults⁴⁵; a brief version for self and proxy administration has been modified for use in community-based settings (refer to **Figures 3a** and **3b**).⁴⁶⁻⁴⁸

Figure 3a. CFS-Brief questionnaires for self and proxy-administration

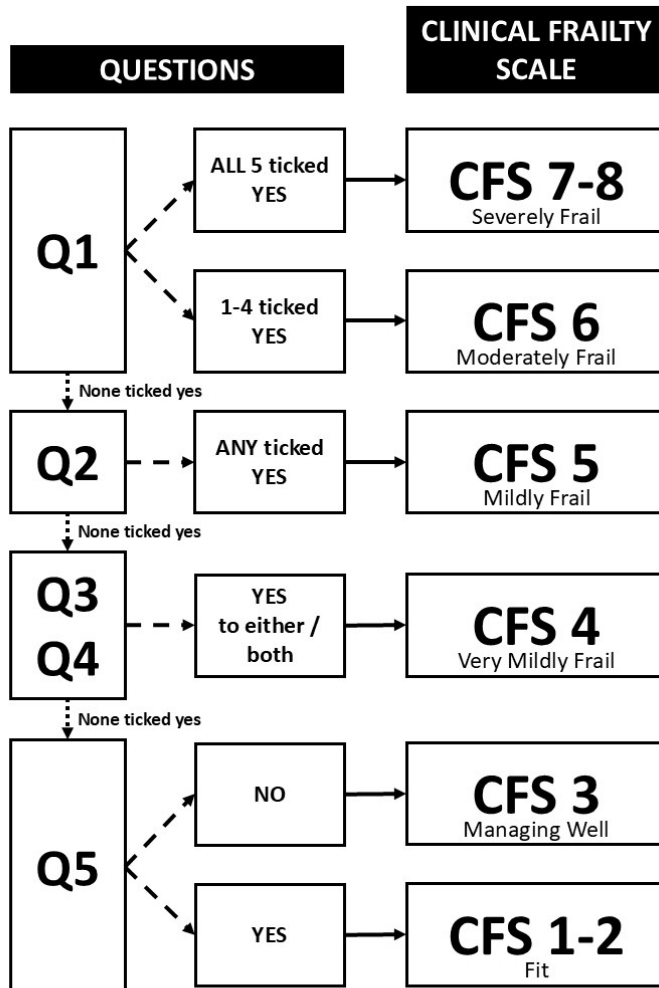
Clinical Frailty Scale (Brief)	Clinical Frailty Scale (Brief)
This questionnaire helps us understand how you manage daily activities and your ability to stay well. Please think of your <u>usual day-to-day living</u> and complete the questionnaire by ticking the boxes that best describe you. Q1. In your <u>usual day-to-day living</u>, do you need help from someone with any of the following? Walking ☐ Yes ☐ No Bathing/Showering ☐ Yes ☐ No Using the toilet ☐ Yes ☐ No Getting dressed ☐ Yes ☐ No Eating meals ☐ Yes ☐ No Q2. In your <u>usual day-to-day living</u>, do you need help from someone with any of the following? Going outside ☐ Yes ☐ No Using money ☐ Yes ☐ No Preparing and taking medications ☐ Yes ☐ No Q3. In your <u>usual day-to-day living</u>, do you feel tired more easily? ☐ Yes ☐ No Q4. In your <u>usual day-to-day living</u>, do you feel that walking is slower? ☐ Yes ☐ No Q5. In your <u>usual day-to-day living</u>, do you exercise (beyond routine walking) at least once a week? ☐ Yes ☐ No Self-administered (English) Version 1.0 (Updated 21.01.2026)	This questionnaire helps us understand how people manage daily activities and their ability to stay well. Please think of your relative's <u>usual day-to-day living</u> and complete the questionnaire by ticking the boxes that best describe him/her. If you are unsure about an activity, please choose the option that best reflects what your relative usually does, not what you think they should be able to do. Q1. In your relative's <u>usual day-to-day living</u>, does he/she need help from someone with any of the following? Walking ☐ Yes ☐ No Bathing/Showering ☐ Yes ☐ No Using the toilet ☐ Yes ☐ No Getting dressed ☐ Yes ☐ No Eating meals ☐ Yes ☐ No Q2. In your relative's <u>usual day-to-day living</u>, does he/she need help from someone with any of the following? Going outside ☐ Yes ☐ No Using money ☐ Yes ☐ No Preparing and taking medications ☐ Yes ☐ No Q3. In your relative's <u>usual day-to-day living</u>, does he/she feel tired more easily? ☐ Yes ☐ No Q4. In your relative's <u>usual day-to-day living</u>, does he/she feel that walking is slower? ☐ Yes ☐ No Q5. In your relative's <u>usual day-to-day living</u>, does he/she exercise (beyond routine walking) at least once a week? ☐ Yes ☐ No Proxy-administered (English) Version 1.0 (Updated 21.01.2026)

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Figure 3b. CFS-Brief scoring algorithm

CFS (Brief) Scoring algorithm

Quick guide to scoring the CFS after completion of questionnaire



CFS (Brief) Scoring algorithm
Version 1.2 (Updated 01.10.2026)

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PRINCIPLES OF MANAGEMENT

After a patient is identified to have sarcopenia and/or frailty, the principles of management include: 1) addressing underlying precipitants; 2) improving core manifestations of physical frailty and sarcopenia through the pillars of exercise and nutrition; and 3) minimising vulnerability to adverse outcomes by addressing socio-environmental risks and reducing exposure to health-related stressors (e.g., undergoing recommended routine vaccinations or falls prevention education as part of preventive healthcare for older adults).

A. Addressing Underlying Causes of Sarcopenia and/or Frailty

A search for underlying causes of sarcopenia should be undertaken (refer to **Table 2**).

Secondary causes of unintentional weight loss and fatigue as features of frailty should be evaluated, such as malignancy, obstructive sleep apnoea, depression, anaemia, hypotension, hypothyroidism, and vitamin B12 deficiency. In addition, medication lists should be reviewed for polypharmacy and potentially inappropriate medications that can be deprescribed or reduced.

B. Exercise

Exercise, particularly progressive resistance training, is first-line for the management of both sarcopenia and frailty.⁴⁹ Resistance exercise has been shown to improve handgrip strength and physical performance with moderate-large effect sizes.^{50,51} Resistance training should be performed at least twice a week, and involve sufficient dose (i.e., frequency, duration, and volume) to induce a training stimulus. Progression in intensity should be individualised to optimise muscle gains without compromising safety and injury risk and should be planned in consultation with trained professionals such as physiotherapists and exercise trainers.⁵²

C. Nutrition

A high-quality diet with sufficient caloric and protein intake is synergistic when combined with exercise interventions for improving lean mass, muscle strength, and physical function in older persons with sarcopenia and/or physical frailty. Older persons have higher protein requirements than younger adults due to anabolic resistance. The recommended daily protein intake is 1.0–1.2 g/kg body weight for healthy older adults, as compared to 0.8 g/kg body weight for the general adult population.^{53,54} A diet-first whole food approach is preferred as food combinations in dietary patterns have potentially synergistic interactions and provide greater diversity of macro- and micronutrients.⁵⁵ Additional nutritional supplementation can be considered in older adults who are unable to meet their recommended protein intake needs through diet. Current evidence remains insufficient for recommending leucine or beta-hydroxy-beta-methylbutyrate (HMB) alone for sarcopenia management.⁵⁶

D. Correcting Vitamin D Deficiency

Low vitamin D levels have been associated with increasing frailty risk.⁵⁷ Vitamin D supplementation in combination with exercise and protein supplementation significantly increased handgrip strength.⁵⁸ Hence, vitamin D supplementation for sarcopenia and frail older adults with vitamin D insufficiency (<30 µg/L) should be considered.⁵⁷

PREVENTION

To maximise muscle healthspan and prevent the onset of sarcopenia and physical frailty, we should start early in younger adulthood-midlife to improve muscle strength, then aim to maintain and/or minimise losses in older adulthood through adequate exercise and physical activity, reducing sedentary time, adopting healthy dietary habits, optimising cardiovascular risk factor control, and maintaining good sleep and mental health.¹² The Singapore Physical Activity Guidelines (SPAG) for older adults recommend a target of 150–300 minutes of moderate-intensity aerobic physical activity per week, with strengthening activities (≥2 days/week) and multi-component physical activity (≥3 days/week) for maintaining muscle strength.⁵⁹ In addition, our Singapore CPG also recommends encouraging older adults to have adequate protein intake of at least 1.0 g/kg body weight/day to prevent sarcopenia.

CONCLUSION

Sarcopenia and frailty are potentially reversible with early recognition and management. Promoting exercise and healthy dietary habits in early to midlife through to older adulthood can attenuate decline in muscle healthspan and provide a window of opportunity for healthcare practitioners to optimise healthy lifespan for our population.

Learning Points

- Sarcopenia precedes the development of physical frailty, with both having similar clinical features, adverse outcomes, and management in older adults.
- Diagnosis of sarcopenia requires the presence of low muscle mass and strength. In the absence of muscle mass measurements, “possible sarcopenia” is defined by low muscle strength, whereas those “at risk for sarcopenia” have normal muscle strength despite presence of muscle health concerns.
- In primary care and community settings, persons with “possible sarcopenia” or are “at risk for sarcopenia” should be provided with exercise and nutritional advice to improve their muscle health.
- Look for and address secondary causes in older adults with or at risk for sarcopenia and frailty.
- Resistance exercise combined with adequate protein intake remain the backbone of sarcopenia and frailty management.

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Unit 3: Vaccination as a Key Enabler of Preventive Care in Older Adults: Redefining Healthy Ageing in Primary Care

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Abstract

As global demographics shift toward an increasingly aged population, maintaining functional capacity and independence in older adults has become a public health imperative. Traditional models of healthy ageing emphasise exercise, nutrition, social engagement, and chronic disease management. However, infectious diseases, particularly respiratory infections, remain a critical yet under-recognised driver of acute functional decline, frailty acceleration, and long-term disability. This paper explores vaccination as the “next pillar” of preventive care for older adults. We examine the biological interplay between immunosenescence, inflammaging, and multimorbidity, highlighting how acute infections trigger systemic inflammation, endothelial dysfunction, neuroinflammation, and cardiovascular events. Furthermore, we outline practical primary care strategies, including life-course adult immunisation schedules, co-administration workflows, and physician-led motivational interviewing to address vaccine hesitancy. By integrating immunisation into routine chronic disease medical reviews and long-term care frameworks, primary care physicians can protect functional reserves and foster resilient, healthy ageing.

Keywords: Healthy ageing; older adults; adult immunisation; vaccination; immunosenescence; inflammaging; multimorbidity; respiratory infections; frailty; preventive care

INTRODUCTION: THE EXPANDING FRAMEWORK OF HEALTHY AGEING

Healthy ageing is defined by the World Health Organization (WHO) as the process of developing and maintaining the functional ability that enables well-being in older age.¹ Historically, primary care strategies for healthy ageing have rested on four primary pillars:

- **Physical activity:** Preserving mobility, muscle strength, and balance
- **Healthy nutrition:** Optimising diet and managing metabolic risks (e.g., moderate alcohol intake)
- **Social interaction:** Promoting social participation and combating isolation
- **Chronic disease management and secondary prevention:** Controlling hypertension, hyperlipidaemia, and diabetes while encouraging smoking cessation and early disease screening

While these pillars are foundational, clinical evidence demonstrates that acute infectious episodes frequently undo years of preventive care.^{1,2} An acute respiratory illness or vaccine-preventable infection can rapidly push a previously physiologically robust or pre-frail older adult across the disability threshold, leading to hospitalisation, cognitive decline, loss of independence, or even death.^{2,3}

Consequently, **infection prevention via adult vaccination** emerges as the essential “fifth pillar” of healthy ageing.¹ By mitigating infection-induced systemic shocks, primary care providers can preserve functional capacity across the life course.

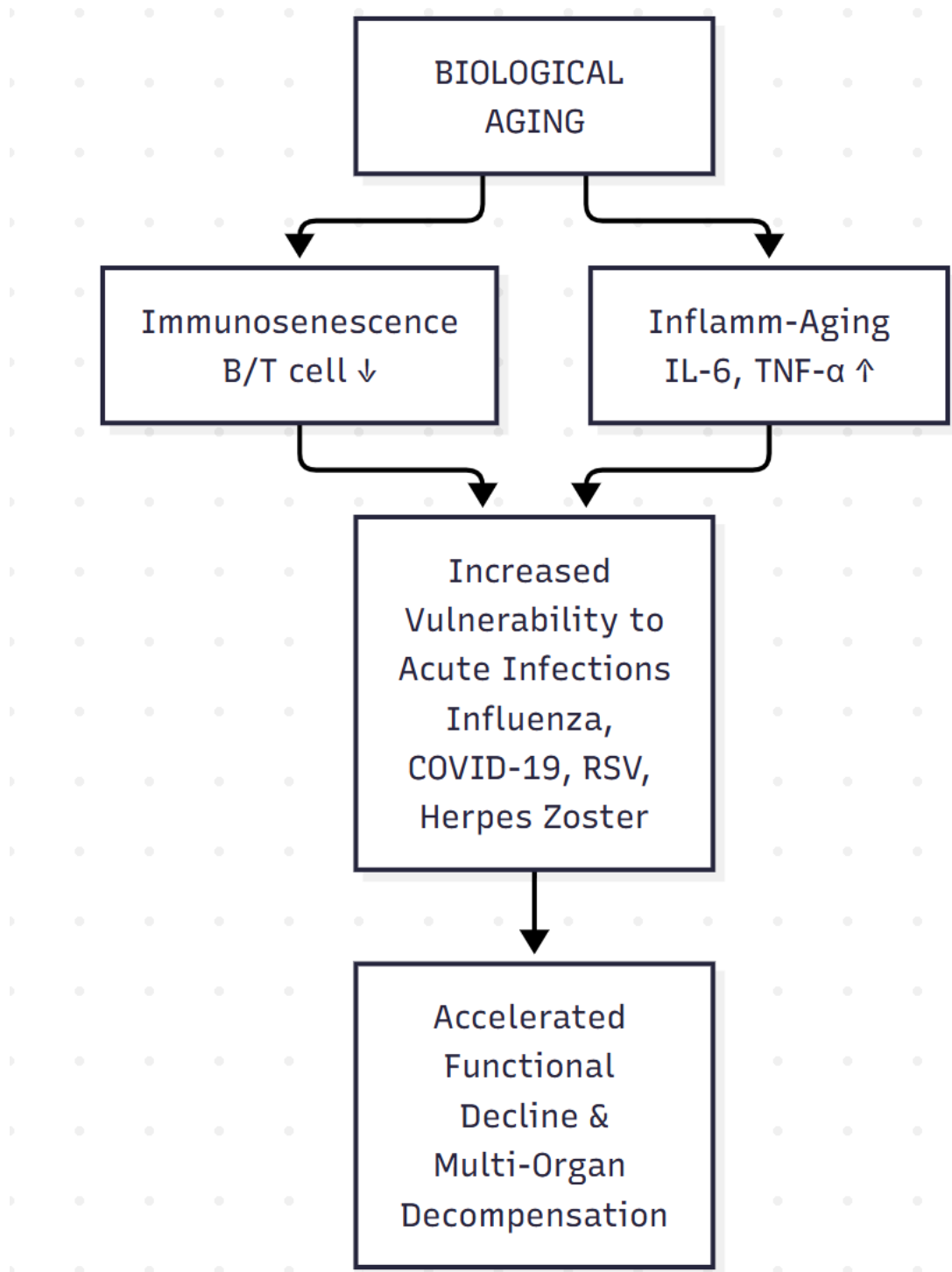
BIOLOGICAL DRIVERS: IMMUNOSENESCENCE, INFLAMMAGING, AND MULTIMORBIDITY

The susceptibility of older adults to severe infections and their downstream complications is rooted in complex biological changes associated with ageing.

Immunosenescence and Inflammaging

Immunosenescence refers to the age-related dysregulation and decline of the immune system. It involves both the innate immune system (impaired phagocytosis by neutrophils and macrophages, altered dendritic cell signalling) and the adaptive immune system (decline in naïve B-cell and T-cell pools, reduced T-cell receptor diversity, and impaired antibody responses).³ This results in poorer immune response to any infection, as well as to vaccinations administered to the elderly.³

Parallel to immunosenescence is **inflammaging**, a state of chronic, sterile, low-grade systemic inflammation driven by cellular senescence, mitochondrial dysfunction, impaired autophagy, and persistent NF- κ B activation.^{4,5} Inflammaging leads to elevated baseline levels of pro-inflammatory cytokines such as Interleukin-6 (IL-6), Interleukin-1 beta (IL-1 β), and Tumor Necrosis Factor-alpha (TNF- α). When an acute pathogen (e.g., influenza, SARS-CoV-2, or respiratory syncytial virus [RSV]) strikes an already inflamed and dysregulated immune system, the host response is often either inadequate in clearing the pathogen or causes a pathologically hyper-inflammatory response, resulting in undesired, further extensive tissue damage.



The Additive Risk of Multimorbidity

The burden of chronic non-communicable diseases increases sharply with age.⁶⁻⁸ In Singapore, for instance, data from the National Population Health Survey indicates that the prevalence of hypertension, hyperlipidaemia, and diabetes mellitus rises exponentially past age 50.⁸ Over 50 percent of adults aged 60 and above live with multimorbidity (two chronic conditions).

The relationship between multimorbidity and infectious risk is reciprocal and additive. Underlying chronic medical conditions such as chronic obstructive pulmonary disease (COPD), asthma, diabetes, renal failure, and cardiovascular diseases significantly increase the risk and severity of vaccine-preventable infections like influenza, COVID-19, herpes zoster (HZ), and invasive pneumococcal disease.^{9–14} Conversely, acute infections trigger acute decompensation of these underlying chronic illnesses.

THE DOWNSTREAM IMPACT: INFECTIONS AS ACCELERATORS OF AGEING

Infections in older adults are not merely acute, self-limiting events; they serve as major systemic stress-tests that accelerate physical and cognitive decline.

Neurological Impact: Disruption of the Blood-Brain Barrier and Dementia¹⁵

Systemic inflammation triggered by acute infections releases circulating cytokines (IL-6, TNF- α , IL-1 β) that interact with brain endothelial cells and perivascular macrophages. This process disrupts tight junction proteins (such as ZO-1 and occludin), compromising the integrity of the blood-brain barrier (BBB). The resulting neuroinflammation induces microglial activation and loss of neurotrophic factors (e.g., BDNF).

Observational real-world data highlight these vascular and cognitive sequelae.¹⁶ A propensity score-matched study using the UK Biobank cohort (50 years of age, COVID-19 cases vs matched controls) evaluated long-term neurological outcomes over a median follow-up of 24.1 months:

- All-cause dementia: Individuals infected with COVID-19 demonstrated a significantly increased risk of new-onset all-cause dementia compared to controls (HR 1.4; 95% CI 1.1–1.8).
- Vascular Dementia: The association was particularly marked for vascular dementia, where COVID-19 infection was linked to an 80 percent higher risk of new-onset diagnosis (HR 1.8; 95% CI 1.1–2.8).

Cardiovascular Risk and Infection-Induced MACE

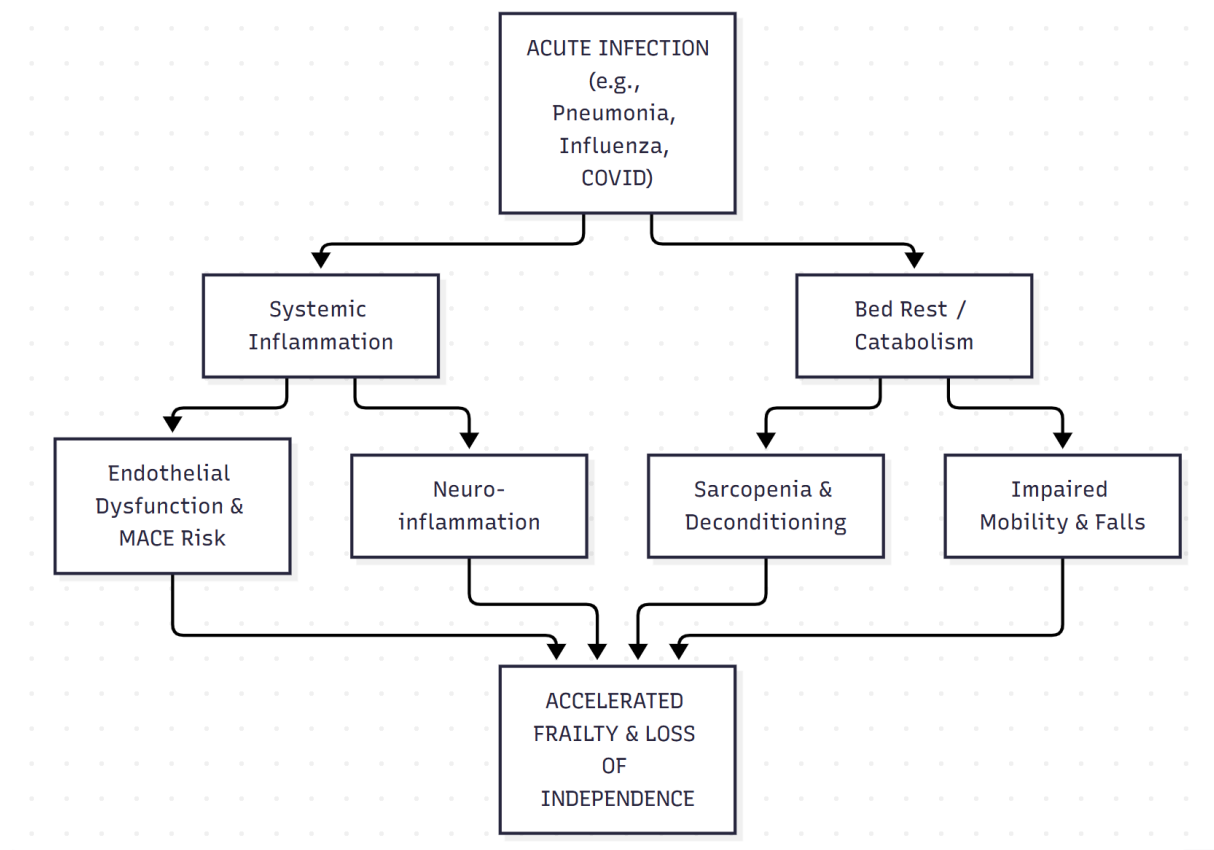
Infections act as acute cardiovascular stressors. Pathogens like influenza, SARS-CoV-2, *Streptococcus pneumoniae*, and RSV induce pro-inflammatory states, plaque instability, pro-thrombotic cascades, and myocardial strain.^{17,18}

The European Society of Cardiology (ESC) consensus statements recognise vaccination as an established form of cardiovascular prevention.¹⁹ Clinical trials show that influenza vaccination post-myocardial infarction (MI) or high-risk coronary intervention leads to a 41 percent reduction in cardiovascular and all-cause mortality, and a 28 percent reduction in major adverse cardiovascular events (MACE). In comparison, the role of primary PCI, beta blocker, and intensive statin reduces all-cause mortality by 27 percent, 26 percent, and 24 percent respectively. Despite this, many clinicians omit influenza vaccinations as a crucial intervention in individuals with ischaemic heart disease.¹⁸

Functional Decline, Sarcopenia, and Frailty Cascades

Acute infection and subsequent hospitalisation routinely lead to enforced bed rest, catabolic stress, anorexia, and muscle mass loss (sarcopenia).²⁰ For a pre-frail older individual, a single hospitalisation for Community-Acquired Pneumonia (CAP)—where 28-day mortality in ICU-admitted European cohorts reaches 17 percent. However, this

mortality rises to 27 percent at six months.²¹ After an acute infection, a cascade of problems begins: from permanent loss of functional reserve, precipitating falls, institutionalisation, further new infections, to death. The initial mortality data does not account for the subsequent death from frailty.



PREVENTION

As the adage goes, prevention is better than cure. Vaccination offers the easiest, and the most cost-effective, method in preventing infections in the population.²² Successful large scale public health implementation might even build an effective herd immunity, further protecting the at-risk individuals (the very elderly and the severely immunocompromised host). Even when a vaccine fails, the severity of the illness is attenuated by the vaccination. This has been well studied in influenza and COVID-19.^{23,24}

Despite this overwhelming evidence, the influenza and COVID vaccine uptake in Singapore is paltry in comparison to our Asian neighbours (e.g., South Korea and Japan).²⁵ More can be done to elevate the health status of our elderly simply by vaccination.

A range of vaccines are available in Singapore and in many countries, with published guidelines recommending their utility in adults, and those with existing chronic illness. A vaccination checklist for older adults in Singapore would currently include^{26,27}:

- Influenza
- Pneumococcal (PCV -20 / PCV 21)
- Shingles

- COVID-19
- Pertussis
- Respiratory syncytial virus

This list is expected to expand to include new pathogens in the distant future.

CONCLUSION

Infections in older adults act as major systemic stressors that trigger systemic inflammation, endothelial damage, neuroinflammation, and acute functional decline. Viewing vaccination purely through the lens of acute pathogen control underestimates its broader clinical value. Adult immunisation is a cornerstone of secondary and tertiary disease prevention, protecting cardiovascular health, cognitive integrity, and physical function. Primary care physicians must champion vaccination as an essential pillar of healthy ageing, embedding life-course immunisation assessments into every routine older adult consultation.

Learning Points

- **Age-related immunosenescence and inflammaging increase susceptibility to severe infection and infection-related complications in older adults.** Acute infections can amplify systemic inflammation and contribute to cardiovascular, neurological, and functional deterioration.
- **Multimorbidity and infection have a reciprocal relationship.** Chronic conditions such as COPD, asthma, diabetes, renal failure, and cardiovascular disease increase vulnerability to vaccine-preventable infections, while acute infections can precipitate decompensation of underlying chronic disease.
- **The consequences of infection in older adults extend beyond the acute infectious episode.** Infection and hospitalisation can contribute to cardiovascular events, neuroinflammation, sarcopenia, frailty, and loss of functional independence.
- **Vaccination should be integrated into routine preventive and chronic disease care for older adults.** The article proposes vaccination as an additional pillar of healthy ageing, with immunisation status assessed during routine primary-care encounters.

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FPSC NO: 136

MCQS ON Optimising Healthspan: Tackling Drivers of Aging

SUBMISSION DEADLINE: 22 December 2026, 12pm

INSTRUCTIONS

- To submit answers to the following multiple choice questions, you are required to log on to the College Online Portal (<https://lms.wizlearn.com/cfps/>)
- Please contact sfp@cfps.org.sg if you have not received an email on the LMS account.
- Attempt ALL the following multiple-choice questions.
- There is only ONE correct answer for each question.
- The answers should be submitted to the College of Family Physicians Singapore via the College Online Portal before the submission deadline stated above.
- There will be NO further extension of the submission deadline

1. Which statement best describes the shift in approach that Healthier SG represents?

- A. A move from specialist-led to hospital-led care
- B. A move from caring reactively for those already ill to proactively preventing illness, anchored by the primary care physician and a personalised health plan
- C. A move from public to private provision of primary care
- D. A move towards expanding acute hospital capacity to meet the rising demand from older adults
- E. A move towards care that begins only after symptoms or complications appear

2. According to the WHO framework, functional ability is determined by which of the following?

- A. Intrinsic capacity alone
- B. Chronological age and the number of comorbidities
- C. The interaction between intrinsic capacity and the environment
- D. Biological age as measured by epigenetic clocks
- E. The level of healthcare utilisation

3. The WHO ICOPE framework is used for brief screening for functional decline. Which option lists the six domains it screens?

- A. Blood pressure, lipids, glucose, weight, smoking, alcohol use
- B. Vaccination status, cancer screening, bone density, dental health, sleep, continence
- C. Frailty, falls, polypharmacy, loneliness, finances, housing
- D. Income, education, employment, housing, food security, social cohesion
- E. Cognition, mobility, nutrition, vision, hearing, mood

4. Which approach to medication review in older adults is consistent with the article?

- A. An annual review using tools such as STOPP/START or the Beers criteria, with particular attention to sedative, anticholinergic, and hypotensive agents
- B. A review only when the patient is admitted to hospital
- C. Stopping all unnecessary medications at once
- D. A review limited to medications for chronic disease, excluding over-the-counter products
- E. No routine review, because polypharmacy has little effect on falls or confusion

5. Which exercise prescription matches the WHO recommendations cited for an older adult at risk of falls?

- A. 30 minutes of brisk walking daily and no other activity
- B. 75 minutes of vigorous-intensity activity per week only
- C. Resistance training once a week, with balance training added only after a fall
- D. 150 to 300 minutes of moderate-intensity aerobic activity per week, muscle strengthening on at least two days per week, and multicomponent balance training on at least three days per week
- E. Complete rest until a formal falls risk assessment has been done

6. It is least appropriate to offer screening for sarcopenia for a 65-year-old lady with:

- A. Cognitive impairment
- B. Swallowing impairment
- C. Recent hospitalisation
- D. Urinary incontinence
- E. Weight loss

7. The following tests can be used to screen for sarcopenia except:

- A. Calf circumference
- B. Five times chair stand test
- C. SARC-F
- D. Timed Up and Go test
- E. Yubi-wakka test

8. A 65-year-old-man comes to you for concerns about his muscle strength. His SARC-F score is 4. Calf circumference is 30 cm. Handgrip strength is 30 kg. Which of the following diagnoses is correct?

- A. At risk for sarcopenia
- B. Frailty
- C. Low muscle mass
- D. Possible sarcopenia
- E. Sarcopenia

9. Which is not an underlying cause of frailty?

- A. Alzheimer's dementia
- B. Chronic heart failure
- C. Polypharmacy
- D. Previous amputation
- E. Progressive malignancy

10. Which of the following is most beneficial for improving muscle strength in older adults with sarcopenia and frailty?

- A. Aerobic exercise
- B. Thyroid hormone replacement
- C. Protein intake
- D. Vitamin D supplementation
- E. Resistance exercise

11. Which age-related biological changes described in the article contribute most directly to increased vulnerability to severe infection in older adults?

- A. Increased naïve T-cell production and reduced cytokine production
- B. Immunosenescence combined with chronic low-grade systemic inflammation
- C. Increased antibody responses combined with endothelial stabilisation
- D. Increased B-cell diversity and reduced innate immune activation
- E. Increased autophagy and reduced cellular senescence

12. A 72-year-old patient with diabetes and cardiovascular disease develops an acute respiratory infection. According to the framework presented in the article, why is this patient particularly vulnerable to adverse outcomes?

- A. Multimorbidity reduces the likelihood of systemic inflammation
- B. Chronic diseases protect against infection-induced organ dysfunction
- C. Multimorbidity increases infection risk, while infection may simultaneously precipitate decompensation of chronic disease
- D. Infection-related complications occur independently of underlying chronic disease
- E. Age-related immune changes affect vaccine responses but not infection severity

13. Which mechanism described in the article provides a plausible link between acute infection and subsequent neurological decline in older adults?

- A. Cytokine-mediated disruption of blood-brain barrier integrity and subsequent neuroinflammation
- B. Suppression of circulating cytokines and increased BDNF production
- C. Reduced microglial activity following systemic infection
- D. Increased tight-junction protein expression in cerebral endothelial cells
- E. Reduction in systemic inflammation following acute infection

14. Why does the article argue that preventing infection may help preserve functional independence in older adults?

- A. Infection-related hospitalisation generally increases muscle mass during recovery
- B. Acute infections affect mortality but have little effect on long-term function
- C. Functional decline occurs only in patients requiring intensive care
- D. Vaccination directly reverses established sarcopenia

- E. Bed rest, catabolic stress, and anorexia during infection can contribute to sarcopenia, deconditioning, and frailty

15. Which approach most closely reflects the article's proposed role of primary care in promoting healthy ageing?

- A. Discuss vaccination only when an older adult presents with an acute infection
- B. Restrict vaccination assessment to patients without chronic disease
- C. Focus preventive consultations exclusively on exercise, nutrition, and cardiovascular risk factors
- D. Incorporate life-course immunisation assessment into routine care of older adults alongside management of chronic disease and other preventive measures
- E. Refer all vaccination decisions to specialist infectious disease services

A SELECTION OF TEN READINGS ON TOPICS RELATED TO 2026 FAMILY PRACTICE SKILLS COURSE

FPSC136: OPTIMISING HEALTHSPAN: TACKLING DRIVERS OF AGEING

SATURDAY, 17 OCT 2026

2.00pm–5.15pm (via Zoom)

All are available as PMC free full text

Selection of readings made by A/Prof Goh Lee Gan

READING 1. QUALITATIVE STUDY OF PUBLIC VIEWS TOWARDS LIFESPAN, HEALTHSPAN, AND HEALTHY LONGEVITY MEDICINE IN SINGAPORE

Wang B,^{1,2} Szücs A,^{1–4} Sandalova E,² Lim ZM,^{1,2} Horberg EJ,⁵ O’Keefe PA,⁵ Island L,^{1,2} Rosenthal S,⁶ Maier AB.^{7–9} Public Views towards Lifespan, Healthspan, and Healthy Longevity Medicine in Singapore: A Qualitative Study from the Healthy Longevity (HELO) Initiatives. *Gerontology*. 2025;71(12):1021–1030. PMID: 41105565.

doi: 10.1159/000548994. Free full text.

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ABSTRACT

INTRODUCTION: Healthy Longevity Medicine (HLM) offers a strategy to reduce the healthspan-lifespan gap, yet public perspectives remain unclear. This study refines the Healthy Longevity (HELO) framework through a qualitative exploration of public views towards lifespan, healthspan, and HLM.

METHODS: Individuals living in Singapore participated in semi-structured group or individual discussions to explore (a) their understanding of lifespan and healthspan, (b) motivational factors for health behaviours, and (c) their awareness of HLM. Sampling maximised variation across age,

sex, and ethnicity. Data obtained through 13 discussions were analysed with a mixed, inductive-deductive approach employing the HELO framework.

RESULTS: Thirty-six participants (mean age = 49.4 years, SD = 15.9, 19 males, 15 ethnic Chinese) were generally familiar with the definitions of lifespan and healthspan, emphasising the importance of quality of life. Health was defined comprehensively, and autonomy over behaviours was highly valued during ageing and in adopting health behaviours. Community resources and government health initiatives were deemed useful, recognising the potential to enhance social, mental, and physical health. Singapore's busy, achievement-oriented culture was identified as a barrier to healthy behaviours. Participants expressed enthusiasm for HLM's potential to extend the healthspan yet voiced concerns about lifestyle changes and potentially losing autonomy.

CONCLUSION: Personal values and priorities were central to motivations towards healthy longevity. HLM should assess and align diagnostic and treatment plans with individual preferences to support sustainable health behaviours. The Singapore public's alignment with government policies presents an opportunity to promote HLM adoption.

READING 2 . THE SG90 COHORT OF THE OLDEST-OLD IN SINGAPORE

Guan L,^{1,2} Feng L,^{1,3,4} Khoo ALY,^{1,3} Ye KX,^{1,3,4} Ho R,^{4,5} Ng TP,⁶ Larbi A,^{7,8} Kennedy BK,^{1,3,9} Koh WP,^{1,10} Chong YS,¹⁰⁻¹² Maier AB.¹³⁻¹⁵ The SG90 cohort of the oldest-old in Singapore. *Eur J Epidemiol.* 2025 Sep;40(9):1133–1141. PMID: 40682752.

doi: 10.1007/s10654-025-01275-0. Free full text.

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ABSTRACT

The global population is ageing rapidly. While genetics, lifestyle, and environment are known contributors to healthspan, most insights are drawn from Western cohorts, leaving Asian populations underrepresented despite unique biological, lifestyle, and cultural factors.

The SG90 cohort study aimed to fill knowledge gaps in healthy ageing by identifying modifiable medical, biological, lifestyle, psychological, behavioural, and social factors that contribute to longevity in the oldest-old.

The study recruited 1,158 participants aged 85 and above from the Singapore Chinese Health Study (SCHS) and Singapore Longitudinal Aging Study (SLAS) between 2015 and 2021. Data collection involved face-to-face interviews to obtain sociodemographic, lifestyle, sleep, functional status, quality of life, medical conditions, and healthcare economics information, along with clinical assessments covering physical examinations, anthropometry, physical performance, cognition, and mental health. Biospecimens, including blood, saliva, stool, urine, toenails, hair, and skin tape strips were collected to support extensive multi-omic and cellular analyses.

Participants, primarily female (64.5%) and Chinese (97.5%) with a median age of 87 years [interquartile range (IQR): 86–89], were mostly non-smokers (72.1%) and infrequent alcohol consumers (94.9%), with 66.5% exercising regularly. Functional assessments indicate high independence, with median Basic activities of daily living (BADL) and Instrumental ADL (IADL) scores of 20 (IQR: 19–20) and 14 (IQR: 11–16), respectively. Thirty-six percent of participants rated their self-reported health as good to excellent.

The SG90 cohort study offers a comprehensive clinical and biological data resource on healthy ageing among Asia's oldest-old, laying a foundation for targeted interventions to promote healthy longevity and quality of life.

READING 3. A SYSTEMATIC REVIEW OF DEFINITIONS OF HEALTHSPAN

Masfiah S,¹ Kurnialandi A,² Meij JJ,³ Maier AB.⁴ Definitions of healthspan: A systematic review. Ageing Res Rev. 2025 Sep;111:102806.PMID: 40523529.

doi: 10.1016/j.arr.2025.102806. Free full text.

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ABSTRACT

The term “healthspan” has been widely used in academic literature, technical reports, and brochures; however, it is unclear if the same definitions and operationalisations for healthspan are being used.

The objective of the systematic review (registration number CRD42023404872) was to summarise definitions of healthspan and their operationalisation searching using four databases: PubMed, Embase, Web of Science, and Scopus.

Out of 14,551 records, 207 records met the inclusion criteria, and 187 articles gave a definition of healthspan. Of these, 113 definitions were considered primary definitions, which refer to an author’s definition without referencing other definitions. Healthspan definitions varied widely, describing the absence of various disease and/or disability and were operationalised by measuring the onset of chronic diseases, disability, or performance limitations. Two definitions included subjective measures, such as quality of life.

In conclusion, definitions of healthspan and their operationalisation are not standardised, hampering comparisons of data. A consensus on the definition and operationalisation of healthspan is urgently needed.

READING 4. TOWARDS DEFINING OPTIMAL CONCENTRATIONS OF MICRONUTRIENTS IN ADULTS TO OPTIMISE HEALTH

Mahadzir MDA,¹ Tan S,² Elena S,³ Chin EM,² Garg V,² Mantantzis K,⁴ Péter S,⁵ Maier AB.⁶ Towards defining optimal concentrations of micronutrients in adults to optimise health. Mech Ageing Dev. 2025 Jun;225:112062. PMID: 40250530.

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ABSTRACT

Micronutrients are essential for maintaining physiological homeostasis and optimising healthspan, defined as the years lived in good health without chronic diseases or disabilities. Despite increasing global life expectancy, improvements in healthspan have not kept pace, partly due to subclinical micronutrient deficiencies that often precede clinical symptoms.

The triage theory highlights how micronutrient insufficiencies compromise long-term health by prioritising critical metabolic functions. Micronutrients such as Vitamins B6, B9, B12, D, and K are particularly crucial in optimising healthspan, by influencing energy metabolism, neurological health, immune regulation, and bone integrity. Traditional tools like Dietary Reference Intakes (DRIs) provide population-level guidelines but fail to account for individual factors such as genetics, lifestyle, and nutrient interactions. Quantitative assessment of micronutrient concentrations using biomarkers offers a more precise approach but faces challenges, including high costs and limited accessibility. National nutrition surveys demonstrate potential in addressing population-level deficiencies and form the basis for advancing precision supplementation strategies to improve health outcomes and extend healthspan by defining optimal micronutrient concentrations.

Future efforts should aim to establish evidence-based thresholds for optimal micronutrient concentrations by integrating biomarker data with clinical outcomes, genetic profiles, and lifestyle factors, providing a framework to guide personalised and population-level supplementation strategies.

READING 5. UNDIAGNOSED POSSIBLE SARCOPENIA, POOR ORAL HEALTH, AND COGNITIVE IMPAIRMENT AMONG COMMUNITY-DWELLING PRE-FRAIL OLDER ADULTS

Wang R,¹ Tee LY,^{2,3} Lim SC.^{4,5} Undiagnosed possible sarcopenia, poor oral health, and cognitive impairment among community-dwelling pre-frail older adults. Sci Rep. 2026 Jul 14. PMID: 42449165.

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ABSTRACT

Frailty is an age-associated state of reduced physiological reserve that increases vulnerability to adverse outcomes following acute insults such as infections, injuries, trauma, and surgery. It is associated with physical disability, dependence, hospitalisation, and premature mortality. Frailty encompasses physical, psychological, social, and oral health domains and is potentially reversible, particularly in its early stages. Given the adverse outcomes associated with frailty, there is increasing interest in identifying pre-frailty and its associated risk factors among community-dwelling older adults.

This study aims to identify risk factors associated with pre-frailty in community-dwelling older adults. A total of 416 community-dwelling older adults underwent comprehensive health screening to identify modifiable risk factors associated with pre-frailty. Assessments included demographic and clinical characteristics, physical performance tests, and oral health evaluations.

Potentially modifiable risk factors independently associated with pre-frailty included possible sarcopenia (OR 9.361, 95% confidence interval [CI] 4.267–20.534, $p < 0.001$), reduced lower limb strength, as reflected by a five-times sit-to-stand test (5xSTS) ≥ 12 s (OR 2.398, 95% CI 1.359–4.229, $p = 0.003$), poor oral health (OHAT ≥ 7) (OR 2.278, 95% CI 1.047–4.955, $p = 0.038$), and cognitive impairment (AD8 ≥ 2) (OR 3.947, 95% CI 2.142–7.274, $p < 0.001$).

Non-modifiable risk factors associated with pre-frailty included six years or fewer of formal education (OR 3.272, 95% CI 1.855–5.770, $p < 0.001$) and a history of falls within the preceding 12 months (OR 3.138, 95% CI 1.221–8.068, $p = 0.017$). After adjustment for education, possible sarcopenia (OR 3.482, 95% CI 1.477–8.211, $p = 0.004$), cognitive impairment (OR 4.875, 95% CI 2.028–11.721, $p < 0.001$), and lower limb strength (OR 5.753, 95% CI 2.402–13.782, $p < 0.001$) were associated with pre-frailty.

All cases of possible sarcopenia, cognitive impairment, and poor oral health identified during screening were previously undiagnosed. Possible sarcopenia, poor oral health, and cognitive impairment are potentially modifiable risk factors associated with pre-frailty. Their high rate of underdiagnosis highlights the importance of targeted case-finding among pre-frail community-dwelling older adults to facilitate early intervention.

READING 6. IMPACT OF SARCOPENIC OBESITY ON FRAILTY, COGNITION, AND FUNCTION IN COMMUNITY-DWELLING OLDER ADULTS

How LA,¹ Lee XX,¹ Hui-En SAL,² Teo YH,² Goh KC,³ Tan LF.³ The Impact of Sarcopenic Obesity on Frailty, Cognition, and Function in Community-Dwelling Older Adults. *J Frailty Sarcopenia Falls*. 2025 Sep 1;10(3):150–156.PMID: 40901342.

doi: 10.22540/JFSF-10-150. Free full text.

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ABSTRACT

OBJECTIVES: The impact of sarcopenic obesity (SO) on frailty, cognition, and function compared to sarcopenia and obesity alone remains unclear. This study examined SO's effects on these domains in community-dwelling older adults.

METHODS: We assessed 202 older adults (mean age 80.4 ± 7.3 years) attending a community frailty screening clinic. Obesity was defined as BMI ≥ 25 , and sarcopenia was assessed using Asian Working Group for Sarcopenia guidelines. SO was defined as the presence of both conditions. Assessments included the Clinical Frailty Scale, Modified Barthel Index, Singapore-modified Mini-Mental State Examination, and mobility aid use.

RESULTS: Multivariate regression showed SO was significantly associated with frailty (OR 4.71), impaired function (β : -16.53), and mobility limitations (OR 5.73). SO was also linked to cognitive impairment (OR 3.56). Sarcopenia alone was associated with frailty (OR 3.39), impaired function (β : -11.46), and mobility limitations (OR 3.32), but not cognition. Obesity alone showed no associations. SO posed higher risks for frailty, cognitive impairment, functional decline, and mobility limitations compared to sarcopenia or obesity alone.

CONCLUSIONS: SO is associated with greater risks of frailty, cognitive impairment, functional decline, and mobility limitations than sarcopenia or obesity alone.

READING 7. SARCOPENIA, SARCOPENIC OBESITY, AND FRAILITY IN INDIVIDUALS WITH CHRONIC KIDNEY DISEASE

Chao CT,¹⁻³ Kovesdy CP,^{4,5} Merchant RA.^{6,7} Sarcopenia, sarcopenic obesity, and frailty in individuals with chronic kidney disease: a comprehensive review. *Kidney Res Clin Pract.* 2026 Mar;45**(2):174–188. 39973319.**

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ABSTRACT

Population ageing is a global challenge that increases the burden of chronic kidney disease (CKD) and geriatric syndromes such as sarcopenia, sarcopenic obesity, and frailty. These conditions affect almost half of older CKD individuals and are associated with poor outcomes, including CKD progression, cardiometabolic complications, increased health and social care costs, and mortality. They can be both the cause and consequent of CKD and lead to a vicious downward spiral if not addressed early.

Frailty is a multidimensional syndrome characterised by reduced physiological reserve and increased vulnerability to stressors. Sarcopenia refers to the progressive and generalised loss of skeletal muscle mass, strength, and/or physical performance with ageing.

Sarcopenic obesity denotes the combination of sarcopenia and obesity that synergistically leads to poor outcomes. They share common pathogenic mechanisms, such as multimorbidity, inflammation, oxidative stress, uraemic milieu, insulin resistance, endocrine disturbances, CKD complications, and psychosocial factors that may limit access to proper nutrition and resources.

Management requires a multidisciplinary and patient-centred approach, taking into consideration their baseline physical function and endurance, CKD stage, nutrition status, comorbidities, symptoms, treatment goals, cost, and accessibility. Interventions include exercise, nutrition, comorbidity optimisation, geriatric assessment, sensory training, and kidney-oriented care.

This review summarises the current knowledge on the diagnosis and treatment of sarcopenia, sarcopenic obesity, and frailty in individuals with CKD, followed by up-to-date summaries of how best to manage affected individuals.

READING 8. GLOBAL BURDEN OF CHIKUNGUNYA VIRUS INFECTIONS AND THE POTENTIAL BENEFIT OF VACCINATION CAMPAIGNS

Ribeiro Dos Santos G,^{1,2} Jawed F,¹ Mukandavire C,³ Deol A,³ Scarponi D,³ Mboera LEG,⁴ Seruyange E,⁵ Poirier MJP,⁶ Bosomprah S,⁷ Udeze AO,⁸ Dellagi K,⁹ Hozé N,^{10–12} Chilongola J,¹³ Nasrallah GK,¹⁴ Cauchemez S,¹⁵ Salje H.¹⁶ Global burden of chikungunya virus infections and the potential benefit of vaccination campaigns. *Nat Med.* 2025 Jul;31(7):2342–2349. PMID: 40495015.

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ABSTRACT

The first vaccine against chikungunya virus (CHIKV) has now been licensed; however, due to a limited knowledge of the underlying global burden, its potential to reduce disease burden remains unknown.

We used data from seroprevalence studies, observed cases, and mosquito distributions to quantify the underlying CHIKV burden in 180 countries and territories, and we explored the potential impact of vaccination campaigns.

We estimate that 104 countries have experienced CHIKV transmission, covering 2.8 billion people, and that, in epidemic settings, the mean duration between outbreaks is 6.2 years, with 8.4 percent of the susceptible population infected per outbreak. Globally, there are 35 million annual infections, mainly in Southeast Asia, Africa and the Americas.

Assuming a vaccine efficacy against disease of 70 percent and a protection against infection of 40 percent, vaccinating 50 percent of individuals over 12 years of age in places and times where the virus circulates would avert 4,436 infections, 0.34 deaths, and 17 disability-adjusted life years per 100,000 doses used. These findings highlight the global burden of chikungunya and the potential of CHIKV vaccination campaigns.

READING 9. LESSONS FROM THAILAND'S SUCCESSFUL PREVENTION OF MOTHER-TO-CHILD HEPATITIS B TRANSMISSION

Poovorawan Y,^{1,2} Inma P,¹ Nilyanimit P,¹ Kanokudom S,¹ Jullapetch C.³ Lessons from Thailand's successful prevention of mother-to-child hepatitis B transmission: Advancing toward elimination by 2030. *Asian Pac J Allergy Immunol.* 2025 Mar;43(1):1–9. PMID: 40094485.

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ABSTRACT

Thailand has achieved remarkable success in preventing and reducing hepatitis B virus (HBV) incidence through its nationwide newborn vaccination programme, introduced in 1992 as part of the Expanded Programme on Immunisation (EPI).

Before the vaccination era, HBV endemicity in Thailand was high, with a carrier rate of 6–8 percent, and mother-to-child transmission was a major route of infection. Early trials demonstrated the efficacy of hepatitis B vaccines, especially when administered within 12 hours of birth, followed by scheduled doses. The national vaccination programme was initially piloted in two provinces in 1988 and expanded to full coverage by 1992. By 2024, carrier rates among children under 10 years dropped to less than 0.1 percent, meeting the WHO goal of zero mother-to-child transmission.

Studies confirm the vaccine's long-term protection, with no cases of chronic infection in vaccinated individuals with detectable anti-HBs over 20 years. Moreover, literature indicates that hepatitis B vaccination provides long-lasting protection more than 35 years. Additional measures, including antiviral use for high-risk mothers and expanded screening and treatment programmes, have further supported HBV elimination.

The programme's impact has significantly reduced liver-related diseases and positioned Thailand as a model for HBV control. As the nation moves towards its 2030 goal of hepatitis elimination, ongoing efforts focus on screening older populations with a high prevalence of infection and ensuring treatment access to achieve lasting eradication.

READING 10. DENGUE VACCINATION: A PRACTICAL GUIDE FOR CLINICIANS

See KC.¹ Dengue Vaccination: A Practical Guide for Clinicians. *Vaccines (Basel)*. 2025 Jan 30;13(2):145. PMID: 40006692.

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ABSTRACT

Dengue is a growing global public health challenge, with rising incidence and case fatality rates fuelled by urbanisation and climate change. The substantial mortality, morbidity, and economic burden associated with the disease underscore the need for effective prevention strategies, including vector control, personal protective measures, and vaccination.

This narrative review provides a practical guide for clinicians to ensure the appropriate administration of dengue vaccines to at-risk groups, such as individuals in endemic regions and travellers to these areas. Live-attenuated tetravalent dengue vaccines, including Dengvaxia®, Qdenga®, and Butantan-DV, have demonstrated efficacy in clinical trials but require careful use due to the risk of antibody-dependent enhancement (ADE).

To mitigate this risk, guidelines recommend vaccination primarily for individuals with prior confirmed dengue infection, emphasising the importance of accessible and affordable point-of-care rapid testing. Co-administration of dengue vaccines with other live-attenuated or inactivated vaccines has been shown to be safe and immunogenic, broadening their potential application. However, live-attenuated vaccines are contraindicated for immunocompromised individuals and pregnant women.

Enhancing clinician awareness, expanding diagnostic capabilities, and prioritising high-risk populations are critical steps in optimising vaccination strategies. Combined with robust prevention programmes, these efforts are essential to reducing the global burden of dengue and mitigating its impact.