Institute for Human Development and Potential
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POLICY BRIEF

Reframing Musculoskeletal Health in Singapore: A Life Course Approach to Risk and Prevention

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Key points

- Decline in muscle and bone health begins decades before clinically recognised outcomes such as falls, osteoporotic fractures or functional impairment. Local longitudinal cohorts demonstrate that only 19 to 31% of women in midlife have healthy body composition profiles, while over a quarter exhibit sarcopenic and sarcopenic-obese body composition profiles.

- Sarcopenic and sarcopenic-obese body composition profiles are associated with lower bone density, poorer physical function, increased cardiometabolic risk and cognitive decline, underscoring the need for earlier risk stratification and targeted prevention.

- Women with suboptimal body composition profiles have modifiable risk factors, with lower level of vigorous physical activity emerging as a particularly consistent correlate. This highlights an opportunity for behavioural musculoskeletal health interventions earlier in the life course.

- Sarcopenic obesity often occurs in individuals with normal body mass index (BMI), highlighting the limitations of BMI as a screening tool. Incorporating measures of body composition (e.g. Bioelectrical Impedance Analysis) and physical performance (e.g. grip strength) may complement existing approaches to risk stratification in community settings.

Sarcopenia in an ageing Singapore

Sarcopenia is defined as the progressive, age-related loss of skeletal muscle mass and muscle function[1]. It is a strong risk factor for falls, functional decline, frailty and loss of independence, and is also associated with poorer cognition[2] and cardiometabolic disease[3].

Sarcopenia affects an estimated 7 to 12% of older adults in Asia[4]. In Singapore, prevalence ranges from 6 to 44% depending on diagnostic criteria and study setting, primarily focused on adults aged 60 and above[5].

The consequences of poor muscle health are substantial. Musculoskeletal disorders account for approximately 14% of disability-adjusted life years (DALYs) in Singapore, and are one of the highest contributors to population health burden[6]. This occurs in the context of a rapidly ageing population, where one in four citizens is projected to be aged 65 years or older by 2030[7].

While life expectancy in Singapore is among the highest globally (83.9 years), healthy life expectancy* lags by approximately a decade (73.6 years)[8] – indicating a prolonged period of morbidity in the final decade of life. Conditions associated with poor musculoskeletal health, including osteoporotic hip fractures, contribute significantly to this gap between lifespan and healthspan. Singapore has one of the highest incidences of osteoporotic hip fractures globally, at 314 per 100 000 population, with a female-to-male ratio of 2.1:1[9].

Despite this substantial burden, sarcopenia is typically identified only in later life – when functional decline is already established. Current diagnostic criteria focus on adults 60 years and above, reflecting its origin as a geriatric syndrome. In this brief we use the term 'sarcopenic' to describe early manifestations of low muscle mass and function in younger populations.

* "Healthy life expectancy (HALE) at birth" is defined as the number of years a person can expect to live in 'full health' from birth, as opposed to years lived in less than full health due to disease and/or injury.

Silent decline in musculoskeletal reserve begins in midlife

Figure 1 *Body composition can be broadly divided into fat mass and fat free mass. Appendicular Skeletal Mass Index (ASMI) is an indicator of functionally relevant muscle compartments of the body normalised for body size using height. Body composition profiles were classified using established cut-offs for percent body fat and ASMI based on international and regional guidelines*[10]

(i) Normal weight sarcopenic obesity prevalent in young women

In a study of 139 women of mean age 32 years in the Singapore Preconception Study of Long-Term Maternal and Child Outcomes (S-PRESTO), only 30.9% of women had healthy body composition profiles. 15.1% had sarcopenic obesity, and these women had body mass indices (BMIs) comparable to those who were healthy and percentage body fat comparable to those who were obese - reflecting the 'thin outside-fat inside (TOFI)' – body composition pattern[11] commonly observed in Asian populations. 11.5% had sarcopenic profiles, with low lean and fat mass.

(ii) Body composition profiles transitioned toward more compromised states through midlife

In a similar analysis in the Growing Up in Singapore Towards healthy Outcomes (GUSTO) cohort (mean age 38 to 44 years), the proportion of women with healthy body composition profiles was 31.3% at baseline and progressed to 18.8% over six years. This

deterioration over a short period into more compromised states highlights the midlife period as an under-recognised window for the early decline of musculoskeletal health.

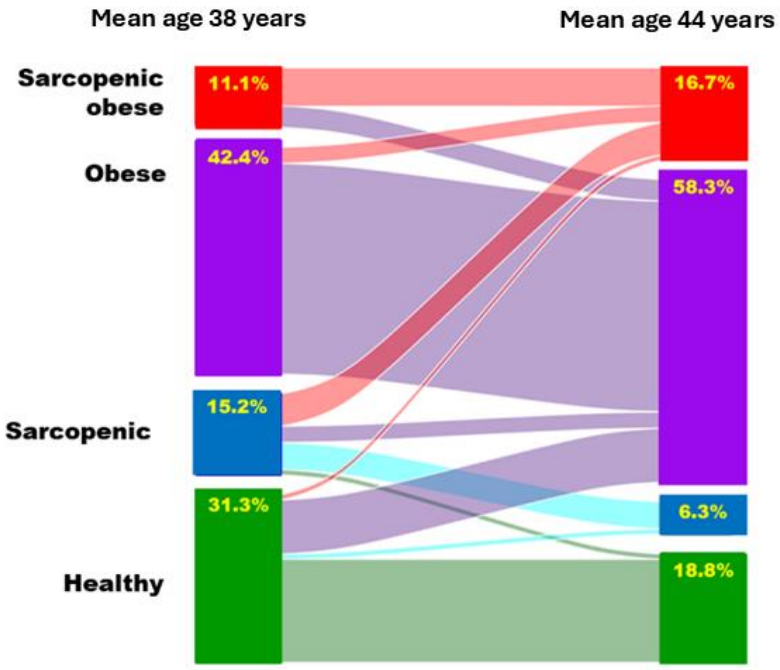

Figure 2 *Transitions in body composition profiles over six years in women in midlife*

(iii) Sarcopenic profiles are associated with adverse health outcomes

Women with unfavourable body compositions also had elevated risks for adverse health outcomes such as fragility fractures (fractures from low-energy trauma such as a fall from standing height, indicating underlying bone fragility), frailty (a state of reduced physiological reserve that increases vulnerability to illness and functional decline) and cardiometabolic disease. Women with sarcopenic and sarcopenic-obese profiles had higher prevalence of low bone mineral density than those with healthy body composition, reflecting an elevated risk of osteoporosis and fractures. Those with obesity and sarcopenic obesity also showed lower hand grip strength , reflecting higher risk of frailty, and more risk factors for cardiovascular disease.

(iv) Ethnic variation in body composition risk profiles

Ethnic variation in body composition profiles was observed in both GUSTO and S-PRESTO. Notably, only 31.5% of Chinese, 14.0% of Malay and 9.2% of Indian women had

healthy body compositions. Sarcopenic-obese profiles were more common among Chinese and Indian women. These findings demonstrate that 'Asian' populations are not homogeneous and highlight the need for ethnicity-informed risk stratification and targeted interventions.

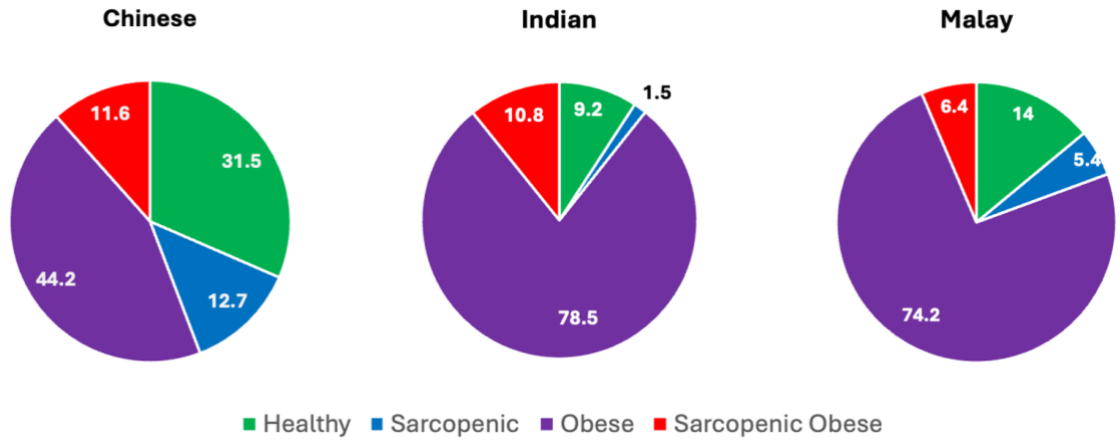

Figure 3 *Distribution of body composition profiles by ethnicity among women in the GUSTO and S-PRESTO cohorts. Profiles were classified using established cut-offs for percent body fat and ASMI, based on international and regional guidelines.*

(v) Modifiable lifestyle factors underpin sarcopenic obese profiles

Women with sarcopenic and sarcopenic-obese profiles exhibited modifiable lifestyle risk factors, particularly low engagement in vigorous physical activity. Suboptimal diet quality, such as lower consumption of dark leafy vegetables and whole fruits, was also identified as a risk factor. Findings from GUSTO and S-PRESTO suggest that these adverse lifestyle patterns may have been established much earlier in adulthood than previously recognised, with their impact on body composition and musculoskeletal health already evident in women as early as their thirties. These findings underscore the importance of adopting and maintaining healthy lifestyle behaviours throughout early adulthood to support long-term musculoskeletal health and healthy ageing.

Current Screening Approaches and Interventions: Limitations

Current clinical approaches to sarcopenia largely rely on a case-finding strategy, with assessment targeted at older adults or individuals with established associated factors such as falls, functional impairment or chronic disease[5]. This reflects the current framing of sarcopenia as a geriatric syndrome and prioritises identification at later stages of decline – after significant loss of muscle mass and function has occurred.

In addition, existing intervention capacity remains limited and largely targeted at older adults with established decline. Recent reports indicate that resistance exercise training programmes tailored to older adults are operating at full capacity, with waitlists of up to nine months and participation periods capped without guaranteed continuation[12]. The expansion of preventive programmes to include midlife and younger at-risk populations may further intensify pressure on already strained services.

Together, these gaps point to the need for a shift from reactive treatment of disease to proactive preventive care focused on optimising musculoskeletal health. This involves reframing how we define risk and when we intervene, while also strengthening infrastructure and delivery capacity to meet the growing demand for musculoskeletal care across the life course.

Recommendations: A Life-Course Approach

(i) Timing of screening and intervention: moving beyond a geriatric focus

Given evidence that musculoskeletal decline begins in early midlife, there is a need to expand screening beyond the geriatric population. Identification of individuals at risk of silent musculoskeletal decline in midlife would enable preventive measures to be initiated before substantial loss of muscle mass and function occurs.

Existing intervention capacity remains largely focused on older adults with established decline. Expanding preventive efforts across the life course may distribute demand more evenly, and reduce reliance on higher-intensity interventions in later life.

(ii) Expand screening tools beyond BMI

Current approaches to risk stratification rely heavily on BMI, which does not distinguish between fat and lean mass, and may fail to identify individuals with high-risk body composition profiles such as sarcopenic obesity. Conversely, clinical gold-standard tools for measuring body composition such as Dual-Energy X-ray Absorptiometry (DEXA), and imaging used in research settings such as magnetic resonance imaging (MRI) or computed tomography (CT) scans are expensive, less accessible and not well suited for repeated use due to radiation in community settings.

There is therefore a need to move towards more accessible measures of musculoskeletal health. In Singapore, Bioelectrical Impedence Analysis (BIA) has been widely used as a practical, non-invasive method for estimating body composition, and may be considered for broader community-level deployment as a screening adjunct. Incorporating simple assessments of muscle function such as grip strength would also help to provide a comprehensive approach to risk stratification. The European and Asian Working Groups for Sarcopenia (EWGS and AWGS) have recognised the use of BIA as an acceptable and practical alternative to measure muscle mass, reflecting its potential utility in screening[13,14]. While it is not yet recommended in Singapore's clinical guidelines due to the lack of robust population-specific validation[5], it is already being used within national initiatives including Active Health programmes by SportSG, as well as in private primary care settings.

(iii) Targeted interventions based on body composition

Body composition profiles can serve as practical risk indicators to guide targeted interventions. For example, individuals with an obese profile may benefit from strategies that prioritise weight loss while preserving muscle mass and improving muscle quality; those with sarcopenia may require interventions focused on increasing muscle mass and strength, while those with sarcopenic obesity require strategies to reduce adiposity while increasing muscle mass. Incorporating body composition-based risk stratification into screening frameworks would enable individualised prevention strategies.

(iv) System-level enablement of healthy behaviours

Beyond early identification and intervention, sustained improvements in musculoskeletal health will require broader system-level action across the life course. Development of a national musculoskeletal health framework could support the integration of services, facilitate systematic screening and support consistent implementation of evidence-based interventions. These should be complemented by scalable lifestyle and nutrition programmes tailored to body composition-based risk profiles, enabling targeted prevention.

While lifestyle factors such as physical activity and diet are modifiable, sustained engagement in healthy behaviours is influenced by broader environmental conditions. Suboptimal nutrition is already a recognised concern in Singapore, with one in two adults aged 50 to 69 years not meeting recommended protein intake[15], and 40% at risk of malnutrition[16]. Affordable and accessible food options may often be carbohydrate-dense and relatively low in protein[17], making it challenging to support musculoskeletal health.

While overall physical activity levels in Singapore appear high, with those achieving sufficient activity levels rising from 75% in 2022 to 85% in 2024, much of this activity comes from commuting (46%) and work-related physical activity (25%), as compared to structured, muscle-strengthening exercise[18]. Work and commuting patterns may limit opportunities for dedicated physical activity, contributing to the reliance on incidental rather than structured exercise.

Population-level strategies may therefore include increasing awareness of the importance of muscle health across the life course, supporting opportunities for physical activity at work and in the community, and ensuring equitable access to nutrition.

Conclusion

Musculoskeletal health is a foundational pillar of healthy longevity, underpinning physical function, metabolic health and independence. Evidence from local cohorts demonstrates that suboptimal body composition profiles, such as sarcopenic and sarcopenic obesity, are already prevalent among women in their 30s and 40s – decades before the onset of clinically recognised outcomes. Many of these women have normal BMI and would not typically be identified as being at high risk using conventional screening approaches, despite the presence of modifiable risk factors.

These findings highlight the need to move beyond BMI-based screening and late-stage models of care, towards earlier risk stratification and intervention. Incorporating body composition and functional measures into screening frameworks would enable earlier identification of at-risk individuals and allow for more targeted interventions.

Improving musculoskeletal health outcomes will require a paradigm shift from reactive, disease-oriented care towards a life-course approach centred on early identification and prevention. The opportunity for action begins early in life, to optimise peak muscle health and muscle mass in early adulthood and maintain musculoskeletal health across adulthood. Recognising midlife as a critical window for intervention is key to preserving musculoskeletal reserve, delaying functional decline and supporting healthy ageing in Singapore.

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