

## Exercise as Medicine in Frailty Prevention and Management: Why Now, Why Here, and Making it Happen

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Frailty is an emerging global public health priority projected to have a major impact on healthcare costs and model of care delivery following its rising prevalence with population ageing.<sup>1</sup> Frailty is an age-related risk state characterised by multisystem impairment which reduces physiologic reserves and increases an individual's susceptibility to negative health-related outcomes even with minor stressor events.<sup>2</sup> A multidimensional syndrome that comprises physical, cognitive, psychological and social dimensions, frailty has been defined via two main approaches: (1) physical phenotypic model of Fried,<sup>3</sup> which classifies frailty as 3 or more out of 5 physical setbacks, namely slowness, weakness, weight loss, exhaustion, and low physical activity; and (2) deficit accumulation model of Rockwood and Mitnitski,<sup>4</sup> which derives a frailty index from a predetermined list of 30 or more variables. Validated tools have been developed to identify frailty across the continuum of both approaches, and these tools are not interchangeable in terms of frailty identification and predictive ability.<sup>5</sup> The highly dynamic nature of frailty attests to its potential reversibility, with community studies reporting reversion rates of 13% to 32% to pre-frail/non-frail states.<sup>6</sup>

Singapore is not spared from the public health consequences of frailty, with 6% of the 65 and older population identified as frail and 40% being pre-frail, depending on the group studied and the type of frailty instrument used.<sup>7</sup> The strikingly high percentage of pre-frail older adults relative to the number of frail individuals is a timely reminder to initiate immediate steps to prevent further decline into the frailty state. A Singapore community-based frailty detection programme, Individual Physical Proficiency Test for Seniors (IPPT-S), used both Fried's phenotype and

frailty index as measurement tools, and has reported low socio-economic status, depression, malnutrition, sarcopenia as risk factors for frailty.<sup>8</sup> The researchers have also identified significantly poorer performance in lower limb strength and power, balance and agility, gait, and endurance in older adults who are pre-frail and frail.<sup>9</sup> Frailty has also been found to be highly prevalent among hospitalised older adults, and predicts in-hospital mortality, prolonged length of stay, death, functional decline, and institutionalisation at one year.<sup>10</sup>

Against this backdrop, this commentary aims to provide an overview of 'exercise as medicine' as an important intervention strategy of frailty prevention and management that is evidence-based, effective, relatively safe/free of adverse effects, and eminently scalable in the context of Singapore, with suggestions to promote exercise interventions in older adults. We will be focusing on the benefits of exercise in the physical aspect of frailty as opposed to the cognitive, psychological or social dimensions. Although this paper mainly addresses the community perspective, evidence in acute settings is also introduced to reflect the pivotal nature of frailty management across the care continuum.

Exercise, as a structured and purposive form of physical activity (i.e. any bodily movement produced by skeletal muscles that leads to energy expenditure)<sup>11</sup> is the critical component in the management armamentarium for frailty, based on benefits demonstrated by landmark intervention studies in Australia<sup>12</sup> and Singapore.<sup>13</sup> Individuals who are pre-frail or frail should be participating in a comprehensive multicomponent exercise programme comprising aerobic, resistance, balance and flexibility components, particularly

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focusing on resistance training.<sup>14</sup> Resistance training reverses sarcopenia,<sup>15</sup> which is characterised by the progressive and generalised loss of skeletal muscle mass and strength that increases the risk of adverse outcomes such as physical disability, poor quality of life and even death.<sup>16</sup> Sarcopenia is believed to be a fundamental component and possible antecedent of physical frailty,<sup>5,16</sup> and this interdependent relationship between sarcopenia and frailty may be a cause of low energetics experienced by many frail older adults.<sup>5</sup>

Recent growing evidence has also demonstrated the association of reduced moderate-vigorous daily physical activity and prolonged bouts of sedentary behaviour ( $\geq 30$  min) with increasing frailty levels,<sup>17</sup> after adjusting for socio-demographic factors. As such, the Asia-Pacific Clinical Practice Guidelines for the Management of Frailty<sup>18</sup> strongly recommends that older adults with frailty engage in a progressive, individualised physical activity programme that contains a resistance training component. As both physical inactivity and lack of exercise can exacerbate age-related muscle loss and predispose frailty,<sup>19</sup> it is important to minimise sedentary behaviour, encourage physical activity and promote exercise (including resistance exercise targeting muscle strength) as part of overall strategy to prevent and manage frailty.<sup>19</sup>

Frailty management across the continuum, including acute hospital setting is crucial to prevent functional decline due to hospitalisation episodes. Compared to the community, similar initiatives to promote resistance training among frail older adults within Singapore healthcare institutions seem to be lacking. This could be attributed to the acuity of medical conditions and perceived reduced ability to participate in an exercise programme during hospitalisation. Interestingly, a recent Spanish study whereby twice-daily exercise sessions (focused on resistance training) of short duration (20 minutes over 5–7 days), yielded significant improvements in the function, cognition, mood and quality of life of hospitalised older adults within an Acute Care for Elderly (ACE) unit.<sup>20</sup> This suggests that the time is ripe to explore how we can translate such evidence-based practice to Singapore hospital settings, to reduce iatrogenic disability and frailty resulting from hospitalisation,<sup>21</sup> ultimately preventing decline in function and quality of life of older adults post-hospitalisation episode.

One in three Singaporeans remain sedentary and fail to meet the recommended weekly targets for physical activity and exercise, particularly for older adults.<sup>22</sup> Despite the body of evidence that supports the benefits of resistance exercise in improving muscle strength and function in

older adults,<sup>23</sup> there is a knowledge-practice gap such that uptake of physical exercise and resistance exercise remains disconcertingly low. While many community programmes including Wellness Kampung,<sup>24</sup> Individual Physical Proficiency Test for Seniors (IPPT-S),<sup>25</sup> and Share a Pot<sup>26</sup> gear towards a comprehensive approach to address healthcare and social needs across the spectrum of frailty,<sup>23</sup> more can be done to promote incorporation of resistive exercise.<sup>5</sup>

Nevertheless, recent developments in Singapore herald encouraging progress. A recent feasibility study describing the benefits of a community-based structured progressive resistance and power training programme demonstrated improvement in Timed Up and Go (TUG) performance and reversal of frailty.<sup>27</sup> In addition, the Healthy Ageing Promotion Programme for You (HAPPY), adapted from Cognicise (a combination of cognition and physical exercise) programme at the National Centre for Geriatrics and Gerontology in Japan, comprising exercises focusing on dual-tasking has successfully improved the frailty status of participants.<sup>6,28</sup> Notably, the Gym Tonic programme launched by Lien Foundation in 2015, demonstrated that the 12-week strength training programme using air-powered equipment enhances muscle function and reverses frailty.<sup>29</sup> Gym Tonic and other resistance training programmes have further sprouted in day rehabilitation and senior care centres, allowing public use of resistance training machines to promote physical fitness with age. This message continues to take flight within the Singaporean community as evident in *The Straits Times* report on 25 January 2019 featuring community-dwelling older adults taking part in a CrossFit programme, which not only improved physical capacity, but also increased confidence to lead independent and healthy lives.<sup>30</sup>

While these initiatives (Table 1) are encouraging, it is necessary to realise that the emphasis of exercise and physical activity programmes must be targeted at the needs of the population. For example, within a multicomponent exercise programme, it is recommended that pre-frail individuals focus on resistance and balance exercises, while frailer individuals target resistance and aerobic exercises, as the latter aims to build aerobic capacity and endurance as foundation.<sup>31</sup> Exercise prescription principles including frequency, intensity, type, time and duration are crucial when planning interventions for different target groups. Here is the challenge of implementing community programmes that strive to be both all-inclusive and tailored to individuals' goals, while ensuring scalability and sustainability in the long run.

Table 1. Community programmes in Singapore

Programmes	Target Population	Aim and Description of Programmes
Wellness Kampung <sup>24</sup>	Community-dwelling seniors and the public	To encourage people of all ages to adopt healthier lifestyles through health intervention programmes and social activities such as health screenings, healthy cooking demonstrations and mass exercises.
Individual Physical Proficiency Test for Seniors (IPPT-S) <sup>25</sup>	Community-dwelling seniors	To improve physical activity and nutrition levels for seniors identified as pre-frail upon screening through physical exercise sessions (1 per week) and nutrition classes (6 sessions in total) as part of a 4-month programme.
Share a Pot <sup>26</sup>	Community-dwelling seniors	To improve nutrition and health where seniors meet at centres to exercise and enjoy a bowl of nutritious soup.
Healthy Ageing Promotion Programme for You (HAPPY) <sup>28</sup>	Seniors identified as pre-frail or have underlying cognitive impairment (MMSE 18–26)	To improve well-being, functional ability and strength through screenings at senior activity centres and void decks, and dual-task exercises (60 minutes twice a week).
Gym Tonic <sup>29</sup>	Community-dwelling seniors	To focus on strength training for residents in eldercare centres, and all seniors at selected public venues such as gyms and activity centres using resistance-focused gym equipment.

MMSE: Mini-Mental State Examination

In Singapore, frailty prevention and management can be viewed against the backdrop of public policies including the Ministerial Committee on Ageing's Action Plan for Successful Ageing, the report for which was released in 2016. The report highlighted key initiatives, including funding to promote ease of mobility through senior-friendly transport amenities. Accessibility to social activities, health education and exercise classes through the creation of Wellness Hubs were also highlighted.<sup>25</sup> Given emerging endeavours across public and private sectors, organisations and stakeholders including the Ministry of Health (MOH), SingHealth Regional Health Systems (RHS), Agency for Integrated Care (AIC), Health Promotion Board (HPB) and Voluntary Welfare Organisations (VWOs) to promote successful ageing, there is strong impetus to coordinate efforts for frailty prevention.

Despite robust evidence for exercise interventions for older adults, there appears to be no clear understanding of variables that impact the effectiveness of these programmes, and how they benefit different population groups (such as the non-frail or pre-frail versus frail individuals).<sup>5</sup> Evidence-based exercise interventions need to be studied further in the context of the Singaporean heartlands to determine not only the type of effective exercise regimes, but also optimal ways to sustain these positive behaviour and lifestyle changes through continual growth of social groups and communities of practice in the long term. Allied health professionals including physiotherapists, exercise physiologists and fitness professionals should amalgamate their expertise and efforts to augment the quality of exercise and physical activity

programmes available in the community for the various population groups.

Additionally, the public should have easy access to exercise programmes that are suited for their physical function and fitness levels, to minimise barriers and enhance motivation. Current international literature highlight that individuals' evaluation of benefits they can derive from exercise (including enjoyment of the activity, and improvement in general health, mood and confidence), and for whether the exercise programme is an appropriate activity to undertake (for example, whether it will be harmful or tiring), correlated with the intention to participate in strength and balance programmes.<sup>32</sup> Other researchers have also reiterated the importance of action planning, and even other less tangible, but no less important considerations to facilitate healthy intentional behaviour.<sup>33</sup> Indeed, a recent Singapore-based study emphasised the importance of interpersonal, environmental and socio-cultural factors in facilitating engagement in healthy behaviours<sup>32</sup> and suggested for a range of strategies including enhancement of physical environment, involvement of families in activities, provision of healthy incentives, and tailoring programmes based on residents' interests and abilities. Further research is required to elucidate the reasons for uptake of community exercise programmes, and particularly, to identify the reasons why some individuals (including older adults who are pre-frail or frail) choose not to participate in physical activity initiatives organised within the community. This will allow for development and application of strategies to better encourage participation, and advance overall effectiveness of ground implementation.

Along with demographic transitions and epidemiological patterns across the world, frailty is a burgeoning public health concern for national public healthcare systems. Exercise is undoubtedly key to frailty prevention, and there is avenue to synergise and structure Singapore's framework for continual evaluation of all exercise interventions and programmes in hand with communication of these to the public for heightened visibility and uptake. We will be in good stead if we can succeed in mobilising a ground-up social movement committed to the concept of 'exercise as medicine'. Indeed, to quote the gerontologist, Dr Robert N Butler, "If exercise could be packed into a pill, it would be the single most widely prescribed and beneficial medicine in the nation."<sup>34</sup>

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