Guidelines

INTERNATIONAL JOURNAL OF SURGERY

OPEN

Perioperative management of sarcopenia in patients undergoing major surgeries in Singapore: a modified Delphi consensus

Frederick H. Koh, FRCS[a,*], Lincoln M.Y. Chew, MBBS[f], Nicky Wong, MBBS[f], Alfred W.C. Kow, FRCS[i], Dominic Yap, MBBS[f], Sherryl Ng, MBBS[f], Jingyu Ng, FRCS[i], Ming-Yuan Tan, FRCS[d], Daniel J.K. Lee, FRCS[d], Angie P.S. Au-Yong, MMed[c], Clement C.K. Yan, PhD[a], Priscilla Darmawirya, BSc[e], Balachandran Jayachandran, MSc[g], Andrea Maier, MD[h], Hazel EL Yeong, MSc[d], Samuel T.H. Chew, MMed[b], Fung-Joon Foo, FRCS[a], Kwang-Yeong How, FRCS[e], Doris HL Ng, DPhil[e]

Background: Ageing population is a worldwide phenomenon with correspondingly higher proportion of older patients being treated in the hospital setting. Sarcopenia, which increases with age, has serious negative implications on health, hospitalisation, and overall postoperative recovery. There is no mutual consensus on perioperative management of sarcopenia in surgical patients in Singapore. The purpose of this study is to create greater clarity pertaining to the recognition of sarcopenia, the application of assessment criteria of sarcopenia and perioperative management of surgical patients in Singapore.

Methods: A modified Delphi consensus consisting of a panel of experts from Singapore forming a multidisciplinary team, including surgeons, geriatricians, anesthesiologists, physiotherapists, and dieticians. Eight recommendations were proposed by the steering committee. Literature search from MEDLINE, Embase, and Scopus for articles up till June 2023 were performed to support recommendation statements. The expert panel voted on agreement to recommendation statements and graded the level of evidence supporting each statement through surveys to achieve consensus, set at 85% a priori.

Results: The panellists underwent two rounds of anonymized, independent voting before reaching consensus for all eight statements. After the first round, seven statements reached consensus, including the corresponding grading for level of evidence. The statement which did not achieve consensus was revised with supporting literature and after the second round of survey, all eight statements and level of evidence reached consensus, completing the Delphi process. These eight statements covered themes to (1) encourage the identification of sarcopenia, (2) guide preoperative, and (3) postoperative management of sarcopenia.

Conclusion: With the varying approaches in perioperative management, poor understanding of and identification of sarcopenia can result in suboptimal management of sarcopenia in surgical patients. Given the abundance of evidence linking beneficial impact on recovery and postoperative complications with prudent management of sarcopenia, it is imperative and urgent to achieve awareness and consensus.

Keywords: Asia, Delphi consensus, guidelines, prehabilitation, sarcopenia, surgery

[a]Sengkang General Hospital, SingHealth, [b]Changi General Hospital, SingHealth, [c]Singapore General Hospital, SingHealth, [d]Khoo Teck Puat Hospital, National Healthcare Group, [e]Tan Tock Seng Hospital, National Healthcare Group, [f]Yong Loo Lin School of Medicine, National University of Singapore, [g]Woodlands General Hospital, Woodlands Health, [h]Alexandra Hospital, National University Health System and [i]National University Hospital, National University Health System, Singapore

Frederick H. Koh, Lincoln M.Y. Chew, and Nicky Wong contributed equally as first authors.

Sarcopenia Interest Group, SingSPEN, Singapore: Frederick H. Koh, Alfred W.C. Kow, Jingyu Ng, Ming-Yuan Tan, Daniel J.K. Lee, Angie P.S. Au-Yong, Clement C.K. Yan, Priscilla Darmawirya, Balachandran Jayachandran, Andrea Maier, Hazel E.L. Yeong, Samuel TH Chew, Fung-Joon Foo, and Doris HL Ng.

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

*Corresponding author. Address: Department of General Surgery, Colorectal Service, Sengkang General Hospital, 110 Sengkang East Way, Singapore 544886, Singapore. Tel.: +65 693 053 48. E-mail: frederickkohhx@gmail.com (F H. Koh).

International Journal of Surgery (2024) 110:4552–4558

Received 18 February 2024; Accepted 14 April 2024

Supplemental Digital Content is available for this article. Direct URL citations are provided in the HTML and PDF versions of this article on the journal's website, www.lww.com/international-journal-of-surgery.

Published online 3 May 2024

http://dx.doi.org/10.1097/JS9.0000000000001515

Introduction

Sarcopenia, first described by Irving Rosenberg in 1988, is defined as a loss in lean body mass and function due to atrophy of muscle cells[1]. The prevalence of sarcopenia increases with age, with at least 1/3 of community-dwelling individuals aged ≥ 60 years having sarcopenia[2–4]. Across multiple medical facilities among ageing adults, to quote the data from the International Sarcopenia Initiative, worldwide prevalence is 1–29% in community, 14–33% in long term care facilities, and 10% in an acute care hospital[5]. In Singapore, large population-based studies revealed that 44.3% of patients in the hospital outpatient setting were at risk for sarcopenia, and 25% of community-dwelling independent older adults have sarcopenia[6].

While there are existing sarcopenia workgroups, such as the Asian Workgroup for Sarcopenia (AWGS) and European Workgroup for Sarcopenia (EWGSOP), which have made tremendous efforts to come up with assessment criteria for sarcopenia[7,8], there is still no mutual consensus on perioperative management of sarcopenia in surgical patients, despite the exceedingly high prevalence of sarcopenia. Hence, there is an urgent need to identify and manage sarcopenia early in surgical patients as there are implications on adverse outcomes such as infection, postoperative complications, and surgically-related or oncologically-related mortality[9–13]. Multiple explanations in the complex pathophysiology of sarcopenia and its effect on surgical outcomes further complicate its perioperative management. Sarcopenia is a worldwide epidemic with serious negative implications on health, hospitalisation, and overall postoperative recovery.

With the expectation that by 2030, Singapore will become a super-aged society (1 in 3 people being ≥ 65-years-old) and hence the prevalence of sarcopenia will rise consequently, there is a pressing need to formulate some guidance in the perioperative management of this condition in the surgical cohort. https://www.straitstimes.com/opinion/live-long-and-prosper-a-super-aged-singapore-society-does-not-have-to-be-a-sad-one
Therefore, our study aims to provide consensus recommendation statements, agreed upon by a panel of multidisciplinary experts to guide the management of sarcopenia in the surgical patients in Singapore.

Developing Singapore guidelines on the perioperative management of sarcopenia for surgical patients

The Sarcopenia Interest Group, a subsection of the Society for Parenteral and Enteral Nutrition (Singapore) (SingSPEN), convened a group of healthcare professionals (HCP) who are involved in the perioperative management of surgical patients and have a keen interest in prehabilitation across the city-state. All participants in this consensus had over 10 years of academic training and experience in the management of surgical patients in healthcare institutions in Singapore, although their opinions might not necessarily represent that of the organisations they are affiliated with. As there are currently no consensus guidelines for the perioperative management of patients with sarcopenia, the objective of this study was to provide scientific evidence-based recommendations with the view to standardise multidisciplinary management of this condition.

HIGHLIGHTS

- Sarcopenia is highly prevalent, and will only get more common with the phenomenon of the ageing population. It also negatively impacts on major surgery recovery and patients' quality of life.
- There has yet to be any consensus on the perioperative management of sarcopenia.
- This Delphi consensus statement conducted by SingSPEN, aims to provide guiding principles of management of sarcopenia for surgical patients in Singapore.
- The eight consensus statements cover (1) preoperative identification of sarcopenia, (2) the preoperative, and (3) postoperative focus of management of sarcopenia in patients going for major surgery.

Material and methods

The consensus was conducted using a Modified Delphi model in two separate meetings, the first was performed online and the second was a face-to-face discussion. Given that majority of the Delphi process took place during the COVID-19 pandemic, virtual surveys were used in order to minimise the risk of cross institutional transmission of COVID-19.

Membership of the consensus panel

Fourteen HCPs were invited to form a multidisciplinary panel, which consisted of five surgeons, three medical physicians, two anesthesiologists, two dietitians, and two physiotherapists. These experts were invited as (1) they were of senior staff grade with at least 10 years of clinical experience and ability to appreciate the nuances of clinical practice in Singapore; (2) fluent in English; and (3) well-versed with sarcopenia and the needs for a surgical patient. To support the validity of results, a minimum of 12 participants were required to form a large enough and representative sample size. This was a consensus amongst the core group to have at least two representations from the hospitals who had an active prehabilitation programme at the time of running the Delphi process, whilst at the same time having a multidisciplinary representation with representation of each of the three healthcare clusters in Singapore. As each programme's prehabilitation group tends to be small, this number was not increased as some institutions may only have 1–2 pax running such prehabilitation programme. This was to avoid over-representation of the bigger units and under-representation of the smaller units. The invited HCPs were representative of the three different healthcare clusters in Singapore to ensure generalisability in recommendations. Informed consent was obtained from all participants.

The invited HCPs were divided into three roles: (1) core group (FHK, DN, SC, FJF, HY) were responsible for draughting the statements and coordinating the process of discussion and voting on the statements; (2) facilitators (FHK, LMYC, NW, DY, SN) were responsible for conducting the literature search, summarising the literature, and collating the survey along with discussion points for the revision of recommendation statements; (3) panellists (rest of the co-authors) were representatives of the multidisciplinary multicluster team who participated in the

discussions and voting of the statements during both the virtual and face-to-face conference.

Ethics

Written informed consent was obtained from all panellists to recruit them for their participation in the Delphi consensus process. Responses of the panellists were collated by a third party and an anonymised summary of the experts' input from each round were reported. All data were handled in accordance with the Personal Data and Protection Act and ethical guidelines of the Singapore Medical Council.

Provisional statements

The consensus is grouped under three topics (1) disease identification for individuals who are going for major surgery; (2) preoperative management strategies of sarcopenia, and (3) postoperative management strategies of sarcopenia. The consensus recommendation statements were draughted by the core group and handed over to the facilitators who conducted the literature search and summary. The first version of the statements, along with the supporting literature and summary, were then sent to the panel for electronic voting.

Literature search

A comprehensive literature search was conducted by the facilitators. Relevant articles published in English language up to June 2023, from Embase, Ovid Medline, PubMed Medline, Cochrane Library, and Google Scholar, were included. Searches were performed in a systematic fashion with usage of different keywords identified for each statement. National and international guidelines on the management of sarcopenia were also solicited. Searches for evidence for and against the consensus statements were both included for the expert panel voting to reduce bias and maintain objectivity. For each statement, the various literature obtained were summarised, either as a forest plot or tabulated. For the first round of voting, the panel was sent the electronic voting form with the consensus recommendation statements and a document which contained a summary of the literature (Supplementary Item 1-8, Supplemental Digital Content 1, http://links.lww.com/JS9/C476, Supplemental Digital Content 2, http://links.lww.com/JS9/C477, Supplemental Digital Content 3, http://links.lww.com/JS9/C478, Supplemental Digital Content 4, http://links.lww.com/JS9/C479, Supplemental Digital Content 5, http://links.lww.com/JS9/C480, Supplemental Digital Content 6, http://links.lww.com/JS9/C481, Supplemental Digital Content 7, http://links.lww.com/JS9/C482, Supplemental Digital Content 8, http://links.lww.com/JS9/C483), along with all the relevant full text articles identified.

Voting process

The panel started the first round of anonymised online voting after receiving the first draft of the statements. A Likert scale anchored by 1–5 (A = accept completely, B = accept with some reservation, C = accept with major reservation, D = reject with reservation, E = reject completely) was adopted. Consensus was deemed to have been achieved if > 85% of the votes indicated 'accept completely' or 'accept with some reservations'. A statement was rejected if > 85% of the votes indicated 'reject completely' or 'reject with reservation'. Statements for which a consensus could not be reached were discussed again and modified by the core group. A second round of literature search was performed for the revised statements. The second survey was conducted electronically with the revised statements and literature review. As per protocol, all participants were required to participate in at least two rounds in the modified Delphi process. The dropout rate for the two rounds of voting was 0%.

During the face-to-face consensus conference, all the five facilitators (FHK, LMYC, NW, DY, SN) were invited to present the literature for each of the three topics (see above) before reviewing each consensus statement for final approval. Each statement was then graded for its level of evidence (Table 1).

Table 1

Voting, quality of evidence, and classification of recommendations.

Category and grade	Description
Voting on recommendations	
A	Accept completely
B	Accept with some reservation
C	Accept with major reservation
D	Reject with some reservation
E	Reject completely
Quality of evidence	
High	Evidence obtained from at least one RCT
Moderate	Evidence obtained from well-designed control trials without randomisation
Low	Evidence obtained from well-designed cohort or case–control study
Very low	Evidence obtained from comparison between time or places with or without intervention OR Opinion of respected authorities, based on clinical experience and expert committees

RCT, randomised controlled trial.

Results

Invitation for the modified Delphi consensus was sent to all 14 panellists, of which there was a 100% response rate across both surveys. Representative from all three healthcare clusters (SingHealth, National Healthcare Group, and National University Health System) participated in the meeting (Table 2). Professions represented include surgeons, geriatricians, internal medicine physicians, anaesthesiologists, dietitians, and physiotherapists.

Table 2

Demographic characteristics of panellists.

Panellists demographics	Total number ($n = 14$)
Surgeons	5
Internal medicine physicians	3
Anesthesiologists	2
Dieticians	2
Physiotherapists	2
Place of practice	
NUHS	3
SingHealth	5
NHG	6

NUHS, National University Health System; NHG, National Health Group; SingHealth, SingHealth Group.

Disease identification for individuals who are going for major surgery

Statement 1: Patients going for major surgery do not need to be screened for sarcopenia but should be assessed for the diagnosis of sarcopenia.

Level of agreement: A–B = 100%, C–E = 0%

Quality of evidence: High

This statement relates to the theme that there is an increasing need to identify sarcopenia because of its high prevalence and its implications on adverse outcomes such as infection, post-operative complications, and surgically-related or oncologically-related mortality. Unlike the recommendation by the AWGS 2019 guidelines[7], where identification of sarcopenia is recommended to adopt a 'Case Finding' followed by a 'Case Diagnosis' strategy, the panel agreed that for a patient cohort who is awaiting major surgery, direct 'Case Diagnosis' would be more efficient in identifying vulnerable sarcopenic patients who can then directly undergo surgical optimisation without unnecessary time or resource wastage in the 'Case Finding' process. This efficiency is deemed necessary as the average waiting time for surgery may be short in certain institutions and cases, and thus, quickly transiting a patient from diagnosis of sarcopenia to treatment is encouraged (Supplementary Item 1, Supplemental Digital Content 1, http://links.lww.com/JS9/C476).

Statement 2: There are benefits and limitations to different imaging modalities for the assessment of lean muscle mass.

Level of agreement: A-B = 100%, C-E = 0%

Quality of evidence: Low-Moderate

The AWGS uses bioelectrical impedance analysis (BIA) or the dual X-ray absorptiometry (DEXA) scan to ascertain the appendicular skeletal mass (ASM) in the diagnosis of sarcopenia[7]. The use of computed tomography (CT) or MRI was not recommended, unlike in the International Sarcopenia Workgroup and the EWGSOP guidelines, mainly due to a lack of data for threshold values to be determined[7,8,14,15]. Despite so, the panel acknowledged that the consistency of ASM measurement and availability of the CT and MRI are more ideal than BIA and DEXA. However, more large international population-based studies may be required to determine the Asian thresholds before they can be assimilated into the guidelines[16].

The advantage of BIA is that it is a cheap modality without the exposure to radiation[17,18]. However, BIA has its limitations with consistency of measurements highly dependent on the fluid status of the patient, bladder fullness, and timing of meals resulting in variability of read-outs for the same individual. Thus, it is important to standardise the protocol for the use of BIA to include a fixed time of day for measurement, empty bladder, and its measurement in relation to meal intake. BIA is also not suitable for use in patients with metal implants as the metallic implants (joint replacements, pacemakers, etc.) can affect the electrical impedance of the body.

Apart from the use in the assessment of bone mineral density, DEXA can also assess body fat-muscle compositions and thus allowing the ASM to be obtained[19]. The scan can be performed quickly and is suitable for individuals with metallic implants while maintaining minimal radiation burden (less than that from a chest radiograph). It is also more affordable than CT and MRI scans. However, the expert panel raised a pertinent point that most DEXA scans in Singapore have yet to be calibrated for clinical ASM assessment and hence, need to be validated before more widespread clinical use for ASM measurement for the diagnosis of sarcopenia (Supplementary Item 2, Supplemental Digital Content 2, http://links.lww.com/JS9/C477).

Preoperative management strategies of sarcopenia

Statement 3: Sarcopenic patients undergoing major abdominal and gastrointestinal surgery should at least receive bimodal prehabilitation that includes resistance training and nutritional therapy.

Initial level of agreement: A–B = 85.7%, C–E = 14.3%

Final level of agreement: A–B = 92.9%, C–E = 7.1%

Quality of evidence: Moderate-High

The initial statement 'Patients undergoing major abdominal and gastrointestinal surgery should at least receive bimodal prehabilitation that includes resistance training and nutritional therapy' obtained an initial level of agreement of 85.7%. However, mixed results on the quality of evidence were obtained due primarily to the application of prehabilitation in a broad-spectrum manner for all patients[20–25]. It was decided by the core group that the statement might have been too generic and emphasis should be focused on a more vulnerable group of sarcopenic patients[9,26]. Hence, statement 3 was revised to 'sarcopenic patients undergoing major surgery should at least receive undergo bimodal prehabilitation that includes resistance training and nutritional therapy', which resulted in a 21.7% increase from 35.7% to 57.1% in high level of evidence. With sarcopenia increasingly being recognised as a risk factor for poor surgical, oncological, and functional outcomes after surgery, paying attention particularly to this vulnerable cohort, and not just the physically frail individuals, would increase the pool of patients requiring prehabilitation[11–13]. This intervention would likely help to further improve the outcomes of a wider surgical population who are known to have increased risk of poorer outcomes (Supplementary Item 3, Supplemental Digital Content 3, http://links.lww.com/JS9/C478).

Statement 4: Treating to target: Nutrition and resistance training should be personalised using a treat-to-target approach.

Level of agreement: A–B = 92.9%, C–E = 7.1%

Quality of evidence: Low-moderate

The importance of the statement hinges on the '*treat-to-target*' approach. Optimisation for sarcopenia in the perioperative setting should not be prescriptive without reassessments. The focus of treatment recommendation, regardless of modality, should require a periodic period of reassessment of effectiveness and of course, compliance of the recommendations given by the treatment team[27–30]. Only then will reinforcement and modifications to the treatment can be instituted to ensure this vulnerable group of patients reap the true benefits of prehabilitation.

A point for discussion arose with regards to the choice of treatment focus to be personalised rather than standardised. This is not to say that personalisation is superior to the standardisation. A standardised approach can help those who are unfamiliar with the condition to follow a set of evidence-based approaches to optimise patient outcomes. An individualised approach may be far more important because of inter-patient variabilities and dynamic changes in physiology in the patient, hence constant reassessment of individual targets is important.

However, as the level of evidence was low to moderate at best, further large randomised controlled trials (RCTs) or real-world evidence comparing different treatment targets, whether it may be

compliance to treatment or functional targets, are still required to strengthen the evidence behind this treatment concept (Supplementary Item 4, Supplemental Digital Content 4, http://links.lww.com/JS9/C479).

Statement 5: Prehabilitation can reduce healthcare costs.

Level of agreement: A–B = 92.9%, C–E = 7.1%

Quality of evidence: Low-Moderate

Most papers linking costs and prehabilitation are not within the Asian context[31,32]. It is not surprising that hospitals in different parts of the world follow different healthcare economic models. Different regions also have different healthcare fundings. Costs can be a major issue in hospitals where subsidies are not readily available to carry out prehabilitation. The lack of resources to acquire knowledge for prehabilitation can be a confounding factor as well. More Asia-specific, or country-specific cost effectiveness analyses should be conducted along with well-designed comparative real-world studies or RCTs on multimodal prehabilitation on sarcopenic patients in order to increase the quality of evidence in this domain (Supplementary Item 5, Supplemental Digital Content 5, http://links.lww.com/JS9/C480).

Statement 6: Three other pillars to consider for prehabilitation include financial, psychological, and social support.

Level of agreement: A–B = 100%, C–E = 0%

Quality of evidence: Low-Moderate

The process of prehabilitation can be both physically and mentally difficult for patients who may otherwise not see the benefits. Caregivers are not only a form of social support who can motivate patients to continue with prehabilitation, they are also an avenue for financial and psychological support[33,34]. Prehabilitation is a journey and optimising perioperative outcomes in surgical sarcopenic patients requires multiple components to smoothen the process[35]. The success of prehabilitation can only be evident over a relatively long period of time[11–13] (Supplementary Item 6, Supplemental Digital Content 6, http://links.lww.com/JS9/C481).

Postoperative management strategies of sarcopenia

Statement 7: Rehabilitation improves outcomes in patients undergoing major surgery especially in patients with adjuvant therapy.

Level of agreement: A–B = 100%, C–E = 0%

Quality of evidence: Moderate-High

A systematic review of rehabilitation and exercise recommendations in oncology guidelines published by Nicole *et al.*[36] suggested that rehabilitation is under-utilised in the care of oncological patients even though rehabilitation is a recognised intervention, which have been shown to have a substantial impact on functional and quality of life on oncological patients. There is a need to educate physicians about the evidence of benefits of rehabilitation in these patients, especially those who are malnourished or sarcopenic, who require adjuvant therapy. Confounding factors like adverse side effects of chemoradiotherapy may preclude patients and even deter physicians from recommending patients to continue with rehabilitation despite the evidence that rehabilitation is not only feasible but also beneficial in terms of tolerance to chemoradiotherapy[36–38]. It is important to define the outcome measures for this group of patients to incorporate the balance between completing the adjuvant therapy and completion of rehabilitation[38,39] (Supplementary Item 7, Supplemental Digital Content 7, http://links.lww.com/JS9/C482).

Statement 8: Optimising a patient's Quality-of-Life should be a goal of rehabilitation.

Level of agreement: A–B = 100%, C–E = 0%

Quality of evidence: Low-Moderate

It may be difficult to standardise the goals of rehabilitation because patients come from diverse backgrounds, cultures, and socioeconomic status. Duration of follow-up for the medical condition requiring operation also differs. However, the intent of major surgery is typically the same – to restore patients to good health and function[40–43]. In addition, every patient has their own goals and wishes in terms of treatment outcomes. However, similar to the operative intent, most, if not all, would wish to return back to their baseline lifestyle through surgery. It is thus better to base the goals of rehabilitation on an individual's quality-of-life to realise the true impact of prehabilitation for sarcopenia[40] (Supplementary Item 8, Supplemental Digital Content 8, http://links.lww.com/JS9/C483).

Summary and conclusion

Sarcopenia is an independent risk factor for poor surgical and oncological outcomes[11–13]. Coupled with the aging population in Singapore https://www.straitstimes.com/opinion/live-long-and-prosper-a-super-aged-singapore-society-does-not-have-to-be-a-sad-one, the prevalence of sarcopenia will only be expected to rise. There will correspondingly be an increased demand for surgery in this vulnerable group[1,44]. While sarcopenia is highly prevalent in the adult population, there has yet to be any mutual consensus on perioperative management of sarcopenic surgical patients in the literature[2–6]. The ability to diagnose and manage sarcopenia remains poor even in the medical fraternity[14,45]. Currently, most attention and resources are focused on the more acknowledged sequelae – clinical frailty.

As the recognition and identification of sarcopenia in patients are still lacking, diagnostic imaging tools such as CT and MRI are still not being routinely used to measure ASM. This is one reason AWGS guidelines were not able to provide a sex-specific cut-off value for CT and MRI assessment, contrary to our European and international counterparts[7,8]. Therefore, much more work is required to validate and encourage the use of these diagnostic modalities for ASM measurement in Asia[7,8]. By increasing awareness of sarcopenia through these consensus statements which provide a framework for the management of sarcopenia, we hope that this will lead to more awareness amongst clinicians of the negative impact of sarcopenia in surgery, provide motivation for more efforts to evaluate for the condition and in doing so, address the unmet clinical gap in the management of sarcopenia in the Singapore and Asia context.

Through early recognition of sarcopenia in surgical patients and taking steps to address the physiological deficiencies incurred as a result of sarcopenia, we hope that an earlier return to functional baseline, reduction in morbidity and mortality would invariably also lead to less healthcare spending or more healthcare cost savings[31,32]. The PREHAB study in Europe, a well-designed multicentre RCT advocating for the role of multimodal prehabilitation in major colorectal resections, supports the above possibility[22]. The ERAS society has also recently included prehabilitation as one of its principles, highlighting the credibility

behind multimodal prehabilitation, which would be more relevant in the vulnerable sarcopenic cohort[46]. Further health economic studies demonstrating cost savings are required in order to justify the resources and sustainability of effort required to manage sarcopenia in the perioperative setting over the long term.

Within the context of Singapore, there are three different healthcare clusters with varying approaches to managing patients with sarcopenia. With the limited evidence and varying opinions on perioperative management in patients with sarcopenia, it will be important for different clusters to compare outcomes of their own perioperative programmes with standardized variables, clinical data, and outcomes, likewise among different countries in the region. Future steps by the authors would include conducting further multicentre clinical efficacy and health economic studies to validate the eight recommendation statements in Singapore and regional countries. Engagement and buy-in by healthcare authorities is essential for widespread adoption and implementation in patient care.

Ethical approval

Not applicable.

Consent

No patient data was used, however, volunteers in the form of expert panels had written consent taken before their participation.

Sources of funding

Not applicable.

Author contribution

F.H.K. and D.H.L.N.: study conceptualisation; F.H.K., L.M.Y.C., N.W., A.W.C.K., D.Y., S.N., J.N., M.-Y.T., D.J.K.L., A.P.S.A.-Y., C.C.K.Y., P.D., B.J., A.M., H.E.L.Y., S.T.H.C., F.-J.F., K.-Y.H., D.H.L.N.: data collection; F.H.K., L.M.Y.C., N.W., D.Y., S.N., H.E.L.Y., S.T.H.C., F.-J.F., and D.H.L.N.: data analysis; F.H.K., L.M.Y.C., N.W.: writing paper; F.H.K., L.M.Y.C., N.W., A.W.C.K., D.Y., S.N., J.N., M.-Y.T., D.J.K.L., A.P.S.A.-Y., C.C.K.Y., P.D., B.J., A.M., H.E.L.Y., S.T.H.C., F.-J.F., K.-Y.H., and D.H.L.N.: vetting manuscript.

Conflicts of interest disclosure

The authors declare that they have no financial conflict of interest with regard to the content of this report.

Research registration unique identifying number (UIN)

NA. This is a Delphi consensus statement process.

Guarantor

Frederick H Koh.

Data availability statement

There is no patient data used during this study. All volunteers on the expert Delphi Consensus panel had their written consent taken prior to the execution of the study.

Provenance and peer review

Paper submission was not by invitation.

Acknowledgement

Assistance with the study: None
Presentation: Selected for oral presentation at Digestive Disease Week 2024, Washington DC, USA

References

[1] Rosenberg IH. Sarcopenia: origins and clinical relevance. J Nutr 1997;127(5 Suppl):990S–1S.
[2] Tan VMH, Pang BWJ, Lau LK, *et al*. Malnutrition and sarcopenia in community-dwelling adults in Singapore: Yishun health study. J Nutr Health Aging 2021;25:374–81.
[3] Chua S, Chia JQ, Lim JP, *et al*. Case-finding for sarcopenia in community-dwelling older adults: comparison of mini sarcopenia risk assessment with SARC-F and SARC-CalF. Ann Geriatr Med Res 2024;28:57–64.
[4] Pham LT, Nguyen BT, Huynh DT, *et al*. Community-based prevalence and associated factors of sarcopenia in the Vietnamese elderly. Sci Rep 2024;14:17.
[5] Cruz-Jentoft AJ, Landi F, Schneider SM, *et al*. Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. Report of the International Sarcopenia Initiative (EWGSOP and IWGS). Age Ageing 2014;43:748–59.
[6] Tan LF, Lim ZY, Choe R, *et al*. Screening for frailty and sarcopenia among older persons in medical outpatient clinics and its associations with healthcare burden. J Am Med Dir Assoc 2017;18:583–7.
[7] Chen LK, Woo J, Assantachai P, *et al*. Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. J Am Med Dir Assoc 2020;21:300–7.e2.
[8] Yang M, Liu Y, Zuo Y, *et al*. Sarcopenia for predicting falls and hospitalization in community-dwelling older adults: EWGSOP versus EWGSOP2. Sci Rep 2019;9:17636.
[9] Jones K, Gordon-Weeks A, Coleman C, *et al*. Radiologically determined sarcopenia predicts morbidity and mortality following abdominal surgery: a systematic review and meta-analysis. World J Surg 2017;41:2266–79.
[10] Ng ZQ, Cohen R, Misur P, *et al*. Poorer outcomes associated with sarcopenia following emergency laparotomy: a systematic review and meta-analysis. ANZ J Surg 2022;92:3145–53.
[11] Trejo-Avila M, Bozada-Gutiérrez K, Valenzuela-Salazar C, *et al*. Sarcopenia predicts worse postoperative outcomes and decreased survival rates in patients with colorectal cancer: a systematic review and meta-analysis. Int J Colorectal Dis 2021;36:1077–96.
[12] Meyer HJ, Wienke A, Surov A. Sarcopenia as a prognostic marker for survival in gastric cancer patients undergoing palliative chemotherapy. A systematic review and meta analysis. Nutr Cancer 2022;74:3518–26.
[13] Ge HP, Song DF, Wu P, *et al*. Impact of sarcopenia and low muscle attenuation on outcomes of ovarian cancer: a systematic review and meta-analysis. Eur Rev Med Pharmacol Sci 2023;27:4544–62.
[14] Yamada M, Lee WJ, Akishita M, *et al*. Clinical practice for sarcopenia in Asia: online survey by the Asian Working Group for Sarcopenia. Arch Gerontol Geriatr 2023;115:105132.
[15] Lim WS, Cheong CY, Lim JP, *et al*. Singapore clinical practice guidelines for sarcopenia: screening, diagnosis, management and prevention. J Frailty Aging 2022;11:348–69.
[16] Arao M, Yajima T. Computed tomography-based abdominal sarcopenic indices and bio-impedance analysis-based skeletal muscle mass index in hemodialyzed patients. Clin Nutr ESPEN 2024;59:21–8.
[17] Nielsen RL, Andersen AL, Kallemose T, *et al*. Evaluation of multi-frequency bioelectrical impedance analysis against dual-energy x-ray

absorptiometry for estimation of low muscle mass in older hospitalized patients. J Clin Med 2023;13:196.
[18] Korzilius JW, Oppenheimer SE, de Roos NM, *et al*. Having breakfast has no clinically relevant effect on bioelectrical impedance measurements in healthy adults. Nutr J 2023;22:55.
[19] Moulias R, Meaume S, Raynaud-Simon A. Sarcopenia, hypermetabolism, and aging. Z Gerontol Geriatr 1999;32:425–32.
[20] Bojesen RD, Dalton SO, Skou ST, *et al*. Preoperative multimodal prehabilitation before elective colorectal cancer surgery in patients with WHO performance status I or II: randomized clinical trial. BJS Open 2023;7:zrad134.
[21] Bausys A, Luksta M, Anglickiene G, *et al*. Effect of home-based prehabilitation on postoperative complications after surgery for gastric cancer: randomized clinical trial. Br J Surg 2023;110:1800–7.
[22] Molenaar CJL, Minnella EM, Coca-Martinez M, *et al*. Effect of multimodal prehabilitation on reducing postoperative complications and enhancing functional capacity following colorectal cancer surgery: the PREHAB randomized clinical trial. JAMA Surg 2023;158:572–81.
[23] Cambriel A, Choisy B, Hedou J, *et al*. Impact of preoperative uni- or multimodal prehabilitation on postoperative morbidity: meta-analysis. BJS Open 2023;7:zrad129.
[24] Duro-Ocana P, Zambolin F, Jones AW, *et al*. Efficacy of supervised exercise prehabilitation programs to improve major abdominal surgery outcomes: a systematic review and meta-analysis. J Clin Anesth 2023;86:111053.
[25] Jain SR, Kandarpa VL, Yaow CYL, *et al*. The role and effect of multimodal prehabilitation before major abdominal surgery: a systemic review and meta-analysis. World J Surg 2023;47:86–102.
[26] Tomassini S, Abbasciano R, Murphy GJ. Interventions to prevent and treat sarcopenia in a surgical population: a systematic review and meta-analysis. BJS Open 2021;5:zraa069.
[27] Volkert D, Beck AM, Cederholm T, *et al*. ESPEN practical guideline: clinical nutrition and hydration in geriatrics. Clin Nutr 2022;41:958–89.
[28] Muscaritoli M, Arends J, Bachmann P, *et al*. ESPEN practical guideline: clinical nutrition in cancer. Clin Nutr 2021;40:2898–913.
[29] Spexoto MCB, Ramírez PC, de Oliveira Máximo R, *et al*. European Working Group on Sarcopenia in Older People 2010 (EWGSOP1) and 2019 (EWGSOP2) criteria or slowness: which is the best predictor of mortality risk in older adults? Age Ageing 2022;51:afac164.
[30] Petermann-Rocha F, Chen M, Gray SR, *et al*. New versus old guidelines for sarcopenia classification: what is the impact on prevalence and health outcomes? Age Ageing 2020;49:300–4.
[31] Ke Y, Ng RRG, Elangovan S, *et al*. Prehabilitation programs - a systematic review of the economic evidence. Front Med (Lausanne) 2023;10:1281843.
[32] Sabajo CR, Ten Cate DWG, Heijmans MHM, *et al*. Prehabilitation in colorectal cancer surgery improves outcome and reduces hospital costs. Eur J Surg Oncol 2024;50:107302.
[33] Powell R, Scott NW, Manyande A, *et al*. Psychological preparation and postoperative outcomes for adults undergoing surgery under general anaesthesia. Cochrane Database Syst Rev 2016;2016:CD008646.
[34] Wylde V, Kunutsor SK, Lenguerrand E, *et al*. Is social support associated with patient-reported outcomes after joint replacement? A systematic review and meta-analysis. Lancet Rheumatol 2019;1:e174–86.
[35] Powell R, Davies A, Rowlinson-Groves K, *et al*. Acceptability of prehabilitation for cancer surgery: a multi-perspective qualitative investigation of patient and 'clinician' experiences. BMC Cancer 2023;23:744.
[36] Stout NL, Baima J, Swisher AK, *et al*. A systematic review of exercise systematic reviews in the cancer literature (2005-2017). PM R 2017;9(9S2):S347–84.
[37] Furmaniak AC, Menig M, Markes MH. Exercise for women receiving adjuvant therapy for breast cancer. Cochrane Database Syst Rev 2016;9:CD005001.
[38] Brown M, O'Connor D, Turkington R, *et al*. Feasibility of delivering supervised exercise training following surgical resection and during adjuvant chemotherapy for pancreatic ductal adenocarcinoma (PRECISE): a case series. BMC Sports Sci Med Rehabil 2023;15:116.
[39] McGovern A, Mahony N, Mockler D, *et al*. Efficacy of resistance training during adjuvant chemotherapy and radiation therapy in cancer care: a systematic review and meta-analysis. Support Care Cancer 2022;30:3701–19.
[40] Phyo AZZ, Freak-Poli R, Craig H, *et al*. Quality of life and mortality in the general population: a systematic review and meta-analysis. BMC Public Health 2020;20:1596.
[41] Otero-Rodríguez A, León-Muñoz LM, Balboa-Castillo T, *et al*. Change in health-related quality of life as a predictor of mortality in the older adults. Qual Life Res 2010;19:15–23.
[42] Sayer AA, Syddall HE, Martin HJ, *et al*. Is grip strength associated with health-related quality of life? Findings from the Hertfordshire Cohort Study. Age Ageing 2006;35:409–15.
[43] Witham MD, Heslop P, Dodds RM, *et al*. Performance of the SarQoL quality of life tool in a UK population of older people with probable sarcopenia and implications for use in clinical trials: findings from the SarcNet registry. BMC Geriatr 2022;22:368.
[44] Yang R, Wolfson M, Lewis MC. Unique aspects of the elderly surgical population: an anesthesiologist's perspective. Geriatr Orthop Surg Rehabil 2011;2:56–64.
[45] Yeung SSY, Reijnierse EM, Trappenburg MC, *et al*. Current knowledge and practice of Australian and New Zealand health-care professionals in sarcopenia diagnosis and treatment: Time to move forward!. Australas J Ageing 2020;39:e185–93.
[46] Gillis C, Ljungqvist O, Carli F. Prehabilitation, enhanced recovery after surgery, or both? A narrative review. Br J Anaesth 2022;128:434–48.