Nutrition, sarcopenia and frailty: An Asian perspective

Jean Woo a,*, Sherlin Ong b, Ruth Chan a, Liz Li a, Jianqin Sun c, Yoke Mun Chan d,e,f, Shiou-Liang Wee g,h, Nghiem Nguyet Thu i, Pham Thang i, Siti Setiati k, Yi-Chen Huang l, Mark L. Wahlqvist m, Lisette CPGM. de Groot n

a Department of Medicine & Therapeutics, Faculty of Medicine, The Chinese University of Hong Kong, Shatin, Hong Kong
b FrieslandCampina Amersfoort, the Netherlands
c Clinical Nutrition Centre, Huadong Hospital, Fudan University, China
d Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Malaysia
e Malaysian Research Institute on Ageing, Universiti Putra Malaysia, Malaysia
f Research Centre of Excellent, Nutrition and Non-communicable Diseases, Faculty of Medicine and Health Sciences, University Putra Malaysia, Malaysia
g Geriatric Education & Research Institute, Singapore
h Duke-NUS Medical School, Singapore
i Clinical Nutrition and Dietetics Department, National Institute of Nutrition, Vietnam
j Geriatric Medicine Department, HMU and Centre for Memory and Dementia Research, NGH, Vietnam
k Division of Geriatric Medicine and Clinical Epidemiology and EBM Unit, Faculty of Medicine Universitas Indonesia, Cipto Mangunkusumo Hospital Jakarta, Indonesia
l Department of Nutrition, China Medical University, Taichung, Taiwan
m Institute of Population Health Sciences, National Health Research Institute, Miaoli County, Taiwan, Monash Asia Institute, Monash University, Melbourne, Victoria, Australia
n Division of Human Nutrition and Health, Wageningen University, the Netherlands

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Abstract
Despite a growing body of evidence that nutrition plays a key role in the pathophysiology, prevention and intervention programs of frailty and sarcopenia, as well as in promoting brain health, the awareness and the need to study the relationship between nutrition and functional goals of healthy ageing have not received as much attention or support from research or policy makers. This review reports on the state of knowledge relating to availability of nutrition survey data for older people relating to prevalence of frailty and sarcopenia in Asia, using data from Netherlands for comparison. Data were obtained from a meeting of a group of nutrition experts from Asia supplemented by literature search using key terms of nutrition, frailty, and sarcopenia. Although nutrition surveys may be carried out regularly in several countries, surveys are mainly carried out for the general adult population rather than specifically among the elderly population, and little data is available relating to the impact of nutrition on sarcopenia and frailty. There is an urgent need for more nutritional data relating to maintaining function with age as opposed to disease prevention, to guide health promotion policies and clinical management of increasingly older population and patients. A shift in the gathering of national nutrition data may need to include such functional measurements in relation to older people, as the latter forms the rapidly growing sector of ageing populations world-wide.

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1. Introduction
Population ageing is occurring in many countries all over the world, and the rate of ageing is particularly rapid in Asia. Traditionally the public health response to ageing populations has been to document and target non-communicable diseases (NCD), as the dominant impact of many infectious diseases in the last century abate with economic development [1]. In recent years the World Health Organization has developed a strategy for healthy aging which places the emphasis away from mortality or longevity to functioning, encompassing both physical and cognitive components [2]. Accompanying this development is the evolution of the concepts of frailty and sarcopenia, an active area of research into...
definitions, diagnosis, prevention and treatment, the ultimate goal being also to prevent functional decline and to maintain function for as long as possible.

Nutrition is key to health throughout the life course, and affects health in states of both undernutrition, still observed in some low-income countries as well as rural areas of developing economies, and also overnutrition, as evidenced by the fast-growing epidemic of obesity worldwide. The co-existence of both under and over-nutrition is not uncommon among some Asian countries, such as China and India. In particular, malnutrition is prevalent among the older age group, whether in the community or hospital long term care institution setting [3]. While the relationship between nutrition and various chronic diseases have been extensively studied, resulting in healthy eating guidelines in many countries as well as regular countrywide health and nutrition surveys, the awareness and the need to study the relationship between nutrition and functional goals of healthy ageing have not received as much attention or support from research or policy makers. Research studies tend to use mortality or longevity as outcomes [4,5]. Similarly healthcare professionals providing service to older adults are seldom familiar with this topic and include this aspect into patient management. This is despite a growing body of evidence that nutrition plays a key role in the pathophysiology, prevention and intervention programs of frailty and sarcopenia [6], as well as in promoting brain health [7,8].

In a workshop on ‘Addressing the nutritional needs of the Aging Consumer in Asia’ held in Singapore on 10th-11th November 2016, experts from the Netherlands, Singapore, China, Hong Kong, Taiwan, Malaysia, Indonesia, and Vietnam met and shared their individual countries’ state of development in the above areas. This paper reports on the state of knowledge relating to availability of nutrition survey data for older people, particularly for key macro and micro nutrients for healthy ageing, as well as data relating to prevalence of frailty and sarcopenia. Data from Netherlands, which has a higher prevalence of older people and a long history of study of nutrition in older people, are also listed for comparison.

1.1. Current Asian landscape

Table 1 shows the percentage of people aged 60 years and over in these countries, with Hong Kong, Taiwan and Singapore showing the highest percentage of the seven Asian countries. Other information included availability of national nutrition survey data, types of nutrition data available, as well as data on prevalence of frailty and sarcopenia.

With regard to National Nutrition surveys, although this is available in most countries with the exception of Hong Kong, regular data consisted of population of all ages in the community, and few extend to the 70 and 80 + age groups. The population of older people age 70 and above tend to be more heterogeneous in terms of health and function, with marked differences between those living independently in the community compared with those living in long term residential care. Information relating to the higher extremes of average life expectancy tends to be carried out as individual research studies. Anthropometry, malnutrition screening data, and intake of key micronutrients for healthy ageing (Vitamin D, Vitamins B1,6,12) as well as serum levels of vitamin D are also available in many countries. Data is also available for the generation of dietary patterns, although there are resource limitations. There are variable data on food habits such as the time spent eating meals out and source of shopping for food. Such information will be relevant to recommendations regarding prevention of physical and cognitive function decline. Frailty prevalence has been documented in most countries, but sarcopenia prevalence data is available only in few countries. Such data are from research cohort studies rather than being representative of each country. In general more studies on the relationship between nutrition and functional ability have been carried out in countries with an older population. For those with younger population profile, studies tend to emphasize the relationship with obesity and related chronic diseases, rather than on frailty or sarcopenia.

Apart from data provided by participants, a recent literature search in the Ovidsp and PubMed databases using the search terms ‘Nutrition surveys’ and ‘older people or aged’ and ‘frailty or sarcopenia or cognitive impairment’ relating to these Asian countries yielded in addition one cross sectional study of nutritional status of 558 people aged 60 years or older in hospital and community in the region of Chonqing, which only focused on lifestyle and malnutrition [9], and one crosssectional study examining dietary pattern and cognitive function in 1504 community-dwelling older people aged 60 years and over showing a beneficial effect of a ‘mushroom, vegetable and fruit’ pattern [8]. A study from Taiwan using National Nutrition Survey data 2014–2016 to generate dietary patterns showed that a pattern with more phytonutrient-rich plant foods, tea, omega-3–rich deep sea fish and other protein rich foods such as shellfish and milk had a reduced prevalence of frailty [10].

The importance of nutrient deficiencies as well as dietary patterns to healthy aging has also been pointed out in a statement from an expert workshop held in Groningen, Netherlands [11]. Intercountry comparisons of dietary patterns and indicators of healthy ageing may provide further insight into the relationship between malnutrition, dietary patterns and indicators such as frailty, sarcopenia and cognitive impairment. Such studies will provide a wider variation in dietary patterns and food cultures, compared with a study within a single country. Studies of the Mediterranean diet and association with frailty and cognition in European countries are an example [12]. Systematic reviews of observational papers examining nutrition (malnutrition, specific nutrients or dietary patterns) with frailty and sarcopenia have recently been published; few are from Asian countries [13,14]. Similarly associations have been documented between nutrition as a component of lifestyle, dietary protein and thiamine, and cognitive function in Caucasian older people [15,16], with only one cross sectional study among Japanese people aged 69–71 showing beneficial effects of higher intakes of vegetables, soy products, fruit and fish [17]. Each country can generate dietary patterns using factor analyses, allowing for comparison within Asia and also with Europe, Australia or the US. Such comparisons are not without challenges, in that there needs to be harmonization of definitions of frailty and sarcopenia, and also adjustment for other lifestyle variables and co-morbidity as covariates.

There may be similarities in beneficial dietary factors and patterns between Caucasians and Asians. Among indigenous and principally non-indigenous peoples of Chinese ancestry in Taiwan, leisure time physical activity (LTPA) reduces sarcopenic risk irrespective of ethnicity, and this is partly dependent on diet [18]. Nevertheless there may be exceptions that affect health promotion messages and policy, an example being vitamin D, a nutrient of particular interest to health in older people. Among Caucasian populations vitamin D levels tend to decline with age, while the younger adult populations are vitamin D replete. In Asia there is a concern of low vitamin D levels even in young people [19–22], and also in women of child bearing age [23] which presumably would result in lower breast milk vitamin D in breast feeding infants. The underlying reason may be a cultural one, of low consumption of dairy products and also an aversity towards sunlight exposure. It may be expected that vitamin D deficiency may have a greater impact on function among the older population in Asia. However, the prevalence of vitamin D > 50 nmol/L actually increases with age, being 50%, 59%, 67% among women aged 50–59, 60–69, and
Table 1
Nutrition and ageing.

<table>
<thead>
<tr>
<th>Country</th>
<th>China</th>
<th>Hong Kong</th>
<th>Taiwan</th>
<th>Singapore</th>
<th>Malaysia</th>
<th>Indonesia</th>
<th>Vietnam</th>
<th>Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>% people aged 60+</td>
<td>60+ (17.3%) [34]</td>
<td>65+ (16.6%) [35]</td>
<td>60+ (19.9%) 65+ (13.2%) [36]</td>
<td>65+ (13.7%) [37]</td>
<td>65+ (6.5%) [38]</td>
<td>60+ (9.0%) [39]</td>
<td>60+ (9%) [40]</td>
<td>60+ (24.4%) 65+ (18.2%) [41]</td>
</tr>
<tr>
<td>Availability of nutrition survey data</td>
<td>Yes National Nutrition and Health Survey in China (1990, 1992, 1998)</td>
<td>Yes National Nutrition And Health Survey in Taiwan (1999–2000 for ages 65 and older)</td>
<td>Yes Nationwide surveillance on nutrition not available, only data from cross-sectional studies are available.</td>
<td>Yes Nationwide surveillance on nutrition not available, only data from cross-sectional studies are available.</td>
<td>Yes Nationwide surveillance on nutrition not available, only data from cross-sectional studies are available.</td>
<td>Yes Nationwide surveillance on nutrition not available, only data from cross-sectional studies are available.</td>
<td>Yes Nationwide surveillance on nutrition not available, only data from cross-sectional studies are available.</td>
<td>Yes Nationwide surveillance on nutrition not available, only data from cross-sectional studies are available.</td>
</tr>
<tr>
<td>- Age group (60+)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- BMI, other anthropometric data available?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Malnutrition data available? (state screening instrument used; setting e.g. hospitals, community; residential care)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>BMI, body weight, calf circumference, Mini Nutritional Assessment-Short Form, Nutrition Risk Screening 2002, Subjective Global Assessment</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hospital setting: Subjective Global Assessment, 3-Minute Nutrition Screening, Comprehensive Nutrition Assessment Initiative DETERMINE checklist, modified Nutrition Risk in Critically ill Residential setting: Subjective Global Assessment, Mini Nutritional Assessment and BMI, Clinician's clinical impression Community setting: Nutritional Screening Initiative DETERMINE checklist, Mini Nutritional Assessment, BMI, albumin, haemoglobin, total cholesterol, Elderly Nutritional Indicators for Geriatric Malnutrition Assessment</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- Vitamin B12 intake (latest update data) B12: Nil</td>
<td>Yes [58]</td>
<td>Yes [98]</td>
<td>Yes [99]</td>
<td>Yes (limited to vitamin B12 intake only) [57]</td>
<td>Yes [103,104]</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
</tbody>
</table>
| Ability to generate various a priori dietary pattern data | Yes | Yes [105,106] | Yes | Yes | Yes | Yes | Yes | Yes | (continued on next page)
70% and 68%, 70% and 100% for corresponding age groups in men. There was no association between vitamin D levels with 4 year incident fracture risk [24]; neither was an association with sarcopenia observed [25]. In Indonesia, it was reported that vitamin D supplementation in the form of alfacalcidol improved handgrip strength and mobility among Indonesia elderly women who had low handgrip strength and low functional mobility [26]. Another nutrient of interest for Asian populations is calcium intake, in view of the low intake of dairy products compared with Caucasian populations. Among the latter calcium supplementation had been reported to increase mortality [27,28]. However among populations with low habitual intake of dietary calcium, the opposite effect was observed in that calcium supplementation reduced mortality [29]. However there are few studies of free vitamin D levels and calcium absorption may vary depending on habitual calcium intake.

Representative studies among older Taiwanese indicate that lower skeletal muscle mass is a more linear predictor of cardiovascular and all-cause mortality than is BMI [30]. Moreover, it is a determinant of health care expenditure, although its impact can be partially offset by dietary diversity and physical activity [31].

1.2. Future work

This report highlights the urgent need for more nutritional data relating to maintaining function with age as opposed to disease prevention, to guide health promotion policies and clinical management of increasingly older population and patients. Assessment of nutritional status in elderly people is complex, influenced by co-morbidities, disabilities, and other age-related changes affecting food intake and/or nutrient absorption. A function-driven model has been proposed as the end point for assessment rather than relating intakes of macro and micro nutrients to arbitrary values determined by national bodies based on a nutrient deficit and disease paradigm [32]. A shift in the gathering of national nutrition data may need to include such functional measurements in relation to older people, as the latter forms the rapidly growing sector of ageing populations world-wide.

There is need for randomized controlled trials (RCT) of dietary patterns and frailty, sarcopenia and cognitive impairment. However there are many challenges such as availability of funding, methodological issues, influence of co-variates which may cover the whole life course including the intrauterine environment. RCT may not be the most appropriate method for nutritional studies to address this research question, similar to the studies on diet and cancer. In the absence of RCTs, we may need to base recommendations on systematic reviews of observational cross sectional or prospective studies. The need for nutrient supplementation may be addressed in a similar way. In spite of these challenges, there is general consensus that poor nutrition is an underlying cause of sarcopenia and frailty, and improvement may be achieved by dietary means [33].

Declaration of competing interest

We declare no conflict of interest.

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