Sarcopenia in Older People

Thesis submitted by

Solomon ChingYehYu(MBBS FRACP)
Bachelor of Medicine
Bachelor of Surgery
Fellow of the Royal Australasian College of Physicians

Department of Medicine
Faculty of Health Science

The University of Adelaide

November 2014

Dedication

I dedicate this thesis to my loving and devoted family:
my loving parents, Lee Ching, Isabelle and Isaac, who
have always been there with patience beyond words.

Special dedication is also extended to my supervisor,
my mentor and my dear friend, Renuka Visvanathan

Above all, this thesis is dedicated to our God Most High,
who is the strength and the rock for me.

The glory of young men is their strength,
gray hair the splendor of the old. **Proverbs 20:29**

Commit to the Lord whatever you do,
and he will establish your plans. **Proverbs 16:3**

Table of Contents

List of tables

chapter 2

chapter 3

chapter 4

chapter 5

chapter 6

chapter 7

List of figures

chapter 3

chapter 6

Publications and Presentations

Published/In press manuscript

Yu S, Appleton S, Adams R, Chapman I, Wittert G, Visvanathan T, Visvanathan R. (2014).An anthropometric prediction equation for appendicular skeletal muscle mass in combination with a measure of muscle performance to screen for sarcopenia in primary and aged care. *J Am Med Dir Assoc.* In Press 2014.Accepted 1st July 2014.1st ranked clinical journal in geriatrics and gerontology. Impact factor 5.30.

Yu S, Appleton S, Adams R, Chapman I, Wittert G, Visvanathan T, Visvanathan R. (2014).The impact of low muscle mass definition on the prevalence of sarcopenia in older Australians. *Biomed Res Int.* 2014; Article ID 361790, 7 pages. http://dx.doi.org/10.1155/2014/361790. Impact factor 2.88.

Yu S, Umapathysivam K, Visvanathan R. Sarcopenia in older people. (2014). *Int J Evid Based Healthc.* In Press 2014. Accepted 7th July 2014.

Yu S, Visvanathan T, Field J, Ward LC, Chapman I, Adams R, Wittert G, Visvanathan R. (2013). Lean body mass: the development and validation of prediction equations in healthy adults. *BMC Pharmacology and Toxicology*.**14**:53. Unofficial impact factor 3.15.

Visvanathan R, **Yu S**, Field J, Chapman I, Adams R, Wittert G and Visvanathan T. (2012). Appendicular skeletal muscle mass: development and validation of prediction equations. *The Journal of Frailty & Aging*. 1(4):147-151.

Dent E, **Yu S**, Visvanathan R, Piantadosi C, Adams R, Lange K, Chapman I. (2012). Inflammatory cytokines and appetite in healthy people. *Journal of Aging Research and Clinical Practice*. 1(1):40-43.

Abstract presentations

National conferences, Platform presentation

Yu S, Appleton S, Adams R, Chapman I, Wittert G, Visvanathan T, Visvanathan R. Prevalence of Sarcopenia in Community Dwelling Older Australian. (2013). Australasian Journal on Ageing.32 (Sppl 1):6-35.

The Australian and New Zealand Society for Geriatric Medicine Annual Scientific Meeting, 17-19 June 2013, Adelaide Convention Centre, Adelaide, SA, Australia.

Yu S, Visvanathan T, Field J, Chapman I, Adams R, Wittert G, Visvanathan R. (2012). A prediction equation to aid diagnosis of sarcopenia in primary care. Australasian Journal on Ageing.31 (Sppl 1):16-33.

The Australian and New Zealand Society for Geriatric Medicine Annual Scientific Meeting 2012.Dementia: Managing Not to Forget. 2-4 May 2012. Hilton Hotel, Sydney, Australia.

Yu S, Adams RJ, Wilson DH, Chapman I, Phillips P and Visvanathan R. (2010). Development and validation of prediction equation for fat free mass using variables consisting of blood and weight measurements. Australasian Journal on Ageing.29 (Sppl 1):17.

The Australian & New Zealand Society for Geriatric Medicine Annual Scientific Meeting, 5-7 May 2010, Hyatt Regency Coolum, Queensland, Australia.

Yu S and Visvanathan, R. (2007). Estimation of fat free mass in routine clinical practice. Internal Medicine Journal.37 (Suppl.3):A64.

Conjoint Scientific Meeting of the Australian & New Zealand Society for Geriatric Medicine, Internal Medicine Society of Australia & New Zealand in association with International Academy of Nutrition & Aging, 5–8 September 2007, Adelaide, Australia.

National conferences, Poster presentation

Yu S, Appleton S, Adams R, Chapman I, Wittert G, Visvanathan T, Visvanathan R. (2014). The impact of low muscle mass definition on the prevalence of sarcopenia in older Australians.*Australasian Journal on Ageing.*33 (Sppl 1):69.

The Australian and New Zealand Society for Geriatric Medicine Annual Scientific Meeting, 28–30 May 2014, Grand Hyatt Melbourne, Melbourne, VIC, Australia.

International conferences, Poster presentation

Yu S, Appleton S, Adams R, Chapman I, Wittert G, Visvanathan T, Visvanathan R. Prevalence of Sarcopenia in Community Dwelling Older Australian.

9th Congress of the European Union of Geriatric Medicine Society (EUGMS), 2-4 October 2013, Venice Lido, Italy.

Invited speaker

Yu S. Sarcopenia in Older People. ILSI SEAR Australasia and The Omega-3 Centre. 24th October 2012, Melbourne, AUSTRALIA.

Other invited research activity

Research Group External Assessor for National Health and Medical Research Council (NHMRC), 2013, Australian Government - in the area of sarcopenia and muscle.

https://www.nhmrc.gov.au/grants/peer-review/peer-review-honour-roll-2013

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

I give consent to this copy of my thesis when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968.

The author acknowledges that copyright of published works contained within this thesis resides with the copyright holder(s) of those works.

I also give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library catalogue and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

Signed …….

Acknowledgements

I would like to express my gratitude and thank you to Professor Robert Adams and Professor Renuka Visvanathan for your tireless effort, time, unwavering support, patience and relentless encouragement, without whom this would not be possible.

Thank you to Professor David Wilson, despite being my supervisor for a short period of time, your kindness and support.

I would like to acknowledge the strong support provided by all the members of Aged and Extended Care Services, The Queen Elizabeth Hospital.

This research was supported by the following

- Divisional scholarship from the Faculty of Health Sciences, University of Adelaide
- Cytokine, Adiposity, Sarcopenia and Ageing Study (CASA) study supported by research grant from the Faculty of Health Sciences, University of Adelaide (Establishment Grant and Early Career Grant) and Vincent Fairfax Family Foundation Research Fellowship through Royal Australasian College of Physicians and Bernie Lewis Foundation Grant through the Hospital Research Foundation.
- Department of Endocrinology, the Queen Elizabeth Hospital for their support in undertaking the required DXA assessments.
- Dataset provided by Florey Adelaide Males Study (FAMAS) and the North West Adelaide Health Study (NWAHS) group for my validation studies.

The following co-investigators for their kind advice and timely assistance beyond measures:

- Dr Sarah Appleton
- Professor Ian Chapman
- Professor Gary Wittert
- Dr Thava Visvanathan
- Dr John Field
- Associate Professor Leigh C Ward
- Dr Kylie Lange
- Dr Elsa Dent
- Dr Cynthia Piantadosa
- Dr Kamilia Tai
- Dr Kandiah Umapathysivam

I thank following people for their assistance with recruitment, clinical assessment and data entry:

- Ms Sandy Pickering
- Ms Tina Stavropoulos
- Dr Kamaruzzaman Esa

I would also like to thank my brothers and all my friends who have been there with their kind words and encouragement.

I would like to acknowledge Ms Barbara Brougham for her editorial assistance, who made the impossible, possible.

Abstract

Under-nutrition and weight loss in older people remain poorly recognized and so are undermanaged. Those at nutritional risk, and especially those losing weight, experience a loss of muscle mass referred to as *sarcopenia*, which is related to many different adverse health outcomes, including falls and increased risk of fracture.

Although research into the condition has gained momentum over the last two decades, especially for those aged eighty years and older, research has predominately been conducted overseas. In Australia, very few studies have investigated the prevalence of sarcopenia in our older population. Local evidence is required in order to inform Australian policy makers and the health and aged care sector. Furthermore, in spite of the increasing call for appreciation, screening and early diagnosis of the condition, there is no consensus as to a preferred screening method. Without acceptable clinical screening tools, identification of sarcopenia continues to be problematic. It is therefore important to develop a simple clinical test to facilitate early detection in primary or aged care settings as part of continuing and increasing Australian research into sarcopenia. Additionally, whilst appetite loss is known to be a contributing factor, the relationship between inflammation and appetite loss in healthy individuals with no recent history of weight loss is unclear.

The aims of this thesis were therefore: (1) to identify the prevalence of sarcopenia in primary care; (2) to develop and validate simple anthropometric prediction equations (PE) for lean body mass (LBM) and appendicular skeletal muscle mass (ASM); (3) to determine the performance of the ASM PE compared to dual absorptiometry x-ray assessment (DXA) of ASM in combination with grip strength; and (4) to explore the association between cytokines and appetite in a healthy population.

Research from this doctoral thesis has confirmed that sarcopenia is common in community dwelling older Australians and increases with age. Anthropometric prediction equations for LBM and ASM were developed and validated: *LBM= 22.932326 + 0.684668 (weight) - 1.137156 (BMI) -0.009213 (age) + 9.940015 (if male)* and *ASM= 10.047427 + 0.353307 (weight) - 0.621112 (BMI) - 0.022741 (age) + 5.096201 (if male).* Cut-offs for low muscle mass for use in Australia was also developed.

The use of ASM PE for the identification of low muscle mass, in combination with a measure of low muscle function, such as grip strength, performs well as a 'rule out' screening test for sarcopenia when compared to the diagnostic test of ASM assessed using DXA in combination with low grip strength. At the same time, appetite was found to be negatively associated with serum levels of pro-inflammatory IL-1ß and positively associated with serum levels of anti-inflammatory cytokine IL-10 in apparently healthy people with no recent weight loss.

Research from this doctoral thesis has contributed to increased awareness that sarcopenia is common and this will aid early intervention. At the same time, a clinical screening tool to support the early diagnosis of sarcopenia was developed.