Study of the Relation between Body Composition and Physical Performance among Elderly

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Marian Wagieh Mansour

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List of Abbreviations

3DPS : Three-dimensional photonic scanner
ADL : Activities of daily living
ADP : Air displacement plethysmography
BDNF : Brain-derived neurotrophic factor
BIA : Bioelectrical Impedance Analysis
BMI : Body Mass Index
CGA : Comprehensive geriatric assessment
COPD : Chronic obstructive pulmonary disease
CRP : C-reactive protein
CT : Computed tomography
DXA : Dual Energy X-xay Absorbiometry
EWGSOP : The European Working Group on Sarcopenia in Older People
FFM : Fat Free Mass
FM : Fat mass
GH : Growth hormone
IADL : Instrumental activities of daily living
IGF-1 : Insulin like growth factor-I
IL : Interleukin
LIF : Leukemia inhibitory factor
MMSE : Mini-mental state examination
MNA : Mini-nutritional assessment
MRI : Magnetic Resonance Imaging
NHANES III: Third National Health and Nutrition Examination Survey

List of Abbreviations (Cont.)

TBW	:	Total body water
TNF-α	:	Tumour necrosis factor-alpha
TUG	:	Timed Up and Go Test
UWW	:	Underwater weighing
WC	:	Waist circumference
WHO	:	World Health Organization
WHR	:	Waist hip ratio

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Introduction

Changes in body composition occur in the elderly, with important consequences for health and wellbeing. Changes include loss of the skeletal muscle component of lean tissue (sarcopenia), changes in body fat content and distribution, and their combination in sarcopenic obesity ***(Woodrow, 2009)***.

Estimates for the total decline in the muscle mass between the ages of 40 and 80 years range from 30% to 50% ***(Faulkner et al., 2007)*** and the annual decline in functional capacity is reported to be 1-2% after the age of 50 increasing to as much as 3% after the age of 60 ***(Masanes et al., 2012).***

Well-recognized life course influences on muscle mass and strength include age, gender, heritability, adult body size, physical activity, nutrition and co-morbid disease ***(Garatachea and Lucia, 2011)***. In addition, there is consistent evidence for a relationship between poor growth in early life and sarcopenia ***(Sayer et al., 2012)***.

However, a subpopulation of older adults has muscle loss that is greater compared to others in their age group ***(Boirie, 2009).***

The age-associated loss of muscle mass was described as sarcopenia ***(Cruz-Jentoft et al., 2010)*** which can result in loss of physical function, disabilities and frailty ***(Hida et al., 2013)***. Furthermore, sarcopenia was also associated with a higher risk of poor quality of life and mortality ***(Fielding et al., 2011).***

The European Working Group on Sarcopenia in Older People (EWGSOP) defined sarcopenia using both low muscle mass and low muscle function (strength or performance) ***(Cruz-Jentoft et al., 2010)***.

Estimates of the prevalence of sarcopenia in older men and women worldwide vary from 5% to 45% according to definition implemented and population studied ***(Abellan van Kan, 2009).***

Sarcopenia staging, which reflects the severity of the condition, is a concept that can help guide clinical management of the condition. EWGSOP suggests a conceptual staging as ‘presarcopenia’, ‘sarcopenia’ and ‘severe sarcopenia’***(Cruz-Jentoft et al., 2010***).

Aging is also associated with change with body fat and fat distripution. A 10-year longitudinal study in elderly showed a decline in subcutaneous fat but overall increase in total fat mass ***(Hughes et al., 2004)***.

Independent of muscle mass, high fat mass or high percentage body fat as the obesity index also significantly increased the risk of physical dysfunction ***(Ochi et al., 2010).***

Third National Health and Nutrition Examination Survey (NHANES III) provided a very large dataset of body composition in adults 15 912 individuals using Bioelectrical Impedance Analysis (BIA). This showed Fat Free Mass (FFM) to increase from adolescence to mid-adulthood, and then subsequently decline ***(Chumlea et al., 2002)***.

In NHANES III, body fat increased with age until around 60 years total fat decreased with progressive increases in waist circumference which reflect redistribution and accumulation of fat in the abdomen ***(Chumlea et al., 2002)***.

A longitudinal study of healthy older adults reported progressive decrease in skeletal muscle. However no weight loss was reported which reflects increase in fat mass ***(Gallagher et al., 2000).***

Another study ***(Raguso et al., 2006)*** of body composition in elderly individuals revealed increase in fat mass with loss of fat free muscle (FFM) and skeletal muscle in the absence of weight change.

Waters and Baumgartner, 2011 proposed four body composition phenotypes in older adults; that is, normal, sarcopenic, obese, and sarcopenic obese.

Sarcopenia and obesity often coexist in older adults. This is important as there may be causative links between the two processes, and their adverse health effects may be additive ***(Zamboni et al., 2008).***

The decrease in muscle mass can be a cause of decreased physical performance and lead to accumulation of fat. Conversely, various adipokines secreted from fat tissue could promote muscle wasting and fatty infiltration. Their combination may also confound the assessment of body composition ***(Zamboni et al., 2008)***.

The changes of body composition that take place in elderly has been suggested to be associated with lower physical function (gait speed) in post-menopausal women ***(Oliveira et al., 2011)***, as well as declined functional ability ***(Bouchard et al., 2010)***, higher risk of frailty and poorer quality of life ***(Baumgartner et al., 2004)***, longer hospital stay (***Kyle et al., 2005)***, and higher mortality risk ***(Prado et al., 2008).***

Aim of the work

The aim of this study was to assess the association between body composition and physical performance among elderly.

Body Composition in Elderly

Body composition is the proportion of fat and fat free mass (muscle, bone, water and organs in the body ***(Wells and Fewtrell, 2006).***

With advancing age, changes of body composition occurs including decrease in skeletal muscle and body water, and increase in body fat with redistribution of fat in the body ***(Woodrow, 2009).***

Muscle mass is strongly age dependent. After the age of 50, about 1-2% of muscle mass lost every year and between the ages of 20 and 80 years muscle mass is reduced up to 50% ***(Wang and Bai, 2012).***

In 1972, ***Novak*** studied body composition changes with age using total body potassium as an index of fat free mass (FFM) and found that body fat increased in elderly men and women (***Wang et al., 2007)***.

Then in 1980 ***Cohn et al.*** using total body neutron activation procedures, found that the main component that decrease in fat free mass was muscle mass, with minimal change in non-muscle mass ***(Cohn et al., 1980).***

In 1989, Irwin Rosenberg proposed the term 'sarcopenia', originating from the Greek words sarx (flesh) and penia (loss), to describe this age-related decrease of muscle mass ***(Rosenberg, 1989).***

Sarcopenia then has been defined as the loss of skeletal muscle mass and strength that occurs with age ***(Morley et al., 2001).***

Then the European Working Group on Sarcopenia in Older People (EWGSOP) developed the current definition for sarcopenia using both low muscle mass and low muscle function (strength or performance) ***(Cruz-Jentoft et al., 2010).***

Skeletal muscle function deficit is a more recent term that has also been developed attemping to better describe the muscle changes with age ***(Correa-de-Araujo and Hadley, 2014).***

Sarcopenia is common in adults over the age of 65 years and its prevalence increases with age. The prevalence varies from 5 to 13% in elderly individuals and can reach up to 50% in those aged above 80 years old and depends on what diagnostic methods and definitions are used ***(Patel et al., 2013).***