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Feature Article

Consequences of sarcopenia among nursing home residents at long-term follow-up

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ABSTRACT

The consequences of and transition into sarcopenia with long-term survival was investigated in the nursing home setting. Eligible residents from 11 nursing homes were followed-up 18-months after their assessment for sarcopenia using the European Working Group on Sarcopenia in Older People criteria, with other demographic, physical and cognitive health measures collected. Of the 102 older adults who consented at baseline, 22 had died and 58 agreed to participate at follow-up, 51.7% of whom had sarcopenic. Sarcopenia at baseline was associated with a depression ($p < .001$), but not mortality, hospitalization, falls or cognitive decline at follow-up. Age was the strongest predictor of mortality ($p = .05$) with the relative risk of death increasing 5.2% each year. The prevalence of sarcopenia is high and increases with long-term survival in end-of-life care. However, the risk of sarcopenia-related mortality is not as great as from increasing age alone.

Introduction

According to the European Working Group on Sarcopenia in Older People (EWGSOP), sarcopenia is an age related syndrome defined by a progressive and generalized loss of muscle mass and muscle function (either or both of below normal muscle strength or physical performance).[1] As a geriatric syndrome, sarcopenia affects quality of life, is associated with poor survival rates,[2] plays an important role in the etiology of frailty and is highly predictive of several adverse health events in later life.[3] In addition, it has been reported that in comparison to non-sarcopenic adults, those with sarcopenia are at greater risk of falls, are more likely to be physically disabled and have greater care needs.[4,5]

Following the definition review in 2010,[1] a large a body of work has emerged looking to establish prevalence and risk factors of sarcopenia across varied older cohorts. However, due to variations in cohort characteristics, diagnostic and measure criteria, prevalence data are mixed.[6] Conclusive is that sarcopenia increases rapidly after the age of 65 years, with prevalence being as high as 50% in people older than 80 years.[7,8] In addition, current research has identified male gender, low body mass index (BMI) and reduced physical activity as common risk factors to being sarcopenic.[9,10]

Work by our group has shown that in the environment where prevalence is highest, the nursing home, >40% of adults are sarcopenic.[10,11] However, while prevalence and risk factor data grows, longitudinal analysis of the consequence of and the progression to sarcopenia is scarce. Given the economical and personal implications of being sarcopenic, a broader understanding of the consequences may assist in informing interventions pathways,

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particularly in light of evidence that a number of sarcopenia risk factors are modifiable.[12,13] The aim of this study was to report the implications of sarcopenia in nursing home residents at an 18 month follow-up, and to track progression in sarcopenia among those with no previous diagnosis.

Methods

Study design

The study employed a longitudinal follow-up of randomly selected adults with secondary data collected 18 months after the parent-study baseline assessment. A detailed account of the methodologies used in the baseline cross-sectional study and of the reported sarcopenia prevalence and risk factors can be found elsewhere, including a CONSORT diagram detailing recruitment, randomization and assessment.[11] In brief, 273 adults residing in 11 purposefully selected South East Queensland (Australia) nursing homes were randomized into the study from an eligible sample of 381 and total resident cohort of 709. The inclusion criteria were (i) $\geq$60 years, (ii) residing in a nursing home and (iii) could provide consent, self or by proxy given directly by the participants substitute decision maker or verbally to the facility Service Manager. Residents were excluded if they; (i) had a pacemaker; (ii) were end-stage palliative or terminal (iii) had difficult behaviors that would limit data collection; or (iv) had a medical condition or other issue that would limit data collection (e.g. total uncommunicable deafness). Ninety-one individual self-consented and 11 consented by proxy to participate in the baseline study (84.5 $\pm$ 8.2 years; >70% women, 1204.2 $\pm$ 1220.1 days in care). Consent to the baseline study included agreement to be approached at the 18-month follow-up and a secondary data set collected. Specifically, facilities were re-contacted and the follow-up study explained to the Service Manager, who was then given the list of participant per facility and a request to seek consent for participation. Consent for the follow-up study was considered appropriate given the time frame, setting and the risk of negative health change among participants. As with the baseline study, consent was obtained directly from cognitive sound participants or from the substitute decision maker of participant not able to consent themselves. The eligibility criteria were retained from the baseline study for the follow-up study.

Approval for the study was provided by the Human Ethics Committee of Bond University and the University of Queensland, and the nursing care provider's internal ethics committee.

Data collection

Participants were assessed individually and data collection was finalized at one facility before moving to the next. For low care participants, the research assistant (RA) was left to conduct the data collection without assistance. For high care and dementia participants, a facility staff member was present.

Measures

All measures were validated for use among old and very old adults and have been described in detail previously.[10,11] Where an individual could not complete a measure due to health or disability issues the measure was excluded, with the exceptions of the 2.4 m walk (scored at 0 if unable) to ensure a measure of physical performance. For individuals who were unable to or would not assent to the bioelectrical impedance analysis (BIA), baseline data were carried forward.

Primary outcome: sarcopenic

Sarcopenia was measured using the EWGSOP definition, cut-off points and assessment criteria. Specifically, a diagnosis of sarcopenia required the presence of both low muscle mass and low muscle function (muscle strength or physical performance).[1] *Muscle mass* was measured using BIA (Maltron BF-906, Maltron International Ltd, Rayleigh, UK) with the participant lying flat and the standardized electrode placement. Skeletal Muscle Mass (SMM) was calculated from the equation (SMM = [(height^2 (cm)/ resistance (ohms) $\times$ 0.401) + (gender $\times$ 3.825) + (age (yrs) $\times$ −0.071)] + 5.102), then divided by height^2 (m) to give the Skeletal Muscle Index (SMI). The SMI cut-off of <8.87 kg/m^2 in men and <6.42 kg/m^2 in women were used to define low muscle mass. *Muscle strength* was measured by Jamar hand grip dynamometer (Sammons Preston Rolyan, Bolingbrook, IL), using the individuals dominant hand with their elbow at 90° and locked at their side. The best of three trials was used in the analysis and cut-off points of <30 and <20 kg for men and women, respectively, used to define low muscle strength. *Physical performance* was measured by the Short Physical Performance Battery (SPPB) 2.4-m walk. The best of three trials was retained for the analysis and the cut-off point of <0.8 m/s used to define low physical performance. In addition, the remaining SPPB measures, the standing balance and the repeated chair stands, where collected to allow the generation of the SPPB summary score.

Secondary outcomes

The RA collected height (cm) and weight (kg) by standardized methodologies. Demographics and clinical data were collected from facility records with outstanding variables collected directly from the participants. The Mini-Mental State Examination and the Geriatric Depression Scale were used to measure cognitive status and depression, respectively, and the Mini-Nutritional Assessment Instrument (MNA) to assess nutritional status.[10]

Statistical analysis

Within cohort, sex and group comparisons were made on demographic, functional and clinical variables between baseline and the follow-up by *t*-test (continuous data) and by Pearson's chi-square test (categorical data). Between group (Sarcopenia versus No Sarcopenia at baseline) differences were investigated by repeated measures analysis of variance (2 $\times$ 2 ANOVA). Generalized linear models were used to quantify the effects of sarcopenia (diagnosed at baseline) on functional and clinical variables whist controlling for the sarcopenic risk factors of age, gender, BMI, physical activity level and nutritional status.[10] For binary data including occurrence of death, hospitalization or a fall, prevalence was not rare and therefore modified Poisson regression models with robust estimation of SE values were used to calculate relative risk (RR).[14] Data were analyzed through a combination of SPSS version 22.0 (SPSS Inc., Chicago, IL, USA) and the geepack statistical package for the R programming language, version 3.1.3. Statistical significance were based on two-tailed tests with $p < 0.05$ considered significant.

Results

Participants

Twenty-two of the 102 baseline participants died within the 18-month follow-up period, and 58 of the surviving 80 participants consented to the follow-up analysis (85.7 $\pm$ 8.2 years; >70%