Estimating the prevalence of muscle wasting, weakness and sarcopenia in haemodialysis patients

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Introduction

Haemodialysis (HD) patients across the globe suffer from a range of comorbidities and nutritional problems, which include cachexia, muscle wasting and muscle weakness. As low muscle mass and strength are associated with poor clinical outcomes, there is currently great interest and debate on how best to assess and manage these issues. Recently, the definition of age-related sarcopenia has evolved to encompass both muscle mass and strength/function. Furthermore, it has been extended to disease states, such as chronic kidney disease. The European Working Group for Sarcopenia in Older People (EWGSOP, 1) and Foundations for the National Institute of Health (FNIH, 2) have developed criteria for the assessment of sarcopenia, including the use of non-invasive and portable techniques such as bioelectrical impedance assessment (BIA), anthropometry and hand grip strength (HGS) dynamometry. This study aimed to investigate the prevalence of muscle wasting, weakness and sarcopenia using the EWGSOP and FNIH criteria.

Materials and methods

BIA was performed in 24 females (F) and 63 males (M) in the post-dialysis period. BIA used the BodyStat 1500 MDD device. Raw impedance (RI) measures at 50 khz were utilised to estimate total skeletal muscle mass (TSMM) and appendicular skeletal muscle mass (ASMM) using the Janssen et al and Sergi et al equations, respectively. Skeletal muscle mass (SMM) index values (kg/m2) were calculated by dividing SMM (kg) by height2 (total skeletal muscle index (TSMI) and appendicular skeletal muscle index (ASMI)). Mid arm circumference and tricep skin fold thickness was measured and mid upper arm muscle circumference (MUAMC) calculated. HGS was measured using a standard protocol and Jamar dynamometer. Suggested cut-points for low muscle mass and grip strength were utilised using the EWGSOP and FNIH criteria, with prevalence estimated.

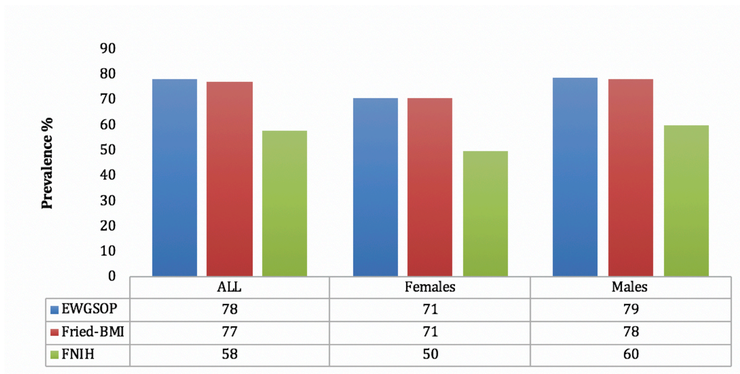
Results

Eighty-seven patients (23 female and 63 male) were studied. The main characteristics of the whole patient group were age (65.9 +/- 13 years), dialysis vintage (5.14 +/- 6.5 years), comorbidity score (6.06 +/- 7.5), height (1.69 +/- 0.10 m) and weight (81.4 +/- 19.4 Kg) (Table 2). The group also had a particularly high prevalence of overweight and obesity (BMI: 28.4 +/- 6.8 kg/m2), with no significant differences between males and females. In addition, dialysis vintage or comorbidities were not significantly different between males and females. T-test results showed a significant difference between females and males for Age ($p < 0.01$), height, weight, RI, TSMI, ASMI and HGS ($p < 0.001$) and MUAMC ($p < 0.05$). Pearson correlations analyses were performed for the whole group (males and females) on key variables of interest (Table 1).

Table 1. Pearson correlations between measures of muscle wasting and weakness in adults maintenance haemodialysis patients

		R	P value
RI	BMI	0.31	< 0.05
RI	MUAMC	0.52	< 0.001
RI	HGS	0.24	< 0.05
TSMI	BMI	0.45	< 0.001
TSMI	MUAMC	0.55	< 0.001
TSMI	HGS	0.22	< 0.05
ASMI	BMI	0.78	< 0.001
ASMI	MUAMC	0.68	< 0.001
ASMI	HGS	0.17	NS
BMI	MUAMC	0.63	< 0.001
BMI	HGS	-0.02	NS
MUAMC	HGS	0.26	< 0.05

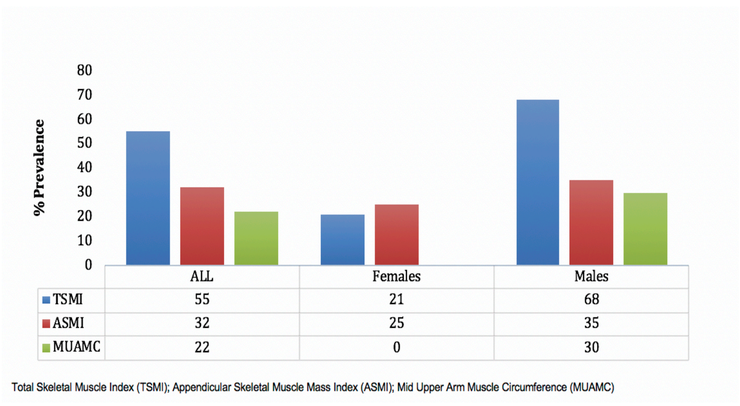
Figure 1. Prevalence of low TSMI (moderate and severe sarcopenia), ASMI and MUAMC for ALL, F & M



	ALL	Females	Males
EWGSOP	78	71	79
Fried-BMI	77	71	78
FNIH	58	50	60

EWGSOP, European Working Group for Sarcopenia in Older People; FNIH, Foundations for the National Institute of Health; Body Mass Index (BMI)

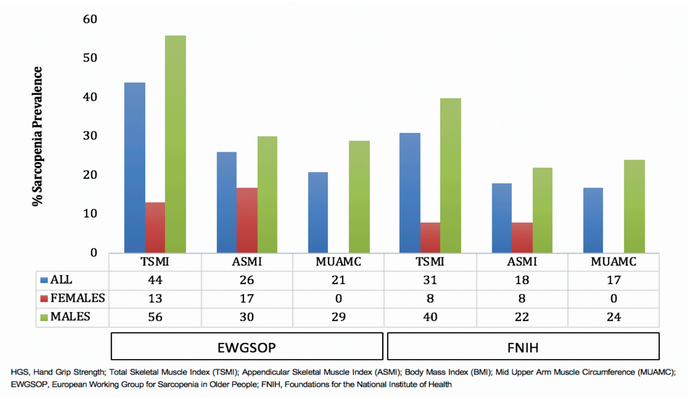
Figure 2. Prevalence of muscle weakness for ALL, F and M EWGSOP, Fried-BMI categorization and FNIH cut-points



	ALL	Females	Males
TSMI	55	21	68
ASMI	32	25	35
MUAMC	22	0	30

Total Skeletal Muscle Index (TSMI); Appendicular Skeletal Muscle Mass Index (ASMI); Mid Upper Arm Muscle Circumference (MUAMC)

Figure 3. Prevalence of muscle weakness (HGS) for ALL, F & M using different combinations of muscle mass measurements (TSMI, ASMI or MUAMC) and using EWGSOP (EWG) and FNIH cut-points



	TSMI	ASMI	MUAMC	TSMI	ASMI	MUAMC
ALL	44	26	21	31	18	17
FEMALES	13	17	0	8	8	0
MALES	56	30	29	40	22	24
	EWGSOP			FNIH		

HGS, Hand Grip Strength; Total Skeletal Muscle Index (TSMI); Appendicular Skeletal Muscle Index (ASMI); Body Mass Index (BMI); Mid Upper Arm Muscle Circumference (MUAMC); EWGSOP, European Working Group for Sarcopenia in Older People; FNIH, Foundations for the National Institute of Health

The RI (cm2/Ω) which is a strong predictor of muscle mass (1, 3) was found to be significantly higher in males than females as may be expected (table 1); however, RI only weakly-moderately correlated with BMI, MUAMC and HGS. TSMM was estimated using a BIA equation developed by Janssen et al (4), in Caucasian adults (3). TSMI values were significantly higher in males than females and correlated moderately well with BMI and MUAMC, and weakly with HGS.

Prevalence of low muscle mass using Janssen et al, (4) cut-points was relatively low (21%) for females and high for males (68%) (1, 4). However, this was calculated as a combination of both 'moderate' and 'severe sarcopenia'. ASMM was estimated using a specific equation developed for older Caucasian adults (5). ASMI was significantly higher in males than females and correlated well with BMI and MUAMC, and weakly with HGS. The prevalence of low ASMI (< 5.45 kg/m2 for females and < 7.26 kg/m2 for males), was estimated to be 25% for females and 35% for males.

Conclusion

This is the first study comparing these specific measures of muscle mass (TSMI and ASMI, using BIA and MUAMC) and) from a representative group of HD patients. Estimates of muscle strength (HG) muscle wasting, weakness and sarcopenia prevalence were made using previously published cut-points. Analysis produced varying results when identifying muscle wasting, weakness and sarcopenia in this population. Further studies should focus on expanding this work and also applying it to other renal populations (both outside Caucasians and HD patients, such as for example peritoneal dialysis patients). This will contribute to the international literature by refining the most appropriate methods and equations to accurately estimate muscle mass in renal disease.

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Literature

1. Studenski SA, Peters KW, Alley DE, Cawthon PM, McLean RR, Harris TB, et al. The FNIH sarcopenia project: rationale, study description, conference recommendations, and final estimates. *J Gerontol A Biol Sci Med Sci* 2014;**69**(5):547–558.
2. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: european consensus on definition and diagnosis: report of the european working group on sarcopenia in older people. *Age Ageing* 2010;**39**(4):412–423.
3. Janssen I, Heymsfield SB, Baumgartner RN et al. Estimation of skeletal muscle mass by bioelectrical impedance analysis. *J Appl Physiol* 2000;**89**: 465–471
4. Janssen I, Baumgartner RN, Ross R, Rosenberg IH, Roubenoff R. Skeletal muscle cutpoints associated with elevated physical disability risk in older men and women. *Am J Epidemiol.* 2004; **15**;159(4):413-21.
5. Sergi G, De Rui M,, Veronese N, Bolzetta F, Berton L, Carraro S, et al. Assessing appendicular skeletal muscle mass with bioelectrical impedance analysis in free-living Caucasian older adults. *Clin Nutr* 2015; **34**: 667-673.