

Prevalence of sarcopenia and associations of sarcopenia components with physical function and health-related quality of life in Australian older adults performing exercise training

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Research article

Keywords: Health-related quality of life, Helsinki University Research, Older adults, Resistance Training, Sarcopenia

Posted Date: August 14th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-52194/v1>

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Abstract

Background

Sarcopenia can be prevented and treated with exercise, particularly resistance training. Our aim was to explore the prevalence of sarcopenia and associations of its components with self-reported function and health-related quality of life (HRQoL) in older adults training at conventional or Helsinki University Research [HUR] gyms owned and operated by an aged care provider, Uniting AgeWell in Melbourne.

Methods

Eighty community-dwelling older adults (mean \pm SD 76.5 \pm 6.5 years) already undergoing resistance training were assessed for muscle strength (hand grip strength and chair stands), appendicular lean mass, and physical performance (gait speed [GS], short physical performance battery [SPPB], timed up and go [TUG] and 400-metre walk [400mW]). Pearson correlations examined associations of sarcopenia components with self-reported function (via SARC-F) and HRQoL (via AQoL-4D) in which higher scores mean worse function and better quality, respectively.

Results

Sarcopenia prevalence ranged from 1.3–10.3% depending on the definition applied, with no significant differences between gym types. In the HUR group, GS ($r=-0.593$) and SPPB ($r=-0.626$) were negatively associated ($p < 0.001$) with function, while TUG ($r = 0.683$; $p < 0.01$) was positively associated with function. Similar associations were observed with the HRQoL independent living component. Equivalent associations for conventional gym participants were observed for SPPB and TUG (function) and GS and TUG (HRQoL). Additionally, 400 mW time ($r = 0.537$) and appendicular lean mass ($r = 0.586$) were positively associated with function in the conventional gym users ($p < 0.01$). Similar, but negative, associations of 400 mW ($r=-0.553$; $p < 0.01$) were also observed with HRQoL, suggesting better function was linked to independent living and better mental health. Hand grip strength was not associated with function or HRQoL in either group.

Conclusion

Sarcopenia prevalence in community-dwelling older adults participating in supervised exercise programs was low and did not differ based on gym type. Mobility-related measures, fitness and lean mass measures in conventional gym users only were associated with function and HRQoL. However, muscle strength was not associated with these outcomes.

Background

Exercise has been shown to reduce pain and joint stiffness, maintain muscle strength, prevent functional decline and enhance physical and mental health and health-related quality of life (HRQoL) [1–4]. While ageing is inevitable and associated with poorer health, this gradual decline can be slowed by engaging in exercises (particularly resistance training) [5, 6]. Given sarcopenia (loss of muscle mass and strength) has only recently received official muscle disease status in the US [7] and Australia [8]—despite the term being initially coined by Rosenberg in 1989 [9]—it is still an unfamiliar concept [10]. To the best of our knowledge, there are no studies that have explored whether sarcopenia components are associated with self-reported function and HRQoL, or whether the type of gym equipment makes a difference to any associations. Aged-care centres regularly provide access to exercise programs for older populations [11–13], however there is limited data on sarcopenia and its components (muscle strength, lean mass, and physical performance) in individuals participating in these programs.

The purpose of this study was to assess the prevalence of sarcopenia and associations of sarcopenia components with self-reported function and HRQoL in older adults performing exercise training at four gyms (three Helsinki University Research [HUR] gyms and one conventional gym) owned and operated by an aged care provider, Uniting AgeWell, with a secondary aim of

establishing whether HUR or conventional gym training are similarly effective. We hypothesized that components of sarcopenia are associated with poor self-reported function and HRQoL in older adults participating in these exercise programs.

Methods

This study applied cross-sectional design using convenience sampling to observe participants that were undergoing training exercises under supervision of exercise physiologists and physiotherapists in Melbourne, Australia.

Participants

Inclusion criteria were that the subjects had to be Uniting AgeWell gym clients. Uniting AgeWell is a not-for-profit aged-care provider in Australia, operating allied health and therapy centres that offer rehabilitation, health promotion and maintenance programs. This includes Helsinki University Research (HUR) gyms and conventional gyms, specifically designed for seniors and supervised by physiotherapists or exercise physiologists [13]. All gym clients who were accepted to take part in the Uniting AgeWell exercise training programs were eligible to participate. Between February and March 2019, 114 subjects were recruited by displaying posters in the four participating gyms. All participants provided fully informed voluntary consent and baseline data was collected in March–May 2019. A total of 80 exercising community-dwelling older adults completed all baseline tests and surveys. The study profile is presented in Fig. 1.

****Figure 1 HERE****

Training Protocol

The participating facilities were the Uniting AgeWell centres at Forest Hill, Noble Park (both attached to a residential care facility), Oakleigh, and Hawthorn. The first three operated HUR gyms and Hawthorn a conventional gym, providing exercise physiology programs. HUR gyms used HUR equipment, which was developed in Finland in 1989 and uses innovative pneumatic technology and computerised smart card and smart touch systems that record clients' visits and work-outs [14, 15]. The Forest Hill and Oakleigh gyms included HUR Active Line equipment, such as pulleys, leg presses, hip abduction/adduction machines, leg flexion/extension machines, chest presses, rhomboid machines, trunk flexion/extension machines and iBalance and NuStep machines. Noble Park, which was the most recently opened facility, had the Premium Line equipment, including an ab/back roller and optimal rhomb. The conventional gym in Hawthorn used standard equipment, such as dumbbells, barbells, kettlebells, TheraBands, steps, medicine balls, treadmills, exercise bikes, an elliptical cross trainer and a cable weight machine. Participants followed their own personal exercise programs (ranging from 2–3 sets with 8–20 repetitions) as developed by the exercise physiologists or physiotherapists. The training duration was usually one hour, and the frequency varied depending on individual programs (generally once or twice per week).

Diagnosis of sarcopenia

Sarcopenia was identified using the Foundation for the National Institutes of Health (FNIH) Sarcopenia Project and European Working Group on Sarcopenia in Older People (EWGSOP1, 2010) and EWGSOP2 (2018, update) criteria. FNIH-defined sarcopenia was assessed by low muscle strength (via hand grip strength [HGS]) and low muscle/lean mass [16]. The EWGSOP1 'presarcopenia stage' was assessed by low muscle/lean mass; the 'sarcopenia' stage by low muscle/lean mass, low muscle strength (via HGS) or low physical performance (via gait speed; GS); and the 'severe sarcopenia' stage as presence of low muscle/lean mass, low muscle strength and low physical performance) [17]. Within EWGSOP2, the pathway of Find-Asses-Confirm-Severity (F-A-C-S) was applied [18]. While the SARC-F questionnaire is used in EWGSOP2 to screen subjects at risk of sarcopenia probable, in this study it was used to self-report physical function, as regardless of the SARC-F outcome, all participants underwent the subsequent body composition and physical function tests. To assess low muscle strength, HGS was used ('probable sarcopenia'); 'Confirmed sarcopenia' was defined as low muscle strength and low muscle/lean mass, and "severe sarcopenia" was confirmed sarcopenia with low physical performance (via GS) [18]. Table 1 shows specific sarcopenia cut-off points according to the three definitions.

Table 1
Sarcopenia cut-off points according to different definitions

Sarcopenia component	Measure	FNIH		EWGSOP1		EWGSOP2	
		Men	Women	Men	Women	Men	Women
Muscle strength	HGS	< 26 kg	< 16 kg	< 30 kg	< 20 kg	< 27 kg	< 16 kg
	CS (5 rises)					15 s	
Lean mass	DXA	ALM/ _{BMI}	ALM/ _{BMI}	ALM/h ²	ALM/h ²	ALM/h ²	ALM/h ²
		< 0.789	< 0.512	< 7.25 kg/m ²	< 5.67 kg/m ²	< 7.0 kg/m ²	< 5.5 kg/m ²
Physical performance	GS	-	-	< 0.8 m/s		≤ 0.8 m/s	
	SPPB	≤ 8-point score					
	TUG	-	-	-	-	≥ 20 s	
	400 mW	Non-completion or ≥ 6 min for completion					

FNIH: Foundation for the National Institutes of Health Sarcopenia Project; EWGSOP: European Working Group on Sarcopenia in Older People; HGS: hand grip strength; CS: chair stand; ALM: appendicular lean mass, BMI: body mass index; GS: gait speed; SPPB: short physical performance battery; TUG: timed up and go test; 400mW: 400-metre walk

Table 1 HERE

Appendicular lean mass (ALM). ALM (kg) was assessed via dual-energy X-ray absorptiometry (DXA) (Hologic Horizon A, MeasureUp, Melbourne), defined as the sum of lean soft-tissue mass from both the arms and legs [19]. According to EWGSOP1 and EWGSOP2 (update 2018), low lean mass was calculated as low ALM adjusted for height squared (ALM/h²) (kg/m²) [17, 18]. Within the Foundation for the National Institutes of Health (FNIH) Sarcopenia Project, low ALM was adjusted for body mass index (ALM/_{BMI}), with BMI calculated as weight divided by height squared (kg/m²) [16]. Height was measured using a stadiometer (Charder HM200P, Charder Electronic Co. Ltd, Tachung City, Taiwan) and weight was obtained from DEXA, calculated as sum of total fat mass and total lean and BMC).

Hand grip strength (HGS). HGS (kg) was measured using a handgrip dynamometer (Jamar Plus+, SI Instruments, Adelaide, Australia). Subjects were seated in the upright position, with the forearm resting on the arm rest and the elbow at 90°. Participants performed one practice and two trials for each hand by squeezing as hard as possible. Dominant hand was recorded. The highest result of the six measurements was used for analysis [20].

Short Physical Performance Battery (SPPB). SPPB was used to assess lower extremity function, involving three standing balance stances with different foot positions (side-by-side, semi-tandem, and tandem); measurement of GS by walking 4 metres at normal speed with one practice and two trials; and chair-stand (CS) test, with the chair placed at the wall for safety. The practice was a single CS without a stopwatch. Participants were asked to fold their arms across chest and stand up from a chair once. If successful, five rises as fast as possible were timed from the first sitting position to the end of the fifth stand. Time was measured with sports stopwatch (cat. no. XC027, Jaycar, Melbourne, Australia).

Timed up and go (TUG). TUG (s) measured participant's mobility, balance and agility involving standing up from a chair, walking across the 3-metre course at their normal speed, turning around the cone, returning to the chair, and sitting down, with one practice followed by two trials [21]. The study reported the fastest of three TUG trials [21].

400-metre walk (400 mW). 400 mW (min) assessed mobility and cardiovascular fitness. The course is normally to walk a 20-metre course up and back 10 times as fast as possible. However, due to limited space in the gyms, participants walked 10 metres formed once and was the final test performed on any given day.

Self-reported function

Participants were asked to complete a rapid sarcopenia risk questionnaire including five components: strength, assistance in waking, rise from a chair, stair climb, and falls (SARC-F) [22]. SARC-F scale score ranges from 0 to 10 (0–2 for each component; 0 is best to 10 is worst).

- **Self-reported HRQoL (via AQoL-4D)**
- HRQoL was measured via a 12-item AQoL-4D survey giving four dimension scores: independent living (self-care, household tasks and mobility), relationships (friendships, isolation and family role), senses (seeing, hearing and communication) and mental health (sleeping, worrying and pain), and an overall index of the health state utility (AQoL-4D utility score) over the previous week. The AQoL-4D score with negative utilities characterises health states worse than death; zero characterises death, and 1 stands for full health [23].

Statistical analysis

Data is presented as mean (SD) or frequency (%) unless otherwise specified. Descriptive statistics were performed on continuous variables and frequency analyses on nominal data. Chi-square tests were used to test for differences between HUR and conventional gym training for sarcopenia prevalence according to FNIH, EWGSOP1 and EWGSOP2 definitions. Continuous data was assessed for normality and parametric tests were used as appropriate. Pearson correlations explored associations for sarcopenia components (muscle strength, lean mass and physical performance) with self-reported function and HRQoL. The Pearson coefficient was interpreted as weak (0.1–0.3), moderate (0.3–0.7) and strong (0.7–1.0). Independent-sample t-tests (continuous data) were applied to compare sarcopenia components vs self-reported status between HUR and conventional gyms. A p-value less < 0.05 at 95% confidence intervals was considered statistically significant. All analyses were performed using IBM SPSS Statistics for Mac, version 25 (IBM Corp., Armonk, NY, USA).

Results

Baseline characteristics

Baseline characteristics of the sample are presented in Table 2. No significant differences were observed in demographics (age, gender, ethnicity), anthropometric measures (height, weight, BMI), years trained at the gym or weekly gym visits between gym groups. Participants had been training for over one year, once a week, on average. There was no significant difference between HUR and conventional gym groups for sarcopenia components related to physical function or lean mass. Regarding self-reported measures, HUR gym participants had a significantly higher SARC-F score than the conventional gym participants, suggesting poorer function. This was similar to a strong trend for the AQoL-4D utility score to be lower in the HUR gym participants, although this did not reach significance ($p = 0.063$).

Table 2
Comparison of baseline characteristics between HUR and conventional gym training (n = 80)

Characteristic	HUR (n = 57)	Conventional (n = 23)	P-value for difference	
Demographics	Age (yr), mean (ST)	75.99 (6.00)	77.88 (7.43)	0.236
	Women (%)	35	15	0.690
	English/Australians (%)	41	17	0.788
Training	Years trained	1.20 (0.64)	1.39 (0.63)	0.235
	Weekly gym visits	1.08 (0.54)	0.99 (0.42)	0.503
Anthropometric measurements	Height (cm)	163.88 (9.47)	163.17 (9.49)	0.765
	Weight (kg)	77.10 (17.91)	70.98 (15.35)	0.155
	BMI (kg/m ²)	28.65 (6.02)	26.46 (3.76)	0.055
Muscle strength	HGS (kg)	26.54 (8.68)	25.47 (7.38)	0.605
	CS (s)	9.93 (3.98)	9.02 (3.48)	0.345
Lean mass	ALM (kg)	19.43 (5.33)	18.12 (4.81)	0.310
FNIH	ALM/BMI (kg/m ²)	0.69 (0.17)	0.68 (0.15)	0.945
EWGSOP1/EWGSOP2	ALM/h ² (kg/m ²)	7.14 (1.42)	6.70 (1.11)	0.195
Physical performance	GS (m/s)	1.31 (0.27)	1.36 (0.17)	0.355
	SPPB (score) median (IQR)	11.00 (2)	12.00 (0)	0.060
	TUG (s)	8.96 (4.62)	7.41 (1.14)	0.116
	400 mW (min)	5.58 (1.79)	5.34 (1.21)	0.560
Self-reported function	SARC-F (score)	1.96 (2.10)	0.96 (0.83)	0.003 *
Self-reported HRQoL	AQoL-4D (utility score)	0.67 (0.23)	0.77 (0.20)	0.063
	Independent Living (dimension score)	0.90 (0.14)	0.93 (0.10)	0.391
	Relationships (dimension score)	0.89 (0.20)	0.95 (0.07)	0.122
	Senses (dimension score)	0.92 (0.08)	0.93 (0.09)	0.566
	Mental Health (dimension score)	0.86 (0.10)	0.90 (0.12)	0.138

All data are mean (SD) or frequency (%). HUR: Helsinki University Research, BMI: body mass index; HGS: hand grip strength; CS: chair stand; ALM: appendicular lean mass; HGS: hand grip strength, GS: gait speed; SPPB: short physical performance battery; TUG: timed up and go test; 400mW: 400-metre walk test; FNIH: Foundation for the National Institutes of Health Sarcopenia Project; EWGSOP: European Working Group on Sarcopenia in Older People; SARC-F: sarcopenia screening tool assessing strength, assistance in walking, rising from a chair, climbing stairs and falls; AQoL-4D: Assessment of Quality of Life

According to FNIH, 8% of the whole cohort had low HGS and 39% had low lean mass (ALM/BMI). For EWGSOP1 and EWGSOP2, 31% and 9% had low HGS, and 21% and 14% had low lean mass (ALM/h²), respectively. According to EWGSOP2, 8% had low CS, 3% had low TUG, and 34% had low 400 mW. By both EWGSOP definitions, 3% reported low GS and 10% low SPPB.

****Table 2 HERE****

According to FNIH, sarcopenia was prevalent in 3.8% (n = 3) of the sample. The highest prevalence of 11.3% (n = 9) was recorded for EWGSOP1. There were 21.3% (n = 17) identified as presarcopenic and none had severe sarcopenia. Using EWGSOP2, 8.8% (n = 7) had probable sarcopenia, but none had confirmed sarcopenia or severe sarcopenia. High SARC-F scores (> 4) predicted one case of sarcopenia according to FNIH and EWGSOP1, one case of pre-sarcopenia (EWGSOP1) and two cases of probable sarcopenia (EWGSOP2) but none with sarcopenia confirmed (EWGSOP2) or severe (EWGSOP1/EWGSOP2). No person had sarcopenia according to all definitions—FNIH, EWGSOP1 and EWGSOP2—or even two of the three definitions. No significant difference in sarcopenia prevalence was observed between HUR and conventional groups according to FNIH, EWGSOP1 and EWGSOP2 criteria (all p > 0.05, see Table 3). SARC-F identified 12.5% (n = 10) cases at risk of sarcopenia, with HUR participants scoring significantly higher than conventional participants (p = 0.003).

Table 3

Prevalence of sarcopenia according to different definitions for older adults participating in HUR and conventional gym training (n = 80)

Definition	HUR (n = 57)	Conventional (n = 23)	P-value for difference
FNIH sarcopenia, n (%)	2 (2.6%)	1 (3.4%)	0.858
EWGSOP1 pre-sarcopenia	11 (14.5%)	6 (20.7%)	0.502
EWGSOP1 sarcopenia, n (%)	6 (7.9%)	3 (10.3%)	0.747
EWGSOP1 severe sarcopenia	0 (0%)	0 (0%)	-
EWGSOP2 probable sarcopenia, n (%)	5 (6.6%)	2 (6.9%)	0.991
EWGSOP2 confirmed sarcopenia, n (%)	0 (0%)	0 (0%)	-
EWGSOP2 severe sarcopenia, n (%)	0 (0%)	0 (0%)	-
FNIH: Foundation for the National Institutes of Health sarcopenia project; EWGSOP: European Working Group on Sarcopenia in Older People; SARC-F: sarcopenia screening tool assessing strength, assistance in walking, rising from a chair, climbing stairs and falls. *All analyses are Chi-square tests			

****Table 3 HERE****

Associations of sarcopenia components with self-reported function and HRQoL

For HUR gym participants, Pearson associations showed a significant weak, negative correlation for CS with SARC-F (p = 0.036), implying that a higher CS time was associated with a lower SARC-F score (lower sarcopenia risk) (Table 4). Regarding physical performance measures, there was a significant moderate, negative correlation for GS (p < 0.01) and SPPB (p < 0.01) with SARC-F and moderate, positive correlation for TUG (p < 0.01) with SARC-F, implying that a higher GS and SPPB score and lower TUG (higher function) were associated with lower SARC-F score (lower sarcopenia risk). There was a significant moderate, positive correlation for GS (p = 0.011) and SPPB (p = 0.017) with AQoL-4D (utility score) and a moderate, negative correlation for TUG (p < 0.01) with AQoL-4D (utility score), implying that higher GS and SPPB and lower TUG (higher function) were associated with a higher AQoL-4D utility score (greater HRQoL). Similarly, there was a significant moderate, positive association for GS (p < 0.01) and SPPB (p < 0.01) with AQoL-4D on the independent living dimension and a moderate negative association for TUG (p < 0.01) with independent living, indicating that higher function was associated with better independent living. No significant relationship was observed for HG and lean mass with AQoL-4D.

Table 4

Associations of self-reported sarcopenia risk and HRQoL with sarcopenia components at baseline for HUR gym participants (n = 57)

Component		Muscle strength		Lean mass			Physical performance			
		HGS (kg)	CS (s)	ALM (kg)	ALM/BMI (kg/m ²)	ALM/h ² (kg/m ²)	GS (m/s)	SPPB (score)	TUG (s)	400 mW (min)
SARC-F (score)	Pearson Coefficient	0.048	-0.278*	0.083	0.002	0.100	-0.593**	-0.626**	0.683**	0.043
	p	0.720	0.036	0.537	0.988	0.460	0.000	0.000	0.000	0.753
AQoL-4D (utility score)	Pearson Coefficient	0.018	0.088	0.131	0.079	0.078	0.335*	0.314*	-0.362**	-0.072
	p	0.893	0.515	0.332	0.561	0.566	0.011	0.017	0.006	0.594
Independent Living (score)	Pearson Coefficient	0.110	0.157	0.103	0.019	0.097	0.571**	0.541**	-0.595**	-0.078
	p	0.416	0.243	0.448	0.889	0.471	0.000	0.000	0.000	0.565
Relationships (score)	Pearson Coefficient	0.067	-0.070	0.175	0.077	0.131	0.181	0.142	-0.103	-0.152
	p	0.619	0.604	0.193	0.567	0.331	0.177	0.294	0.444	0.260
Senses (score)	Pearson Coefficient	-0.101	0.040	-0.021	0.172	-0.156	-0.048	-0.061	0.039	0.136
	p	0.454	0.768	0.876	0.201	0.248	0.722	0.652	0.773	0.313
Mental Health (score)	Pearson Coefficient	-0.094	0.162	-0.025	-0.010	-0.028	0.011	0.086	-0.212	0.047
	p	0.486	0.228	0.853	0.944	0.835	0.935	0.525	0.113	0.727

HRQoL: health-related quality of life; HUR: Helsinki University Research; HGS: hand grip strength; CS: chair stand; ALM: appendicular lean mass; BMI: body mass index; SPPB: short physical performance battery; TUG: timed up and go test; 400-metre walk test; SARC-F: sarcopenia screening tool assessing strength, assistance in walking, rising from a chair, climbing stairs and falls; AQoL-4D: Assessment of Quality of Life. All analyses are Pearson correlations; ** p < 0.01, * p < 0.05

****Table 4 HERE****

For conventional gym participants, within lean mass, ALM had a significant moderate, positive correlation with SARC-F ($p < 0.01$), indicating that a higher ALM is associated with higher SARC-F (higher sarcopenia risk) (Table 5). SPPB had a significant moderate, negative relationship with SARC-F ($p = 0.039$), indicating that a higher SPPB (better balance, strength in legs and GS) was associated with a lower SARC-F score (lower sarcopenia risk). Indeed, in support of this, there was a moderate positive association with CS and moderate negative association with GS, although neither of these reached significance ($p = 0.071$ and $p = 0.099$, respectively). There was a significant moderate, positive correlation for TUG and SARC-F ($p < 0.01$). Further, 400 mW had a significant moderate, positive relationship with SARC-F ($p < 0.01$). This suggests that a lower 400 mW time was associated with a lower SARC-F score (lower sarcopenia risk).

Table 5
Associations of self-reported sarcopenia risk and HRQoL with sarcopenia components at baseline for conventional gym participants (n = 23)

		Muscle strength		Lean mass			Physical performance			
Component		HGS	CS	ALM	ALM/BMI	ALM/h ²	GS	SPPB	TUG	400 mW
		(kg)	(s)	(kg)	(kg/m ²)	(kg/m ²)	(m/s)	(score)	(s)	(min)
SARC-F (score)	Pearson Coefficient	0.262	0.384	0.586**	0.396	0.412	-0.352	-0.432*	0.627**	0.537**
	p	0.227	0.071	0.003	0.061	0.051	0.099	0.039	0.001	0.008
AQoL-4D (utility score)	Pearson Coefficient	0.265	-0.395	0.202	-0.144	0.352	0.562**	0.293	-0.473*	-0.553**
	p	0.221	0.062	0.355	0.511	0.099	0.005	0.174	0.023	0.006
Independent Living (score)	Pearson Coefficient	0.101	-0.464*	0.051	-0.128	0.153	0.473*	0.393	-0.432*	-0.500*
	p	0.646	0.026	0.819	0.562	0.486	0.023	0.064	0.039	0.015
Relationships (score)	Pearson Coefficient	0.276	-0.325	0.194	0.079	0.222	0.461*	0.188	-0.386	-0.387
	p	0.202	0.130	0.374	0.720	0.309	0.027	0.391	0.069	0.068
Senses (score)	Pearson Coefficient	0.241	-0.006	0.144	0.183	0.080	0.149	-0.119	-0.035	0.005
	p	0.268	0.978	0.512	0.405	0.716	0.497	0.590	0.874	0.981
Mental Health (score)	Pearson Coefficient	0.194	-0.377	0.183	-0.337	0.428*	0.577**	0.342	-0.526*	-0.663**
	p	0.376	0.077	0.402	0.116	0.042	0.004	0.111	0.010	0.001

HRQoL: health-related quality of life; HGS: hand grip strength; CS: chair stand; ALM: appendicular lean mass; BMI: body mass index; SPPB: short physical performance battery; TUG: timed up and go test; 400-metre walk test; SARC-F: sarcopenia screening tool assessing strength, assistance in walking, rising from a chair, climbing stairs and falls; AQoL-4D: Assessment of Quality of Life. All analyses are Pearson correlations; ** p < 0.01, * p < 0.05

There was a significant moderate, negative correlation between CS and HRQoL ($p = 0.026$) on the independent living dimension, implying that lower chair stand time is associated with better independent living (Table 5). No significant correlation was observed for HGS or ALM/BMI with any of the self-reported measures. However, ALM/h² had a significant moderate positive correlation with AQoL-4D ($p = 0.042$) on the mental health dimension, implying that higher ALM/h² was associated with better mental health. Regarding physical performance, GS had a significant moderate positive correlation with AQoL-4D (utility score; $p < 0.01$), moderate positive correlations with its independent living ($p = 0.023$) and relationships ($p = 0.027$) dimensions and a moderate positive correlation with mental health ($p < 0.01$) dimension. These results suggest that higher GS (better function) is associated with a higher AQoL-4D utility score, independent living, relationships and mental health dimensions (greater HRQoL). There was a moderate negative correlation for TUG with AQoL-4D (utility; $p = 0.023$), its independent living ($p = 0.039$) and mental health ($p = 0.010$) dimensions, implying that a lower TUG time was associated with a lower SARC-F score (lower sarcopenia risk), a higher AQoL-4D utility score, independent living and mental health (higher HRQoL). There was a moderate negative relationship of 400 mW time with AQoL-4D (utility score; $p < 0.01$) and its mental health ($p < 0.01$) dimension as well as a moderate negative relationship with the independent living ($p = 0.015$) dimension. This suggests that a lower 400 mW time was associated with a higher AQoL-4D utility score and the independent living and mental health dimensions (greater HRQoL).

****Table 5 HERE****

Discussion

Among 80 community-dwelling older adults undertaking regular gym exercise in Melbourne, the prevalence of sarcopenia ranged from 3.8–11.3%, varying according to definition. This is similar to values reported in the general community of older Melbournians (11% according to EWGSOP1) [24]. However, it is lower than that reported according to FNIH and EWGSOP1 in community-dwelling older adults in Amsterdam (7.9% and 31.9%, respectively) [25], hospitals in Italy (24% and 36%, respectively) [26], or people in aged care in China (31.4% and 32.5%, respectively) [27] or Australia (40.2% according to EWGSOP1) [28], suggesting an overall healthy, well-functioning group of individuals, with high self-reported QoL.

Due to changes to the algorithm from EWGSOP1 and lower cut-off points [18], sarcopenia prevalence in this sample was lower for EWGSOP2 than for EWGSOP1, which supports recent findings that the use of EWGSOP2 will potentially underestimate sarcopenia prevalence compared to EWGSOP1 [29]. Consequently, public spending on sarcopenia would be greater if EWGSOP1 guidelines are followed. Given the association of low muscle mass and function with morbidity and mortality [30–32], underestimating the prevalence of sarcopenia will likely have more dire consequences and higher health care costs in the long run. SARC-F has poor sensitivity but high specificity for sarcopenia definitions including FNIH and EWGSOP1 [33] and may detect severe cases [18]. In our study, SARC-F predicted one case of sarcopenia according to FNIH and EWGSOP1, one case of pre-sarcopenia (EWGSOP1) and two cases of probable sarcopenia (EWGSOP2), but none were sarcopenia confirmed (EWGSOP2) or severe (EWGSOP1/EWGSOP2). HUR gym individuals had a significantly higher SARC-F score, implying that they felt they were less functional, thus at higher risk of sarcopenia than the conventional gym group.

Low HGS and GS or the combination of both are associated with higher functional disability levels in older adults [34]. This study demonstrated low proportions of low HGS (8% and 9% according to FNIH and EWGSOP2, respectively) implying that overall the Melbourne cohort are at a low risk of physical disability based on their physical function. However, when applying EWGSOP1 criteria, more participants (31%) of the sample had a low HGS. Regarding physical performance, only 3% of participants had low GS and poor TUG performance but 34% participants had poor 400 mW performance suggesting that walking tests of longer distances may be more sensitive for detecting low physical performance in older adults. Poor 400 mW performance may imply that exercising only once a week is insufficient to provide significant protection above routine activities of daily living (ADLs) in community-dwelling older adults. Certainly, it is below current exercise guidelines for resistance exercise [35]. The Position Statement providing recommendations for healthy older adults and those with special considerations for frailty, sarcopenia or other chronic conditions incorporates a combination of resistance training, power and functional training, 2–3 times a week, 1–3 sets of 8–12 repetitions [35]. Alternately, members of the gyms may have begun training due to identified weakness/issues with ADLs, and thus sarcopenia prevalence may have been higher if it were measured prior to them beginning their gym exercise.

Since EWGSOP2 offers many measurement options for each sarcopenia component, discrepancies in prevalence estimates, depending on the option applied, are to be expected. Phu, Vogrin [24] demonstrate that sarcopenia prevalence varied depending on EWGSOP2 measures, stating that highest prevalence was reported when using CS for muscle strength and lowest when using TUG for physical performance. In this study, HGS was used for muscle strength. However, sarcopenia prevalence would be lower if it was assessed by CS, as poor CS performance was slightly less common than poor HGS. GS was used to assess physical performance. If TUG had been used, sarcopenia prevalence would also be lower. However, if 400 mW was assessed, it would be higher due to highest proportions of poor 400 mW performance across the sample. This demonstrates the inconsistency of sarcopenia prevalence assessment, even within the same definition. A universally accepted consensus on sarcopenia is necessary for consistent diagnosis and implementation in clinical settings [36].

Given that there were no significant differences between HUR and conventional gyms for sarcopenia prevalence, it could be inferred that exercise training at both types of gyms operated by Uniting AgeWell have similar effects on sarcopenia. However, associations between the components did differ between the gyms. Regarding muscle strength components, low CS time was weakly associated with higher SARC-F scores for HUR gym participants. Conversely, past research shows high CS time and low HGS are associated with low SARC-F scores [37]. It is not immediate apparent why the CS associations are in the opposite direction in this study in the HUR group. Indeed, the expected (and stronger) association of high CS times with higher SARC-F scores was observed in the conventional gym group, although this did not reach statistical significance, most likely due to the

HGS has functional importance in ADLs, such as opening containers, lifting weights, using tools or holding handrails when ascending stairs [38]. However, no associations were observed for HGS in either gym group. Low GS and SPPB are significantly correlated with low SARC-F scores [37]. Similarly, in our study, both low GS and SPPB were associated with poor SARC-F scores, irrespective of the gym setting. In contrast, despite no difference between the two groups, longer 400 mW times were associated with SARC-F in the conventional gym group only, perhaps suggesting that lower leg cardiorespiratory fitness is a focus of the conventional gym exercises. Indeed, the conventional gym included dynamic exercises (e.g., plyometrics using medicine balls and jumping), which may be more effective for improving cardiovascular fitness and endurance than training with resistance equipment alone.

Slow GS and TUG had consistent associations with poor HRQoL among both HUR and conventional gym participants. Lower SPPB scores (HUR group) and slower 400 mW time (conventional group) were associated with poor HRQoL, consistent with past research showing that lower SPPB and higher 400 mW are significantly correlated with lower physical components of HRQoL (using SF-36) [39]. Although poorer HRQoL (using SarQoL) appears to be more related to muscle function than to muscle mass (Beaudart et al., 2018), our study showed that low lean mass (ALM/h^2), along with low physical performance measures (GS, TUG and 400 mW), were associated with poor HRQoL on the mental health dimension (sleeping, worrying and pain) among conventional gym participants. The conventional group also experienced a positive association for GS with HRQoL on the relationships dimension (friendships, isolation and family role). Outdoor mobility is important for engaging in social relations and activities [40]. In support, exercise and social support from friends are both correlated with lower scores of depression, anxiety and perceived stress in older community-dwellers [41]. Further, our results showed that while GS was positively associated with poor HRQoL on the independent living dimension (self-care, household tasks and mobility) in the conventional group, low CS along with low TUG and 400 mW, was negatively associated. This supports past research that GS and CS but not HGS correlate with most subscales of HRQoL (using SF-36) [42]. However, this study's HUR group did not experience any association for CS with the independent living dimension. Inconsistent associations for CS and missing associations for HGS infer that maybe HRQoL is not a good indicator of muscle strength.

Despite an average of a year of training, the mean AqoL-4D utility score (0.70) was lower than the mean of 0.76 previously reported in this age group [23]. This appeared to be influenced by the HUR gym group, which had a 0.1 lower score (0.66 v 0.76) compared to the conventional gym group, although this did not reach statistical significance ($p = 0.063$). Again, the dynamic nature of the exercises at the conventional gym extending beyond machine-based exercises may be the explanation for this, as they are important for balance, mobility and falls prevention [43], although further work would be required to demonstrate this. Differences between the gyms could also reflect site-specific differences, and as such education and socioeconomic status of participants. However, we did not collect that information, thus this would need further investigation.

Due to the cross-sectional design and convenience of the sample, the population may be unrepresentative of the general population, and the unbalanced groups at HUR and conventional gyms may have limited finding significant associations, particularly in the conventional gym group. The study was limited to exercising older adults in Melbourne and results may not be generalised for the broader population. Another limitation is that we do not know what the health status of participants was prior to the starting at the gyms. Apart from gym sessions, participants could take part in regular exercise groups and extra activities were not measured in this study.

Conclusion

Sarcopenia prevalence in community-dwelling older adults participating in supervised exercise programs was low whether using HUR gym equipment or a conventional gym. Both self-reported function and HRQoL correlated with sarcopenia components including gait speed and agility (TUG), with the addition of cardiorespiratory fitness in the conventional gym. Mobility-related components of sarcopenia, rather than lean mass and strength, are most consistently associated with self-reported function and HRQoL. Thus, exercise programs for older adults should target improvements in mobility as a priority.

Abbreviations

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ALM: Appendicular lean mass; ADL:Activities of daily living; AQL-4D:Assessment of Quality of Life; BMC:Bone mineral content; BMI:Body mass index; DXA:Dual-energy X-ray absorptiometry; EWGSOP:European Working Group on Sarcopenia in Older People; FNII:Foundation for the National Institutes of Health Sarcopenia Project; GS:Gait speed; HGS:Hand grip strength; CS:chair stand; SF-36:36-item short form; SARC-F:sarcopenia screening tool assessing strength, assistance in walking, rising from a chair, climbing stairs and falls; SPPB:Short physical performance battery; TUG:Timed up and go test; 400mW:400-metre walk

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Victoria University Human Research Ethics Committee (approval number HRE18-195). All subjects provided written informed consent before data collection.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors have no competing interests to declare.

Funding

Not applicable

Authors' contributions

EA: conceived and conducted study; data collection, analysis and interpretation, drafting the manuscript. AH, DS: study concept and contribution to data interpretation; JPR, CAG, JM: contributed to data collection; SD: contributed to study concept. All authors contributed to a critical revision of the manuscript and approved its final version.

Acknowledgements

We acknowledge the research sponsor Uniting AgeWell in Melbourne for providing access to their gym facilities, their client-base and a great support from their management and staff. Many thanks go to participants, their families and carers.

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Figures

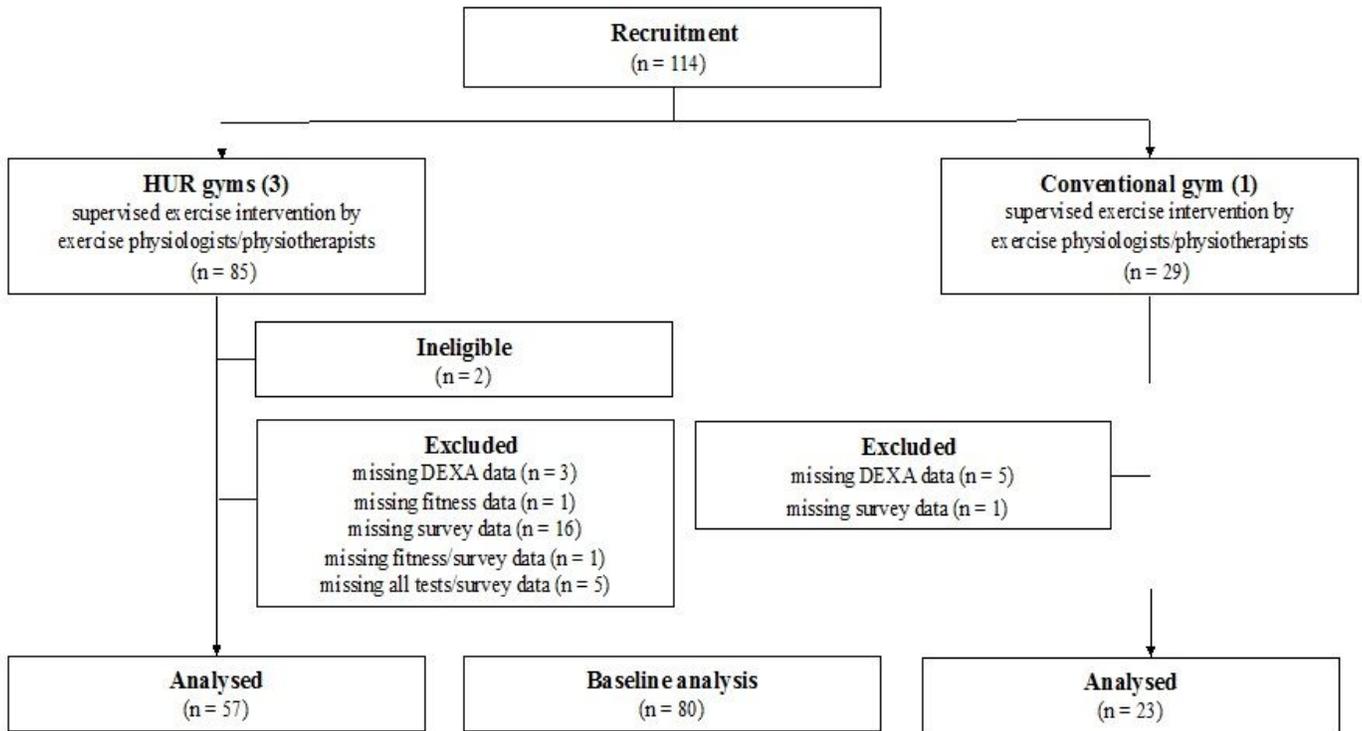


Figure 1

Study profile