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ORIGINAL RESEARCH

Predictors of muscle strength in older individuals

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PURPOSE: To analyze possible relationships between load, body mass and lean body mass in an effort to provide norm-referenced standards for the one repetition maximum test and to predict whole body muscle strength (WBMS) in older individuals.
METHODS: We measured body mass, lean body mass and the one repetition maximum (1RM) test in different exercises in 189 older men and women aged 61 to 82 years. Whole body muscle strength (WBMS) was calculated as the sum of loads of the different exercises.
RESULTS: For women, the inclusion of body mass or lean body mass increased the R^2 from 0.41 to 0.82, and yielded the following equation: WBMS = 75.788 + (2.288 × load in kg of latissimus pull down) + (0.799 × lean body mass in kg). For men, the inclusion of either body mass (WBMS = 290.33 – [3.140 × age in years] + [1.236 × body mass in kg] + [1.549 × load in kg of leg press]) or, in particular, lean body mass (WBMS = 343.25 – [3.298 × age in years] + [.415 × lean body mass in kg] + [1.737 × load in kg of leg press]) decreased the standard error of the estimate.
CONCLUSION: Our data support the idea that load correlates with body mass and lean body mass and that the load used for a specific exercise is significantly associated with WBMS, thereby permitting the development of a predictive model of WBMS with increased accuracy.

KEYWORDS: Aging, Muscle strength, Resistance exercise.

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INTRODUCTION

Accumulating evidence indicates that aging affects the neuromuscular system[1] and, consequently, activities of daily living.[2,3] Resistance exercises have been recommended as a strategy to decrease the speed and magnitude of neuromuscular aging, especially as an important resource to preserve physical function and reduce the relative demand for activities of daily living, regardless of the health status.[4-6]

Aging itself determines the magnitude by which specific intrinsic variables (e.g., exercise order, velocity of muscle action) should be adjusted during resistance training programs. In general, exercise intensity should be maintained within a certain percentage of the one repetition maximum (1RM) test.[4,7] In addition, load *per se* or load adjusted for body mass or for fat-free mass may be employed as a norm-referenced standard.[8]

Nevertheless, there is an increased difficulty in establishing norm-referenced standards in older individuals because aging is typically associated with the presence of diseases,[9] which in turn may underlie the variability in their neuromuscular performance.[10] In contrast, norm-referenced standards may assist in identifying older individuals at risk for immediate or prospective mobility limitations[11] and could serve as a reference for monitoring therapeutic efficacy.[4,6] In this way, from a practical point of view, our study could assist clinicians and therapists in the management of load

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during session exercises and allow clinicians to estimate whole-body muscle strength with a satisfactory level of accuracy. Therefore, the purpose of this study was to analyze possible relationships between load, body mass and lean body mass in an effort to provide norm-referenced standards for the 1RM test and to predict whole-body muscle strength (WBMS) using univariate or multivariate regressions models in clinically healthy older individuals.

METHODS

Subjects

Physically inactive male and female volunteers aged 60 to 82 years were recruited from the community. They were informed of the procedures and risks and then gave their written consent to participate in this study, which had been approved by the institutional research ethics committee (cases #842/11 and #0095/03).

A preliminary telephone screening focused on current health status, drug and cigarette use, and habitual physical activity; this was followed by a hospital visit for a detailed history and physical examination covering past and current health status, symptoms of depression, self-reported ability to perform the basic and instrumental activities of daily living, a 12-lead electrocardiogram, an assessment of body composition, and general laboratory blood and urine tests. Subsequently, volunteers were excluded if they (i) had participated in any regular physical activity program during the previous three months; (ii) were involved in alternative dietary therapy; (iii) were undernourished or obese; (iv) smoked cigarettes; (v) had a cardiovascular, pulmonary, or metabolic disease or a chronic infectious or an auto-immune disease; (vi) had a central or peripheral nervous system disorder; (vii) had been treated for or had a history of cancer; (viii) had chronically used corticosteroids; (ix) had any surgery during the previous three months; (x) had been forced to take bed rest during the previous three months; or (xi) had any orthopedic condition(s) that could limit exercise or that could be exacerbated by exercise testing.

Body composition

Body mass and height were measured using standard techniques. Body mass index was calculated as the body mass (kg) divided by body height squared (m^2). For men, fat mass and lean body mass were determined using the air displacement plethysmograph for men (BODPOD®, Life Measurement Instruments, Concord, CA, USA),[12] whereas for women, a bioelectrical impedance device was used (Biodynamics®, model 450, USA).

Acclimation period

This period comprised three sessions performed during one week with three sets of 12 repetitions for different exercises (older men: chest press, leg press, vertical traction, abdominal crunch, leg curl and lower back exercises, which were performed using appropriate devices manufactured by Technogym®, Italy; older women: seated chest press, *latissimus* pull down, seated row, knee extension, and leg press exercises, which were performed using appropriate devices manufactured by Biodelta Equipment®, Brazil). Initially, volunteers performed the exercises with no load, and subsequently, the load was calibrated based on the rating of perceived exertion (6-8 on a 10-point scale). During this period, volunteers learned how to perform the exercises correctly, learned an adequate respiratory technique (expiration during the concentric phase), performed each exercise at an adequate velocity of execution (1- to 2-sec concentric and 2- to 3-sec eccentric action), and took adequate rest intervals (120 s intersets and 180 s interexercises). Approximately 5-10 min of upper- and lower-extremity mobility and stretching exercises preceded and followed all sessions during the acclimation period.[8]

One repetition maximum test

1RM was determined as the maximum amount of weight a subject could move once, using the proper technique. “Proper technique” was defined as the subject performing each resistance exercise using the specified muscle groups and without using momentum or changes in body position to apply force.[8]

Load and muscle strength

Absolute load indicates the total load, i.e., the weight moved in the 1RM test. The relative load is the total load adjusted to body mass and lean body mass.[8] Thus, our cutoffs are presented as absolute and relative loads. We also developed an indicator of whole body muscle strength (WBMS), which in men, was the sum of loads on the chest press, leg press, vertical traction, abdominal, leg curl and lower back exercises. In women, WBMS was characterized as the sum of loads on the chest press, leg press, latissimus pull down, knee extension and seated row exercises.

Statistical analysis

The Shapiro-Wilk test was used to analyze data normality. The Pearson product-moment correlation coefficient was used to determine the univariate associations of muscle force with body mass or lean body mass. A principal component analysis was calculated that included chest press, leg press, vertical traction, abdominal crunch, arm curl and back extension. Hierarchical multiple regression analyses were also performed to develop prediction equation models for whole-body muscle strength as a function of age, absolute load, body mass, and lean body mass. All analyses were performed using the *Predictive Analytics Software* 17.0 version for Windows package (PASW, Inc., Chicago, IL). Data are presented as the mean ± the standard error of the mean.

RESULTS

General demographics

With few exceptions, our subjects fell into the "young-old" age category regardless of gender. The average body mass index and fat mass were within normal ranges (Table 1).

Association between body composition and load

Body mass was significantly correlated with load in all exercises for both genders. The same phenomenon was observed for lean body mass, but in this case, only for men. In contrast, lean body mass correlated with chest press, knee extension, and seated row only in women; in the first two exercises, the correlation was higher for lean body mass (data not shown).

Cutoffs and absolute and relative load

We established cutoffs for each exercise based on the absolute and relative load (adjusted for body mass and lean body mass). These cutoffs were higher when the load was matched for lean body mass regardless of gender (Tables 2 and 2A).

Principal components analysis (PCA)

We submitted the men (vertical traction, biceps curl, triceps extension, abdominal, leg curl, leg press and lower back) and women exercise data (chest press, latissimus pull down, leg press, knee extension and seated row) to the principal component analysis (PCA) analysis. The Kaiser-Meyer-Olkin value was 0.82 for men and 0.79 for women, and Bartlett's test of sphericity attained statistical significance (p = 0.001) in both genders. PCA revealed that its first component only had an Eigenvalue exceeding 1 for both men (3.989) and women (2.968), which explained 54% and 59.5% of the variance, respectively (Table 3).

Prediction models

We developed prediction models to estimate WBMS as a function of absolute load for each exercise and adjusted for important covariates, such as age, body mass, and lean body mass (Tables 5 and 6). The predictive power of all models was age independent only for women (Table 6); for men, all outputted models reached statistical significance. We present only the first three models based on the standard error of estimate (Tables 5 and 6).

In men, the leg press exercise, when modeled either with body mass (77% and 30.72 kg) or lean body mass (73% and 33.44 kg), was more accurate than other exercises For women, the model using the latissimus pull down exercise demonstrated elevated predictive power and a low standard error of estimate, regardless of the variable included in the model (body mass [81% and 11.09 kg] or lean body mass [82% and 11.01 kg]). The

Table 1 - Sample population demographics*

	Male (N = 150)	Female (N = 39)
Age (years)	68.7 ± 0.3 (64.0 – 82.0)	68.1 ± 0.7 (61.0 – 77.0)
Body height (m)	1.69 ± 0.01 (1.52 – 1.87)	1.55 ± 0.01 (1.43 – 1.71)
Body composition		
Body mass (kg)	75.4 ± 1.0 (53.4 – 107.1)	61.7 ± 1.8 (43.8 – 80.0)
Body mass index (kg•m^2)	26.3 ± 0.3 (17.0 – 35.4)	25.5 ± 0.7 (18.4 – 35.6)
Lean body mass (kg)	53.9 ± 0.6 (39.2 – 75.3)	42.4 ± 0.9 (35.4 – 57.5)
Fat mass (%)	27.9 ± 0.6 (7.6 – 45.3)	31.4 ± 0.9 (18.0 – 43.0)
Muscle strength		
Chest press (kg)	42.1 ± 0.7 (22.7 - 70.3)	18.4 ± 0.5 (10.0 – 25.0)
Latissimus pull down (kg)		34.1 ± 1.5 (20.0 – 57.5)
Vertical traction (kg)	69.5 ± 1.7 (40.8 - 181.4)	
Seated row (kg)		36.3 ± 0.7 (25.0 – 52.5)
Triceps extension (kg)	44.5 ± 1.1 (22.7 - 77.1)	
Arm curl (kg)	22.3 ± 0.7 (6.8 - 43.1)	
Abdominal crunch (kg)	29.0 ± 0.6 (15.9 - 56.7)	
Lower back (kg)	46.4 ± 0.9 (22.7 - 88.5)	
Leg press (kg)	112.9 ± 2.5 (54.4 - 226.8)	74.8 ± 1.6 (50.0 – 100.0)
Knee extension (kg)		24.1 ± 0.9 (15.0 – 37.5)
Leg curl	42.5 ± 0.7 (27.2 - 77.1)	
Whole-body muscle strength (kg)		

*Values are shown as the mean ± SEM (min - max).

Table 2 - Cutoffs for the absolute and relative load in distinct exercises for men

	Percentiles				
	< 20	20 – 40	40 – 60	60 – 80	> 80
Chest press					
Absolute load (kg)*	< 34.02	34.03 - 38.56	38.57 - 45.36	45.37 - 49.90	> 49.91
Load by BM ($kg \cdot kg^{-1}$)	< 0.45	0.46 - 0.53	0.54 - 0.60	0.61 - 0.67	> 0.68
Load by LBM ($kg \cdot kg^{-1}$)	< 0.66	0.67 - 0.73	0.74 - 0.81	0.82 - 0.91	> 0.92
Leg press					
Absolute load (kg)	< 90.72	90.73 - 99.79	99.80 - 117.93	117.94 - 136.08	> 136.09
Load by BM ($kg \cdot kg^{-1}$)	< 1.20	1.21 - 1.42	1.43 - 1.57	1.58 - 1.82	> 1.83
Load by LBM ($kg \cdot kg^{-1}$)	< 1.72	1.73 - 1.91	1.92 - 2.20	2.21 - 2.44	> 2.45
Vertical traction					
Absolute load (kg)	< 54.43	54.44 - 63.50	63.51 - 68.04	68.05 - 77.11	> 77.12
Load by BM ($kg \cdot kg^{-1}$)	< 0.78	0.79 - 0.87	0.88 - 0.93	0.94 - 1.02	> 1.03
Load by LBM ($kg \cdot kg^{-1}$)	< 1.10	1.11 - 1.20	1.21 - 1.30	1.31 - 1.37	> 1.38
Abdominal					
Absolute load (kg)	< 22.68	22.69 - 27.22	27.23 - 29.48	29.49 - 34.02	> 34.03
Load by BM ($kg \cdot kg^{-1}$)	< 0.32	0.33 - 0.36	0.37 - 0.41	0.42 - 0.46	> 0.47
Load by LBM ($kg \cdot kg^{-1}$)	< 0.44	0.45 - 0.50	0.51 - 0.56	0.57 - 0.63	> 0.64
Leg curl					
Absolute load (kg)	< 36.29	36.30 - 40.82	40.83 - 44.23	44.24 - 49.90	> 49.91
Load by BM ($kg \cdot kg^{-1}$)	< 0.47	0.48 - 0.55	0.56 - 0.59	0.60 - 0.66	> 0.67
Load by LBM ($kg \cdot kg^{-1}$)	< 0.68	0.69 - 0.75	0.76 - 0.83	0.84 - 0.90	> 0.91
Lower back					
Absolute load (kg)	< 36.29	36.30 - 43.09	43.10 - 47.63	47.64 - 54.43	> 54.44
Load by BM ($kg \cdot kg^{-1}$)	< 0.53	0.54 - 0.59	0.60 - 0.64	0.65 - 0.71	> 0.72
Load by LBM ($kg \cdot kg^{-1}$)	< 0.74	0.75 - 0.82	0.83 - 0.90	0.91 - 0.98	> 0.99
Arm curl					
Absolute load (kg)	< 15.88	15.89 - 20.41	20.42 - 24.95	24.96 - 27.22	> 27.23
Load by BM ($kg \cdot kg^{-1}$)	< 0.24	0.25 - 0.28	0.29 - 0.31	0.32 - 0.36	> 0.37
Load by LBM ($kg \cdot kg^{-1}$)	< 0.35	0.36 - 0.39	0.40 - 0.43	0.44 - 0.48	> 0.49
Triceps extension					
Absolute load (kg)	< 34.02	34.03 - 41.96	41.97 - 47.63	47.64 - 52.16	> 52.17
Load by BM ($kg \cdot kg^{-1}$)	< 0.50	0.51 - 0.57	0.58 - 0.63	0.64 - 0.70	> 0.71
Load by LBM ($kg \cdot kg^{-1}$)	< 0.69	0.70 - 0.78	0.79 - 0.88	0.89 - 0.98	> 0.99

BM: body mass; LBM: lean body mass.

model constituted by age, lean body mass, and leg press also provided significant accuracy for women. Other single models and the model comprising the chest press plus body mass showed similar predictive power and standard errors of the estimate (Table 5 and 6).

DISCUSSION

Our data offers substantial information, which may be considered as norm-referenced standards for the 1RM test in clinically healthy and sedentary older individuals. Our results also support the idea that load correlates with body mass and lean body mass; the load used for a specific exercise is significantly associated with WBMS and allows the development of predictive models of WBMS with significant accuracy. To the best of our knowledge, no previous reports exist demonstrating that the load used in a certain exercise represents an important predictor of WBMS regardless of age and, in some cases, regardless of body mass or lean body mass.

Table 3 - Cutoffs for the absolute and relative load in distinct exercises for women

	Percentiles				
	<20	20 – 40	40 – 60	60 – 80	>80
Chest press					
Absolute load (kg)*	< 15	15.1 – 17.5	17.6 – 20.0	> 20.1	
Load by BM (kg•kg^{-1})	< 0.25	0.26 – 0.28	0.29 – 0.33	0.34 – 0.36	> 0.37
Load by LBM (kg•kg^{-1})	< 0.37	0.38 – 0.41	0.42 – 0.46	0.47 – 0.51	> 0.52
Horizontal leg press					
Absolute load (kg)	< 71	71 – 76	76 – 81	81 – 84	> 84
Load by BM (kg•kg^{-1})	< 1.05	1.06 – 1.18	1.19 – 1.29	1.30 – 1.43	> 1.44
Load by LBM (kg•kg^{-1})	< 1.62	1.63 – 1.71	1.72 – 1.80	1.81 – 2.02	> 2.03
Latissimus pull down					
Absolute load (kg)	< 26	26 – 31	31 – 35	36 – 41	> 41
Load by BM (kg•kg^{-1})	< 0.45	0.46 – 0.53	0.54 – 0.60	0.61 – 0.68	> 0.69
Load by LBM (kg•kg^{-1})	< 0.62	0.63 – 0.74	0.75 – 0.86	0.87 – 1.00	> 1.01
Knee extension					
Absolute load (kg)	< 20.0	20.1 – 22.5	22.6 – 25.0	25.1 – 30.0	> 30.1
Load by BM (kg•kg^{-1})	< 0.34	0.35 – 0.37	0.38 – 0.41	0.42 – 0.46	> 0.47
Load by LBM (kg•kg^{-1})	< 0.50	0.51 – 0.55	0.56 – 0.58	0.59 – 0.63	> 0.64
Seated row					
Absolute load (kg)	< 34	34 – 36	36 – 39	39 – 41	> 41
Load by BM (kg•kg^{-1})	< 0.53	0.54 – 0.59	0.60 – 0.61	0.62 – 0.66	> 0.67
Load by LBM (kg•kg^{-1})	< 0.81	0.82 – 0.84	0.85 – 0.90	0.91 – 0.96	> 0.97
WBMS (kg)					
Absolute load (kg)	< 170	170.01 – 177.50	177.51 – 192.50	192.51 – 205.00	> 205.01
Load by BM (kg•kg^{-1})	< 2.74	2.75 – 3.07	3.08 – 3.28	3.29 – 3.38	> 3.39
Load by LBM (kg•kg^{-1})	< 4.01	4.02 – 4.44	4.45 – 4.60	4.61 – 4.86	> 4.87

*Only four cutoff points were generated due to granularity in the data (thus, data are in quartile format: P_0–P_{25}, P_{25}–P_{50}, P_{50}–P_{75}, P_{75}–P_{100}). BM: Body mass, LBM: Lean body mass, WBMS: Whole-body muscle strength.

On the other hand, these data may have limited generalizability because the models were developed in a selected group of clinically healthy older individuals. Certainly, further studies are required to determine the ability of our models to predict WBMS in groups of individuals whose demographics vary substantially from the range of our sample (e.g., physical activity level, health status, disease severity).

It is also important to consider that evidence from populations with different lifestyles may simply characterize the consequences of their respective lifestyles rather than the inevitable expression of aging.[10] Therefore, our study is relevant because a significant proportion of our findings may be explained by aging *per se* (due to the fact that these volunteers were selected using rigorous eligibility criteria). But these subjects may represent a homogeneous group of people with an elevated predisposition to health care and who volunteer to participate in research projects. In this way, a certain degree of caution should be considered for our results particularly if our cutoffs are compared with older individuals with transmissible or non-transmissible diseases.

The performance of activities of daily living is dependent upon muscle strength, which may be used objectively as a preclinical marker of mobility limitations.[13-15] Our norm-referenced standards may assist in identifying individuals who are susceptible to mobility limitations or individuals with a neuromuscular reserve that could be used to protect against mobility limitations.[11]

The multiple regression model obtained using combined variables (i.e., load with a certain body composition parameter) showed improved sensitivity.

For women, when estimating WBMS, the inclusion of body mass or lean body mass increased the R^2 from 0.41 (model 6) to 0.82 (model 5); this accounts for the additional 41% of the variability for the WBMS. Moreover, an important decrease was observed in the standard error of estimate (SEE), and the following predictive equation (R = 0.90, SEE=11.01 kg, p < 0.0005) was obtained: WBMS = 75.788 +

Table 4 - Vectors for the principal component analysis of data from the men and women

	Men			Women		
Component	First	Second	Third	First	Second	Third
% of variance explained	57.0	11.5	10.3	59.5	16.0	11.0
Abdominal	.330	.837				
Biceps curl	.715	.331	.393			
Chest press					.913	
Knee extension					.646	.546
Latissimus pull down				.716		.483
Leg curl	.165	.782	.359			
Leg press	.324		.834	.937		
Lower back	.183	.436	.741			
Seated row						.896
Triceps	.640	.364	.370			
Vertical traction	.922	.165	.155			

Table 5 - Predictive models to estimate whole-body muscle strength as a function of absolute load and body composition for men

Prediction model		Variable	Coefficients	SE	B	P	Constant	R(R²)	SEE	P
		Age	-3.140	.733	-.173	.0005				
	1	Body mass	1.236	.236	.226	.0005	290.33	.88 (0.77)	30.72	.0005
		Leg press	1.549	.093	.726	.0005				
		Age	-1.897	.912	-.105	.039				
Body mass	2	Body mass	1.953	.273	.357	.0005	141.40	.82 (0.66)	37.31	.0005
		Chest press	4.378	.364	.620	.0005				
		Age	-1.962	.992	-.108	.050				
	3	Body mass	1.134	.326	.207	.001	258.97	.78 (0.60)	40.40	.0005
		Vertical traction	1.914	.189	.626	.0005				
		Age	-3.298	.798	-.182	.0005	343.25	0.86 (0.73)	33.44	.0005
	4	Lean body mass	.415	.374	.049	.0005				
		Leg press	1.737	.094	.815	.0005				
		Age	-1.997	1.035	-.110	.031	362.10	0.76 (0.56)	42.32	.0005
Lean body mass	5	Lean body mass	-1.373	.477	-.161	.0005				
		Chest press	5.151	.409	729	.0005				
		Age	-1.824	1.033	-.101	.046	319.77	0.76 (0.57)	42.09	.0005
	6	Lean body mass	-.082	.468	-.010	.0005				
		Vertical traction	2.218	.174	.726	.0005				
	7	Age	-3.313	.795	-.183	.0005	375.44	0.86 (0.73)	33.47	.0005
		Leg press	1.726	.094	.809	.0005				
Univariate	8	Age	-1.822	1.025	-.100	.078	313.56	0.76 (0.57)	41.94	.0005
		Vertical traction	2.220	.173	.726	.0005				
	9	Age	-2.130	1.057	-.117	.046	280.71	0.74 (0.54)	43.40	.0005
		Chest press	4.950	.411	.701	.0005				

*The models were outputted regardless of age; SE: standard error; SEE: standard error of estimate (kg).

Table 6 - Predictive models to estimate whole-body muscle strength as a function of absolute load and body composition for women*

Prediction model		Variable	Coefficients	SE	B	p	Constant	R(R^2)	SEE	p
Body mass	1	Chest press	4.215	1.030	0.534	0.0005	67.351	0.70 (0.49)	18.30	0.0005
		Body mass	0.694	0.296	0.306	0.025				
	2	Leg press	1.862	0.245	0.731	0.0005	13.384	0.85 (0.72)	13.62	0.0005
		Body mass	0.569	0.218	0.251	0.014				
	3	Latissimus pull down	2.260	0.221	0.819	0.0005	85.928	0.90 (0.81)	11.09	0.0005
		Body mass	0.401	0.182	0.177	0.035				
Lean body mass	4	Leg press	1.909	0.240	0.750	0.0005	-3.337	0.85 (0.73)	13.47	0.0005
		Lean body mass	1.139	0.415	0.258	0.010				
	5	Latissimus pull down	2.288	0.217	0.829	0.0005	75.788	0.90 (0.82)	11.01	0.0005
		Lean body mass	0.799	0.347	0.181	0.028				
Univariate model	6	Chest press	5.063	1.010	0.641	0.0005	94.517	0.64 (0.41)	19.43	0.0005
	7	Knee extension	3.322	0.553	0.708	0.0005	107.544	0.71 (0.50)	17.91	0.0005
	8	Seated row	4.054	0.657	0.717	0.0005	40.432	0.72 (0.51)	17.65	0.0005

*The models were outputted regardless of age; SE: standard error; SEE: standard error of estimate (kg).

(2.288 × load in kg of latissimus pull down) + (0.799 × lean body mass in kg). The most practical equation was WBMS = 85.928 + (2.260 × load in kg of latissimus pull down) + (0.401 × body mass in kg; R = 0.90, SEE = 11.09 kg, $p < 0.0005$).

For men, the most practical equation was WBMS = 375.44 - (3.313 × age in years) + (1.726 × load in kg of leg press; R = 0.86, SEE = 33.47 kg, $p < 0.0005$). However, the inclusion of either body mass (WBMS = 290.33 – [3.140 × age in years] + [1.236 × body mass in kg] + [1.549 × load in kg of leg press]) or lean body mass (WBMS = 343.25 – [3.298 × age in years] + [.415 × lean body mass in kg] + [1.737 × load in kg of leg press]) decreased the standard error of estimate.

Some practical implications should be noted. Our predictive models may be used by clinicians and therapists in the management of load during exercise sessions as well as for the estimate of the whole-body muscle strength with satisfactory accuracy.

In conclusion, our data supports the idea that load correlates with body mass and lean body mass, and that the load used for a specific exercise is significantly correlated with WBMS, allowing the development of satisfactory models to predict WBMS in older individuals.

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CONFLICTS OF INTEREST

The authors declare that they have no further conflict of interest.

AUTHOR CONTRIBUTIONS

Study concept and design: Raso V. Acquisition of data: Boscolo RA, Grassmann V, Santana MG, Viana VAR, and Raso V. Analysis and interpretation of data: Raso V. Drafting of the manuscript: Raso V. Critical revision of the manuscript for important intellectual content: Cassilhas RC, Mello MT and Raso V. Statistical analysis: Raso V. Administrative, technical, or material support: Mello MT and Tufik S. Study supervision: Mello MT and Tufik S.

PREDITORES DE FORÇA MUSCULAR EM IDOSOS

OBJETIVO: Analisar as relações entre carga, massa corporal e massa magra na tentativa de fornecer normas padrão de referencia para o teste de uma repetição máxima e predizer a forca muscular corporal em idosos.

MÉTODOS: A massa corporal, a massa magra e o teste de uma repetição máxima (1RM) foram medidos em 189 idosos com idade entre 61 e 82 anos. A forca muscular corporal (FMC) foi calculada como a somatória das cargas dos diferentes exercícios.

RESULTADOS: Para mulheres, a inclusão da massa corporal ou da massa magra aumentou o R^2 de 0.41 para 0.82, e resultou na equação: FMC = 75.788 + (2.288 × carga em kg para

o puxador) + (0.799 × massa magra em kg). Para homens, a inclusão da massa corporal (FMC = 290.33 – [3.140 × idade em anos] + [1.236 × massa corporal em kg] + [1.549 × carga em kg para o leg press]) ou da massa magra (FMC = 343.25 – [3.298 × idade em anos] + [.415 × massa magra em kg] + [1.737 × carga em kg para o leg press]) diminuiu o erro padrão da estimativa.

CONCLUSÃO: Nossos resultados suportam a ideia de que a carga correlaciona-se com a massa corporal e massa magra, e que a carga empregada em determinado exercício está significativamente associada com a forca muscular corporal. Portanto, isso permite o desenvolvimento de um modelo preditivo de forca muscular corporal com substancial acurácia.

PALAVRAS-CHAVE: Envelhecimento, forca muscular, exercícios com pesos.

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