Duke University School of Medicine
Doctor of Physical Therapy

Rating of Perceived Exertion to Approximate %1RM in Resistance Training

Claire Hsing, SPT[1], Nicholas Mahaffey, SPT[1], Trac Norris, SPT[1], Thomas Bandholm, PhD[2],
Michael R. Reiman, PT, DPT, OCS, SCS, ATC/L, FAAOMPT, CSCS[1]
[1]Duke University, [2]Physical Medicine & Rehabilitation Research - Copenhagen

Background

Subjective reports of exercise intensity have historically been captured using standardized ratings of perceived exertion. Patient reported ratings on these scales are frequently applied to endurance exercise testing and have been validated in terms of their relationship to heart rate, VO_2max and blood lactate. To date, **limited research** has been conducted on the **application** of this tool in **resistance training** and its utilization in exercise prescription.

Borg Rating of Perceived Exertion (RPE)

6	Zero exertion
7	Very easy
8	Minimal recognition of effort
9	Very light
10	Can start to hear own breathing
11	Speaking during exercise is easy
12	Light exertion
13	Somewhat hard
14	Audible breathing, not struggling
15	Can speak during exercise, not in full sentences
16	Hard
17	Very hard
18	Heavy breathing, no longer able to speak during exercise
19	Extremely hard
20	Maximal exertion

Purpose

1. This systematic review examines the available research that focuses on the application of **subjective perceived exertion to strength training**
2. The studies reviewed the **concurrent validity of a subjective RPE measurement** compared to a lifted load quantified as %1RM
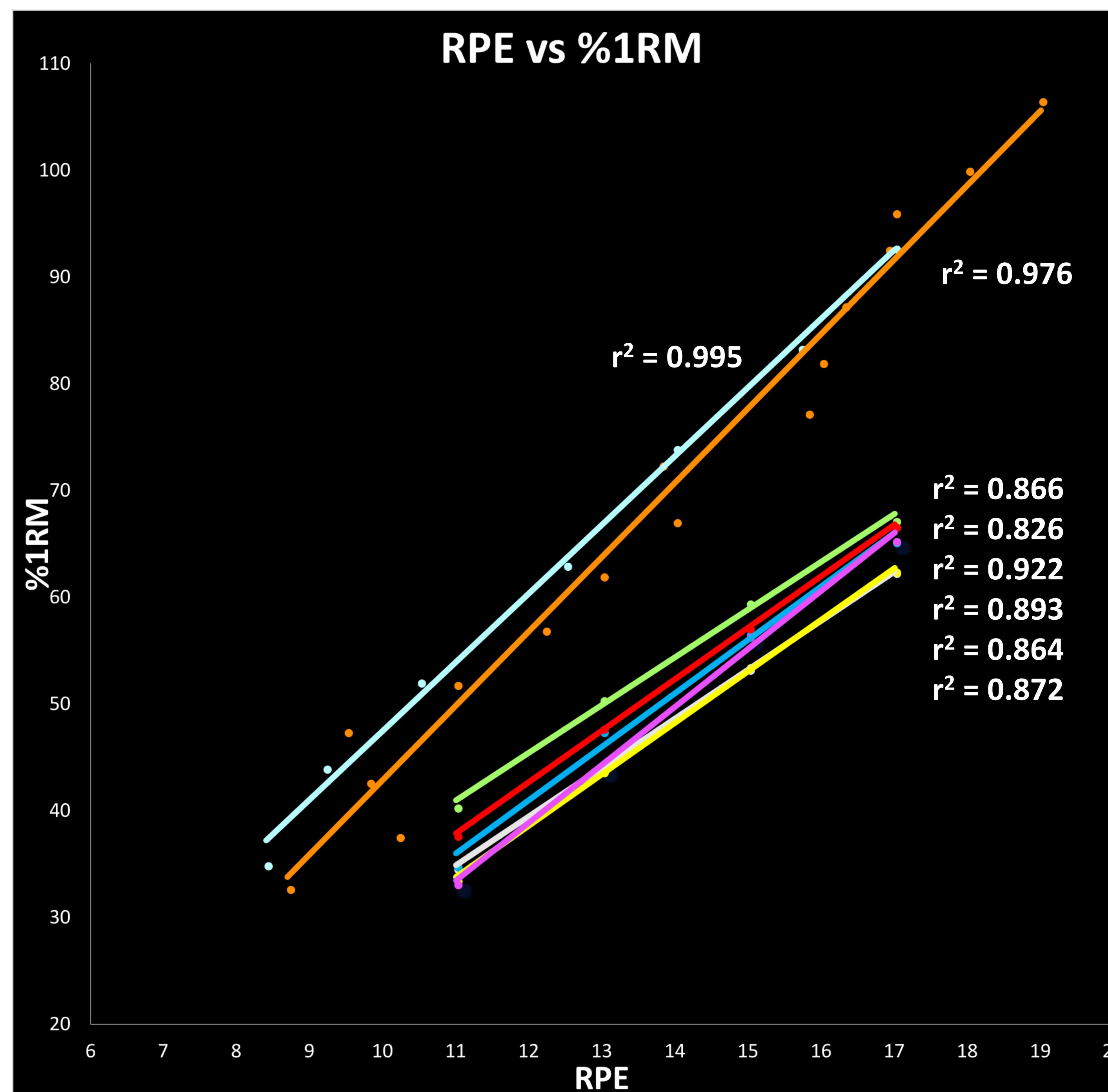
Methods

Study Design
- Systematic Review
- Embase, Medline, Cochrane, and SportDiscus

Inclusion Criteria
- Healthy subjects >19 years old
- Any form of resistance training used
- Resistance training focused on <15 repetitions
- Subjective rating reported with Borg, Modified Borg CR-10, or OMNI-RES scales
- Reported results with sufficient detail to allow for calculation of concurrent validity
- Studies written in English

https://lorimichielfitness.com/wp-content/uploads/2014/09/Photo_20100513_YMCA_Seniors_0787_HR.jpeg

Results

RPE vs %1RM

$r^2 = 0.976$
$r^2 = 0.995$
$r^2 = 0.866$
$r^2 = 0.826$
$r^2 = 0.922$
$r^2 = 0.893$
$r^2 = 0.864$
$r^2 = 0.872$

Interpretation of r^2 correlation	$0 < r^2 < 0.3$	$0.3 < r^2 < 0.7$	$0.7 < r^2 < 1.0$
	Low Correlation	Moderate Correlation	High Correlation

	Author	Subject	Exercise
	Row et. al (2012)	21 adults >65 yo	Leg Press
	Row et. al (2016)	20 adults >60 yo	Chest Press
	Tiggeman et. al (2010)	10 strength-trained males 18-34 yo	Bench Press
	Tiggeman et. al (2010)	10 strength-trained males 18-34 yo	Leg Press
	Tiggeman et. al (2010)	10 physically active males 18-34 yo	Bench Press
	Tiggeman et. al (2010)	10 physically active males 18-34 yo	Leg Press
	Tiggeman et. al (2010)	10 sedentary males 18-34 yo	Bench Press
	Tiggeman et. al (2010)	10 sedentary males 18-34 yo	Leg Press

Results

Most studies fit a regression line to their data, replicated here with lines over data points representing mean %1RM taken for each RPE tested. Data was collected for a variety of exercises and in varying test subject ages. The r^2 for each line indicates how accurately the linear model accounts for the correlation between RPE and %1RM.

- Older adults experienced a steeper rate of change in %1RM with each increase in RPE relative to the younger adults
- Among young adults, the corresponding %1RM was higher for any given RPE as the activity level or strength-training background of the test subject increased

Conclusions

Subjective reporting of RPE using standardized scales such as the Borg RPE scale can approximate %1RM in healthy populations across the adult lifespan. The application for individual rehabilitation remains to be seen since only healthy, non-pathological individuals were assessed in the studies included in this systematic review.

Training Goal	%1RM						
	100% 95% 90%	85%	80%	75%	70%	65%	
Strength	**Strength**	Strength	Strength	Strength			
Power	**Power**	Power	Power	Power			
	Hypertrophy	Hypertrophy	**Hypertrophy**	Hypertrophy	Hypertrophy		
	Muscular Endurance	Muscular Endurance	**Muscular Endurance**				
	1 3 4 5 6	7 8 9 10 11 12	13 14 15 16 17 18 19 20				

Repetitions

Clinical Relevance

- Due to the high correlation between RPE measurements and %1RM, a subjective RPE scale can be used to **self-direct** a resistance training program
- Populations for whom 1RM testing is impractical or unsafe, such as **rehabilitation** or **untrained elderly patients**, can still approximate %1RM based upon their subjective RPE
- Subjective RPE can also help account for **external stress factors** that impact performance, such as diet, sleep, and baseline fatigue from previous activity

Acknowledgements / References