Health and Social Care Institute

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Inter-Individual Variation in Response of VO_2Peak & Body Mass to Exercise Training

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Background to 'Precision Medicine'

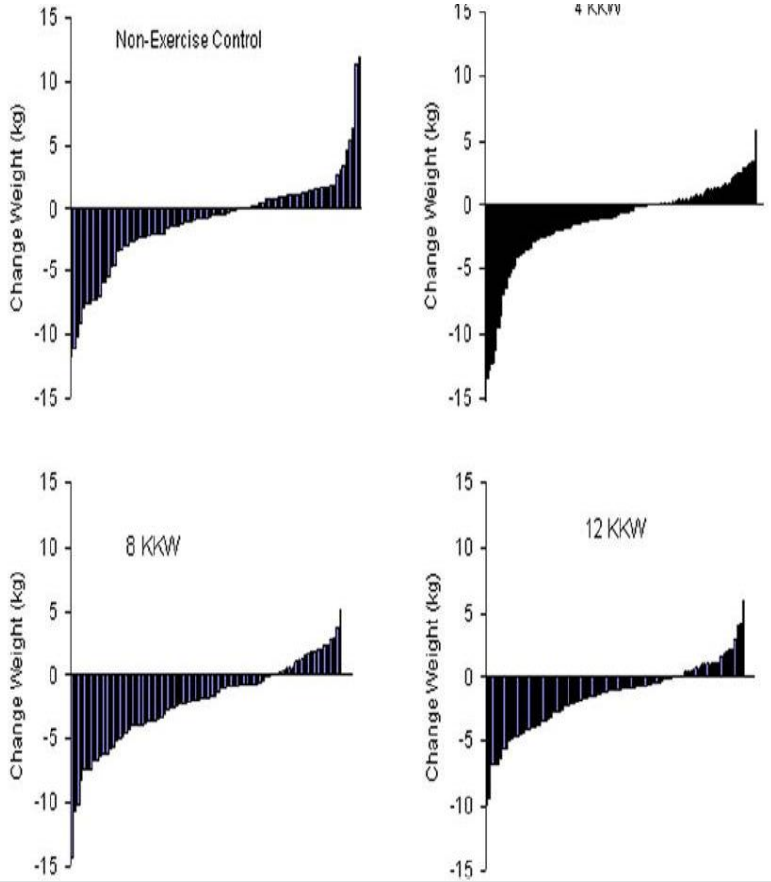
Personalized Preventive Medicine: Genetics and the Response to Regular Exercise in Preventive Interventions

Claude Bouchard[a,*], Ligia M. Antunes-Correa[b], Euan A. Ashley[c,d], Nina Franklin[e], Paul M. Hwang[f], C. Mikael Mattsson[c,g], Carlos E. Negrao[b,h], Shane A. Phillips[e], Mark A. Sarzynski[a], Ping-yuan Wang[f], Matthew T. Wheeler[c,d]

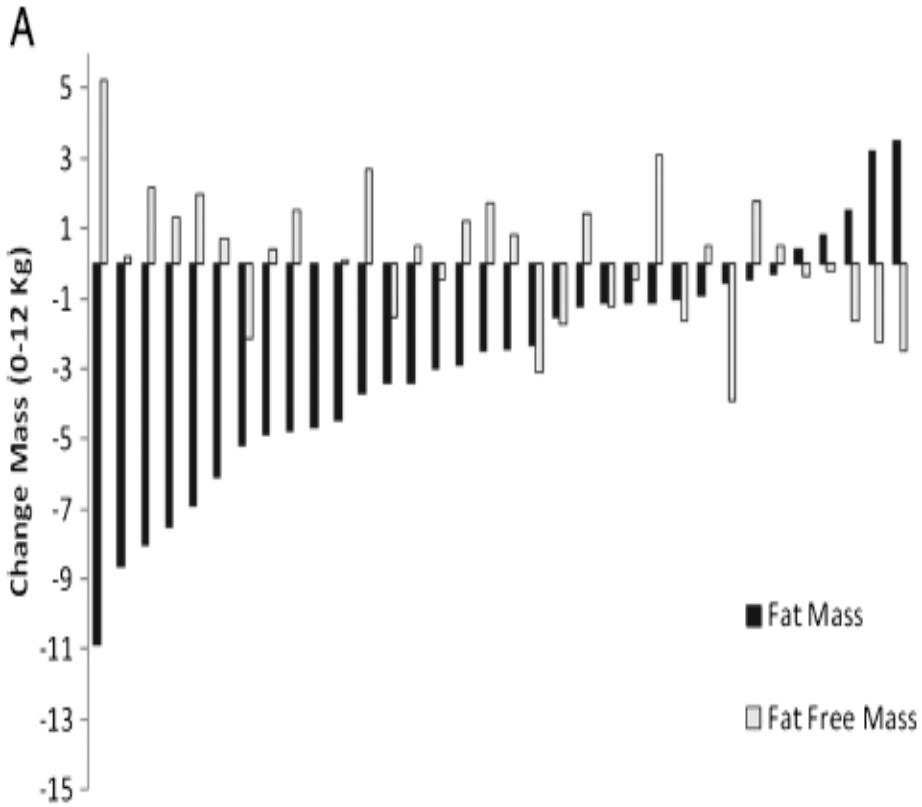
The mean response of a sample '*fails to recognize that there are considerable inter-individual differences in responses to any exercise program*'

(Bouchard *et al*., 2014; p.2[1]).

The Importance of a Control Group



Church *et al*., *Sports Med.* 2009;41:539 [2].



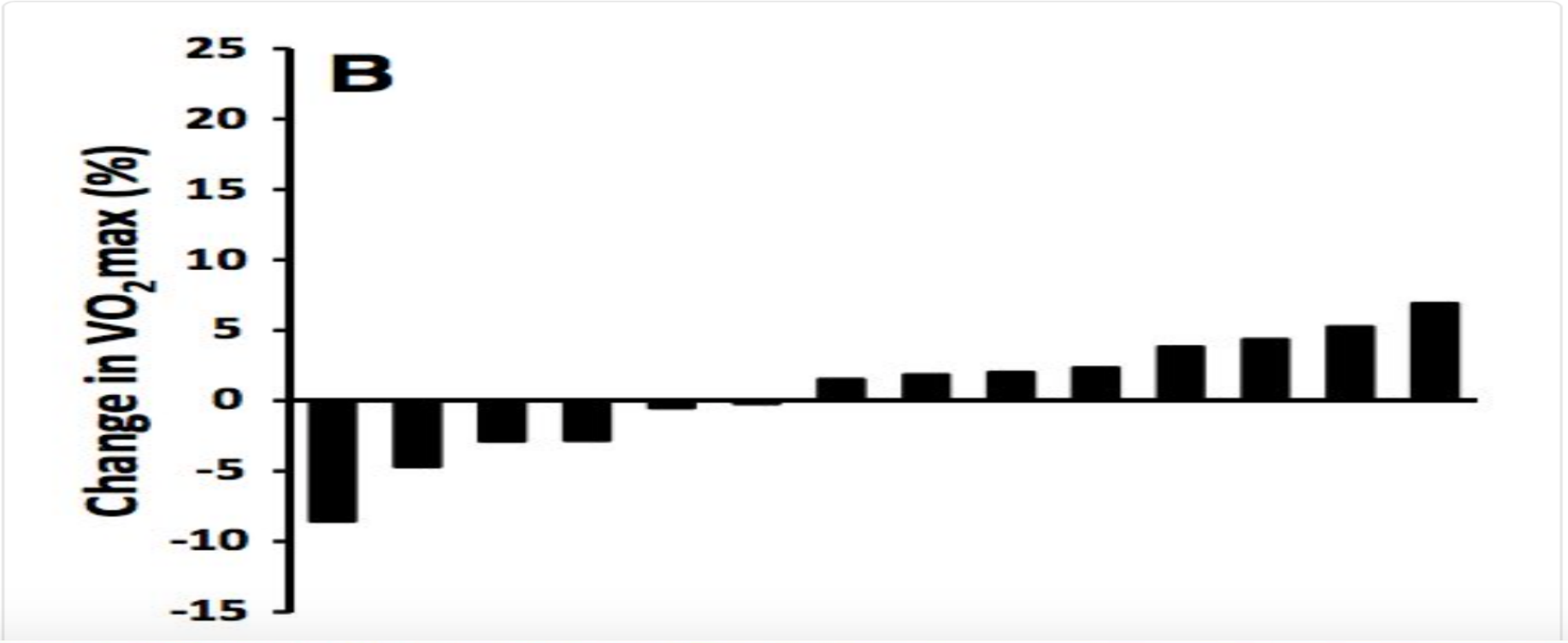
Caudwell *et al*., *Med Sci Sports Exer*. 2013;45:351 [3]

Therefore, we need data from a comparator group for reliable quantification of individual differences.

David J Bishop
@BlueSpotScience

Following

Looks like an impressive example of 'Individual Response to Training'....until you realise it is the control group
buff.ly/2IDLylc



Individual Difference in Exercise Response: The "error" in the way

	Test-retest study	mean change = 10	mean change = 50	mean change = 100
mean	-3.7	10.6	52.7	104.1
SD_{diff}	168.8	174.3	165.4	169.4
TEM	119.4	123.3	117.0	119.8
Sample size	1000	1000	1000	1000
No. non-responders	762	739	658	535
% non-responders	76.2	73.9	65.8	53.5

All four of the above samples (including the test-retest sample) have **very similar** individual differences in VO_2peak response. This can be seen by the similar SDs of the change scores (SD_{diff}) of 165-174 ml/min. Now what researchers have been doing is counting how many people show change scores below a certain threshold increase (say <120 ml/min). This **"non-responder" threshold** is often selected as the **Technical Error of Measurement (TEM)** from the test-retest sample (**a mistake in itself**). Anyway, researchers get excited when they see more or less "non-responders" in certain samples. This is **not** necessarily a sign at all that individual differences in response are more or less in certain samples. In the above cases, it's simply just a reflection of **shifts in the whole distribution (including the tails) of change scores** as the sample mean changes. Note that the TEMs are also **very similar** between these samples. Therefore, **none of the samples show individual differences in VO_2peak response that are above those expected due to random within-subject variability over time.**

Are We Too Late?

Sports Medicine

August 2017, Volume 47, Issue 8, pp 1501–1513 | Cite as

Inter-Individual Responses of Maximal Oxygen Uptake to Exercise Training: A Critical Review

Authors | Authors and affiliations

Philip J. Williamson, Greg Atkinson, Alan M. Batterham

Review Article

First Online: 17 January 2017

The mean response of a sample "*fails to recognize that there are considerable inter-individual differences in responses to any exercise program*"
(Bouchard *et al*., 2014; p.2).

Weight Change Systematic Review and Meta Analysis

- In previous individual differences in weight change studies, suitable comparator groups **STILL** typically absent, ignored, or the data are otherwise analysed inappropriately.
- 14 electronic databases searched for relevant studies up to March 2017.
- Search terms focused on structured training, RCTs and body weight.

Weight Change Systematic Review and Meta Analysis

- Results sifted these results for those RCTs (*n*=12, 1500 participants) that included relevant comparator groups.
- Standard deviations (SD) of weight change, and thereby the SD for true inter-individual differences in weight-loss for each study, were extracted.
- Prediction Interval (PI) for future studies was also derived.

Weight Change Systematic Review and Meta Analysis

- Pooled SD (95% CI) for true individual responses was **0.63** (-0.8 to 2.1) kg.
- The 95% prediction interval (based on 2 × SD) for true inter-individual responses was -2.0 to 3.3 kg.

The probability (% chances) that this individual response variability would, in a future study in similar settings, be clinically meaningful (>2.5 kg) is only 23%.

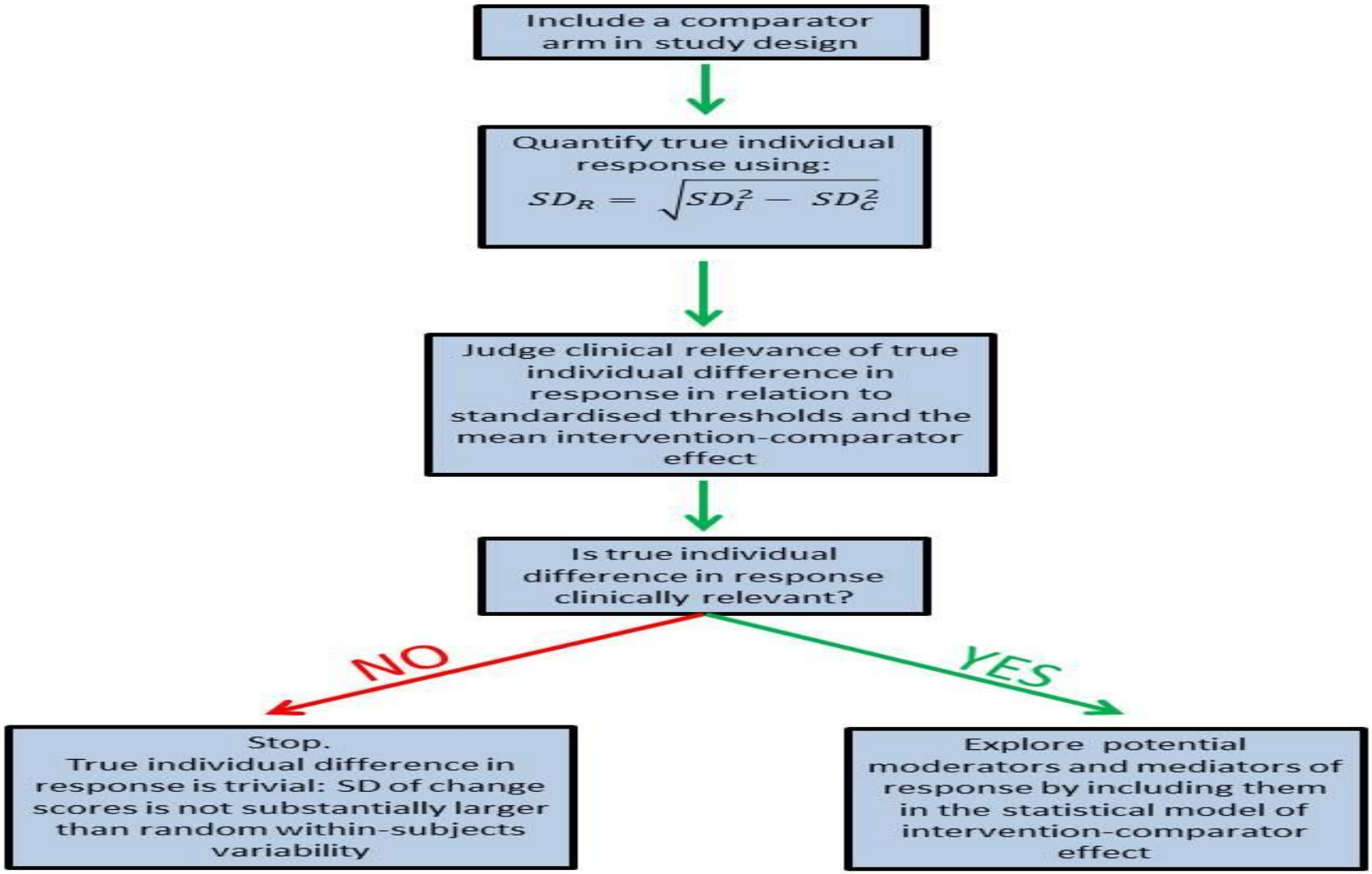
Weight Change Systematic Review and Meta Analysis

Model	Study name	Statistics for each study							Point estimate and 95% CI	Weight (Random)
		Point estimate	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value	-20.00 -10.00 0.00 10.00 20.00	Relative weight
	Baillot	-3.110	9.950	99.003	-22.612	16.392	-0.313	0.755		0.18
	Burtscher	-2.710	10.170	103.429	-22.643	17.223	-0.266	0.790		0.17
	Church	0.950	1.930	3.725	-2.833	4.733	0.492	0.623		4.68
	Dalager	1.480	1.440	2.074	-1.342	4.302	1.028	0.304		8.40
	Dognes	1.370	0.750	0.563	-0.100	2.840	1.827	0.068		30.96
	Donelly	3.940	6.230	38.813	-8.271	16.151	0.632	0.527		0.45
	Lockwood	1.000	1.810	3.276	-2.548	4.548	0.552	0.581		5.32
	Prabhakara	-1.490	1.890	3.572	-5.194	2.214	-0.788	0.430		4.87
	Schmitz	0.430	1.340	1.796	-2.196	3.056	0.321	0.748		9.70
	Tan	1.060	0.840	0.706	-0.586	2.706	1.262	0.207		24.68
	Teixeira	-1.670	1.490	2.220	-4.590	1.250	-1.121	0.262		7.84
	Vilela	0.000	2.510	6.300	-4.920	4.920	0.000	1.000		2.76
Random		0.753	0.417	0.174	-0.065	1.571	1.805	0.071		

Future Directions

- A ‘road-map’ for future studies has been presented:
  - Inter-individual differences in response should be quantified properly and judged for clinical importance FIRST.
  - If above is true, only then should moderators and mediators of response be explored for.

Future Research 'Road Map'



Atkinson & Batterham, *Exp Physiol.* 2015;100:577 [(9)].

Conclusions

- In HERITAGE and more recent studies, there are often no comparator samples.
- The **inclusion of data from a comparator group** is of **principal importance**
  - SD of change for intervention must be compared formally to SD of change in a control group or relevant test-retest reliability data
- Evidence is lacking for the notion that there are clinically important individual differences in exercise-mediated weight change.