Combining aerobic and resistance training for health

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Acute Endocrine and Force Responses and Long-Term Adaptations to Same-Session Combined Strength and Endurance Training in Women

Neuromuscular Adaptations to Different Modes of Combined Strength and Endurance Training

ARTICLE

Fitness, body composition and blood lipids following 3 concurrent strength and endurance training modes

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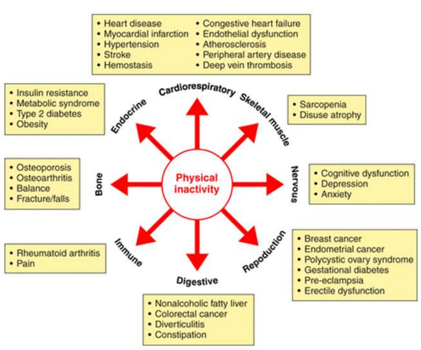
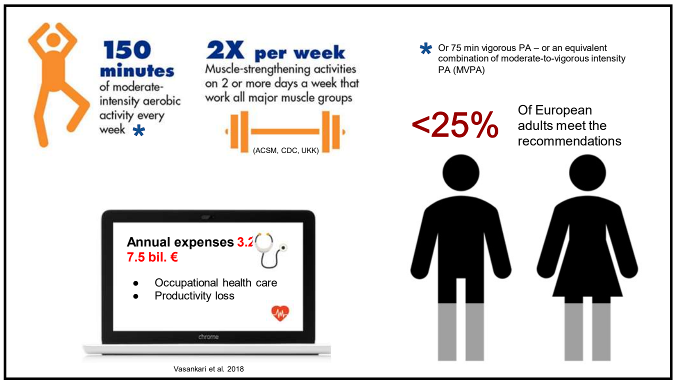
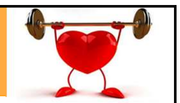




Rationale for resistance training



- Increases in muscular strength, mass (e.g. Häkkinen et al. 2003) → may delay onset of / help in managing sarcopenia (e.g. Landi et al. 2014)

- Promotes independence, minimizes falling (elderly)

- Assists in maintenance of BMR (via increasing LBM)

- Aids submaximal endurance performance e.g. submaximal time to exhaustion (cycling) / reduced walking time

- No need to neglect resistance training for individuals with MetSyn, obesity..

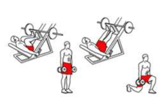
- Few adverse effects reported for low-risk heart patients (Fletcher et al. 2013 Circulation)

Aerobic and resistance training complement each other!

Variable	Aerobic Exercise	Resistance Exercise
Bone mineral density	↑↑	↑↑
Body composition		
% Fat	↓↓	↓
LBM	↔	↑↑
Strength	↔	↑↑↑
Glucose metabolism		
Insulin response to glucose challenge	↓↓	↓↓
Basal insulin levels	↓	↓
Insulin sensitivity	↑↑	↑↑
Serum lipids		
HDL	↑↔	↑↔
LDL	↓↔	↓↔
Resting heart rate	↓↓	↔
Stroke volume, resting and maximal	↑↑	↔
Blood pressure at rest		
Systolic	↓↔	↔
Diastolic	↓↔	↓↔
$\dot{V}O_2$max	↑↑↑	↑↔
Submaximal and maximal endurance time	↑↑↑	↑↑
Basal metabolism	↑	↑↑

Pedersen & Saltin 2015

Cardiopulmonary / -vascular variables, maximum oxygen uptake



(Neuro)Muscular adaptations, strength, Lean body mass

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Blood pressure at rest		
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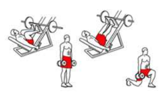
Diastolic	↓↔	↓↔
Vo_2max	↑↑↑	↑↔
Submaximal and maximal endurance time	↑↑↑	↑↑
Basal metabolism	↑	↑↑

Cardiopulmonary / -vascular variables, maximum oxygen uptake



(Neuro)Muscular adaptations, strength, Lean body mass

Pedersen & Saltin 2015

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Exercise as medicine – evidence for prescribing exercise as therapy in 26 different chronic diseases

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This review provides the reader with the up-to-date evidence-based basis for prescribing exercise as medicine in the treatment of 26 different diseases: psychiatric diseases (depression, anxiety, stress, schizophrenia); neurological diseases (dementia, Parkinson's disease, multiple sclerosis); metabolic diseases (obesity, hyperlipidemia, metabolic syndrome, polycystic ovarian syndrome, type 2 diabetes, type 1 diabetes); cardiovascular diseases (hypertension, coronary heart disease, heart failure, cerebral apoplexy, and claudication intermittent); pulmonary diseases (chronic obstructive pulmonary disease, asthma, cystic fibrosis); musculo-skeletal disorders (osteoarthritis, osteoporosis, back pain, rheumatoid arthritis); and cancer. The effect of exercise therapy on disease pathogenesis and symptoms are given and the possible mechanisms of action are discussed. We have interpreted the scientific literature and for each disease, we provide the reader with our best advice regarding the optimal type and dose for prescription of exercise.

Combined training (CT) interventions

- Possible to target AER and RT -induced adaptations simultaneously – may be more effective than adhering to only one training mode? (e.g. Pan et al. 2018 Int J Behav Nutrit Phys Act)

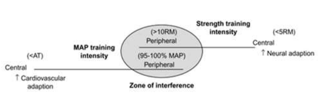


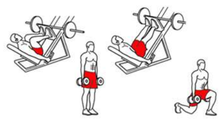
Fig. 3. Intensity continuums and primary location of adaptations for both maximal aerobic power (MAP) and strength training, and the possible overlap when the 2 modes of training are combined. **AT** = anaerobic threshold; **RM** = repetition maximum; ↑ = increased.

Docherty & Sporer 2000

- How to compare AER / RT / CT

→ e.g: AER 3x30min/wk, RT 10 exercises 3/wk, CT: **both or half of both?**

Effects on fat mass?



CT and visceral fat?

- Pan et al. 2018 systematic review: no added effect in comparison to AER / RT alone, but is *at least* as effective
- The effect of dietary supervision varies across studies
- Could be intensity-dependent

Different modalities of exercise to reduce visceral fat mass and cardiovascular risk in metabolic syndrome: the RESOLVE* randomized trial

Frédéric Dutheil [a,b,c,d,e,*], Gérard Lac [a], Bruno Lesourd [a,f], Robert Chapier [a], Guillaume Walther [g], Agnès Vinet [g], Vincent Sapin [h], Julien Verney [a], Lemlih Ouchchane [i], Martine Duclos [c,d], Philippe Obert [b,g], Daniel Courteix [a,b]

High-Resistance–moderate-endurance group: 70% 1RM + 30% of VO_{2max}

Moderate-resistance (30%) –high-Endurance(70%)

Moderate-resistance(30%)–moderate-endurance (30%)

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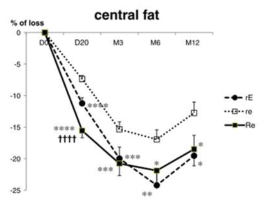

Fig. 3. Central fat loss in the three groups of physical activity: high-Resistance–moderate-endurance (Re), moderate-resistance–high-Endurance (rE), moderate-resistance–moderate-endurance (re). ****: p < .001, ***: p < .001, **: p < .01, *: p < .05 Re and rE vs. re. ††††: p < .0001 Re vs rE.

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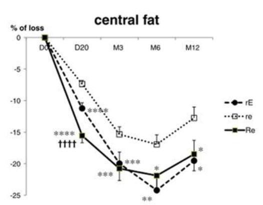

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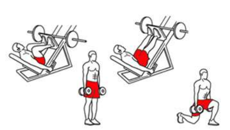
→ Higher intensity **resistance** training: greater central abdominal fat loss

→ Emphasizes need for a sufficient intensity also in R-training!

→ Independent follow-up period M6-M12 states the importance of supervision / guidance

Effects on glycemic control?



HbA1c and combined training?

- CT more effective than AER or RT alone / American Diabetes Association (Colberg et al 2016).
- Pan et al. 2018 systematic review: More pronounced changes in glycemic control
- A recent study (Magalhaes et al. 2018) found no changes in HbA1c after a 12 mo intervention, but cited no dietary supervision

Effects of Aerobic Training, Resistance Training, or Both on Glycemic Control in Type 2 Diabetes

A Randomized Trial

Ronald J. Sigal, MD, MPH; Glen P. Kenny, PhD; Normand G. Boulé, PhD; George A. Wells, PhD; Denis Prud'homme, MD, MSc; Michelle Fortier, PhD; Robert D. Reid, PhD, MBA; Heather Tulloch, MSc; Douglas Coyle, PhD; Penny Phillips, MA; Alison Jennings, MA; and James Jaffey, MSc

Aerobic group = 3x/wk 15-20min 60%HR_{max} → 45min 75%HR_{max}

Resistance group = 2x/wk: 7 exercises, 2-3 sets each, 7-9RM

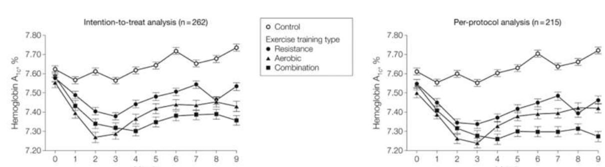
Combined group = Aerobic + resistance intervention combined

Variable	Mean (SD) Value			Difference in Change from Baseline to 6 Months (95% CI)	P Value
	Baseline	3 mo	6 mo		
Hemoglobin A_{1c} [patients], % [n]†					
Combined exercise group	7.46 (1.48) [64]	6.99 (1.56) [60]	6.56 (1.55) [58]	–	–
Aerobic training group	7.41 (1.50) [60]	7.00 (1.59) [58]	6.98 (1.50) [49]	–	–
Resistance training group	7.48 (1.47) [64]	7.35 (1.57) [62]	7.18 (1.52) [56]	–	–
Control group	7.44 (1.38) [63]	7.33 (1.49) [62]	7.51 (1.47) [59]	–	–
Intergroup comparisons					
Aerobic training vs. control	–	–	–	−0.51 (−0.87 to −0.14)	0.007
Resistance training vs. control	–	–	–	−0.38 (−0.72 to −0.22)	0.038
Combined exercise vs. aerobic training	–	–	–	−0.46 (−0.83 to −0.09)	0.014
Combined exercise vs. resistance training	–	–	–	−0.59 (−0.95 to −0.23)	0.001

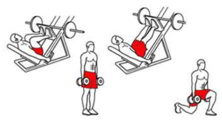
Effects of Aerobic and Resistance Training on Hemoglobin A1c Levels in Patients With Type 2 Diabetes:

A Randomized Controlled Trial (Church et al. 2010 JAMA)

Control group: non-exercise
Resistance group: 3 days a week 10-12RM
Aerobic group: 150min / week, expenditure 12 kcal/kg /wk (50-80% VO_{2max})
Combined group: AER- expenditure 10 kcal/kg /wk + resistance training 2x/wk (10-12 RM)



Effects on inflammation markers?

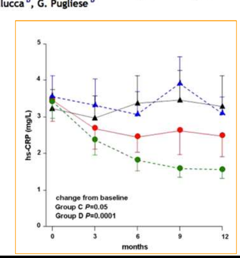


Evidence for improved inflammatory profile

- Aerobic training is potent in improving inflammatory profile (Beavers et al. 2010), resistance training more limited (Calle & Fernandez 2010).
- Some evidence for improvement also after CT:
- Brunelli et al. 2015: reduced markers of subclinical inflammation over 24 weeks
- Balducci et al 2010: →

Anti-inflammatory effect of exercise training in subjects with type 2 diabetes and the metabolic syndrome is dependent on exercise modalities and independent of weight loss

S. Balducci[a,b,*], S. Zanuso[c], A. Nicolucci[d], F. Fernando[e], S. Cavallo[f], P. Cardelli[f], S. Fallucca[f], E. Alessi[b], C. Letizia[g], A. Jimenez[h], F. Fallucca[b], G. Pugliese[b]



▲ Control group = no exercise intervention

▲ Aerobic group 1 = Exercise counseling (low-intensity exercise)

● Aerobic group 2 = 2x/week 60 min of aerobic exercise at 70-80% VO_{2max}

● **Combined group =** 2x40min 70-80% VO_{2max} /week + 2x20 min resistance exercise at 80% 1RM (same caloric expediture as group Aer 2)

hs-CRP levels
- decreased with high-intensity
- combined training > high-intensity aer > low intensity

Anti-inflammatory effects (IL-1b,-g,TNF-a,IFN-g,IL-4,-10)
- particularly improved by **combination training**, but also aerobic groups
→ exercise in general has anti-inflammatory effects

No weight reduction in groups

IN SUMMARY

- No adverse effects of including resistance training
- Benefits for body composition, HBA1c, inflammation markers are at least of the same magnitude as AER / RT
- Sufficient intensity is key for both AER and RT!
- The presented adaptations apply for the given populations

ALL EXERCISE IS BENEFICIAL!

THANK YOU!

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