THE AGING ATHLETE:
GENERAL CONDITIONING & STRENGTHENING

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DISCLOSURE

David Z. Prince has no relevant financial disclosures.
OVERVIEW

• Categories of athletes
• Why they present
• Underlying motivation
• General conditioning
• Strengthening
• Enhancing recovery
• Educational opportunities
• Enhancing performance - prescribing
CATEGORIES

• All our patients are athletes
• Categories:

<table>
<thead>
<tr>
<th>Novice</th>
<th>Intermediate</th>
<th>Experienced</th>
</tr>
</thead>
</table>

• David’s Formulas:
  • Intervention  Result  Population
  • Population  Result  Intervention
Seeking information
Guidance
Encouragement
Expertise in Rx Exercise
Examples:
  s/p CABG or major surgery
  s/p new diagnosis (cholesterol, HTN, DM)
• History of injury
• Desire to prevent future injury
• Recent injury
• Sudden increase in motivation – life event
  • Medical
  • Personal
• Information, guidance, encouragement
• Your medical expertise
  • Examples: weekend warrior – battle of Meniscus
LIFELONG, EXPERIENCED, MASTERS, ELITE

- Lifelong – sport is not only for health, multiple motivations in multiple domains (social, medical, professional, emotional)
- Experienced – committed to sport over long period of time
- Masters – 35+ track & field, cross country, road running
  - 1977 World Assoc. Vet Athletes Championships
  - 2001 World Masters Athletics
- “Masters” – anyone over 35
- Elite – Olympics or professional competitor
WHY PATIENTS PRESENT?

<table>
<thead>
<tr>
<th>Novice</th>
<th>Intermediate</th>
<th>Experienced</th>
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</thead>
</table>
| • Seeking information  
• Guidance  
• Encouragement  
• Physician expertise in ExRx | • History of injury and desire to prevent recurrence  
• Recent Injury  
• Sudden increase in motivation (see novice)  
• Following major life event | • Debilitating injury the prevents competition  
• Dysfunctional pin that interferes with BADLs  
• Seeking supplementation |
MOTIVATIONS...
THE AGEING ATHLETE - PHYSIOLOGY

- Cardiopulmonary – CO, BP, VO2max (-10%/10 yrs > 25), VC
- MSK – reaction time, strength (1.25%/yr >35), decline: power > endurance, tendon structure, cartilage structure, bone mass, flexibility, balance.
- Fiber shift Type 1 > Type II
- Medications affect cardiopulmonary response to exercise as well as risk (AC)
- Disease processes contribute esp DM (GT > fat infiltration)
- Downhill after 60!
- *Exercise can modify age-related changes
FORCE & POWER

FIGURE 5: Men’s Master jumping fractional records by age groups.

FIGURE 3: Combined fractional records for track results by age groups. Curves of best fit using the equation \( y = (1 - \exp((T - T_0)/\tau)) \) are shown.
FIGURE 7 Men’s Master throwing events fractional records by age groups.

FIGURE 9 Masters walking fractional records by age groups.
Cardiovascular conditions

<table>
<thead>
<tr>
<th>History</th>
<th>Personal history</th>
<th>Physical examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sudden death</td>
<td>Exertional chest pain/discomfort</td>
<td>Heart murmurs</td>
</tr>
<tr>
<td>Atherosclerotic CAD</td>
<td>Unexplained syncope/presyncope</td>
<td>Femoral pulses to exclude aortic coarctation</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Excessive exertional and unexplained dyspnea/fatigue associated with exercise</td>
<td>Physical stigmata of Marfan syndrome</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>Previous recognition of a heart murmur</td>
<td>Brachial artery blood pressure (sitting position)</td>
</tr>
<tr>
<td>Hx:</td>
<td>Elevated systemic blood pressure</td>
<td></td>
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<tr>
<td></td>
<td>Premature death (sudden and unexpected) before age 50 yr due to heart disease in one relative or more</td>
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<td></td>
<td>Disability from heart disease in a close relative aged ≤50 yr</td>
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<td></td>
<td>Specific knowledge of certain cardiac conditions in family members: hypertrophic or dilated cardiomyopathy, long QT syndrome or ion channelopathies, Marfan syndrome, or clinically important arrhythmias</td>
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</tbody>
</table>
OVERVIEW

• Categories of athletes
• Why they present
• Underlying motivation
• **General conditioning**
• Strengthening
• Enhancing recovery
• Educational opportunities
• Enhancing performance - prescribing
PRINCIPLES OF EXERCISE

• Overload
• Threshold of training
• Adaptation
• Principle of progression
• FITT
• Individuality
• Specificity
COMPONENTS OF FITNESS (XFIT)

- **Cardiopulmonary endurance**
- **Stamina** Process, deliver, store and utilize energy
- **Strength** Ability to apply force
- **Flexibility** Maximize ROM
- **Power** Force/Time
- **Speed** Minimize cycle of repetition
- **Coordination** Combine several distinct movement patterns into one
- **Agility** Minimize transition time from one movement pattern to another
- **Balance** Control COG relative to BOS
- **Accuracy** Control movement in a given direction or at a given intensity
CONDITIONING

- FITT principle
  - Frequency 3 – 5x/week
  - Intensity 50 – 85% of VO2max
  - Time 20 – 60 minutes
  - Type Major muscle groups, more muscle mass movement = more benefit
    - Specificity
    - Chronicity ? Intermittent bursts vs. continuous energy expenditure
- Warm up – MSK protective, mindful surveillance
- Cool down – CV protective
# CORE STRENGTHENING

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| • Education with functional anatomy  
• Address potential injuries | • Building on basics:  
• Functional training  
• Sport specific  
• Specialized PT | • Functional training  
• Resistance training  
• Instruct Trainer |
To determine cardiovascular range:

1. % of maximum heart rate (MHR)
   
   MHR = 220 – age

   Target HRR between 60 – 80 % MHR

2. Karvonen formula - % of heart rate reserve
   
   • Heart rate reserve: the difference between the maximal heart rate and the resting heart rate

   MHR = 220 – age 
   Take resting pulse (RHR)

   Heart rate reserve (HRR) = MHR – RHR
e.g., 85% training intensity = HRR x 0.85 + RHR

<table>
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<tr>
<th>% $V_{O2\text{max}}$</th>
<th>%HRR</th>
<th>% MaxHR</th>
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<tbody>
<tr>
<td>50</td>
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# STRENGTHENING – RESISTIVE EXERCISE (RE)

## Variable components of RE
- RE movements
- Intensity (% 1RM)
- Volume – reps & sets
- Sequencing
- Repetition velocity
- Training frequency
- Rest interval length (between sets)

## Training goal
- Hypertrophy
- Strength
- Power
- Endurance

- Which is most important?
LIMITATIONS...

• Literature is not clear regarding which rest interval is more appropriate to accomplish a specific training goal
• Most studies looked at high volume/mod intensity (bodybuilding) programs
• What about mod – low volume/high intensity???
• Age of study participants

• ..........SOLUTIONS
• Rest interval variations
• Periodization
• Goals: hypertrophy & strength / body comp
• Older population
Short rest interval lengths between sets optimally enhance body composition and performance with 8 weeks of strength resistance training in older men

Matthew G. Villanueva · Christianne Joy Lane · E. Todd Schroeder

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Abstract
Purpose To determine if 8 weeks of periodized strength resistance training (RT) utilizing relatively short rest interval lengths (RI) in between sets (SS) would induce greater improvements in body composition and muscular performance, compared to the same RT program utilizing extended RI (SL).
Methods 22 male volunteers (SS: n = 11, 65.6 ± 3.4 years; SL: n = 11, 70.3 ± 4.9 years) were assigned to one of two strength RT groups, following 4 weeks of periodized hypertrophic RT (PHRT): strength RT with 60-s RI (SS) or strength RT with 4-min RI (SL). Prior to randomization, all 22 study participants trained 3 days/week, for 4 weeks, targeting hypertrophy; from week 4 to week 12, SS and SL followed the same periodized strength RT program for 8 weeks, with RI the only difference in their RT prescription.
Results Following PHRT, all study participants experienced increases in lean body mass (LBM) (p < 0.01), upper and lower body strength (p < 0.001), and dynamic power (p < 0.001), as well as decreases in percentage body fat (p < 0.05). Across the 8-week strength RT phase, SS experienced significantly greater increases in LBM (p < 0.001), flat machine bench press 1-RM (p < 0.001), bilateral leg press 1-RM (p < 0.001), narrow/neural grip lat pulldown (p < 0.01), and Margaria stair-climbing power (p < 0.001), compared to SL.
Conclusions This study suggests 8 weeks of periodized high-intensity strength RT with shortened RI induces significantly greater enhancements in body composition, muscular performance, and functional performance, compared to the same RT prescription with extended RI, in older men. Applied professionals may optimize certain RT-induced adaptations, by incorporating shortened RI.

Keywords Hypertrophy · Maximal dynamic strength · Sarcopenia · Acute hormonal responses · Physical function

Abbreviations
ANOVA Analysis of variance
AR Androgen receptor
CERC Clinical Exercise Research Center
CV Coefficient of variance
DEXA Dual-energy X-ray absorptiometry
ES Effect size
LBM Lean body mass
RM Repetition maximum
RT Resistance exercise
SEBT Star excursion balance test

Introduction
The effects of planned and systematically progressed (i.e., periodized) resistance training (RT) programs can serve as a countermeasure against the reductions in skeletal muscle mass, strength, power, physical activity, and activities of daily living, which are associated with sarcopenia (Kraemer

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ENHANCING RECOVERY

- Sleep
- Nutrition
- Supplementation
- Return to sport
SLEEP & AGING

- Poor sleep – extremely common
- Prevalence of insomnia >20%
- Sleep quality degrades
- Increase in sleep fragmentation
- Reversal of light/deep sleep
- Sleep quality inversely related to depression

- Foley DJ, Sleep 1995
Sleep and Performance

- Circadian rhythm
- Temperature
- Performance rhythm
- VO2
- Sleep restriction:
  - “Brain restitution theory”
  - Body tissue
    - Gross motor vs. fine motor
- Anxiety state / Reaction time
- Sex difference?
- Strength training
  - isolated vs. “power” lifts

Fig. 1. Changes in anxiety state (a) and unprepared single reaction time (b) in five-a-side players over 71 h without sleep. The data showed a trend with time of sleep deprivation and a time-of-day effect (data from [17]).
NUTRITION : AGING ATHLETE

- Less responsive to post-exercise feeding if baseline protein intake is low
- If high-quality protein intake is adequate > diet induced stimulation = younger adults
- Post-RE (immediate)
  
  10gm protein + 7gm carbs + 3gm fat
NUTRITION : AGING ATHLETE

• Less responsive to post-exercise feeding if baseline protein intake is low
• If high-quality protein intake is adequate > diet induced stimulation = younger adults

Sarcopenia : 0.5 g/kg/d

Adequate : 1.2 g/kg/d
SUPPLEMENTATION: AGING ATHLETE - 1

• Amino Acid in excess of recommended protein – of no proven benefit (strength or mass)

• Beta-hydroxy-beta-methyl butyrate (B-HMB):
  • Increased fat-free mass & reduced body fat compared to placebo
  • Has not been replicated
  • Currently not supported by data

• Chromium picolinate
  • No effect of moderate to high-dose chromium (strength, mass, glucose metabolism)
  • + linoleic acid – no effect on weight loss (overweight young/middle aged women who are exercising)

• Creatine monohydrate – small benefit (1-2% in high intensity repetitive sprint activities)
  • No studies addressing this population attempting this kind of training
  • 3 vs. 1 – benefit 5g/d x 3 – 6 months + RE gains, FF mass, strength
SUPPLEMENTATION: AGING ATHLETE - 2

- Conjugated linoleic acid (CLA) – 6g/d
  - Younger / overweight – promotes fat loss
  - Older / overweight
    - Intermediate & resistance trained: not recommended
    - Novice: 2kg weight loss over FIRST 6 months
    - Safety / Efficacy > 6 months – unknown

- Vitamins & Micronutrients – no evidence that supra-supplementation provides benefits
- Deficiencies should be corrected! (iron, selenium, B12, D, E > myopathy, neuropathy)
### MOST COMMON INJURIES

<table>
<thead>
<tr>
<th>Upper Extremity</th>
<th>Lower Extremity</th>
</tr>
</thead>
<tbody>
<tr>
<td>• OA</td>
<td>• Calf pain (structural vs. strain)</td>
</tr>
<tr>
<td>• CPPD</td>
<td>• Osteonecrosis</td>
</tr>
<tr>
<td>• Calcific tendonitis</td>
<td>• Distal calf pain</td>
</tr>
<tr>
<td>• Adhesive capsulitis</td>
<td>• Achilles tendon</td>
</tr>
<tr>
<td>• Distal clavicular osteolysis (DCO)</td>
<td>• Foot pain / Metatarsalgia</td>
</tr>
<tr>
<td>• Rotator cuff</td>
<td>• Capsular / Plantar plate tears</td>
</tr>
<tr>
<td>• Elbow pain (Med / Lat / Ant / Post)</td>
<td>• Plantar fascia : fasciitis &amp; rupture</td>
</tr>
<tr>
<td>• Hand / Wrist – impaction</td>
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**EDUCATIONAL OPPORTUNITIES**

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</table>
| Educational Opportunities | • DOMS  
• OTC pain medication                               | • Rehabilitative activities between competition.  
• Nutrition  
• Sleep                                           | • Nutrition  
• Supplementation  
• Early PT (before injury)                         |

http://www.andjrnl.org/content/podcast
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## ENHANCING PERFORMANCE – RX’ING

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</thead>
<tbody>
<tr>
<td>Enhancing</td>
<td>Accountability to MD</td>
<td>Compliance with “pre-hab”</td>
<td>CPET testing</td>
</tr>
<tr>
<td>Performance</td>
<td>Family accountability</td>
<td>HR education</td>
<td>Consultation w/coach</td>
</tr>
<tr>
<td>Medical Rx.</td>
<td>Removing barriers</td>
<td>Interval training education</td>
<td>Counselling: anabolic</td>
</tr>
<tr>
<td></td>
<td>Accessing resources</td>
<td></td>
<td>Orthotics, taping, bracing</td>
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<tr>
<td></td>
<td>Journaling</td>
<td></td>
<td>Procedures: CS, PRP, Viscosupplementation</td>
</tr>
<tr>
<td></td>
<td>Footwear</td>
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</tbody>
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FIGURE 7 Men’s Master throwing events fractional records by age groups.

FIGURE 9 Masters walking fractional records by age groups.
Figure 1: Age of the overall top ten women (Panel A) and men (Panel B) for the Olympic, the Half-Ironman and the Ironman distance. The ten fastest athletes during the investigated period of time were included. Results are presented as means±SD after one-way ANOVA.
VELOCITY & ENDURANCE

FIGURE 7 Men’s Master throwing events fractional records by age groups.

FIGURE 9 Masters walking fractional records by age groups.
“THERE’S AN EXCEPTION TO EVERY RULE…”
PERMISSIONS AND CREDITS

• “I’m afraid”
• “I did something stupid”
• “I refuse to quit”
• Novice exerciser: http://newoldage.blogs.nytimes.com/2010/02/02/for-seniors-an-underused-heart-therapy-the-gym/?_php=true&_type=blogs&_r=0
• Surprise: http://commons.wikimedia.org/wiki/Category:Surprise#mediaviewer/File:Himmelsst%C3%BCrmer_staunen.JPG
• Boxer: http://www.huffingtonpost.com/2014/10/21/old-boxer-knocks-out-young-guy_n_6025530.html
• All uncited images downloaded from wikicommmons and are in the public domain