A Historical and Scientific Exploration of High Intensity Training with College Athletes

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Objectives

1. *Explore historical background for High Intensity Training?*
2. *Understand physiological responses to High Intensity Training?*
3. *Identify programing considerations when using High Intensity Training?*
4. *Investigate the effectiveness of High Intensity Training with college athletes? What does the Research/Evidence Support?*

Definition of High Intensity Training

- Vigorous to maximal effort exercise for brief periods of time, known as the work segment, followed by a rest/recovery/relief period.
- Periods of rest/recovery/relief can be at a lower intensity of exercise or complete rest

1. Historical background for Training?

- Roots of most physical training are found in preparing young men for military service
- 1st & 2nd Century
  - Greeks – Spartans
  - Romans
- Renaissance 16th Century
  - Francois Rabelais – French Monk and Physician
  - Esquire Gynast – Francois's Assistant

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1. Historical background for Training?

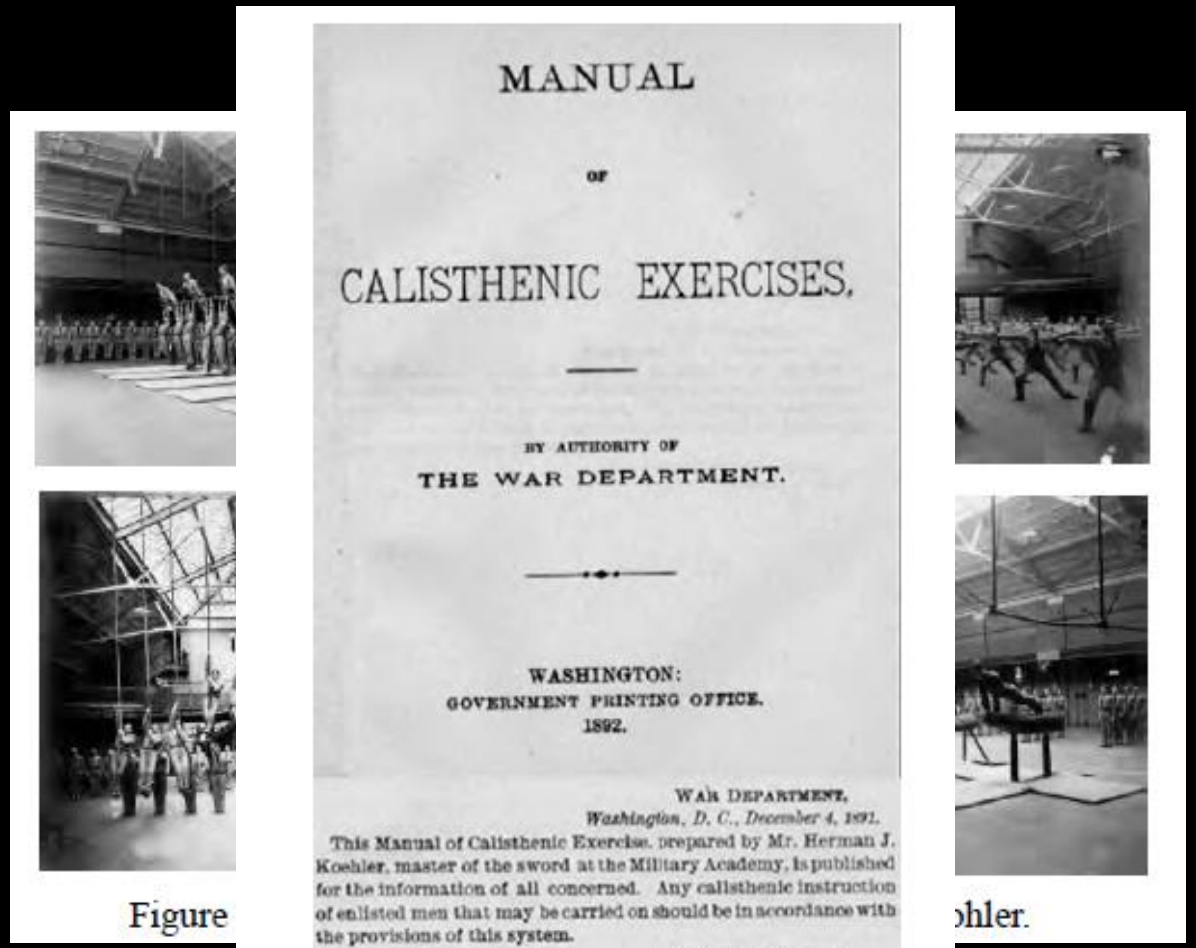

Figure 5. Kohler's First Manual for the Army (1892).

- United States Military Academy (USMA) – Master of the Sword – Head of the Physical Education Department (1814)
- 10th Master of the Sword Lt. Colonel Herman Koehler
  - 1887 – *A System of Calisthenic Exercises for use in School of the Solider.*
  - *1921 First Manual of Calisthenic Exercises published by War Dept.*

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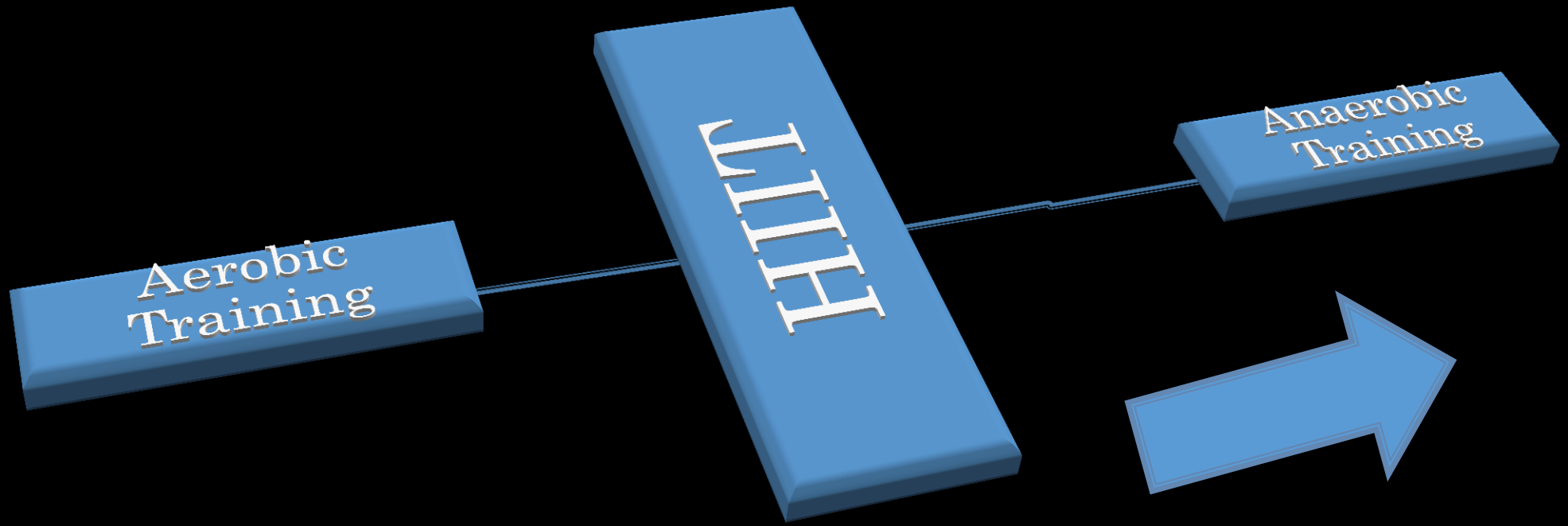
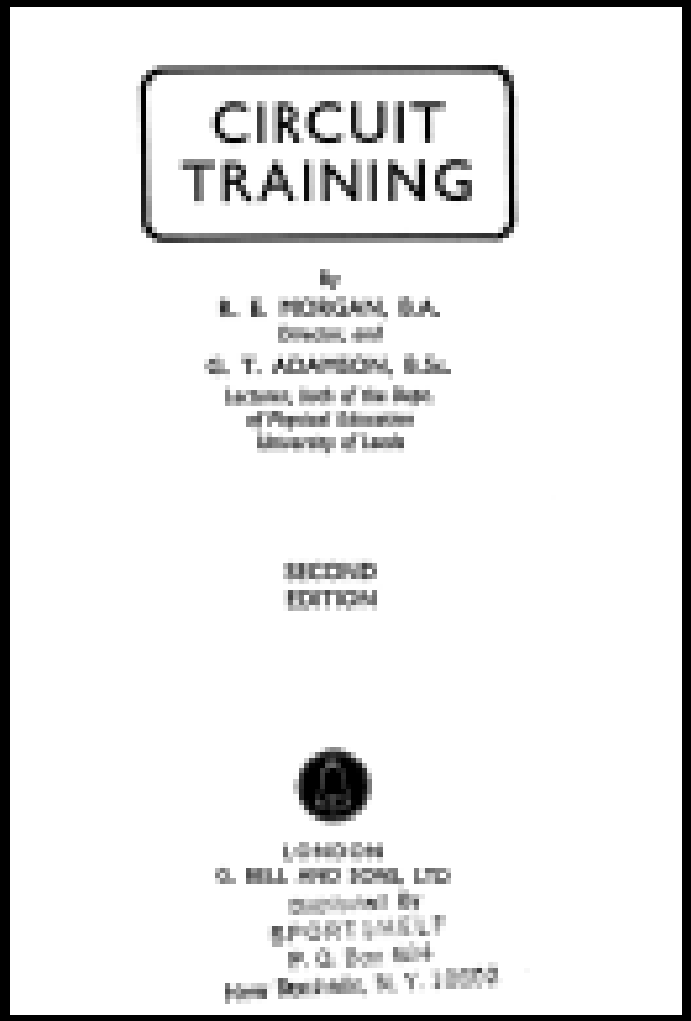
1. Historical background for Training?



1. Historical background for High Intensity Training?

- Terminology Issue
  - Interval Training Program (ITP)
  - Circuit Training (CT)
  - High Intensity Training)
  - High Intensity Interval Exercise (HIIE)
  - High Intensity Interval Training (HIIT)
- Focus
  - Impact of H.I.I.T. on Strength & Power Athletes
  - Resistance Training, Calisthenics and Body Weight Exercises

1. Historical Background


CIRCUIT TRAINING

By

R. E. MORGAN, B.A.

Director, and

G. T. ADAMSON, B.Sc.

Lecturer, both of the Dept. of Physical Education University of Leeds

SECOND EDITION

LONDON
G. BELL AND SONS, LTD

- Morgan, RE and GT Admason, *Circuit Training*. 1st Ed. Bell, London, UK (1959)

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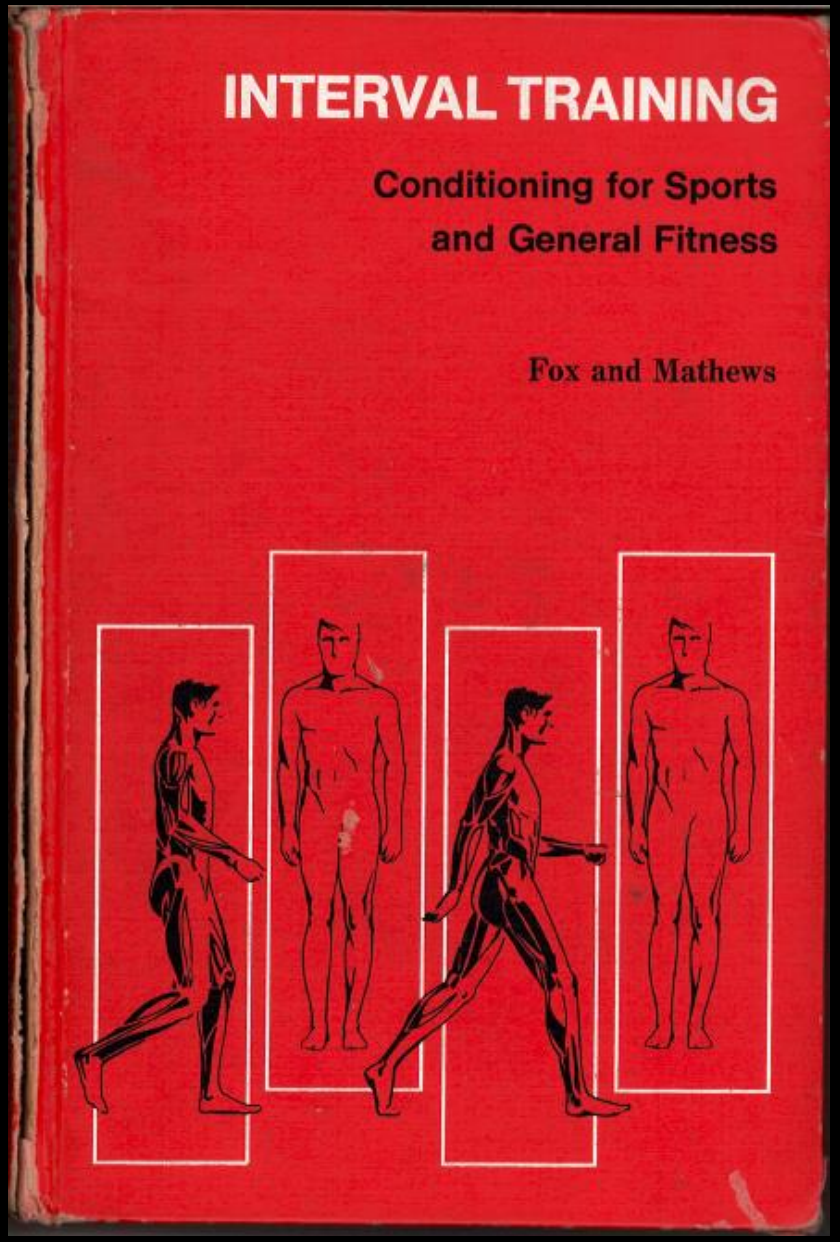
1. Historical Background

- Edward L Fox, PhD
  - Associate Professor of Physical Education
  - The Ohio State University
- Donald K Mathews D.P.E.
  - Professor of Physical Education and Physiology
  - The Ohio State University
- W.B. Saunders Company, Philadelphia, PA 1974



2. Physiological Response to HIIT

- Energy Systems
- Know your Physiology - Recovery Kinematics

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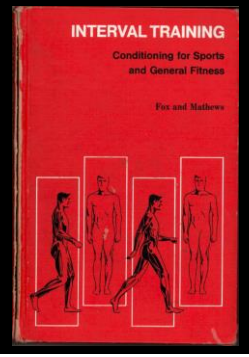
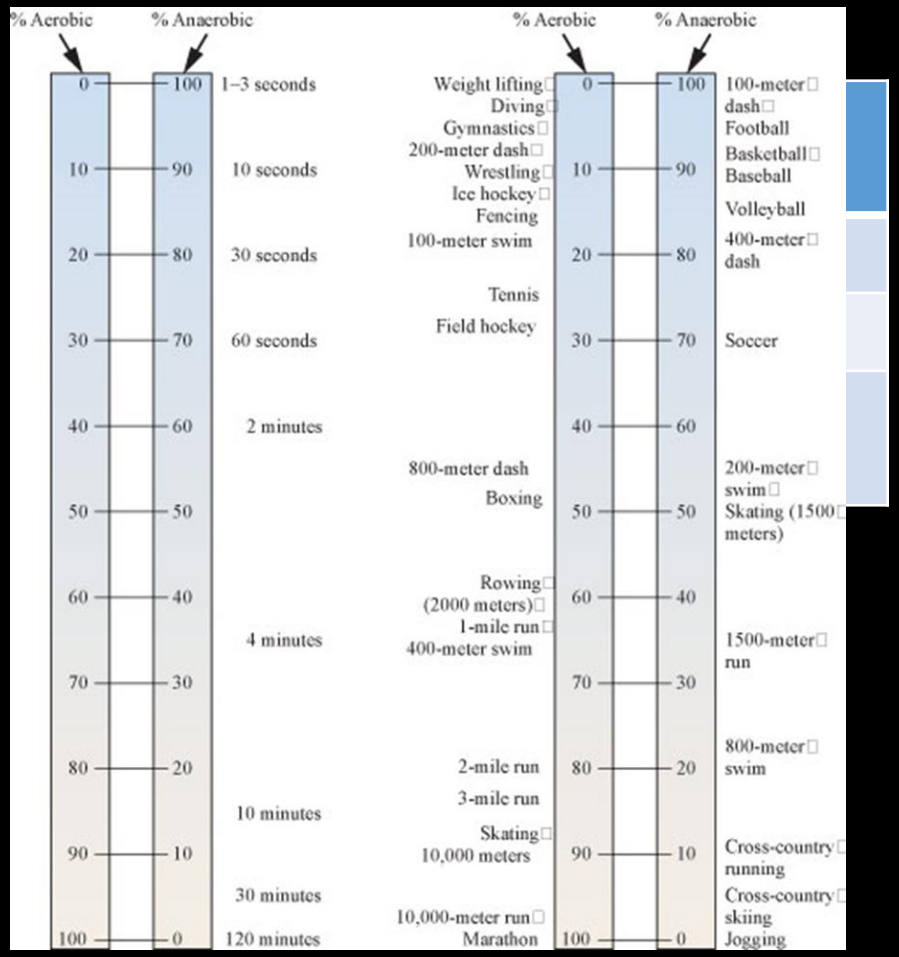
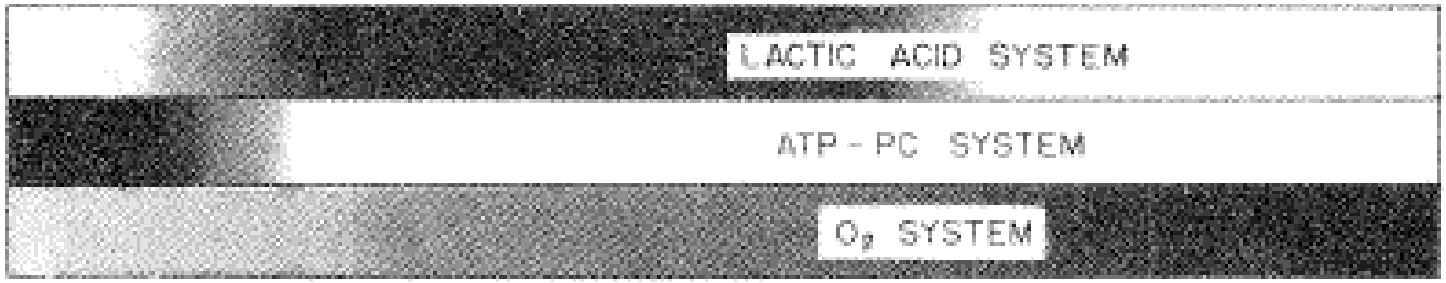


2. Energy Systems





ATP-PC SYSTEM	ATP-PC and L A SYSTEM	LA and O_2 SYSTEM	O_2 SYSTEM
Shot Put	220-440 Yd. Sprints	880 Yd Dash	Soccer and Lacrosse(except Goalies)
100 Yd Sprint	Halfbacks-Fullbacks	Gymnastics Events	Cross Country Skiing
Base Stealing	Speed Skating	Boxing (3 Min. Rounds)	Marathon
Golf-Tennis Swings	100 Yd. Swim	Wrestling (2 Min. Periods)	Jogging

Figure 6. The energy continuum. On one end are the short-term, high-intensity types of activities such as the 100 yard dash, in which the total ATP required is supplied by the ATP-PC system. On the other end, the long-term, low-intensity types of activities such as the marathon race are supported by the oxygen system. In the middle is the LA system, with the major portion of its ATP production used to support types of activities such as the 440 and 880 yard dashes.

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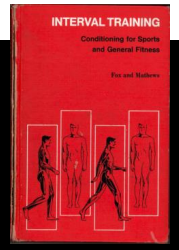
2. Recovery Kinematics of PCr

TABLE 2. RELATION OF RELIEF INTERVAL TO PER CENT OF ATP-PC RESTORED*

DURATION OF RELIEF INTERVAL IN SECONDS	PER CENT POWER RESTORED (ATP-PC SYSTEM)
under 10 seconds	Very little
30	50
60	75
90	88
120	94
over 120	100

*The longer the relief interval a greater percentage of the ATP-PC system (power) will be restored to the muscle. During intermittent work, the relief interval delays the accumulation of lactic acid, the fatigue product.



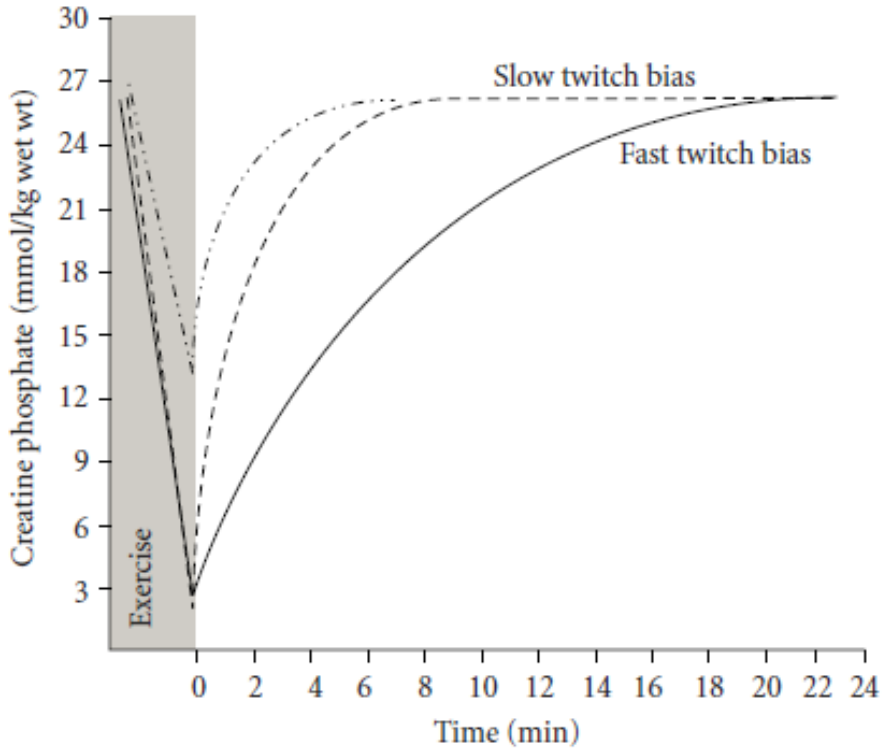


FIGURE 6: Representative kinetics of creatine phosphate (CrP) recovery in subjects with different end exercise CrP concentrations and different proportions (bias) of slow or fast twitch muscle. Note the more rapid recovery of CrP when there is less exercise-induced depletion (-·····) versus near complete depletion (- - - -). Based on unpublished research observations of the authors.

Julien S. Baker, Marie Clare McCormick, and Robert A. Robergs, "Interaction among Skeletal Muscle Metabolic Energy Systems during Intense Exercise," Journal of Nutrition and Metabolism, vol. 2010, Article ID 905612, 13 pages, 2010. doi:10.1155/2010/905612

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2. Recovery Kinematics of PCr

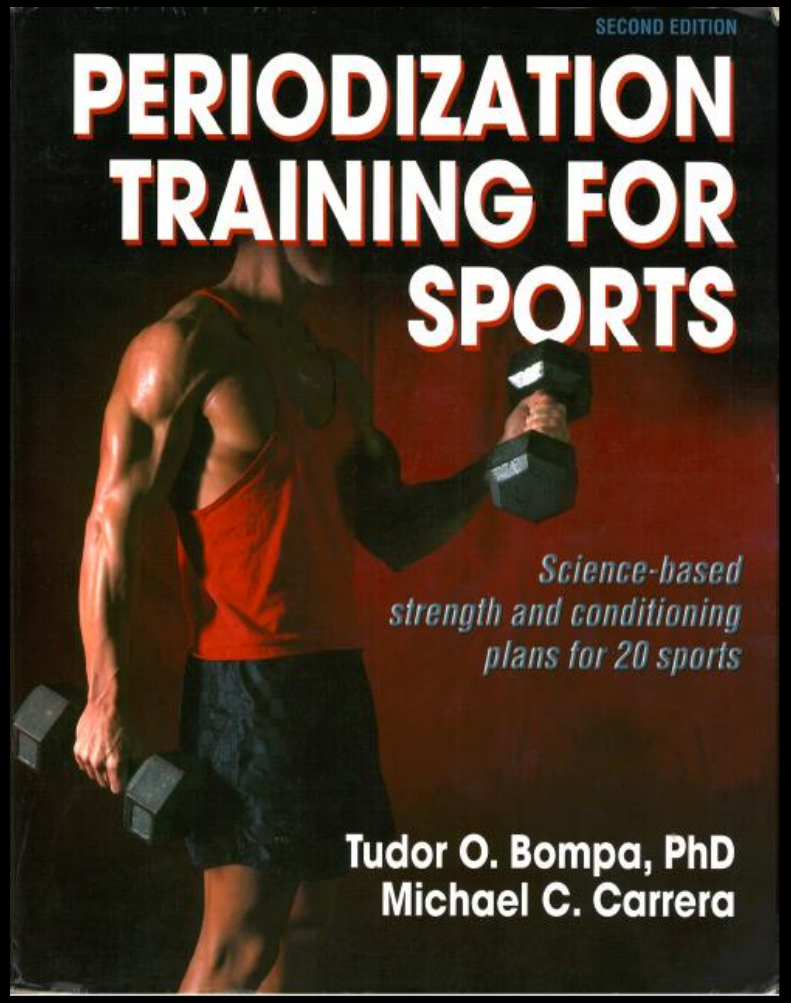

Table 13.1 Recovery Times After Exhaustive Strength Training

Recovery process	Recovery time
Restoration of ATP/CP	3-5 minutes
Restoration of muscle glycogen: After prolonged exercise After intermittent exercise (such as strength training)	 24-48 hours 24 hours
Removal of lactic acid from muscle and blood	1-2 hours
Restoration of vitamins and enzymes	24 hours
Recovery from overly taxing strength training (both metabolic and CNS to reach overcompensation)	2-3 days
Repayment of the alactacid oxygen debt	5 minutes
Repayment of the lactacid oxygen debt	30-60 minutes

Adapted, by permission, from E. Fox, 1989, *Physiological basis of physical education and athletics* (New York: McGraw Hill), 56.

3. Program Considerations

- Where would HIIT fit into a colligate Periodized training regime?
- Volume / Intensity
- Rest Time

Haff, GG & NT Triplett (2016) Essential of Strength Training & Conditioning, 4th Edition. Human Kinetics, Champagne, IL

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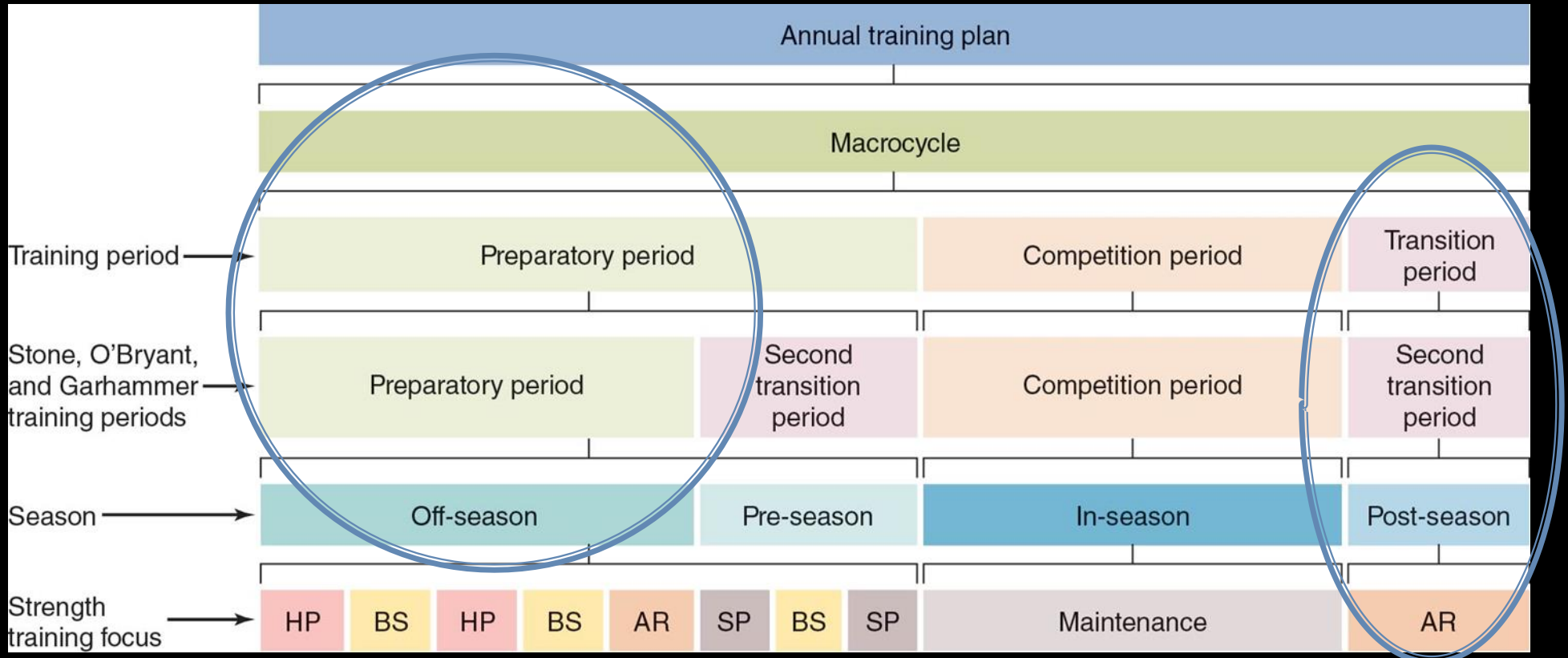
3. Program Considerations

- Volume - Repetitions



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3. Program Considerations

- Volume
- Intensity

TABLE 17.9 Load and Repetition Assignments Based on the Training Goal

Training goal	Load (%1RM)	Goal repetitions
Strength*	≥85	≤6
Power:**		
Single-effort event	80-90	1-2
Multiple-effort event	75-85	3-5
Hypertrophy	67-85	6-12
Muscular endurance	≤67	≥12

*These RM loading assignments for muscular strength training apply only to core exercises; assistance exercises should be limited to loads not heavier than an 8RM (2).

**Based on weightlifting-derived movements (clean, snatch, and so on). The load and repetition assignments shown for power in this table are *not consistent* with the %1RM–repetition relationship. In nonexplosive movements, loads equaling about 80% of the 1RM apply to the two- to five-repetition range. Refer to the discussion of assigning percentages of the 1RM for power training for further explanation.

Data from references 7, 20, 32, 33, 45, 86, 91, and 92.

TABLE 17.11 Volume Assignments Based on the Training Goal

Training goal	Goal repetitions	Sets*
Strength	≤6	2-6
**Power:		
Single-effort event	1-2	3-5
Multiple-effort event	3-5	3-5
Hypertrophy	6-12	3-6
Muscular endurance	≥12	2-3

*These assignments do not include warm-up sets and typically apply to core exercises only (2, 45).

**Based on weightlifting-derived movements (clean, snatch, and so on). The load and repetition assignments shown for power in this table are *not consistent* with the %1RM–repetition relationship. In nonexplosive movements, loads equaling about 80% of the 1RM apply to the two- to five-repetition range. Refer to the discussion of assigning percentages of the 1RM for power training for further explanation.

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3. Program Considerations

- Rest Interval between Sets

TABLE 17.12 Rest Period Length Assignments Based on the Training Goal

Training goal*	Rest period length
Strength	2-5 min
Power: Single-effort event Multiple-effort event	2-5 min
Hypertrophy	30 s to 1.5 min
Muscular endurance	≤30 s

*Because there are occasions when the prescribed percentage of the 1RM for assistance exercises falls outside the range associated with the training goal (e.g., ≥8RM loads are recommended for assistance exercises as part of a muscular strength training program [2]), the strength and conditioning professional should examine the loads used for each exercise when assigning rest periods rather than generally applying the guidelines for a training goal.

Data from references 20, 47, 50, 86, and 96.

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3. Program Considerations

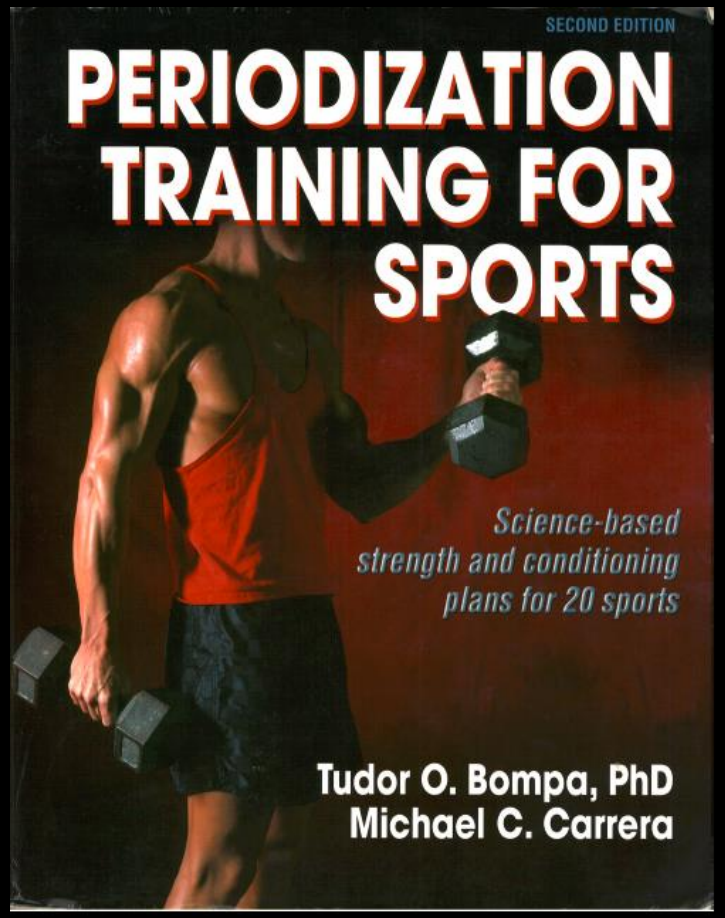

Table 8.1 Training Parameters for Circuit Training

Training parameters	Novice athletes	Experienced athletes
Duration of AA	8-10 weeks	3-5 weeks
Load (if weights are used)	30-40 percent	40-60 percent
No. of stations per circuit	9-12 (15)	6-9
No. of circuits per session	2-3	3-5
Total time of CT session	20-25 minutes	30-40 minutes
Rest interval between exercises	90 seconds	60 seconds
Rest interval between circuits	2-3 minutes	1-2 minutes
Frequency per week	2-3	3-4

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3. Program Considerations

Sports Med (2016) 46:487–502
DOI 10.1007/s40279-015-0451-3

CrossMark

SYSTEMATIC REVIEW

Effect of Training Leading to Repetition Failure on Muscular Strength: A Systematic Review and Meta-Analysis

Tim Davies[1] · Rhonda Orr[1] · Mark Halaki[1] · Daniel Hackett[1]

Published online: 14 December 2015

increases in muscular strength (+ 2%). It has been shown that training with shorter RI durations may impair performance and the total number of repetitions per set [8, 10]. Cumulatively, this would lead to a lower total training volume, as training volume is calculated as load × repetitions × sets. Due to the direct relationship between muscular adaptations and training volume in a dose–response fashion [48], it would seem that the use of a shorter duration RI is insufficient for maximizing gains in muscular strength.

5 Conclusion

The body of research indicates that long-duration RIs (i.e., > 2 min) are required to maximize gains in muscular strength in trained individuals. It is unclear if RIs longer

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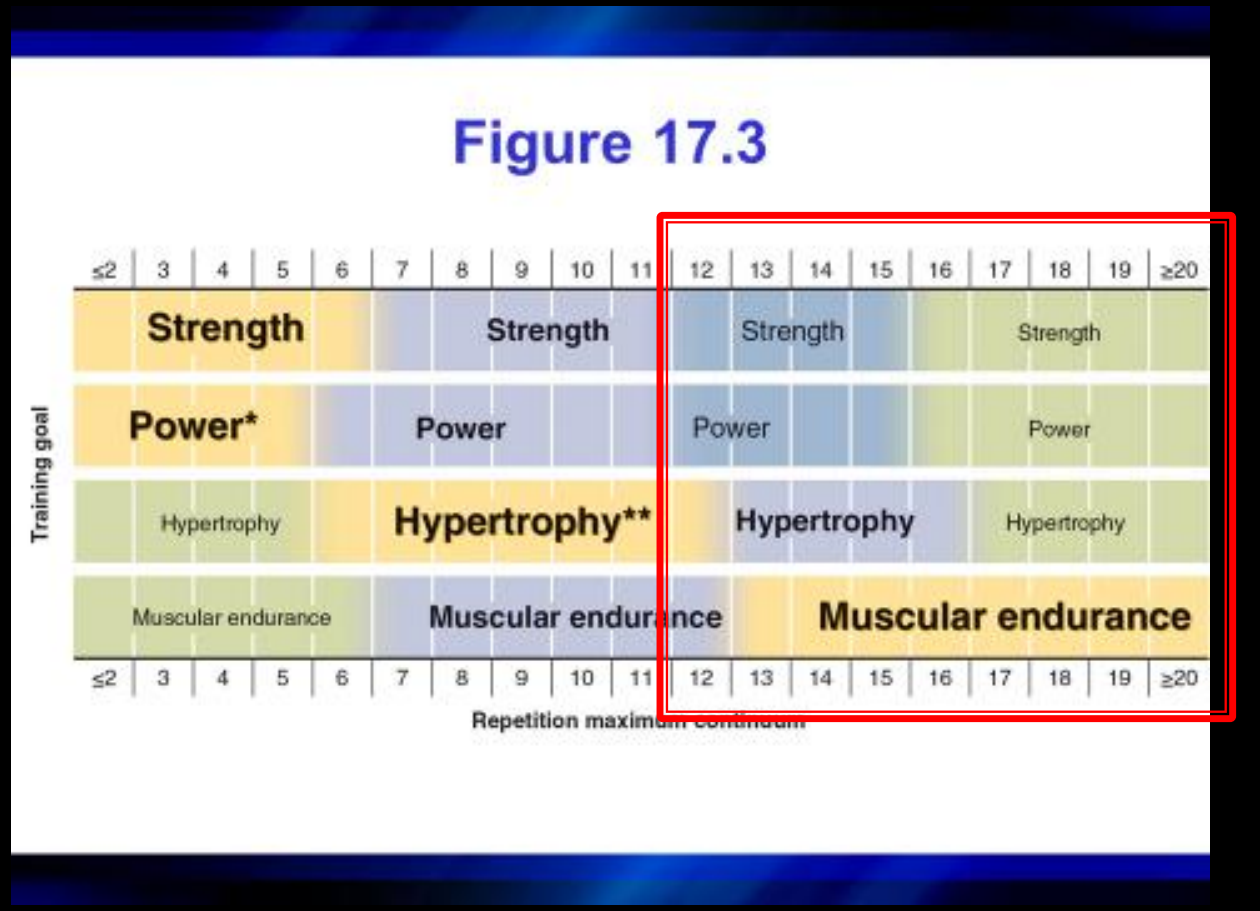
3. Program Considerations

- Where would HIIT fit into a colligate Periodized training regime?



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What is the physiological price of Rhabdomyolysis?

- How long are players out after Rhabdo?
- 4 Phase = 4 weeks

Journal of Athletic Training 2016;51(5):406–409
doi: 10.4085/1062-6050-51.5.12

www.natajournals.org

short report

Return to Play After Exertional Rhabdomyolysis

Kevin Schleich, PharmD*; Tyler Slayman, BS*; Douglas West, PhD, ATC*; Kyle Smoot, MD†

*The University of Iowa, Iowa City; †University of Kentucky, Lexington

Objective: To outline a 4-phase progressive program that safely and successfully enabled athletes to return to sport without recurrence of exertional rhabdomyolysis symptoms.

Background: In January 2011, a large cluster of National Collegiate Athletic Association Division I football athletes were evaluated and treated for exertional rhabdomyolysis. After the athletes were treated, the athletic trainers and sports medicine providers were challenged to develop a safe return-to-play program because of the lack of specific reports in the medical literature to direct such activities.

Treatment: A progressive 4-phase program based on existing recommendations, including guidelines for continued clinical and laboratory monitoring.

Conclusions: Although the actual process of reintegrating players will differ based on each athlete's unique circumstances, this program provides a safe and effective foundation that can be modified based on the response to activity and sport.

Key Words: athletes, football, reintegration program

4. Research / Evidence: Effectiveness of High Intensity Training with college athletes?

- Limitations H.I.I.T Research / Evidence
  - Endurance Athletes
    - Plethora of Evidence for H.I.I.T. during training (Running, Cycling, Rowing)
  - Recreational
  - Strength & Power Athletes
- There are very few research studies that use college athletes at any level as subjects for HIIT.
  - Possible conclusion, it does not fit the performance development paradigm.

4. Research / Evidence: Effectiveness of High Intensity Training with college athletes?

- When and Why to use HIIT?
- Transition Periods
- Weight Loss
- Develop Aerobic Capacity (Running, Cycling)
- Build Mental Toughness

Questions

Thoughts

Corrections

Thank You for you time and attention.

Whoever heeds life-giving correction will be at home among the wise.
Proverbs 15:31