Assessing the Athlete

Gender: *Male* *Female*

Weight: *Light* (57/75kg) *Middle* (75/100kg) *Heavy* (90/125kg) *Super Heavy* (90+/125+)

Height: *Short* (160/170cm) *Medium* (167/182cm) *Tall* (175/195cm) *Very Tall* (175+/195+cm)

Strength: *Low* (Class VI-III) *Moderate* (Class II-I) *High* (Master-Elite) *Very High* (Intl Elite)

Experience: *Beginner* (<4 Years) *Intermediate* (4-8 Years) *Advanced* (8-12 Years) *Very Advanced* (12+ Years)

Age: *<19 Years Old* *20-29 Years Old* *30-39 Years Old* *40-49 Years Old* *50+ Years Old*

Diet: *Poor* (Not Getting Sufficient Calories) *Average* (Calories Equated but Macros/Timing Off) *Good* (Calories Equated with Good Macro Balance and Nutrient Timing)

Sleep: *Poor* (<5hrs/night) *Average* (5-7hrs/night) *Good* (7+hrs/night)

Stress Away from Training: *High* *Medium* *Low*

Performance Enhancing Drugs: *No* *Yes*

Historical Recovery Ability: *Poor* *Below Average* *Average* *Good* *Exceptional*

Determining MRV

Lower Volume										*Higher Volume*
-5	*-4*	*-3*	*-2*	*-1*	*0*	*1*	*2*	*3*	*4*	*5*
					MALE					*FEMALE*
	SUPER		*HEAVY*				*MEDIUM*		*LIGHT*	
			V TALL	*TALL*		*MEDIUM*	*SHORT*			
		V HIGH		*HIGH*	*MODERATE*	*LOW*				
			V ADVANCED		*ADVANCED*		*INTERMEDIATE*			
					BEGINNER					
	50s		*40s*		*30s*	*20s*	*<19*			
		POOR			*AVG*	*GOOD*				
		POOR			*AVG*	*GOOD*				
		POOR			*AVG*	*LOW*				
					NO				*YES*	
			POOR	*B. AVG*	*AVG*	*GOOD*	*EXCEPTIONAL*			

Determining Frequency

Squat:	**1x/Week**	**2x/Week**	**3x/Week**	**4x/Week**
Bench Press:	**2x/Week**	**3x/Week**	**4x/Week**	**5x/Week**
Deadlift:	**1x/Week**	**2x/Week**	**3x/Week**	

		Male	***Female***	
Super	***Heavy***		***Medium***	***Light***
V Tall	***Tall***		***Medium***	***Short***
V High	***High***		***Moderate***	***Low***
V Advanced	***Advanced***		***Intermediate***	***Beginner***
50s	***40s***	***30s***	***20s***	***<19***
Poor	***Avg***	***Good***		
Poor	***Avg***	***Good***		
High	***Avg***	***Low***		
	Yes	***No***		
Poor	***B Avg***	***Avg***	***Good***	***Exceptional***

Organizing The Week/Cycle

Week	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1							
2							
3							
4							

Other Notes

Why do these factors cause Volume and Frequency to change?

Gender

Female lifters are generally smaller and less muscular than their male counterparts of similar qualification, this coupled with lower testosterone, causes each session to be less fatiguing and necessitates them to train at higher volumes.

Weight

A lifter's bodyweight is highly correlated (hopefully) to their muscle mass. More muscle mass means more muscle to be damaged and this greater amount of damaged muscle will take longer to recover, lessening the amount of training the athlete can do.

Height

A taller lifter will move the bar a greater distance on each rep causing more work to be done on each rep, this will make each set more fatiguing than it would be for a shorter lifter.

Strength

The stronger a lifter becomes the more stimulating each set of work they do is and the more fatigue a given set will generate.

Experience

A more experienced lifter will have a greater special work capacity than a beginner lifter, and more than they had when they were beginners or intermediates. This greater special work capacity should allow them to train with more volume throughout the week.

Diet

The quality of a lifter's diet will provide them with the calories, macronutrient breakdown and micronutrient content to effectively recovery from training. Proper nutrient timing will further enhance their recovery a small amount.

Sleep

Sleep is a cornerstone of effective recovery, not sleeping enough will make it difficult for even the most gifted of lifters to tolerate high training volumes.

Stress

The body doesn't know the difference between stress imposed from lifting, or long work hours, exams or a hectic home life. You must account for all stressors when determining how much volume you can handle.

Performance Enhancing Drugs

Performance Enhancing Drugs help you recover faster from training but they also make the neural effect of training more profound and lead you to lift more weight which is more fatiguing, so their effect on MRV isn't as profound as some would lead you to believe.

Historical Recovery Ability

How much training have you been able to recover from in the past? Some people are able to recover better than others and while this is largely a genetic quality, we can't measure your genetics so understanding your training history is the next best thing.

Variation and Fatigue

Squat Variations

Reverse Band Squat, Walkout and Hold, High Pin/Box Squats	Most Fatiguing
Low Bar Squat w/ Wraps	
Low Bar Squat	
High Bar Squat	
Front Squat	
Leg Press, Hack Squat, Belt Squats	
Unilateral Variations (Split Squats, Lunges, Step Ups)	Least Fatiguing

Bench Variations

Reverse Band Bench, Slingshot, High Pin Press, Negatives	Most Fatiguing
Bench, Closegrip Bench, Widegrip Bench, Standing Overhead	
Incline Bench, Spoto Press, Floor Press, Seated Overhead	
Dumbbell Press Variations	
Machine Pressing Variations	
Single Joint Exercises (Skullcrushers, Shoulder Raises, etc)	Least Fatiguing

Deadlift Variations

Reverse Band Deadlift	Most Fatiguing
Deficit Pulls, Sumo Block Pulls (If done for Mechanical Overload)	
Conventional Deadlift	
Conventional Block Pulls (Assuming You Can Do More from Floor)	
Sumo Deadlift, RDLs, Good Mornings	
Back Raises, Reverse Hypers, GHRs	Least Fatiguing

Learn More…

Read…

-Scientific Principles of Strength Training
-A Thoughtful Pursuit of Strength
-How Much Should I Train?
-Recovering from Training

Watch…

-Scientific Principles of Strength Training
-Undulating Periodization Strategies
-Selecting and Progressing Weights
-

Recovery-Adaptive (RA) Principles Pt 1 Theoretical Basis

Dr. James Hoffmann

Introduction to RA




Introduction to RA

"It is important to note that recovery-adaptive (RA) strategies and techniques are not sufficiently powerful to overcome stupid coaching, bad planning, and a lack of talent"

Dr. Bill Sands, Developer and researcher of the recovery center for the USOC

Introduction to RA

Recovery defined by Kellmann:

"The compensation of deficit states of an organism according to the homeostatic principle, a reestablishment of the initial state"

Simply put, a return to baseline

Traditional models of recovery fit well when addressing biological systems, but have major short comings in the context of performance enhancement

What's missing ?!

Introduction to RA

- Recovery which does not also promote or at least address adaptation is largely incomplete recovery
- Confusion remains on differentiating recovery from injury vs recovery from training
- Our working definition of recovery:

"The return of physiological systems to baseline, which results in a restoration of athletic performance to pre-disruption levels, or at least to levels sufficient for further overload training"

Fatigue

- Fatigue :
  - The inhibition of maximal performance that comes about as a result of stressors imposed on the individual
  - An acute impairment in the exercise performance, which ultimately can impair the ability to produce maximal force or control motor function (Bompa)
  - Stone, Stone, Sands
    - Acute Fatigue: Occurs during exercise and the post exercise phase, resulting in the inability to maintain or repeat an absolute force or power level.
    - Chronic (accumulated) Fatigue: Chronic poor or diminished performance as a result of the inability to recover from the training load and the summation of physical and emotional stressors

Fatigue

Training Factors

- Volume
- Intensity
- Density
- Frequency
- Impact, contacts, and direct distruptions

Lifestyle Factors

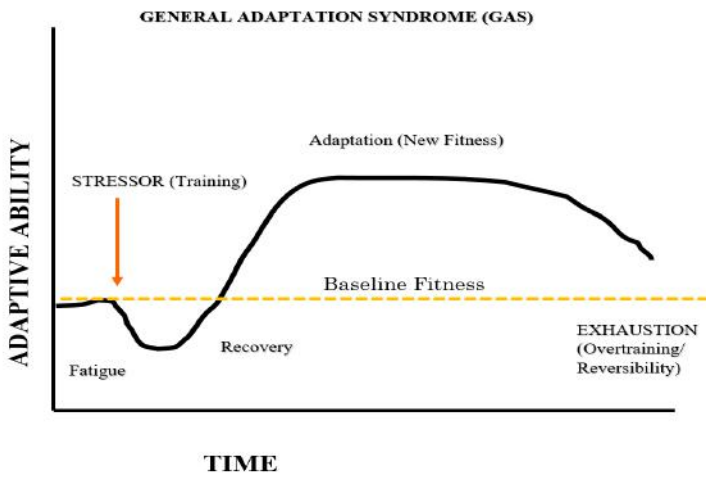
- Daily physical tasks
- Sleep deprivation
- Poor nutrition
- Psychological stress
- Illness
- Toxin exposure

Fatigue is manifested both centrally (heart, lungs, brain, spinal cord) and peripherally (muscles and innervating tissues). Confusion

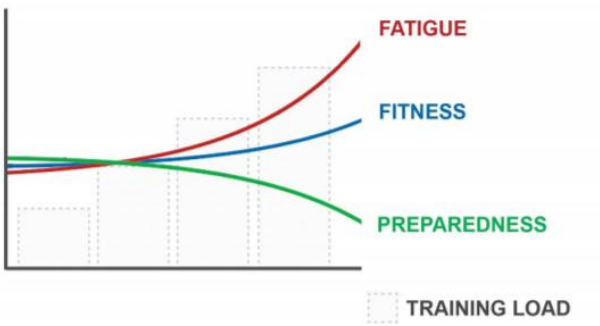
Fatigue

- Important concept – The Fitness Fatigue Paradigm:
  - Training stresses lead to gains in fitness while simultaneously raising fatigue
  - Residual and accumulated fatigue mask gains in fitness or its expression
  - New fitness (adaptations) are only expressed after fatigue has been alleviated
- Adaptations can generally only occur during **recovery**

Fatigue



Fatigue



Fatigue

- For training related factors <u>VOLUME</u> appears to be the largest contributing variable
- Within volume, the greater the intensity of effort, the more fatiguing the activity becomes
- The more fatigue, the less fitness that can be expressed or trained

Fatigue

- So fatigue is bad right ?! WE MUST ELIMINATE FATIGUE AT ALL COSTS!
- Not quite … Fatigue needs to be managed, not eliminated
- We should not seek out strategies that violate overload , OR interfere with the adaptive processes

Recovery Modalities

- Fitness-Fatigue Conundrum
  There is so much stuff out there, where do we start!?

- There is clearly a need to mechanistically differentiate effective strategies from non-sense

Recovery Modalities

Figure 4: Primary recovery hierarchy

Recovery Modalities

- Prerequisite Concept – **<u>The Volume Landmarks:</u>**
  - Maximum Recoverable Volume (**MRV**) : The highest volume of training an athlete can do in a particular situation and still recover to present a full overload in the next training timescale
  - Minimum Effective Volume (**MEV**): The lowest volume of training an athlete can do in a particular situation and still measurably improve
  - Maximum Adaptive Volume (**MAV**): the amount of training that, in any one unit of time, yields the greatest adaptive response
  - Maintenance Volume (**MV**): The lowest volume of training an athlete can do in a particular situation and still retain his or her abilities

Recovery Modalities

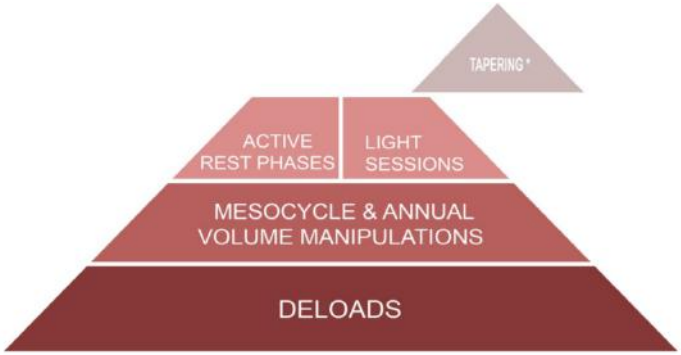
Passive Recovery Hierarchy

Recovery Modalities

Nutrition Recovery Hierarchy

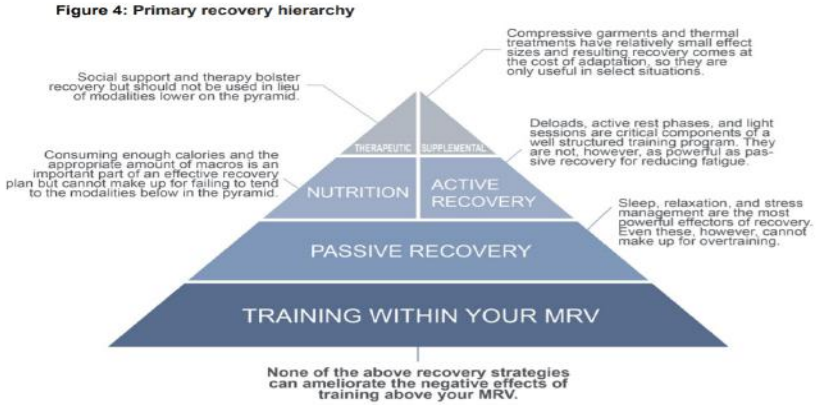
Recovery Modalities

Active Recovery Hierarchy



Recovery Modalities

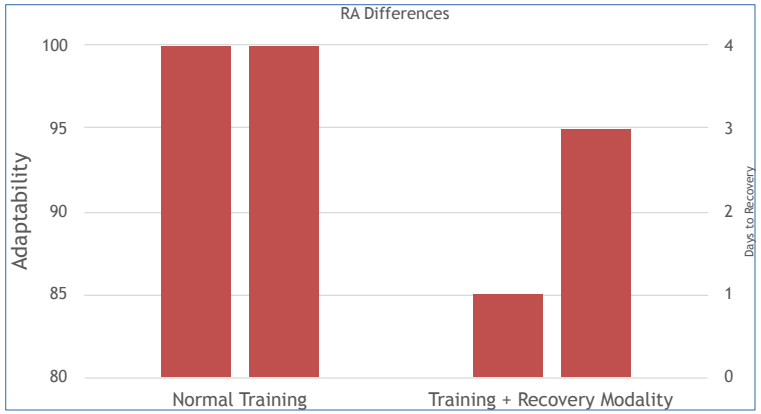
Figure 4: Primary recovery hierarchy



Recovery Modalities

- The byproducts of training based fatigue :
  - Soreness / Stiffness
  - Edema
  - Swelling
  - Inflammation
  - Tissue damage
  - Metabolite accumulation
- These actually are part of the 'snowball' effects of adaptation , and should be managed rather than avoided
- Strategies that reduce these effects also have a tendency to blunt the RA processes

Recovery Modalities



Recovery Modalities

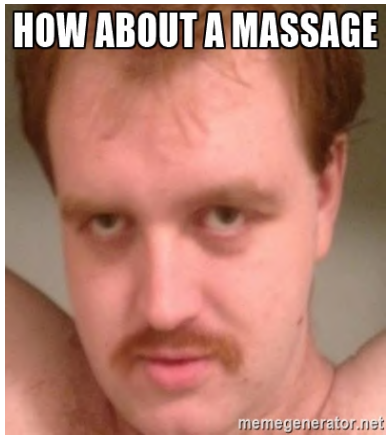
- Cold therapy
  - Causes vasoconstriction, blunts inflammatory cascade and edema
  - Decreases perception of pain and fatigue
  - Increases recovery of exercise performance
- Heat therapy
  - Causes vasodilation, increases blood flow
  - Reduces spasming, local pain, and DOMS
  - Enhances nutrient uptake, waste removal, lymphatic drainage, and relaxation

Recovery Modalities

- Contrast
  - Uses both cold and heat therapies
  - Reduce local pain, edema, and DOMS
  - Improves recovery of exercise performance, lymphatic drained, and perception of fatigue
- Compression
  - Increases local blood flow
  - Enhances nutrient uptake, waste removal, lymphatic drainage, and recovery of exercise performance
  - Decreases perception of pain, edema, and DOMS

Recovery Modalities

- Social Support
  - Helps maintain positive psychological state
  - Aids in stress management
- Compassionate Touch
  - Mostly perceptive, virtually no physical effects of recovery
  - Increases feelings of well being and perceived recovery
  - Reduces low to mod intensity pain and DOMS



Applying RA Strategies

- Typically the first question people ask about improving recovery is :

  What do I need to add to my program to make me recover better?

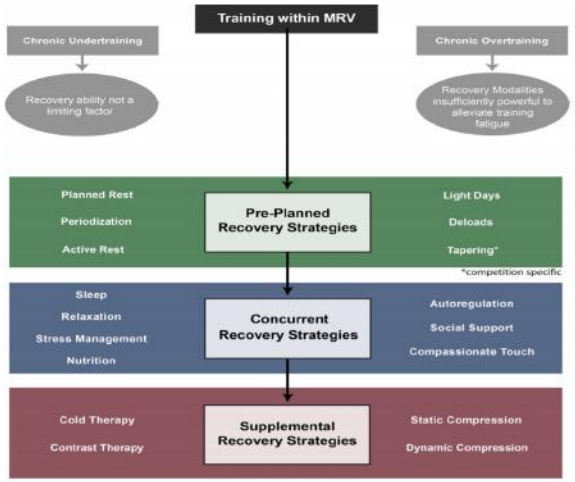
- We can't just add stuff willy nilly to our plan. If we can simply ADD recovery methods to make things better, our plan is probably already is disarray

Applying RA Strategies

- So how do we set up proper RA strategies ?

1. Determine the athletes volume landmarks: MRV, MAV, MEV, MV
2. Start planning ahead
3. Start modifying lifestyle and activities to accommodate intense training
4. Selectively seek out additional modalities when recoverability becomes a limiting factor to performance

Applying RA Strategies



Applying RA Strategies

PRE-PLANNED RECOVERY STRATEGIES

Recovery Method	Frequency of Use	Application
Training within MRV	Always	Establishing maintenance volume (MV), minimum effective volume (MEV), and maximum recoverable volume (MRV)
Planned Rest	At least 1x per microycle	No structured training
Planned Light Sessions	1-2x per microcycle	50% reduction in volume, 0-15% reduction in relative intensity / Volume and intensity reduced for recovery-specific sessions
Deloading	Every 3-6 weeks / 1x per mesocycle	Placed after overreaching periods / Volume reduced to MV, Intensity maintained or reduced slightly
Mesocycle and Annual Volume Manipulations	Athletes shift training emphasis every 1-3 mesocycles / For physique and health training, shift every 2-3 mesocycles	Shifting training emphasis / Use resensitization periods
Tapering	Needs basis only	Only used for important competitions

Applying RA Strategies

CONCURRENT RECOVERY STRATEGIES

Recovery Method	Frequency of Use	Application
Nightly Sleep	Always / Consistently	6-10 hours on a weekly average depending on fatigue levels
Stress management	Always / Consistently	Minimize emotional responses, engage in low stress behaviors
Nutrition	Always / Consistently	Consuming sufficient calories, protein, carbohydrate, and water to meet daily needs
Therapeutic Strategies	Always / Consistently with increases as needed	Use of social support, therapy, and time with loved ones to manage stressors
Relaxation	As much as possible / at least 45 minutes per day	Find activities that reduce psychological arousal and minimize physical work
Naps	As needed	20-30 minutes at a time
Autoregulated Active Recovery	Occasionally / As needed	Light sessions, deloads, and active rest phases when fatigue is excessive

RP

Applying RA Strategies

SUPPLEMENTAL RECOVERY STRATEGIES

Recovery Method	Timing of Use	Application
Cold Therapy	Immediately post-training	15-20 minute bouts with breaks and repetitions as needed
Contrast Therapy	0-90 minutes post-training	Alternating bouts of cold and heat for a total time of 10-30 minutes
Static Compression	12-48 hours post-training	Set it and forget it Continue as desired
Dynamic Compression	12-24 hours post-training	15-30 minute bouts with breaks and repetitions as desired

RP

Applying RA Strategies

- No Bueno
  - Excessive Flexibility / Mobility
  - Excessive Cardio
  - Prolonged Heat Exposure
  - Relying on NSAIDS
  - Making light days really hard
- Not sure …?
  - Cupping
  - E-Stim
  - Dynamic Compression

🤔 Recovery?

RP

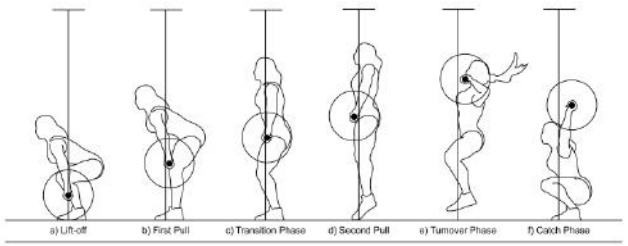
Applying RA Strategies

- Recovery Toolbox
  - What does the scientific literature say on this method?
  - How does it actually work in promoting recovery-adaptation?
  - Is the net effect of this method adding fatigue or removing f atigue?
  - Can this method be explained or confounded by an already e stablished method?
  - What are the potential benefits and risks of using this metho d?
  - What is the potential magnitude of effect
  - Is there an appropriate timescale for use of this method?
  - Do I have any personal experience or evidence to support or refute this method

RP

Technique Development for Weightlifting

Mechanics **VS** **Style**



Mechanics of lifting

Objectively defined components of the exercises that are universal to all successful lifts.

- **Universal components of the lifts**
- **Movement of the barbell through distinct positions**
- **Movement of the athlete through distinct positions**

Relative height of the bar

How high the barbell is being pulled/driven during the lift

- **Maximum**

Creates loss of efficiency, lifter spends to much time pulling

- **Minimum**

Leads to weak positions, lifter sacrifices height on the bar for speed under the weight

- **Optimal**

Best of both worlds

Trajectory

The coordination and movement of the barbell and body during the lift

- Complete miss
Barbell is not moved into the correct position for successful lifts to occur

- Outside target zone
Barbell is fixed, but with minor errors. Including technical (press-out, elbow touch)

- Inside target
Successful lifts with no Technical infractions, but lifter needs multiple steps to balance

Time to fixation

Time between actively exerting vertical force to the barbell
And fixing the barbell overhead/in the front rack.

- Good
Moving under the bar in the proper sequence

- Better
Elimination of any wasted movements or “hesitations”

- Best
Maximization of technical efficiency. Able to achieve optimal bar height

Style of technique

An individual athletes expression of the mechanics of lifting

- Positions of the body and limbs
- Tempo of execution
- Rhythm and coordination

Factors that influence style of technique

- Limb length ratios
- Height
- Muscular strengths
- Style of learning

Long term considerations for technique

Beginner

- Inconsistent technical errors, 10/10 misses may be different
- Technical mistakes arise from conceptual issues
- Learning through the use of external knowledge and cueing

Beginner training recommendations

- Low to moderate intensities, no maximum attempts
- Use basic progressions and or technical drills
- Focus on understanding concepts of technique in addition to execution
- Non technical training should support learning technique or help prevent injury

Intermediate

- Technical errors are consistent 10/10 errors are the same
- Technical errors are related to physical weaknesses
- Technical improvements take place through the use of special exercises

Intermediate training recommendations

- Use mostly moderate and some high intensity training
- Greater focus on classic lifts in addition to special exercises
- Focus on making execution of the technique consistent and automatic
- Non technical training should be to eliminate muscular weaknesses

Advanced

- Solidification of technique has taken place
- Technique is now automatic
- Technical changes are now very difficult to elicit

Advanced training recommendations

- Moderate and high intensities used regularly
- Primary focus on classic lifts with narrow focus on special exercises
- Focus on performance and absolute results in competitions
- All non specific training is devoted to increasing results in the classic lifts

RP +PLUS

MEMBERSHIP

Reducing Risk & Managing Injury For The Strength Athlete

Quinn Henoch, DPT
2018 Juggernaut Performance Summit

CLINICAL ATHLETE

About Me

- BS Valparaiso University '09
- Doctorate of Physical Therapy Univ of Indy '13
- Located in Orange County, CA
- ClinicalAthlete Provider
- Athletic Background
  - Football
  - Weightlifting

CLINICAL ATHLETE

Expectations

Applying evidence to practice

Think in "principles"

"Golden Nuggets"

This is just the start

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Presentation Outline

- Training workload and Injury Risk
- Managing training variables in injury scenarios
- The evidence on passive implements
  - *if there's time
- Case Examples
  - *if there's time

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Injury Risk

Strains, Tendinopathies, & idiopathic joint sensitivities are Training Injuries

How much stress can the system handle?

How much stress is the system prepared for?

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Injury Risk

- Strains/Sprains - Acute overload
  - Inability to handle acute intensity
- Tendinopathy - Chronic overload
  - Inability to handle volume of intensity

BUT…

We Need Sufficient Stress to Progress

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Injury "Prevention"

~~Injury Prevention~~ = **REDUCE RISK**

Your program **IS** the modifiable risk factor.

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Injury Risk Reduction

Training Load monitoring as a means of reducing risk:

Training Load Defined As:

"The cumulative amount of stress placed on an individual from single or multiple training sessions over a period of time." - Eckard 2018

"The accumulation of high chronic workloads while avoiding training spikes maximize the positive physiological adaptations to training and thereby reduce injury risk." (Windt 2016)

"The appropriately graded prescription of high training loads should improve players' fitness, which in turn may protect against injury". (Gabbett 2016)

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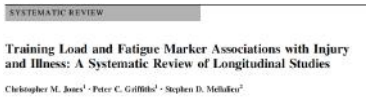
Training Load
Metrics

- External load - quantifying stimulus applied to lifter
  - Exposures/frequency
  - Duration
  - Skill reps
  - Velocity
  - Absolute intensity
  - Average intensity
  - Tonnage


SYSTEMATIC REVIEW

Training Load and Fatigue Marker Associations with Injury and Illness: A Systematic Review of Longitudinal Studies

Christopher M. Jones[1] · Peter C. Griffiths[1] · Stephen D. Mellalieu[2]

- Internal load – quantifying lifter's response to stimulus
  - sRPE
    - RPE X session time = AU
- Absolute Load – ex) week to week increases in intensity
- Relative Load – current workload vs your preparation

CLINICAL ATHLETE

CLINICAL ATHLETE

Training Load
Metrics

Relative Load

– **Acute:Chronic workload ratio (ACWR)**

$$\frac{\text{Load of 1 Microcycle}}{\text{Average Load of the Previous 4 weeks}}$$

Example: week's training load was 500 AU and the mean training load of the previous 4 weeks was 250 AU, the ACWR for that week would be 2.0.

Acute on Chronic Training Loads

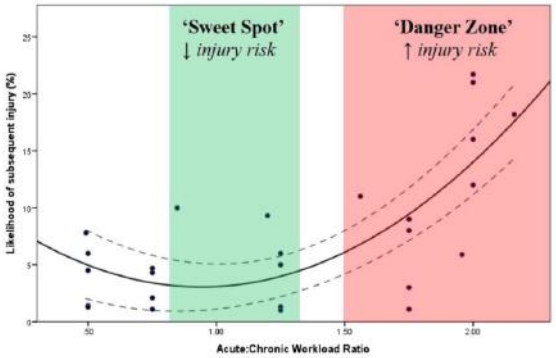
Blanch & Gabbett 2015

Chronic workload (% of normal average)								
	110	4.7	4.1	3.6	3.4	3.2	3.3	3.5
	100	4.3	3.7	3.4	3.3	3.3	3.6	4.0
	90	3.9	3.5	3.3	3.3	3.6	4.2	4.9
	80	3.5	3.3	3.3	3.7	4.3	5.3	6.6
	70	3.3	3.3	3.7	4.6	5.8	7.5	9.5
	60	3.3	3.8	4.9	6.6	8.8	11.6	14.9
	50	4.0	5.5	7.9	11.0	14.9	19.6	25.1
	40	6.6	10.1	14.9	20.9	28.2	36.7	46.5
	30	14.9	23.2	33.7	46.5	61.4	78.6	98.0
		60	70	80	90	100	110	120
		Acute workload (% of normal average)						

For example, if an athlete returned to sport and had a normal 100% loading week (acute workload) but if over the past 4 weeks due to the rehabilitation of their injury had only averaged 40% of their normal load (chronic workload), we could expect the likelihood of suffering an injury in the following week to be 28%.

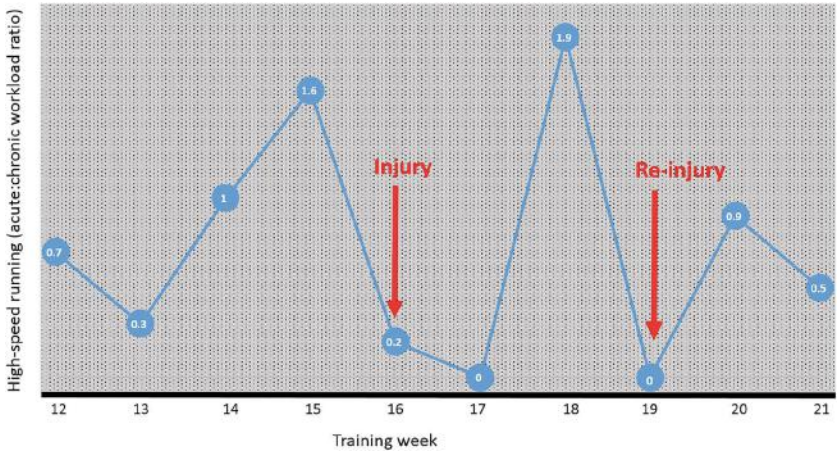
Acute:Chronic Training Loads

$$\frac{\text{Load of 1 Microcycle}}{\text{Average Load of the Previous 4 weeks}}$$



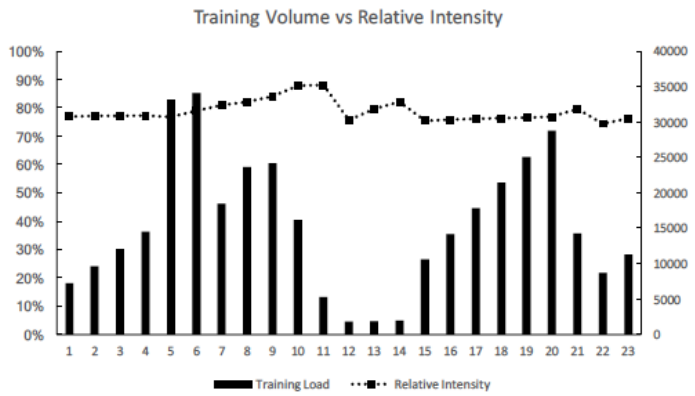
Windt & Gabbett 2016

Training Loads
Injury case in the research

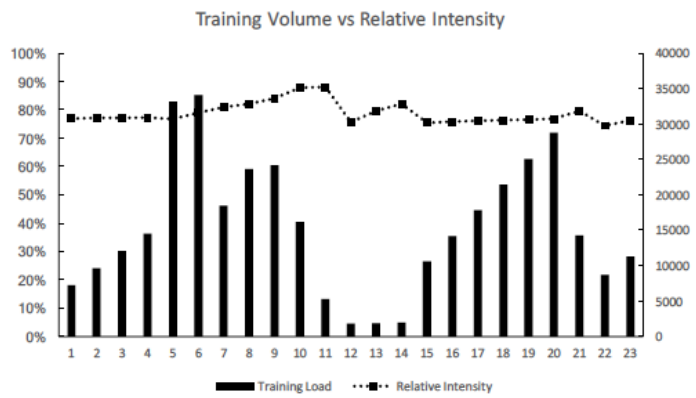


High speed running loads of a rugby league player:
Week 15 – A:C ratio of 1.6
Week 18 – A:C ratio of 1.9
TAKE HOME – level out the spikes
Blanch & Gabbett 2015

Training Loads
Injury case in the clinic



Competitive Powerlifter with left shoulder pain while benching (no prior history)
Weeks 1-4 – bench 2x/week, mod-low volume, mod intensity
Week 4 – decided to register for meet 6 weeks out
Weeks 5-10 - meet prep (400lb bench goal); bench 4x/week, high vol, progressive intensity
Week 9 – first complaint of shoulder discomfort
Week 10 – Meet; hit 400lbs (15lb PR)
Week 11 – post-meet, low-load training. Continued shoulder discomfort



Competitive Powerlifter with left shoulder pain while benching (no prior history)
Weeks 12-14 – International travel, no training at all.
Weeks 15-20 – beginning of meet prep, 16 weeks out. Shoulder pain gone.
Weeks 19 – shoulder pain returns
Week 20 – unable to train bench press due to pain
Weeks 21-30 – inconsistent training due to pain.
Week 30 – competition bench press 30lbs off of previous PR

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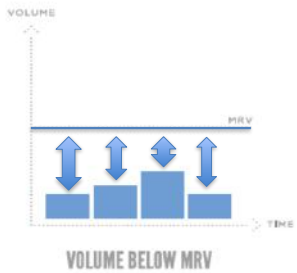
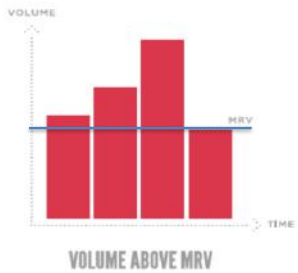
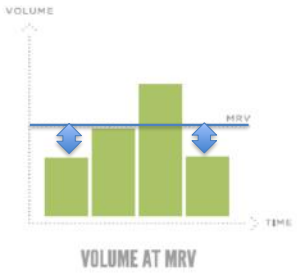
TAKE HOME:
Level out the spikes







To increase MRV & manage margin:
Increase capacity or decrease load, depending on individual, task, and environment.

Training Load
Metrics

- External load – quantifying stimulus applied to lifter
  - Exposures/frequency
  - Duration
  - Skill reps
  - Velocity
  - Absolute intensity
  - Average intensity
  - Tonnage
- Internal load – quantifying lifter response to stimulus (external load)
  - sRPE
    - RPE X session time = AU
- *Relative* Load
  - ACWR
  - **10% rule? - weekly training load Increases to find a "sweet spot"**
    - ***Not enough evidence to be married to specific numbers. Just start somewhere.**

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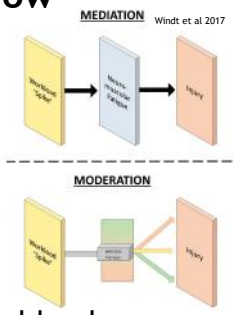
Training Load Cautions

what we still do not know



Mediators of injury
- Neuromuscular fatigue, others?

Moderators
- No injury history, training hx, age, etc

Metrics
- Interplay between internal and external load markers

Specific A:C workload ratios for more subgroups, activities, levels of performance
- Don't be married to the current parameters

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Training Load *TAKE HOME* #1

"Ultimately, attaining high chronic training loads without rapid spikes in the process is considered current best practice."

Why do workload spikes cause injuries, and which athletes are at higher risk? Mediators and moderators in workload–injury investigations

Johann Windt,[1,2] Bruno D Zumbo,[3] Ben Sporer,[4,5] Kerry MacDonald,[6] Tim J Gabbett[7]

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Training Load *TAKE HOME* #2

- "This body of evidence suggests that to minimize injury risk, athletes should receive gradually increasing doses of loading during the off-season and pre-season, with the goal of obtaining a protective 'vaccine' that results from having a high chronic load to prevent injuries during the competition period, **although this must also be balanced against load scheduling for performance optimization."**

SYSTEMATIC REVIEW

The Relationship Between Training Load and Injury in Athletes: A Systematic Review

Timothy G. Eckard[1] · Darin A. Padua[1] · Darren W. Hearn[1] · Brett S. Baxa[1] · Barnett S. Frank[1]

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Anecdotes of The Injured

Post Injury Delusions
- decreases in pain perceived as 100% function

Post Injury Panic
- "have to make up for lost time"

Post Injury Max Out Sessions
- "I just wanted to see where I'm at"

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Programming Considerations For The Injured Lifter

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Obligatory Disclaimer

Get it cleared by a licensed professional first

Programming Considerations For The Injured Weightlifter

Goal of Training When Managing Injury:

Maintain fitness/mitigate fitness loss in the midst of healing

- "Inactivity markedly decreases collagen turnover in both tendon and muscle"
  - Kjaer, 2004
- "Counteracting [overuse injuries] requires adjusted loading rather than absence of loading." – Kjaer 2004

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Programming Considerations For The Injured Weightlifter

Self-Efficacy

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Top-Down Exercise Modification

- Sufficient stress is required for adaptation.
  - Magnitude plays a key role vs. the type of contraction. (Allison 2009, Arampatzis 2007, 2010, Bohm 2015)
- Pick the next most difficult variation to illicit training effect
  - This is where many physical rehab programs fall short

Tiered (prioritized) Approach to Injury-Induced Training Modification

- **Manipulate Training Variables Before Complete Rest**
- **Top-Down Exercise Modification**

Tier 1: Workload

- Relative training load trends – acute spikes either up or down?
- Intensity trigger? – find threshold
- Volume trigger? – find threshold

Tier 2: Movement Modification

- Variation (top down)
- Position/Biomechanics (alter force distribution)
- Range of motion – find threshold
- **Tempo** (intensity limiting)

Tempo

- Isometrics vs. light isokinetics
  - Analgesia
  - Decreased corticol inhibition
    - (Rio 2015, Van Ark, 2016)
  - 3-5x/week, 2-4x/day, 2' rest, 80% MVC, 30-45 sec holds
  - No structural/physiological change
- HSR vs. Ecc
  - Similar physiological change
  - HSR less total work needed, higher athlete satisfaction
  - "It may be that tendinopathic regions, as long as they are subjected to a certain magnitude of load at a slow speed, independent of whether this is eccentric or concentric in nature, can reestablish their normal tendon fibril alignment and cell morphology." – Kjaer
    - (Beyer 2015, Kjaer 2014, Kongsgaard 2010)

HSR back squat protocol for patellar tendinopathy

- Wk 1: 3x15 (15RM)
- Wk 2-3: 3x12 (12 RM)
- Wk 4-5: 4x10 (10RM)
- Wk 6-8: 4x8 (8 RM)
- Wk 9-12: 4x6 (6RM)

Tempo: 3-0-3

Rest: 2-3' in between sets

Programming Considerations For The Injured Weightlifter

Take Home:

1. Train what you can while minimizing apprehension to the movement and compensatory avoidance patterns.
2. Minimize deconditioning while creating environment that allows Mother Nature to do her thing (she's pretty good at it).
3. Increasing 'load tolerance' is the goal. Take caution in focusing on minutia.

Passive "mobility" Modalities

True changes in physiology take time and sufficient stressors

- Mobility implements?
- Stretching?

Passive "mobility" Modalities:

"The three-dimensional model's equations revealed that very large forces (8-9k N, >2000lbs), outside the normal physiologic range, are required to produce even 1% compression and 1% shear in fascia lata and plantar fascia."

Chaudhry H et al.Three-dimensional mathematical model for deformation of human fasciae in manual therapy. J Am Osteopath Assoc. 2008 Aug; 108(8):379-90.

Passive "mobility" Modalities:

<u>Static Stretching</u>

Mechanisms of Action:

"Most of these studies suggest that increases in muscle extensibility observed after a single stretching session and after short-term (3- to 8-week) stretching programs are due to modified sensation." (Weppler 2010)

"The increased range of motion could not be explained by the structural changes in the muscletendon unit, and was likely due to increased stretch tolerance possibly due to adaptations of nociceptive nerve endings." (Konrad 2014)

"Stretching interventions with 3-8 weeks duration do not seem to change either the muscle or the tendon properties, although it increases the extensibility and tolerance to a greater tensile force. Adaptations to chronic stretching protocols shorter than 8 weeks seem to mostly occur at a sensory level." (Freitas review 2017)

Passive "mobility" Modalities:

<u>Static Stretching</u>

Performance Loss?

"Most studies did not include post-stretching dynamic activities; when these activities were included, no clear performance effect was observed".

(Behm 2016)

Passive "mobility" Modalities:

<u>Static Stretching</u>

"PNF"

"One session of eccentrically training through a full range of motion improved hamstring flexibility better than the gains made by a static stretch group or a control group."

(Nelson 2006)

Passive "mobility" Modalities:

<u>Static Stretching</u>

Injury Reduction:

"No clear effect on Injuries"

"Does not meaningfully reduce lower extremity injury risk"

(Andersen 2005)

Passive "mobility" Modalities

TAKE HOME:

- Mechanism: non-specific (neurophys), short term
- Implementation: interspersed when needed
- Duration: short bouts
- Intensity: enough to change perception
- Consideration: cost:benefit vs. doing more of the training movement.

What DOES change structure and physiology?

What DOES change structure and physiology?

- Move through a full range of motion with load.
- Repeat. Repeat. Repeat.
  - Over time, your tissues will adapt accordingly, and the need for correctives should diminish.

This is a *PROCESS* not a singular event

Sufficient Load

Mechanotransduction

- "Physiological process where cells sense and respond to loads" - Khan 2009
  - Collagen synthesis and turnover
  - Tendon fibril density and area
  - Increase load resistance
  - Enhanced growth factors
    - » Kjaer 2004, 2009, Bohm 2015, Kongsgaard 2010, Heinemeier 2011

Mechanotherapy

- "Intervention that introduces mechanical forces with the goal of altering molecular pathways and inducing a cellular response that enhances tissue growth, modeling, remodeling, or repair."

  - Thompson 2015

Questions?

Contact & Resources

- Instagram
  - @quinn.henochdpt
  - @clinicalathlete
- Facebook
  - Quinn Henoch (personal)
  - Quinn Henoch, DPT (coach's page)
  - ClinicalAthlete
- YouTube
  - Search
    - Quinn Henoch
    - ClinicalAthlete
    - Juggernaut
- Email
  - info@clinicalathlete.com
- Clinician Directory:
  - www.clinicalathlete.com
- Book:
  - "Weightlifting Movement Assessment & Optimization"

FROM INSPIRATION TO PASSION

HANDOUT

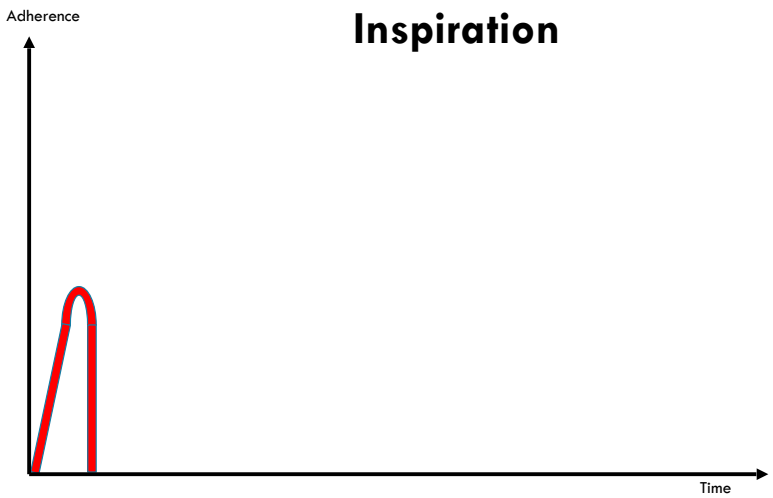
The Six Constructs

1.) Inspiration
2.) Motivation
3.) Intention
4.) Discipline
5.) Habit
6.) Passion

When the diet begins, the early factors dominate.

As the diet goes on, later factors take precedence.

Inspiration



Helping to Inspire

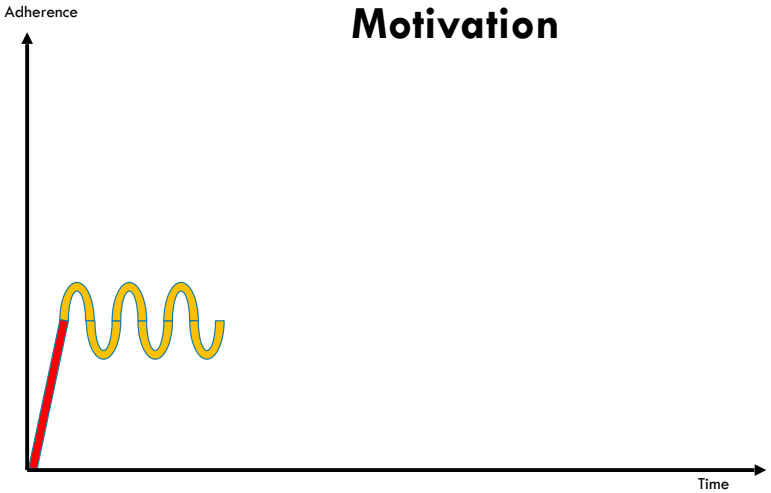
Lead by example!

Don't humiliate. Be positive and supportive.

Educate about risks of non-diet, benefits of diet.

Success stories: impressive BUT REALISTIC.

Motivation



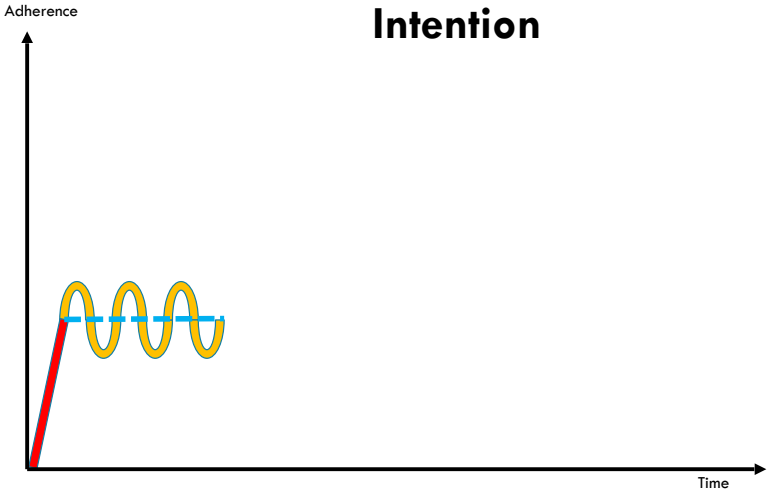
Helping to Motivate

Help them set a GOAL. Inspiration pushes, motivation PULLS.

Goals must be specific. “In shape” is not a goal. “Lose 15lbs by November 1” IS.

Goals must be challenging but realistic.

Intention



Developing Intention

Goals aren’t good enough. Must have a PLAN to EXECUTE.

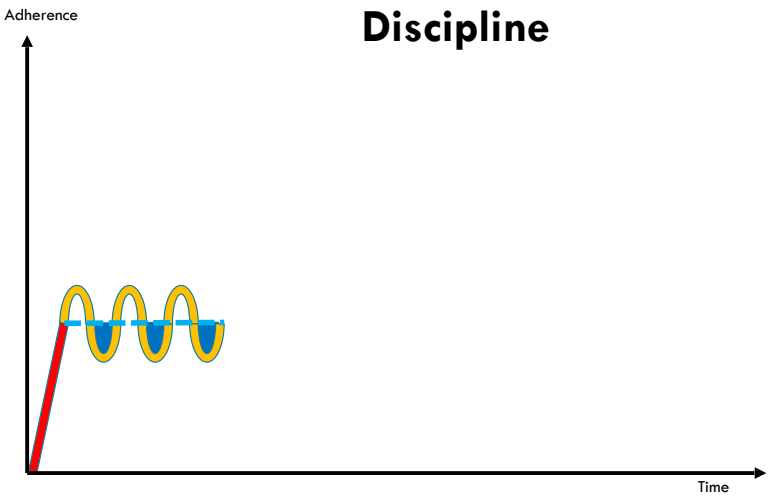
What do you HAVE TO DO meal, day, week in and out to reach the goal. THAT is the watermark of adherence.

Help develop or choose a specific plan of calories, macros, meals, whatever. RP COUGH COUGH.

Plan details don’t matter nearly as much as HAVING A PLAN.

Plan must be strict enough to get results but not so tough it causes burnout.

Discipline



Cultivating Discipline

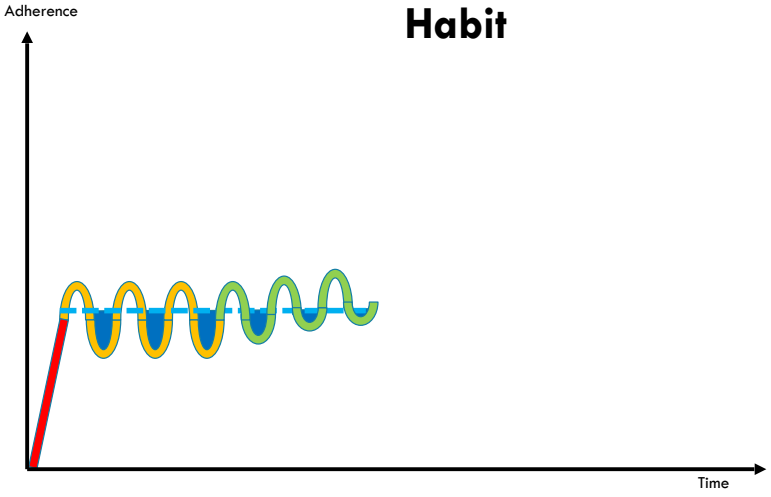
You know what your intentions are (executing the plan), now you've got to use willpower to meet them when the plan gets tough or motivation wanes.

REMIND those you're helping that it's not all sunshine and rainbows. The plan WILL get tough, motivation WILL sag, and you have to use willpower and grit your teeth on occasion!!

"I'm not feeling motivated today." NOTED… STICK TO PLAN. Motivation will return later. Honor the plan you made.

Remind: things WILL get easier, but you've gotta make it that far first.

Habit



Fostering Habit

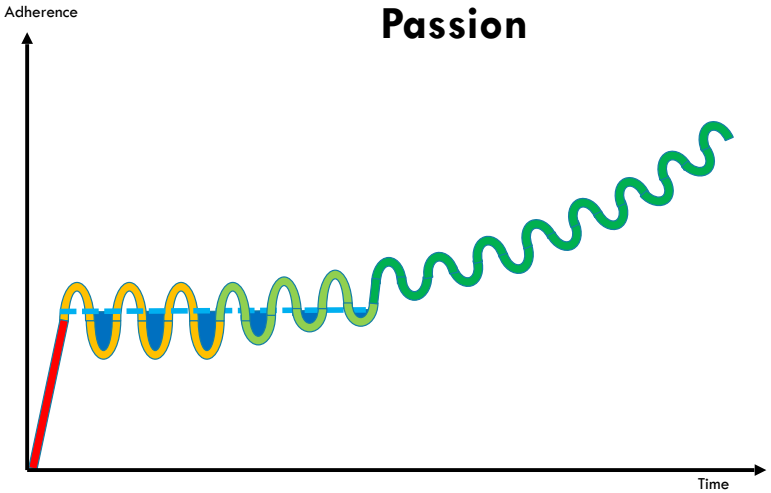
Plan they are using to generate intention should be SUSTAINABLE and CONVENIENT. RP COUGH COUGH

A meal plan that's easy to automate.
A workout that fits your body/preference.
A gym location that's close to home/work.
An approach to fitness that's SIMPLER.

Remind that habits take a while (weeks/months) to develop… it's not going to happen overnight and that's OK.

Hang in there, it will get MUCH easier and SIMPLER.

Passion



Unlocking Passion

Not everyone will become passionate about dieting, so don't promise it or force it.

Make sure fitness habits are FUN! IIFYM vs. clean eating 100% of time.
Diverse food choices.
Cook books and delicious healthy foods.
Workouts that are FUN! Vary them if you want.

Find a COMMUNITY of folks that love fitness just like you do.

Experience success from your goals and LET IT GET TO YOU. This will increase your love of the process!

When Coaching

Talk to your clients.

Determine where they are on the adherence sequence.

Supply them the support/education they need FOR WHERE THEY ARE.

If they need to be inspired, do that. If they need a talk about discipline, do that. If they need help settling into sustainable habits…

RP

RENAISSANCE PERIODIZATION

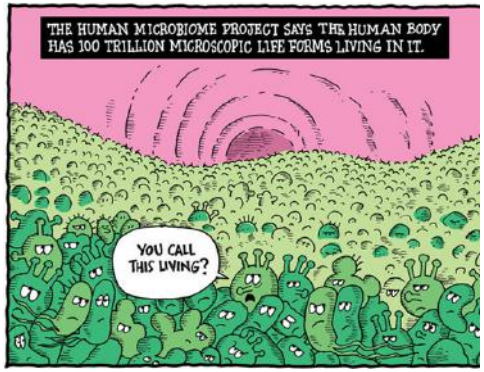
Of Microbes and Muscles

Understanding the Role of The Gut in Health and Performance

Dr. Gabrielle Fundaro, CISSN, CHC

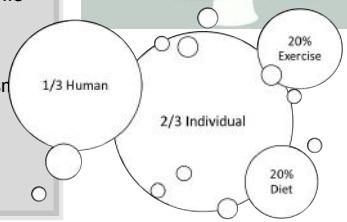
Human Microbiome Project & Integrative Human Microbiome Project (2007-2016)

- $170 million in NIH funding
- Over 190 peer-reviewed publications
- New databases and reference sets
  - "Healthy" core biome
- HMP1
  - 242 healthy US male and female volunteers contributing 5,000 samples from multiple sites
- iHMP
  - Pregnancy and pre-term birth
  - Inflammatory bowel diseases
  - Type 2 diabetes



The Gut Microbiome

- Microscopic organisms inhabiting the digestive tract
  - ~99% bacteria
  - ~3-4 lbs worth of biomass
  - ~100 trillion bacteria with 1000's species and millions of genes
  - Energy harvesting, nutrient synthesis, pathogenic resistance, immune function, behavior
- Bacteria
  - Beneficial and pathogenic single-celled organism
  - Characterized by structure and metabolism
    - Grouped into 'taxa' by genetic similarity
      - Human – Human = 99.9%
      - Human – Chimpanzee = 98.8%
      - Operational Taxonomic Unit (OTU) = 97%

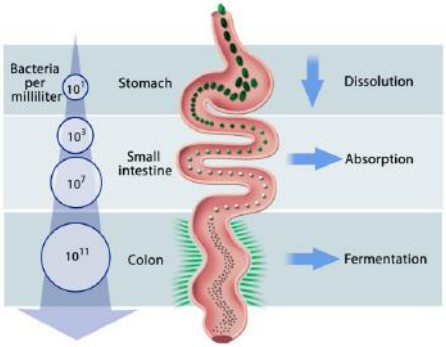


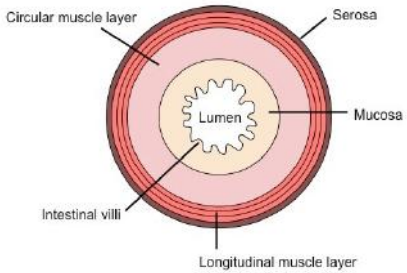
Bacterial Taxa

Bacteria	**Kingdom**	
Firmicutes	**Phylum**	
Bacilli	**Class**	
Lactobacillales	**Order**	
Lactobacillaceae	**Family**	
Lactobacillus	**Genus**	Canis (jackals, wolves, dogs)
acidophilus	**Species**	Canis lupus (wolves and dogs)
*no technical definition for bacterial species but subspecies exist	**Sub-Species**	Canis lupus familiaris (dog)

The Gut

Factors Influencing Microbial Profile
- Acidity
- Oxygen availability
- Nutrient availability
- Rate of growth
- Structure
- Numbers and diversity increase





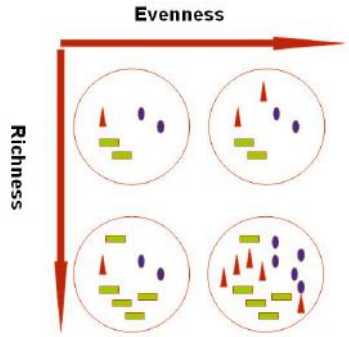
Studying the Biome: Form and Function

- Metagenomics
  - Genetic blueprints (DNA and 16sRNA)
- Metatranscriptomics and metaproteomics
  - Translation of blueprints into proteins
- Metabolomics
  - Metabolites

Studying the Biome: Form and Function

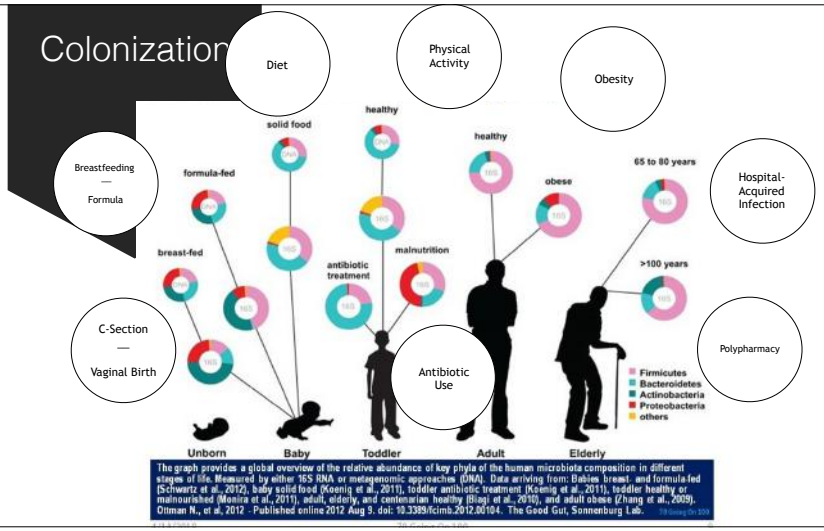
12 main phyla; 90% representation in main four
- Firmicutes
- Bacteroidetes
- Actinobacteria
- Proteobacteria

- Diversity
  - Richness: # of species
  - Evenness: representation
  - Phylogeny: relatedness
  - Alpha- and beta-diversity



El-Ashram, Saeed. (2017). NEXT GENERATION SEQUENCING AND MICROBIAL COMMUNITY ASSOCIATED WITH EUKARYOTES INCLUDING PARASITIC HELMINTHS: A REVIEW ARTICLE.. International Journal of Advanced Rese 5. 10.21474/IJARD1/3599.

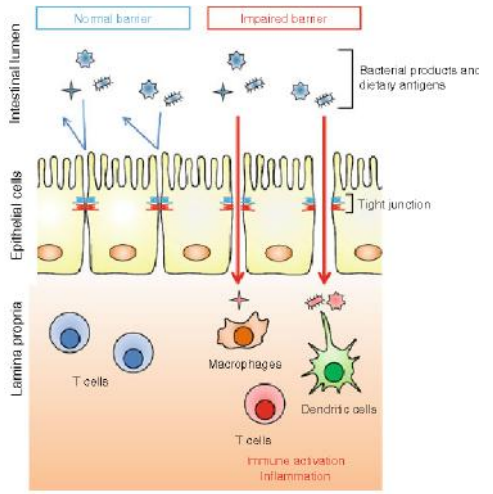
Colonization



The graph provides a global overview of the relative abundance of key phyla of the human microbiota composition in different stages of life. Measured by either 16S RNA or metagenomic approaches (DNA). Data arriving from: Babies breast- and formula-fed (Schwartz et al., 2012), baby solid food (Koenig et al., 2011), toddler antibiotic treatment (Koenig et al., 2011), toddler healthy or malnourished (Monira et al., 2011), adult, elderly, and centenarian healthy (Biagi et al., 2010), and adult obese (Zhang et al., 2009). Ottman N., et al, 2012 - Published online 2012 Aug 9. doi: 10.3389/fcimb.2012.00104. The Good Gut, Sonnenburg Lab.

Defining Dysbiosis

- No definition or specific profile of healthy or unhealthy microbial profile
- Common characteristics of GI and metabolic diseases
  - Lack of diversity
    - Low richness
    - Uneven representation of good/bad bacteria
  - Intestinal permeability & inflammation

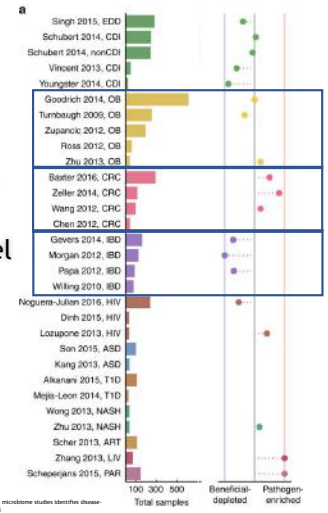


Suzuki, T. (2012). Regulation of intestinal epithelial permeability by tight junctions. Cellular and Molecular Life Sciences, 70, 631-659.

Obesity

Colorectal Cancer

Inflammatory Bowel Diseases



No definitive pattern

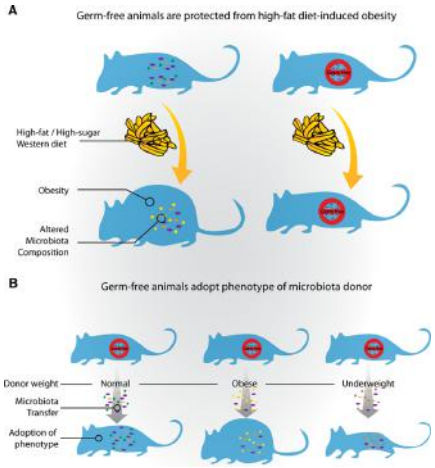
Increase in harmful microbes

Loss of beneficial microbes

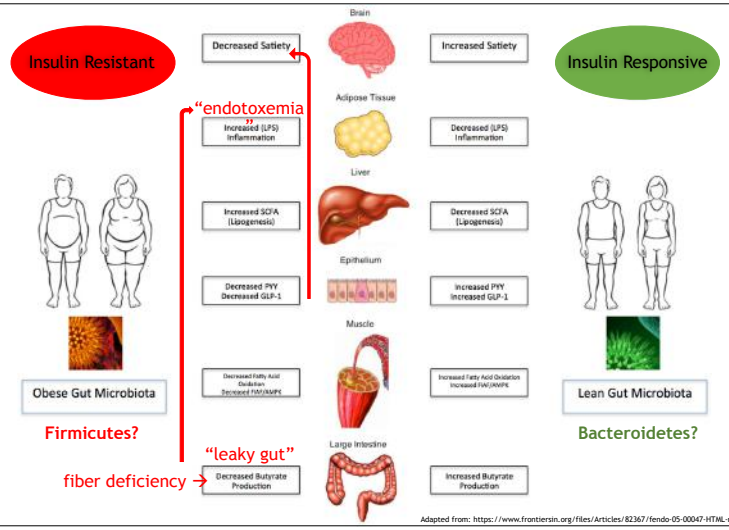
Adapted from: Duvallet, C., Gibbons, S. M., Gurry, T., Irizarry, R. A., & Alm, E. J. (2017). Meta-analysis of gut microbiome studies identifies disease-specific and shared responses. Nature Communications, 8, 1784. http://doi.org/10.1038/s41467-017-01973-8

Defining Dysbiosis

- Rodent fecal transplants cause obesity
  - Increased energy harvesting
  - Increased appetite
- Method of replicating human disease states and responses to diet
  - Germ-free
  - Gnotobiotic
  - Conventionalized

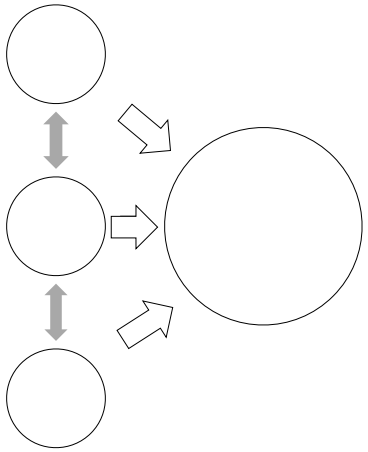


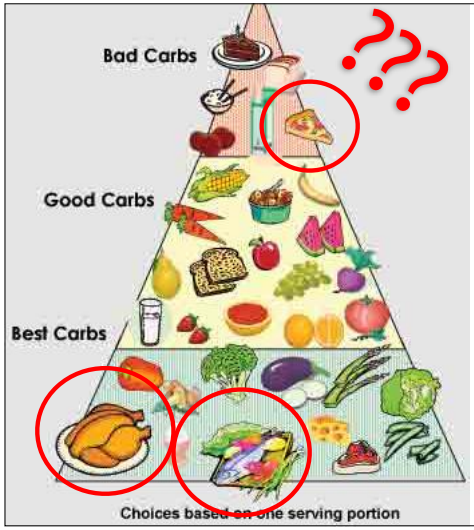
From: Minireview: Gut Microbiota: The Neglected Endocrine Organ
Mol Endocrinol. 2014;28(8):1221-1238. doi:10.1210/me.2014-1108
Mol Endocrinol | Copyright © 2014 by the Endocrine Society



Adapted from: https://www.frontiersin.org/files/Articles/82367/fendo-05-00047-HTML-r1/image_m/fendo-05-0004

Diet and the Microbiome

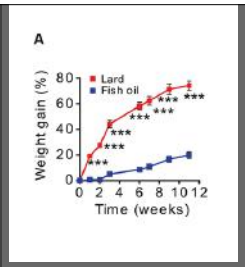


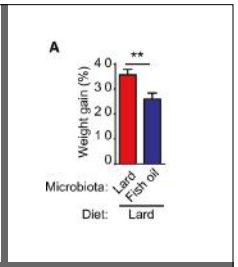


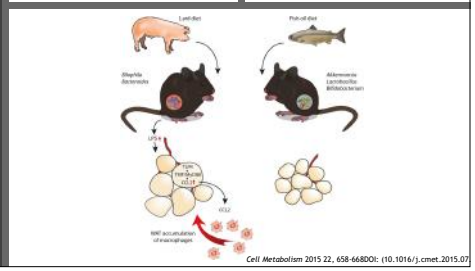
"I have to cut carbs to lose weight…"

Fats

- Saturated or unsaturated
  - Mono- or polyunsaturated
    - Omega-3 and omega-6
- HFD (>40% kcal) = reduced diversity in rodents & humans
  - Low in fiber
    - Bifidobacteria
  - High in protein
    - Bacteroides
  - Usually high in sat fat
- Intestinal permeability & endotoxin
  - Reduced butyrate



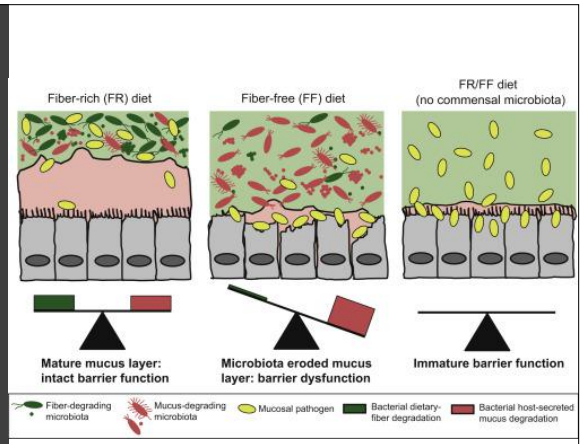




Cell Metabolism 2015 22, 658-668DOI: (10.1016/j.cmet.2015.07

Carbohydrates and Fiber

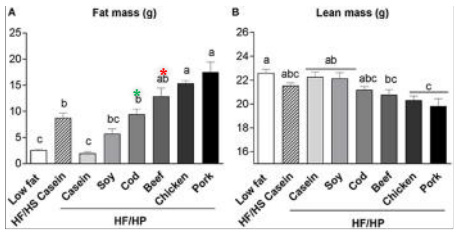
- Plant diversity drives microbial diversity
- Complex (starch and fiber)
  - Soluble (fermentable)
  - Insoluble (bulk-forming)
- Fermentation of fiber to SCFA's
  - Tight junctions
  - Appetite regulation
  - pH regulation
- FODMAP's associated with IBS
- Little/no effect of AS at physiologic doses
  - Sucralose may affect ~1% of people



Adapted from: Desai, M. S., Seekatz, A. M., Koropatkin, N. M., Kamada, N., Hickey, C. A., Wolter, M., ... Martens, E. C. (2016). A dietary fiber-deprived gut microbiota degrades the colonic mucus barrier and enhances pathogen susceptibility. Cell, 167(5), 1339-1353.e21. http://doi.org/10.1016/j.cell.2016.10.043

Protein

- Positively correlated with improved body composition, weight management, appetite suppression
- Differing potential for lean/fat mass gain in mice
- HPD diets may increase mucin-degraders
- Differing fatty acid & fiber content
  - Plants = unsaturated + fiber
  - Animal = saturated – fiber
- Avoiding gluten?
  - No benefit to non-CD
  - Low fiber & weight gain



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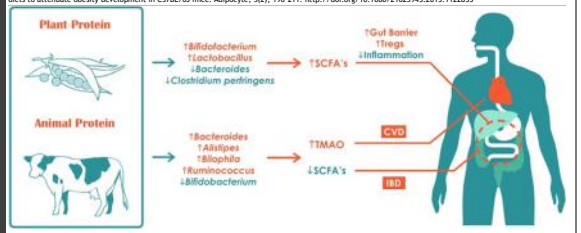
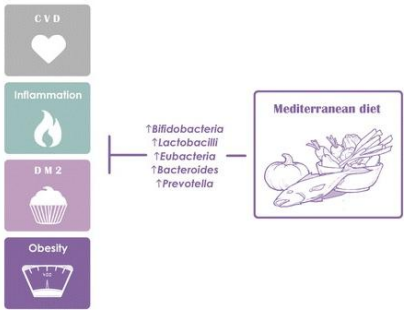
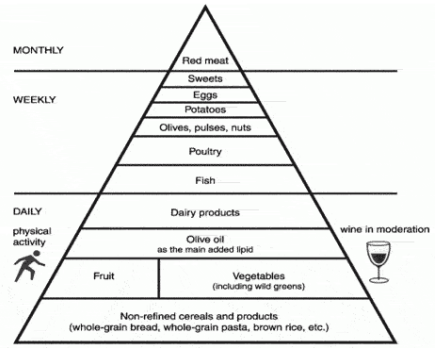


Singh, R. K., Chang, H.-W., Yan, D., Lee, K. M., Ucmak, D., Wong, K., ... Liao, W. (2017). Influence of diet on the gut microbiome and implications for human health. Journal of Translational Medicine, 15, 73. http://doi.org/10.1186/s12967-017-1175-y

Too extreme?
Not translational?
People aren't eating such one-dimensional diets…

There is no “best” diet, but…





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Trichopoulou A. Traditional Mediterranean diet and longevity in the elderly: a review. Public Health Nutrition. 2004 Oct;7(7):943-7 Review.

Supplements and Snake Oil

	Expensive	Inexpensive
Effective	Probiotics	Fiber, Plant Proteins, Whey, Coffee, Antioxidants
Ineffective	SIBO Breath Testing, IgG Antibody Testing	Collagen & Glutamine, Cleanses/Detoxes

Supplements and Snake Oil

Somewhat Beneficial to the Gut

- Coffee
  - Bifidogenic?
- Whey and Casein
  - Anti-obesogenic?
  - Bifidogenic?
- Probiotics
  - Symptoms of IBS and IBD
    - GI distress associated with endurance exercise?
  - Intestinal permeability
  - Insulin sensitivity during HFD
  - Receptivity & enrichment location
- Antioxidants
  - Additive effect with probiotics in triathletes
  - Beneficial plant compounds (polyphenols & anthocyanins)

Very Beneficial to Someone’s Wallet

- SIBO breath tests
  - No gold standard
  - False positives and negatives
    - 20-90% accuracy
- Collagen and glutamine
  - Low bioavailability
  - Non-essential amino acids
  - No trials in humans
    - Cell culture & weaning piglets
- IgG testing
  - *“It is important to understand that this test has never been scientifically proven to be able to accomplish what it reports to do.”* --American Academy of Allergy, Asthma and Immunology
- Cleanses
  - Diarrhea, hepatotoxicity

Exercise and the Microbiome

Forced Exercise	Voluntary Wheel Running
Increased forced swimming performance in colonized v. germ-free mice No effect on diversity or minimal effects on specific strains	Increased butyrate & lactic-acid bacteria More effective in juvenile mice Distance↑ Firmicutes↓ Exercise↑ Firmicutes↑

Outrunning a Bad Diet?

DIET	TRAINING	RESULTS
"High-Fat" (24%) or Chow (5%)	HIIT (90% VO2max ~10min/day) or LIT (40-50% VO2max ~2hr/day) and SED control	HFD blocked exercise-related change in diversity
High-fat (45%) or Chow (10%)	Voluntary wheel running (VWR) or SED	Reduced weight gain, markers of inflammation, and insulin levels during HFD
High-fat (45%) + Obese or Chow	1 hour of interval running at 1:1 ratio at max speed 3x/wk for 6 weeks	Improved insulin sensitivity and diversity independent of body composition
High-fat (60%) or Chow	VWR or SED	Reduced weight gain and insulin resistance Increased butyrate-producers
High-fat (45%) +/- exercise and calorie restriction	VWR or SED (CR or ad lib)	CR and exercise similarly controlled weight gain Minimal effects on diversity

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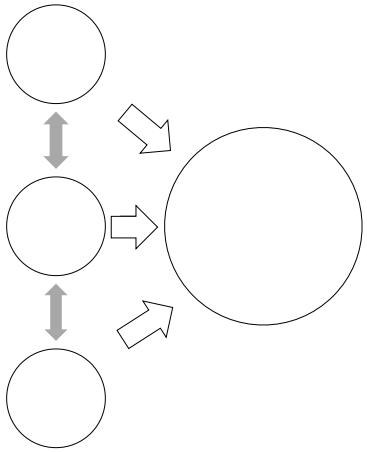

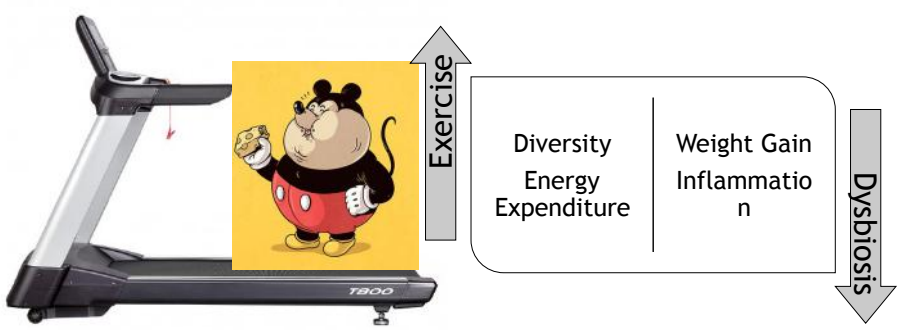

Exercise

Diversity Energy Expenditure	Weight Gain Inflammation

Dysbiosis

Gastric Distress in Athletes

Physical activity is linked to increased microbial diversity, but…

20-60% of athletes report exercise-related gastric distress

- Cramping, nausea, diarrhea
  - Impaired nutrient utilization
  - Performance impediment

Most prevalent in endurance athletes and females

- Heat and psychological stress
- Intensities >60% VO2max
- Hyperthermia, lack of blood flow, pH changes, free radicals, mechanical stress

Changes in intestinal permeability lead to increased circulating endotoxin

- Commonly associated with GI distress

Emerging Trends in Endurance Exercise

Healthy and Sedentary	Healthy and Meeting the WHO Exercise Recommendations	Amateur Marathoners	CAT 1 or Professional Cyclists	Professional Rugby Players
CV fitness = alpha-diversity ↑ functional diversity ↓ Clostridiales Lachnospiraceae Roseburia	Active females= Faecalibacterium prausnitzii ↑ Roseburia hominis Akkermansia mucinphilia	Change in metabolic pathways cell motility ↑ energy production ↓	Clusters: Prevotella, Bacteroides, Diverse Cycling >16h = Prevotella Professional = M. smithii activity ↑	Rugby players = diversity Akkermansia ↑ Prevotella low BMI controls= functionally similar to athletes
Both diet and CV fitness explained 15-20% of diversity; increased numbers of butyrate-producers	Increased numbers of butyrate-producers associated with CV fitness	Acute bouts of exercise change function rather than profile of gut; dietary practices correlated with species	M. smithii enhances efficiency of fermentation in the gut; illustrated profile v. function assessments	Athletes' guts microbially and functionally primed for SCFA production and CHO metabolism

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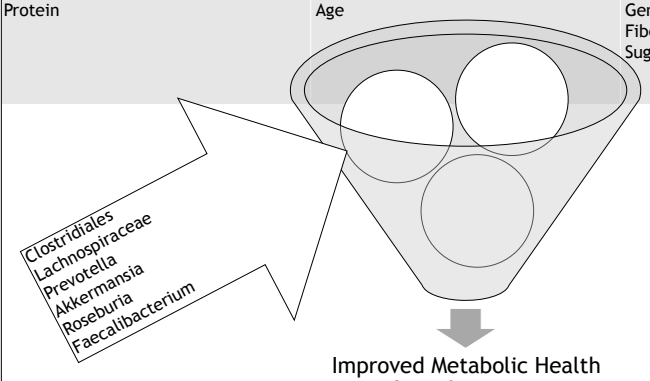
Cardiovascular Fitness: Diversity & Diet

Alpha-Diversity	Beta-Diversity	Functional Diversity
CV Fitness Protein	Protein Age	CV Fitness Gender Fiber Sugar



Improved Metabolic Health & Performance

Resistance Training

Curves Workout Centers: a Failproof Weight Loss Success Formula

Curves™ system of resistance training

- 3x/wk for 12 weeks
  - Single cycle of machines with floor exercise intervals
- Sedentary overweight/obese
- Significantly reduced circulating endotoxin levels
- Accompanied by weight loss
- No measurement of microbiome changes

Moderate aerobic exercise and resistance training

- 3x aerobic exercise, 3x RT (3x8 @70% 1RM) for 8 weeks
- Sedentary overweight/obese
- Accompanied by whey protein supplementation and weight loss
- No change to fecal microbiome

Practical Applications for Performance and Health

Probiotics: USP label and at least 1 billion CFU

Whole grains, fruits, and veggies	Dietary fats to <40% calories	Incorporate low- and moderate-intensity training
Fiber	Saturated fat to <10% calories	Rest, sleep, recover
Fermented products (yogurt, kefir, kimchi, kombucha)	Artificial sweeteners and refined sugar in moderation	Fuel and hydrate properly during endurance events
Omega-3 fats (fish, walnuts, flax, chia)	FODMAPs if necessary	
Plant & lean		

References

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