Run Better

Current management of running injury and performance enhancement

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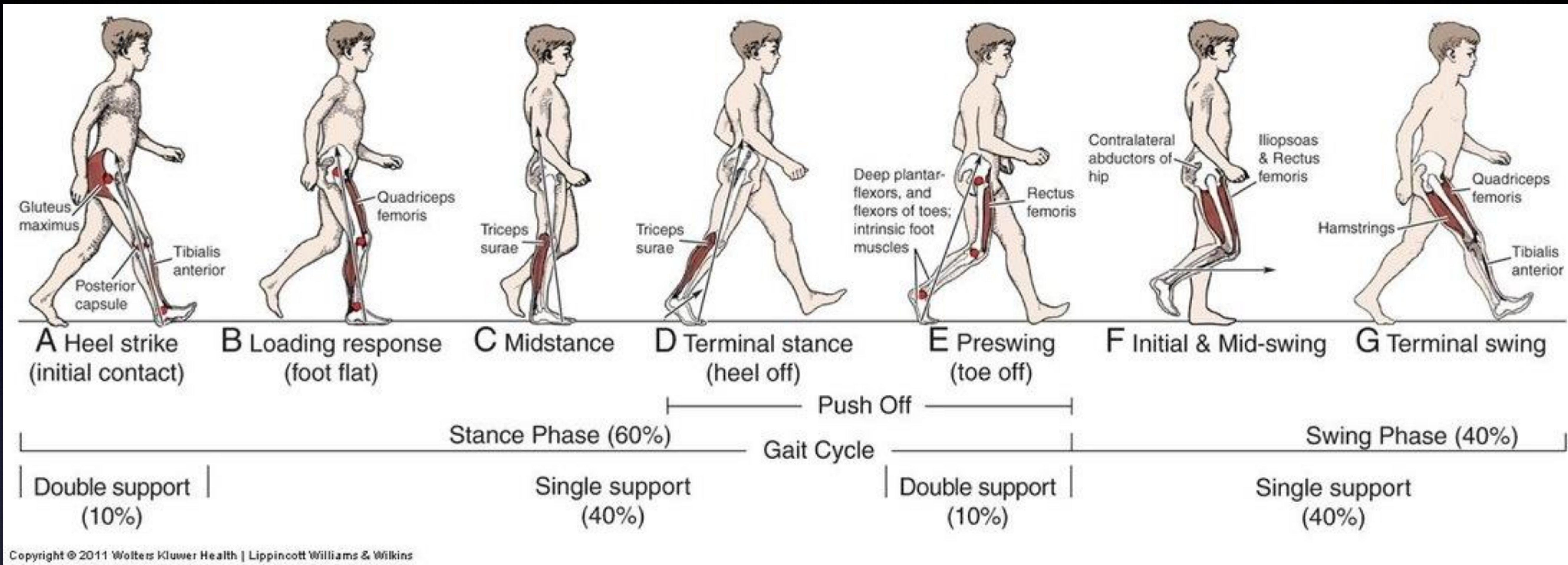
- **Consultant Sports Physiotherapist** & Clinical Director Active Therapy Ltd
- **Specialist Running Clinic** - all levels of athlete/runner
- **UK Tutor/Business Development Lead for The Running Clinic** - educate health & fitness professionals
- Provided services to - **UK Athletics, Loughborough University HPC, Runners World, Brookes UK**, The FA, The LTA, The PGA
- Former Head of Physiotherapy & Sports Medicine Hearts FC

Before we commence !

- Lots of varied opinion online and within running communities - **everyone is an expert!**
- Significant amounts of this opinion will be based upon **CONFIRMATION BIAS** from **CHERRY PICKED DATA**
- Be aware this exists and use reputable, evidence based sources for **INFORMED DECISION MAKING**
- Be aware that there is a HUGE body of evolving research in the area

Outline

1. Biomechanics of running - Practically applied
2. Injury epidemiology - The Big 5
3. Strategies for injury risk reduction and performance enhancement
4. Strength & Conditioning for runners
5. Footwear selection - What do I do?
6. Summary



Running Biomechanics

Practically applied

Current trends in running

- There is an exponential growth in number of recreational runners - GREAT!
- **Average marathon times are getting slower**

  1980 - 3.32 2002 - 4.20

- Approx 26% of runners training for marathons don’t make event due to injury
- Many more runners commencing running with

  Compromised physical competence

  Inefficient biomechanics

  Reduced ‘training age’

  Following inappropriate training plans

Health benefits of running

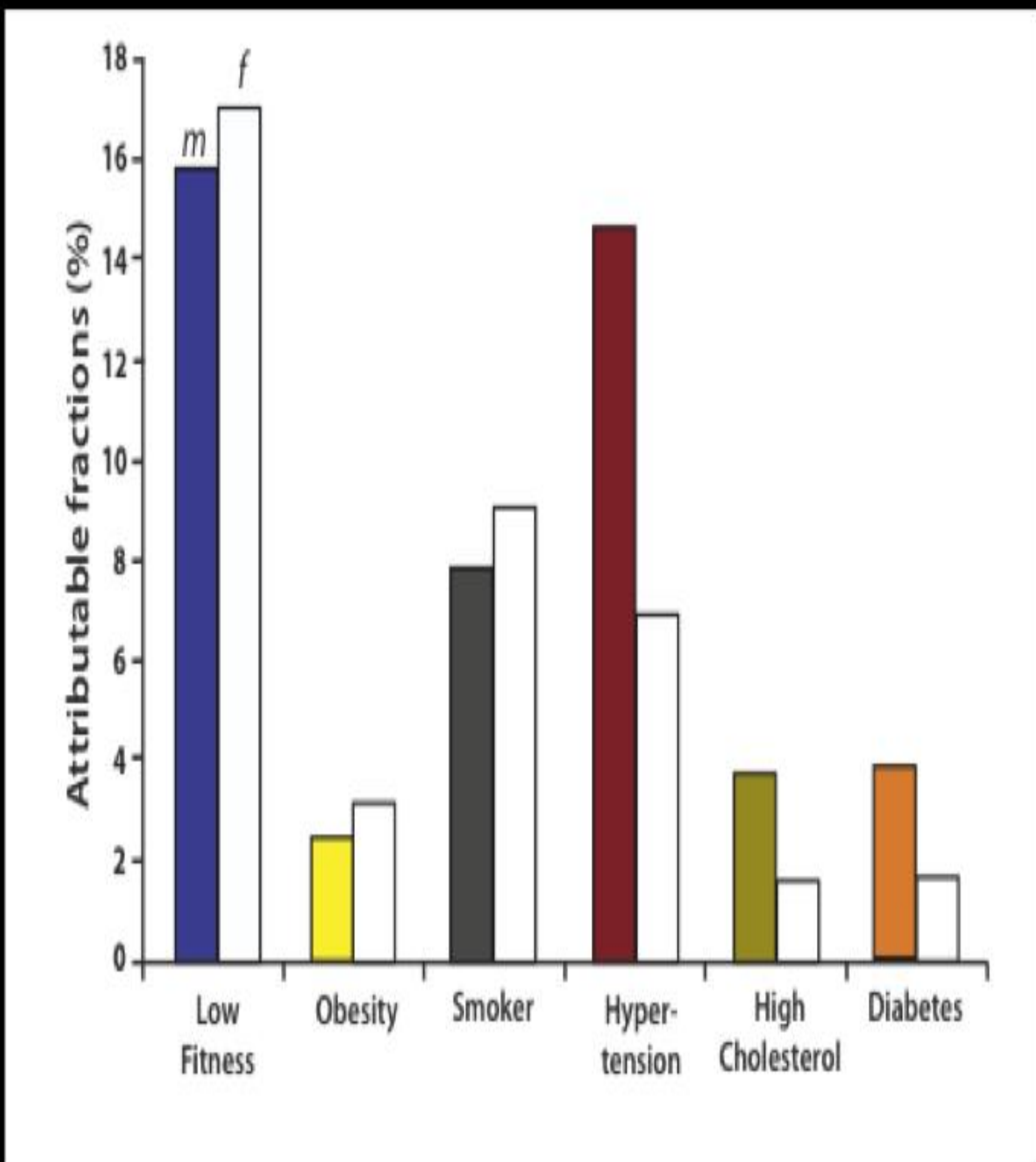
There is no MEDICATION in use or development which REDUCES ALL CAUSE MORTALITY as effectively as regular exercise!

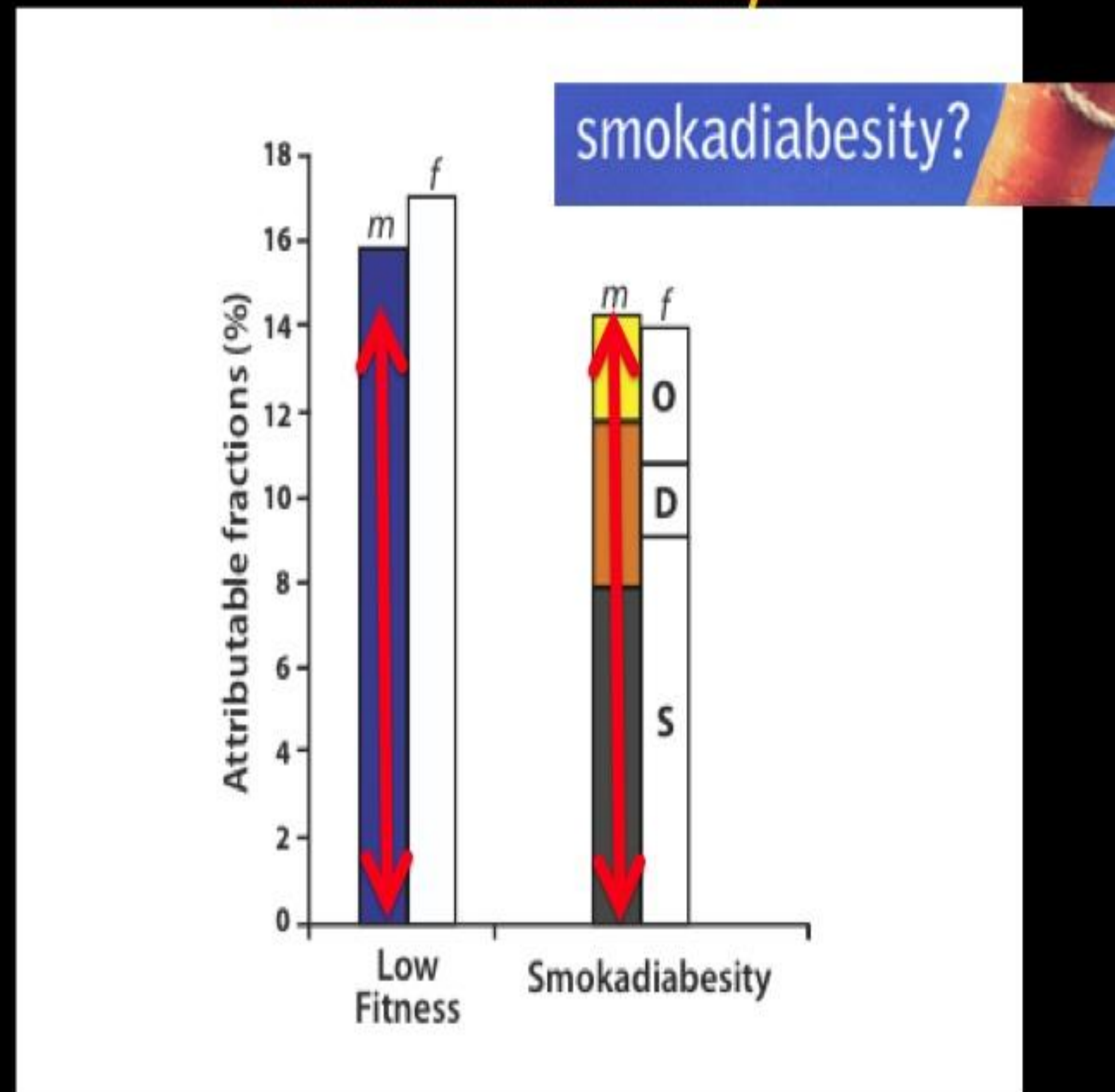
Health benefits of running

If you run regularly your ALL CAUSE MORTALITY reduces by

63%

Which risk factor kills more people? Low fitness kills more people than smokadiabesity





Blair SN, BJSM 2009

Loads during running

Each footstrike **2-3x B.W in 0.2s**

PFJ – **4.3-7.6x BW**

Achilles - 6-12x BW

Approx **1500 contacts per mile**

Runner of 70kg at 9 min/mile

Mile = 262,500 kg

Half marathon = 3,412,300 kg

Marathon = 6,825,000 kg

Loads during runni

Each footstrike **2-3x B.W in 0.2s**

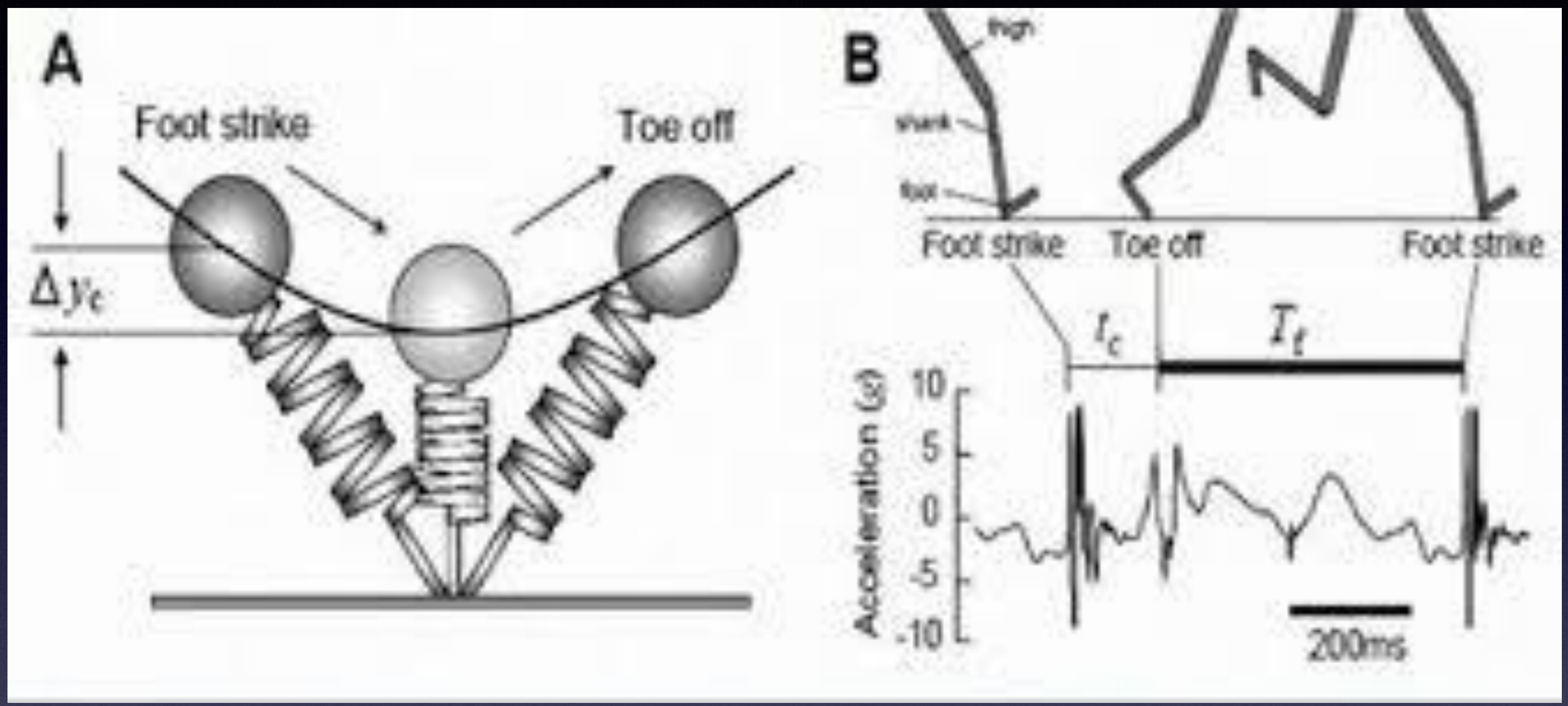
PFJ – **4.3-7 6**

A

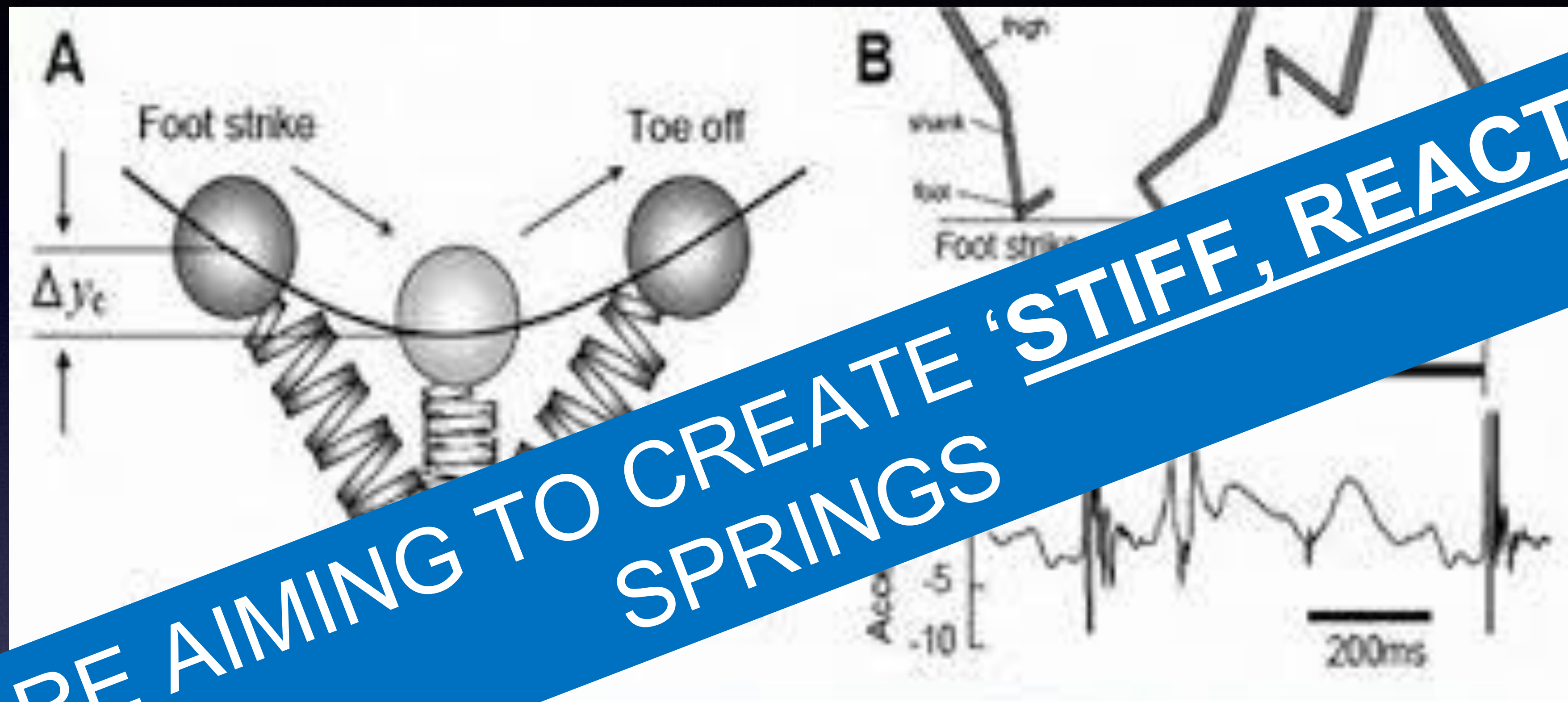
,412,300 kg

arathon = 6,825,000 kg

YOU NEED TO BE STRONG TO RUN WELL AND REDUCE YOUR INJURY RISK



Muscles & Tendons are Springs!
Approx **80% kinetic energy returned**
35% Achilles 17% Plantar Fascia



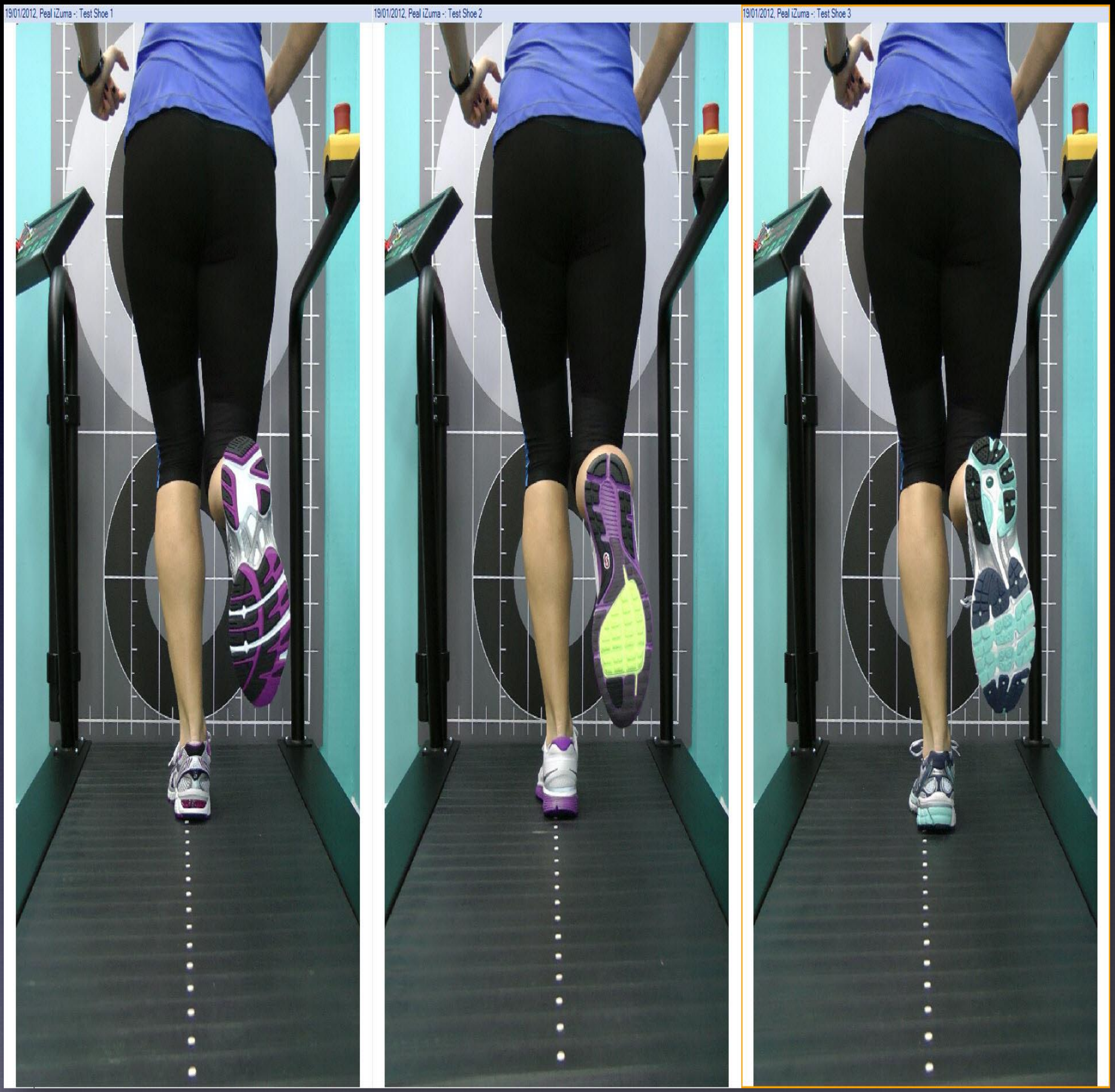
WE ARE AIMING TO CREATE ‘**STIFF, REACTIVE**’ SPRINGS

Muscles & Tendons are Springs!

Approx **80% kinetic energy returned**

35% Achilles 17% Plantar Fascia

How many people have been advised they ‘**<u>OVER-PRONATE</u>**’



What is 'normal' pronation??

THERE IS NO 'PERFECT' RUNNING TECHNIQUE

MOVEMENT VARIABILITY IS NORMAL AND HEALTHY

THERE ARE CHARACTERISTICS OF RUNNING TECHNIQUE THAT ARE DESIRABLE

Efficient gait pattern

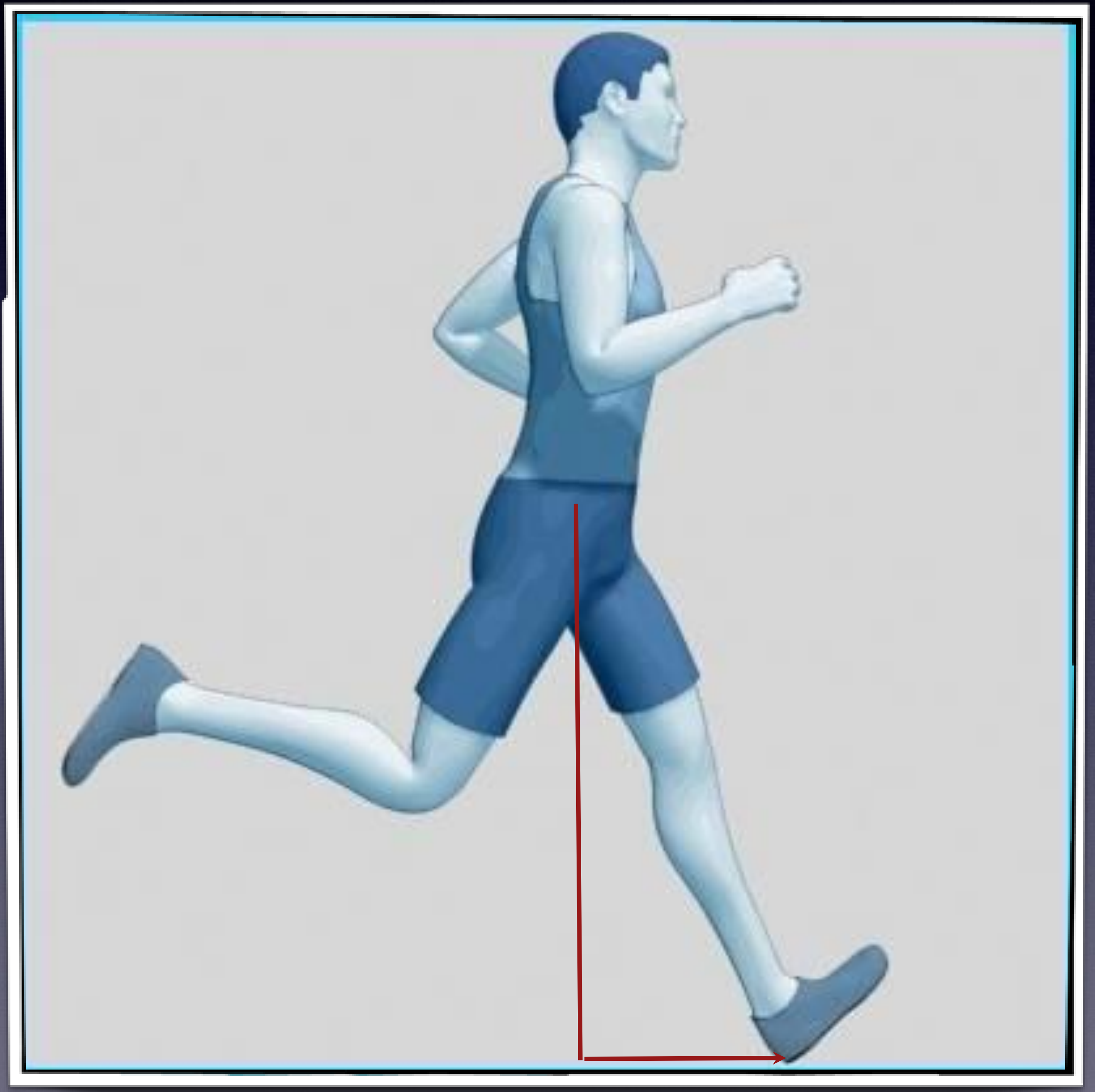
2013-Ogueta-Alday, 2011-Storen, 2011-Heise, 2011-Halvorsen, 2010-Fletcher, 2009-Pontzer, 2008-Tseh, 2007-Fletcher, 2007-Hasegawa, 2007-Romanov, 2007-Heise, 2006-Conoboy, 2005-Dallam, 2005-Divert, 2004(R)-Saunders, 2004-Arendse, 2004-Saunders, 2004-Hardin, 1996-Anderson, 1994-Morgan, 1992-Martin, 1990-Kaneko, 1989-Cavanagh, 1982-Cavanagh, 1982-Power

- Controlled posture - looking ahead
- Compact arm swing - cross body patterning
- **Active knee drive**
- **Footstrike under C.O.M**
- **Light/Reactive/Stiff**, reduced ground contact time, ?MFS
- **Cadence circa 180 spm** - not the holy grail!

Inefficient gait pattern

2011-Arellano, 2011-Storen, 2008-Tseh, 2000-DeWit, 2005-Divert, 2004-Arendse, 2005-Dallam, 1997-Milani, 1996-Hennig, 1994-Morgan

- Often 'poking chin' posture
- Rounded shoulders
- **Excessive arm swing**
  ?substitution for low knee drive
- **Overstriding foot contact ahead of COM** - 'braking' effect
- **Increased vertical displacement, vertical loading rate**
- **Reduced cadence** circa 156 spm



SHOD BIOMECHANICS

- 75-90% of runners in PECH shoes RFS
- Tendency toward lower cadence
- PECH shoes permit HEAVY RFS - **TRY IT!!**
- Pronation control shoes DON'T actually 'control' pronation

Roy et al 2011

BAREFOOT BIOMECHANICS

- The human foot is a highly sensate region
- Improved impact moderating behaviour - reduced VLR
- Tendency toward higher cadence
- 'Barefoot' and Minimalist shoes don't reproduce BAREFOOT BIOMECHANICS

FOOTSTRIKE CONTINUUM

BASED ON FOOT STRIKE INDEX

Increase load on hip & knee

Increase load on foot & calf

Running Injuries

INJURY ‘PREVENTION’ IS NOT ACHIEVABLE

INJURY RISK REDUCTION IS POSSIBLE BUT CAN BE **COMPLEX & MULTI-FACTORIAL**

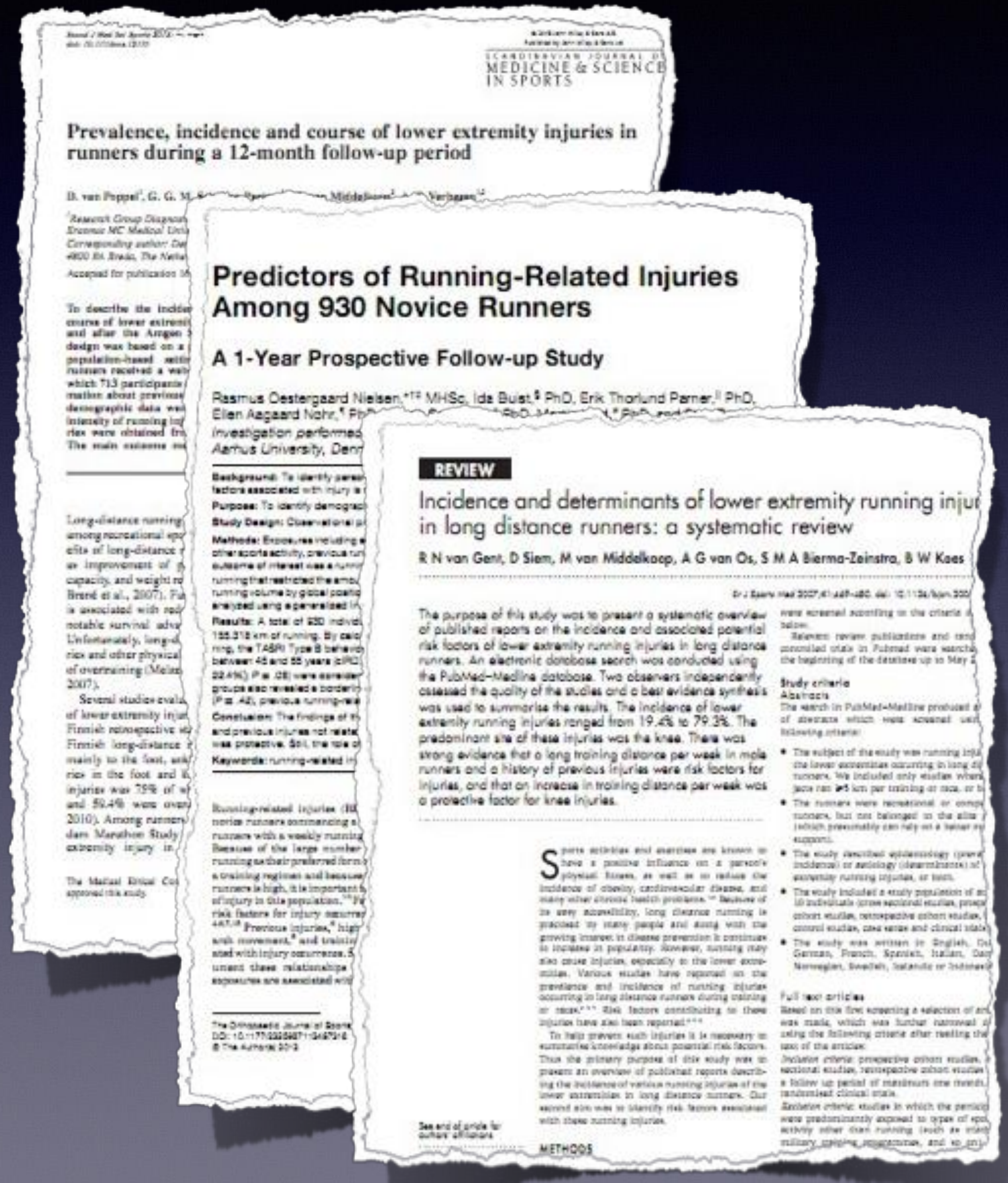
Risk factors for Injury

30-80% Runners injured per annum

Injury rates haven't decreased significantly in 30 YEARS

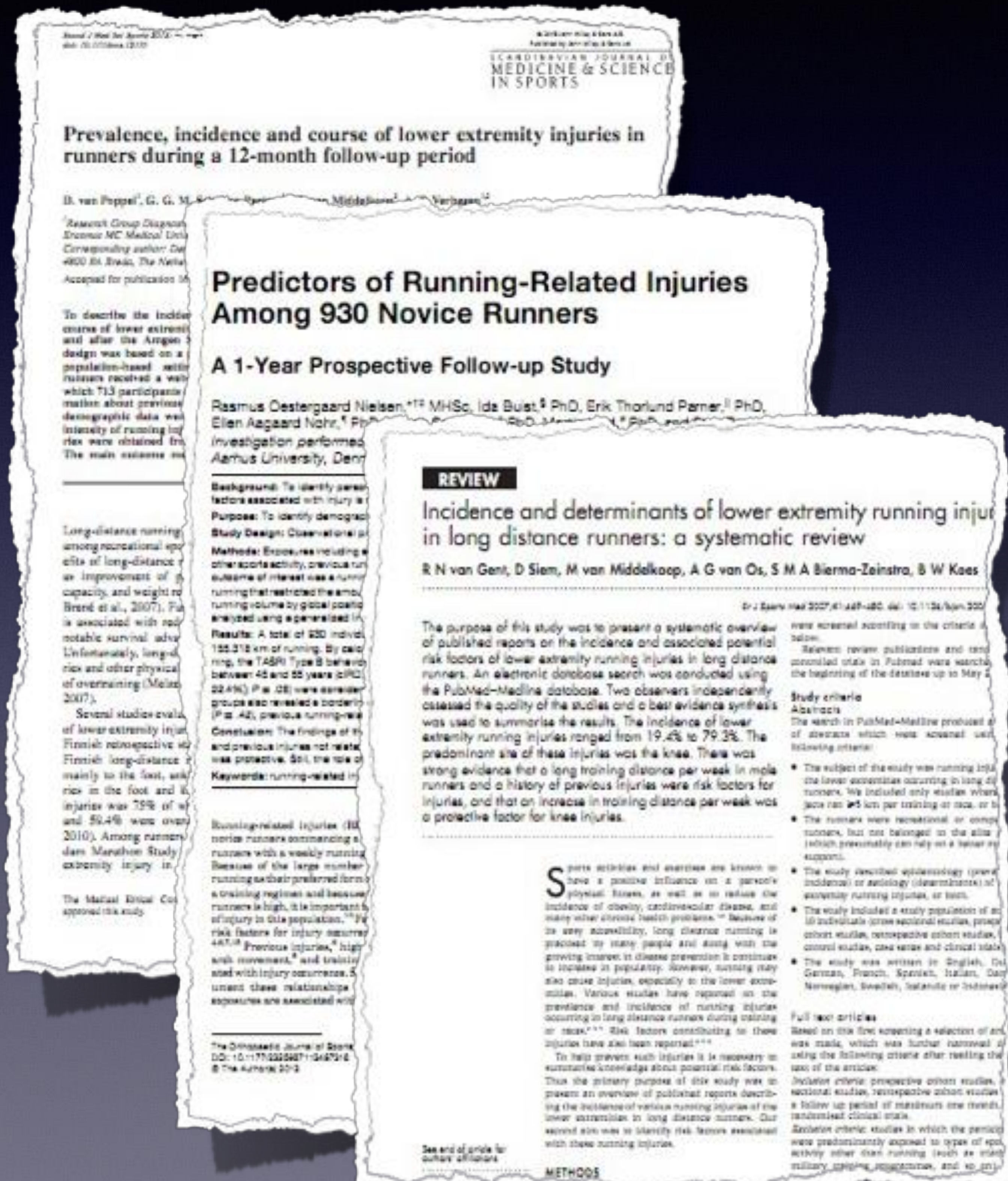
Big 5

1. MTSS
2. Knee pain/PFPS
3. Tendinopathy – Achilles/Patella
4. PHP
5. Ankle Sprain



Risk factors for Injury

- Novice runners
- **BMI>30**
- **Prior Injury**
- Age 45-65
- **MPW <18 & >40 miles**
- Training Load Errors – Frequency, Volume, Intensity
- Acute:Chronic Training Load



R 000 hours

reational

7.7

Sports Med
DOI 10.1007/s40279-015-0333-8

SYSTEMATIC REVIEW

CrossMark

Incidence of Running-Related Injuries Per 1000 h of running in Different Types of Runners: A Systematic Review and Meta-Analysis

Solvej Videbæk[1,2] · Andreas Moeballe Bueno[3] · Rasmus Oestergaard Nielsen[3] · Sten Rasmussen[1,2]

Abstract *Background* No systematic review has identified the incidence of running-related injuries per 1000 h of running in different types of runners. *Objective* The purpose of the present review was to systematically search the literature for the incidence of running-related injuries per 1000 h of running in different types of runners, and to include the data in meta-analyses. *Data Sources* A search of the PubMed, Scopus, SPORTDiscus, PEDro and Web of Science databases was conducted. *Study Selection* Titles, abstracts, and full-text articles were screened by two blinded reviewers to identify prospective cohort studies and randomized controlled trials reporting the incidence of running-related injuries in novice runners, recreational runners, ultra-marathon runners, and track and field athletes. *Study Appraisal and Synthesis Methods* Data were extracted from all studies and comprised for further analysis. An adapted scale was applied to assess the risk of bias. *Results* After screening 815 abstracts, 13 original articles were included in the main analysis. Running-related injuries per 1000 h of running ranged from a minimum of 2.5 in a study of long-distance track and field athletes to a maximum of 33.0 in a study of novice runners. The meta-analyses revealed a weighted injury incidence of 17.8 (95 % confidence interval [CI] 16.7–19.1) in novice runners and 7.7 (95 % CI 6.9–8.7) in recreational runners. *Limitations* Heterogeneity in definitions of injury, definition of type of runner, and outcome measures in the included full-text articles challenged comparison across studies. *Conclusion* Novice runners seem to face a significantly greater risk of injury per 1000 h of running than recreational runners.

Key Points

'Injuries per 1000 h of running' is an important and useful measure of association that enables comparison of the risk of injury across studies.

Novice runners are at significantly higher risk of injury 17.8 (95 % CI 16.7–19.1) than recreational runners, who sustained 7.7 (95 % CI 6.9–8.7) running-related injuries per 1000 h of running.

More studies on ultra-marathon runners and track and field athletes are needed in order to calculate weighted estimates.

1 Introduction

Running is one of the most popular and accessible sport activities worldwide [1, 2]. It can be performed with minimal equipment, and by a broad variety of people in

Electronic supplementary material The online version of this article (doi:10.1007/s40279-015-0333-8) contains supplementary material, which is available to authorized users.

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Published online: 08 May 2015

Springer

Running Injury risk per 1000 hours

Novice
17.8

Recreational
7.7

Specific types of running injury

Table 1. *The frequency (percentage) of specific diagnoses based on 2002 injury cases according to Taunton et al. The diagnoses are divided into volume or pace injury groups.*

Diagnosis	Frequency (%)	Volume injury	Pacing injury
Patellofemoral pain syndrome (PFPS)	16.5%	Yes	
Iliotibial band friction syndrome (ITBFS)	8.4%	Yes	
Plantar fasciitis (PF)	7.9%		Yes
Patellar tendinopathy (PT)	4.8%	Yes	
Achilles tendinopathy (AT)	4.8%		Yes
Gastrocnemius injuries (GI)	1.4%		Yes
TOTAL	**43.8%**	**29.7%**	**14.1%**

Nielsen et al 2013

Overstride with RFS

- Increases retropatella loading forces - Higher risk of PFPS/Anterior Compartment Syndrome
- High braking forces - inefficient
- Associated increase vertical displacement

SOLUTION - INCREASE CADENCE +/- LIGHTER SHOE

Effects of cadence manipulation - Heiderscheit et al (2011)

- Cadence below **164** increased likelihood of shin pain

Luedke et al (2016)

- Jack Daniels '180' cadence was an observation study only
- +10% from preferred steady run cadence

1. Reduced vertical displacement
2. Reduced footstrike distance from COM
3. Reduced foot strike angle

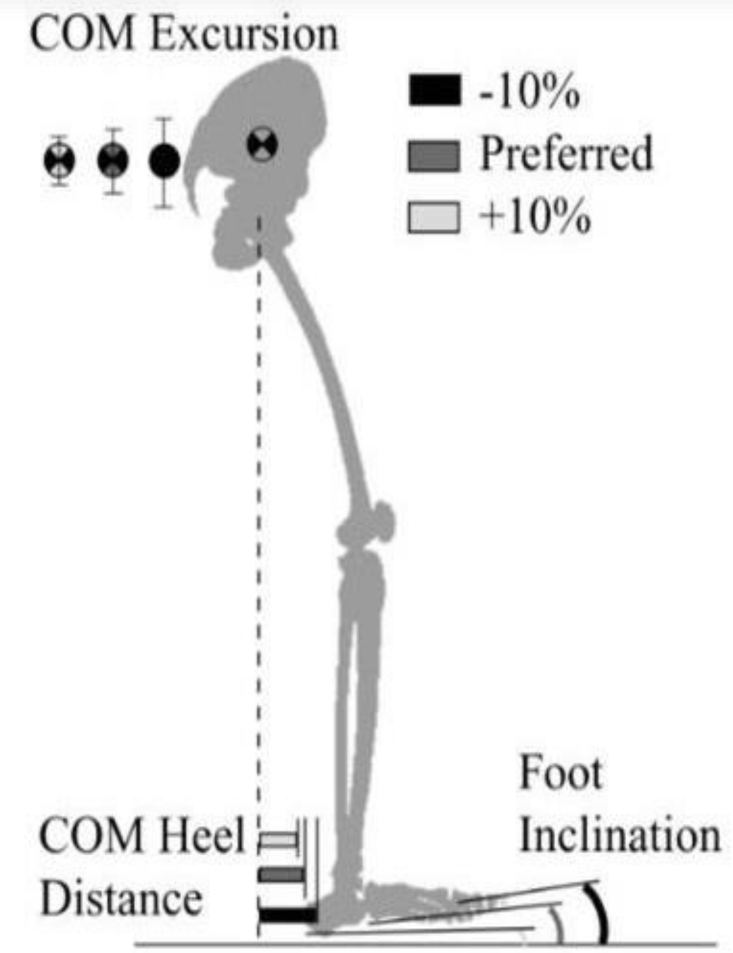


FIGURE 1—Center of mass (COM) vertical excursion, horizontal distance from COM to heel at initial contact, and foot inclination at initial contact decreased as step rate increased.

Excessive Adduction/IR

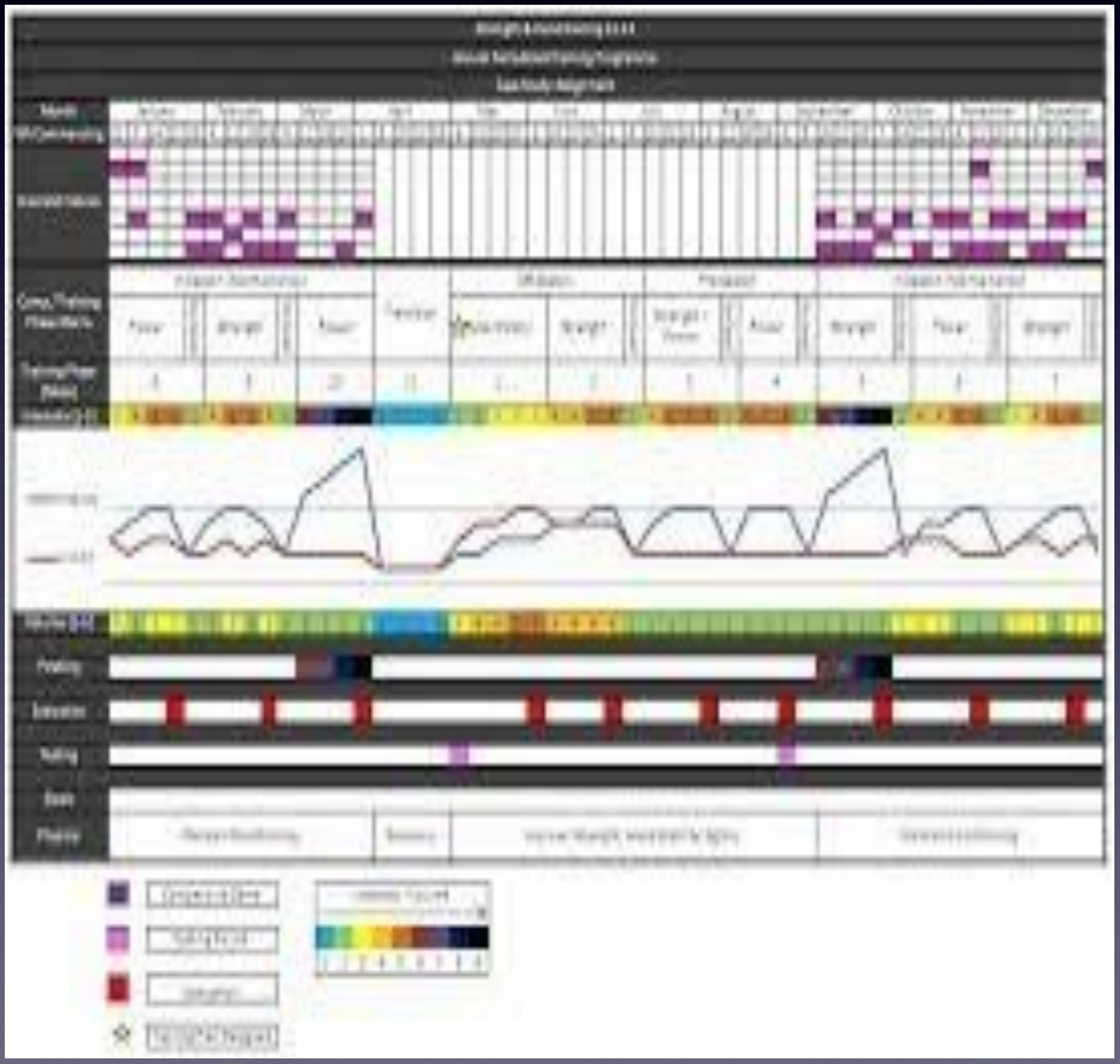
- Associated with higher risk of PFPS/ITBS/G.T
- Gmax/GMed strengthening alone will not address
- Need to re-educate running biomechanics in conjunction

TEST in 2's - SKB (Small knee bend to 45 degrees)

SOLUTION - Run either side of line/Push markers out to the walls

Training Load Error

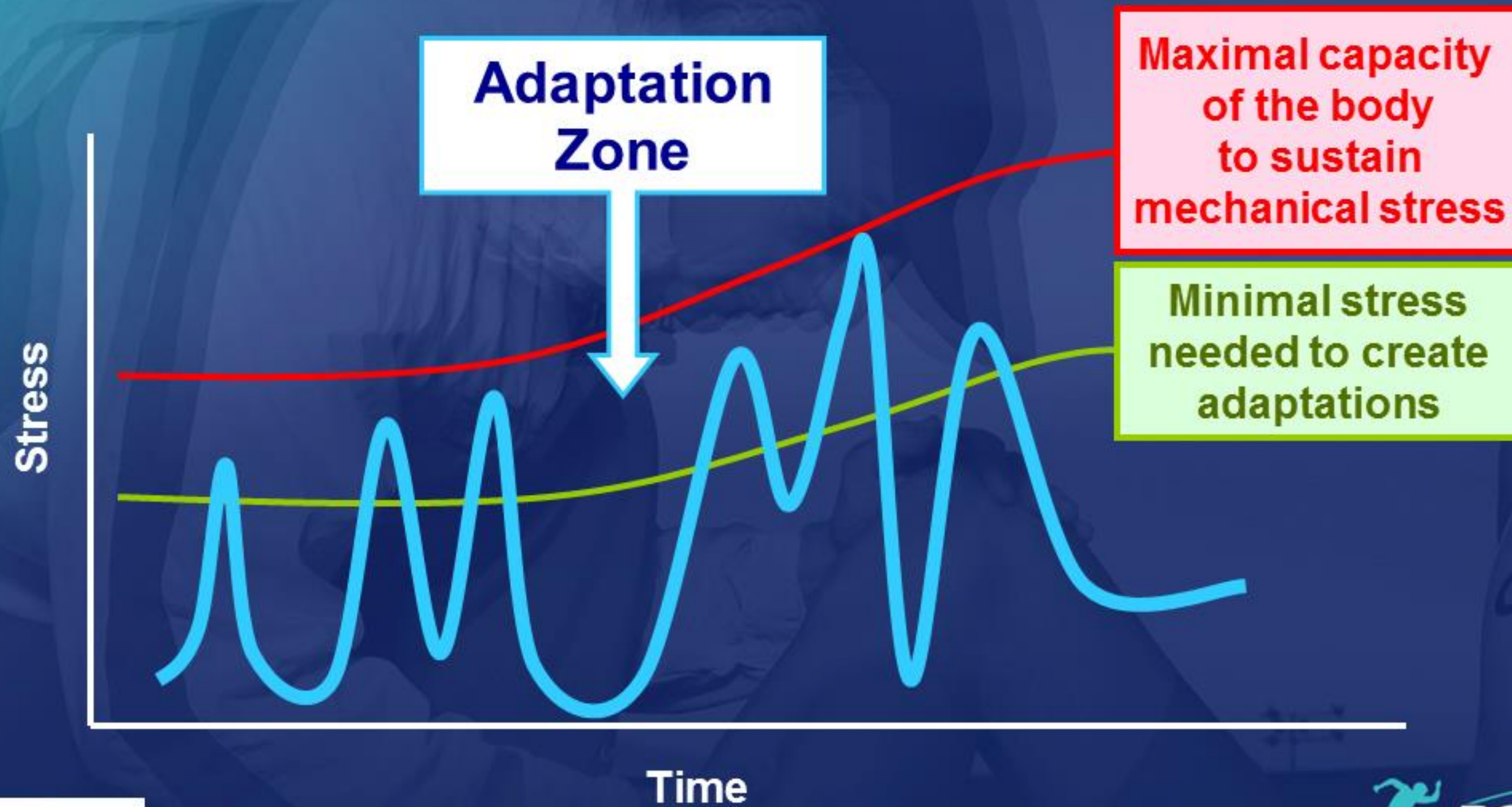
<u>75% </u>of running injuries are <u>CUMULATIVE</u>



BALANCING LOAD & CAPACITY

RUNNINGPHYSIO
BETTER. FASTER. STRONGER

Soft Tissue Adaptation



Cause
of overuse injuries
(2005-Hreljac)

MISADAPTATION

Intrinsic Factors

Mechanical Stress

Extrinsic Factors

Biomechanical factors
Tissue overload
Prior injury

Training errors
Insufficient recovery

Running shoe
Surface

Prevention
of Overuse Injuries

ADAPTATION

Intrinsic Factors

Mechanical Stress

Extrinsic Factors

Biomechanical factors
Tissue overload
Prior injury

Training errors
Insufficient recovery

Running shoe
Surface

ACTIVETHERAPY
Physiotherapy & Sports Injury Clinic

PCN Physiothérapie et médecine du sport

Prevention
of Overuse Injuries

ADAPTATION

In ic
F rs

Calculated
mechanical stress

Ex ic
F rs

Fix faulty biomechanics
… and muscle dysfunctions
Solidify all structures

Be progressive

Appropriate running shoe
Adequate surface

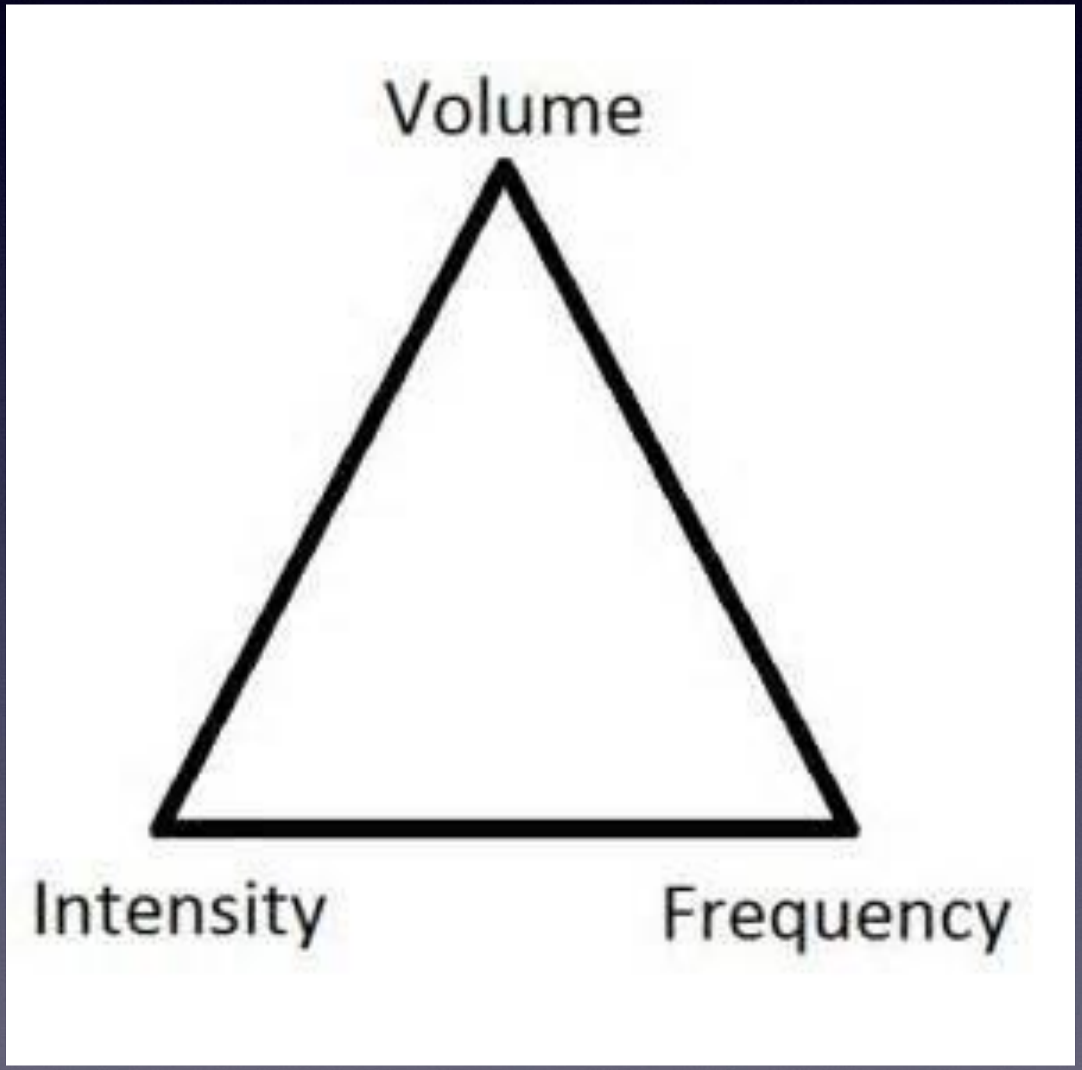
Training Load Error

Volume 10-20% per week rule – no robust evidence.

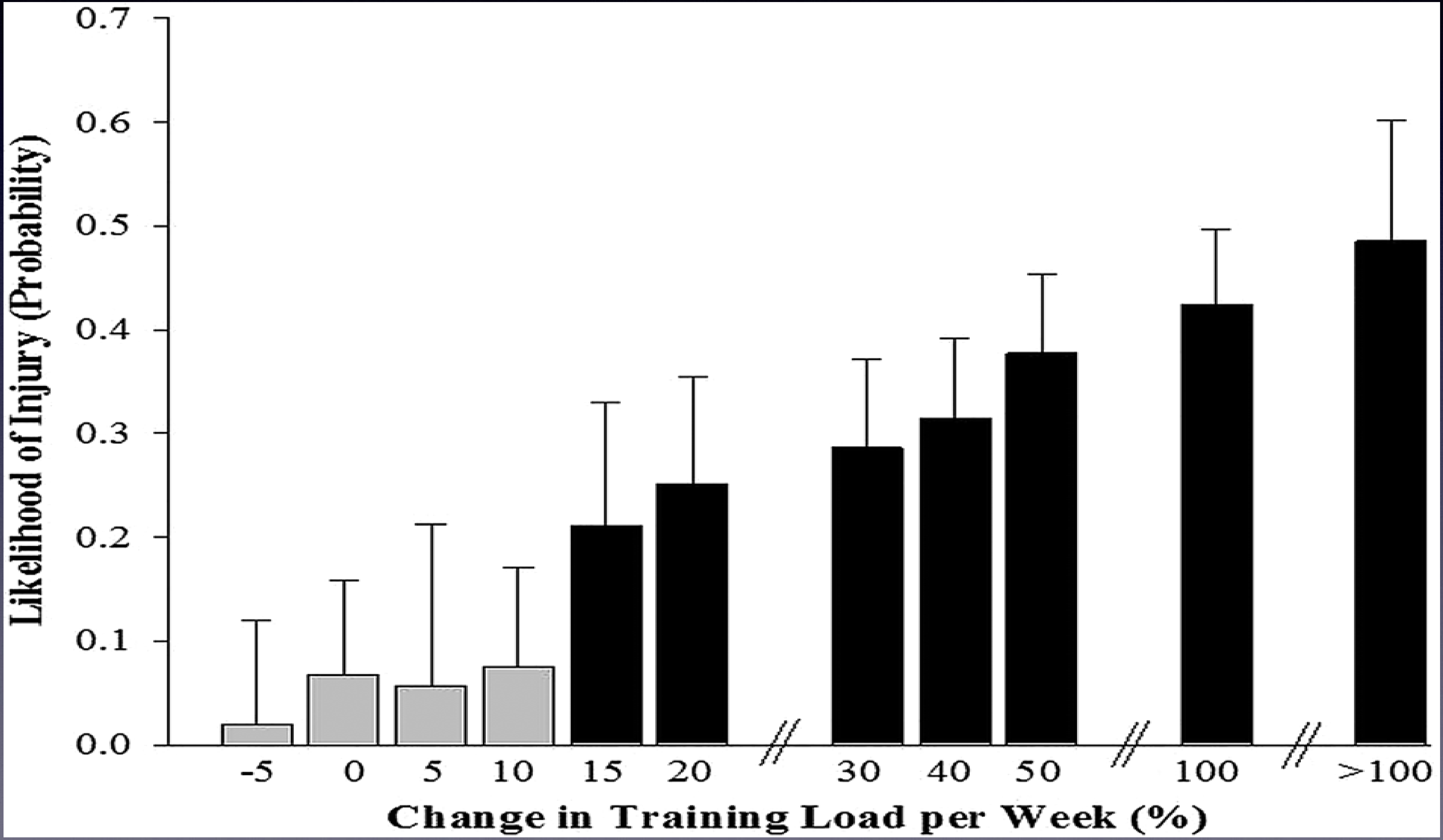
Sensible progression

Intensity Manipulate after solid aerobic and strength base

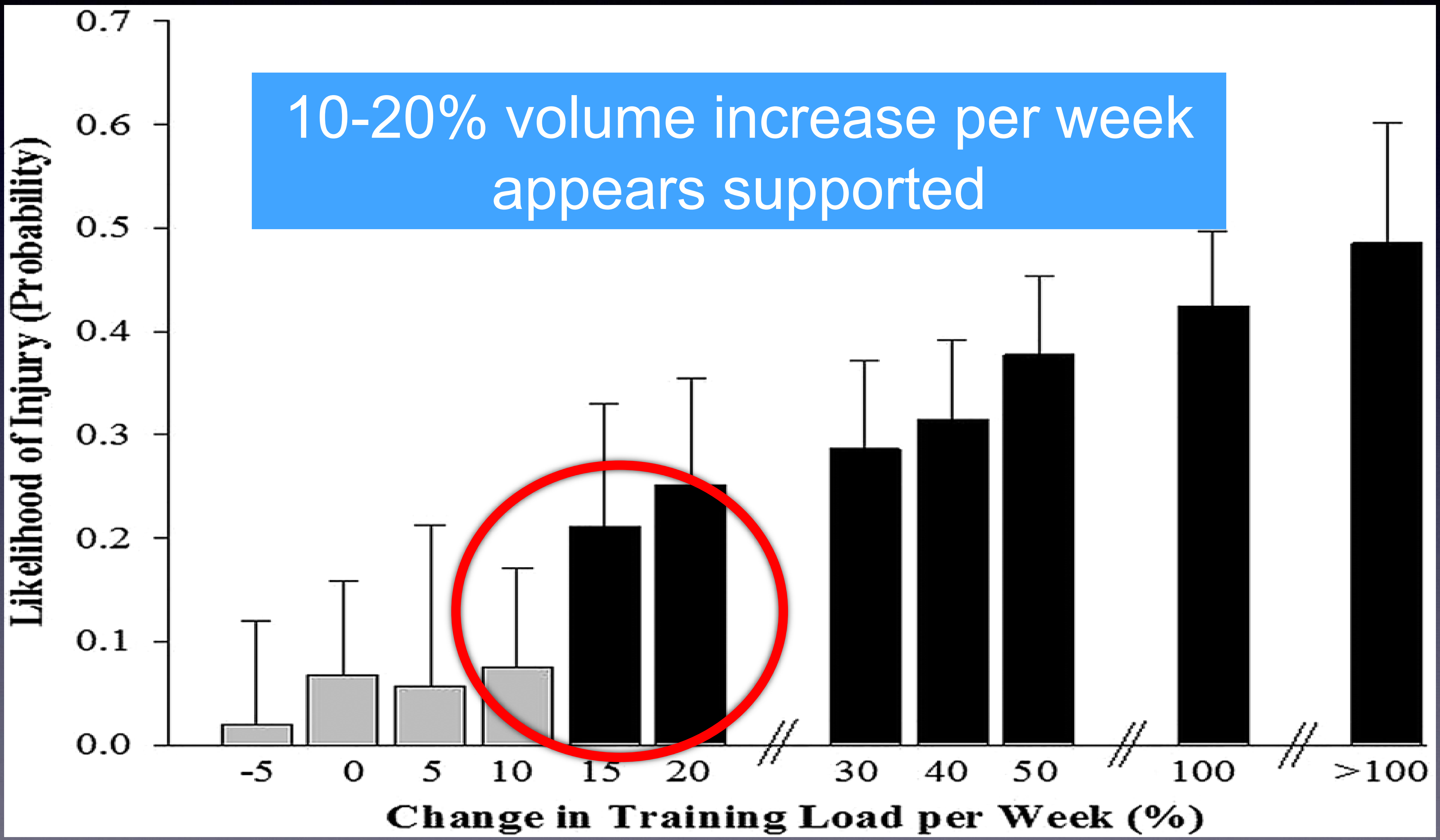
Frequency Consider more frequent runs (x5 week) with lower volume or run/walk intervals



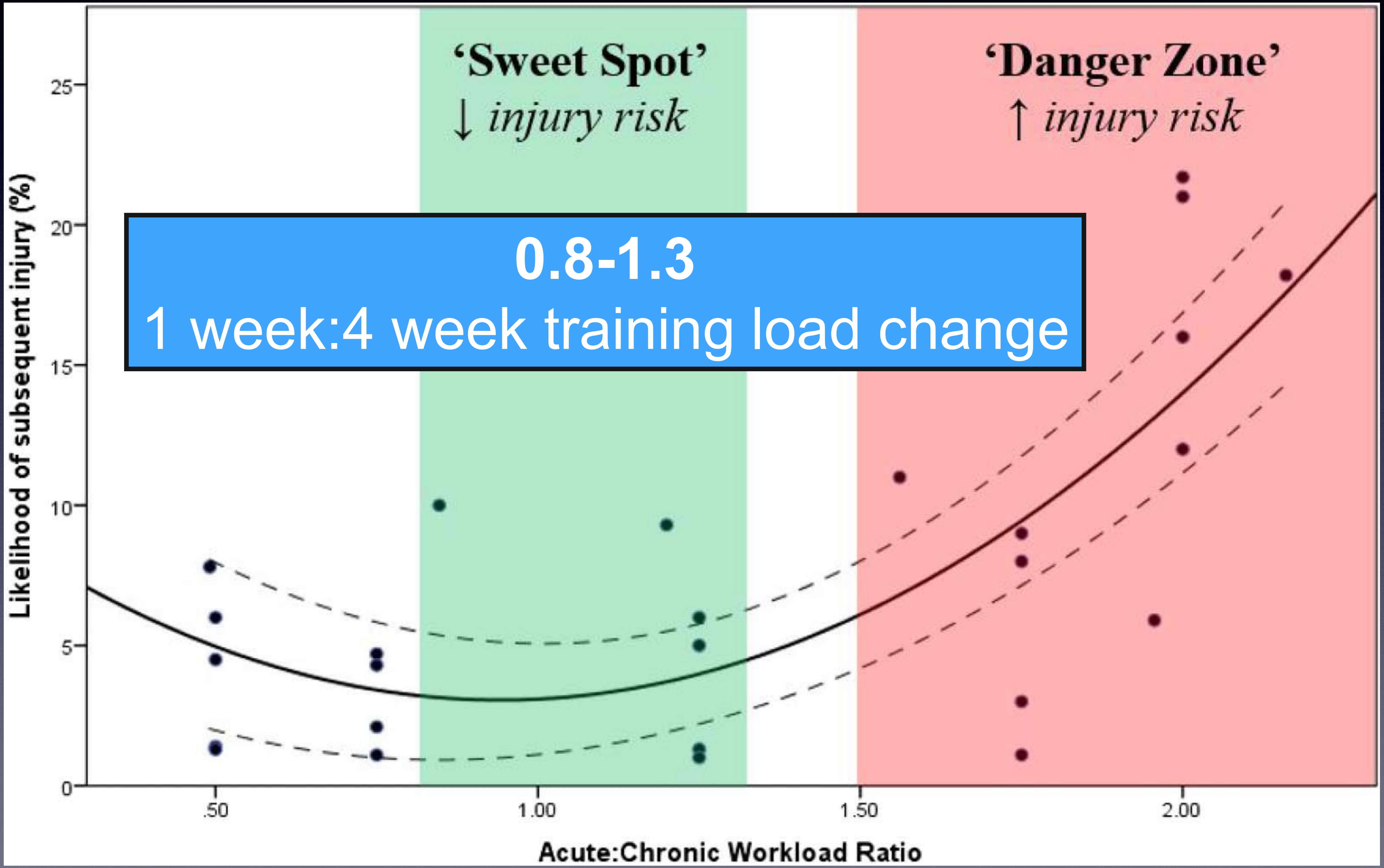
Training load progression



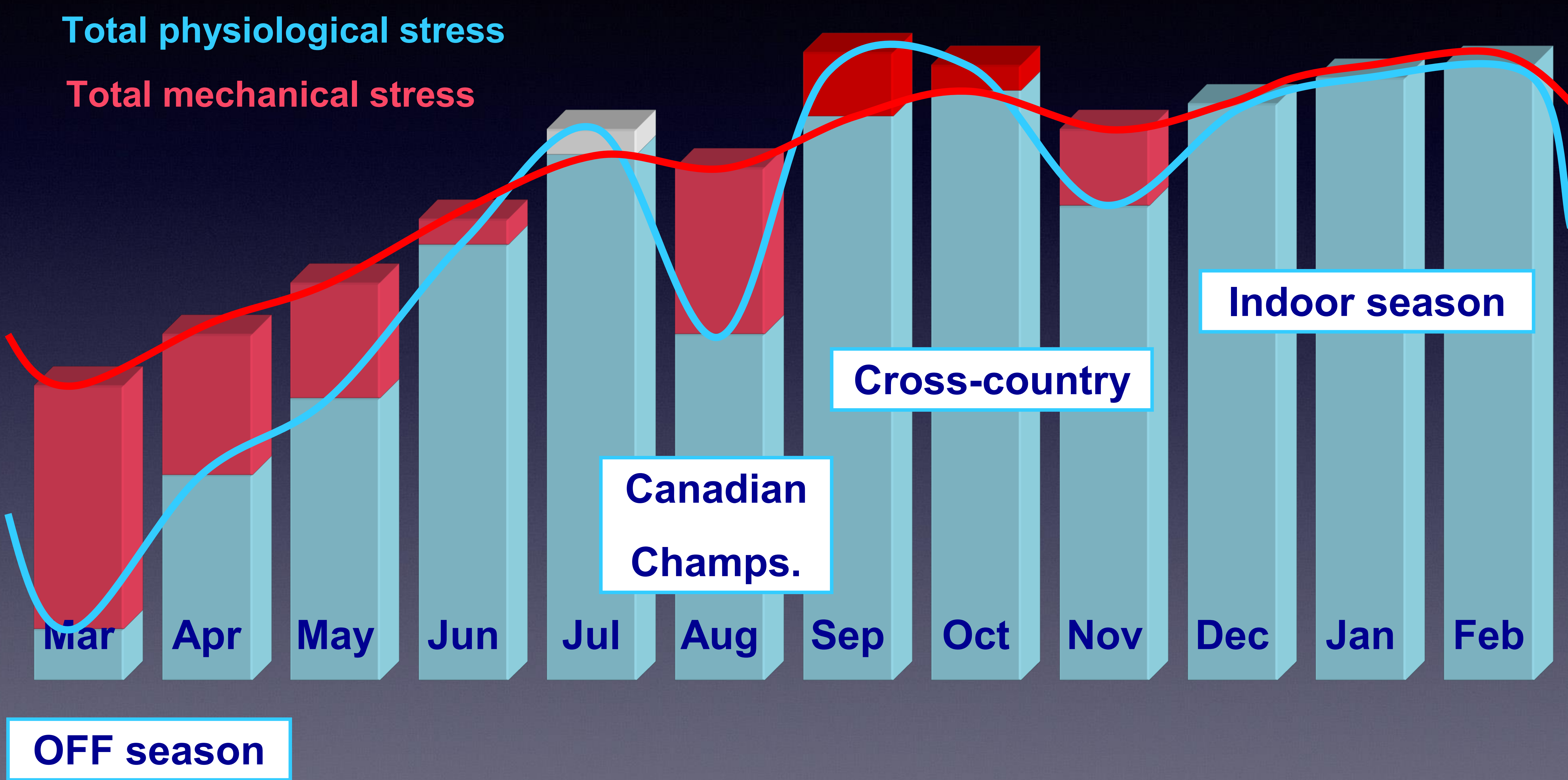
Training load progression



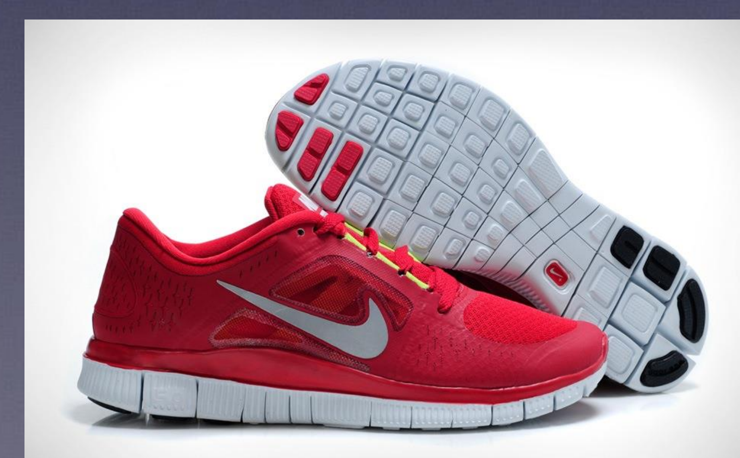
Training load progression



Annual Periodisation



Shoe evolution!



Current practices of shoe selection

- Use of the 'wet foot test/arch type' isn't valid
- Shoe selection on this basis is suggested to simplistic and may **INCREASE** injury risk
- More expensive shoes don't reduce injury risk

Reasons to change shoe?

- **Recurrent or chronic injury** - take advice from specialist practitioner **NOT** running store
- Need to **improve tissue loading profile** - we can't abolish load just re-distribute
- Want to **reduce O2 consumption** - 1% reduction per 100g shoe weight
- Not **comfortable** in current shoe

How do I select the right shoe?

- **Wide Toe Box**
- ?Anatomical lacing
- Correct syping point for metatarsal mobility
- The **lightest, most flexible shoe you can tolerate**
- **COMFORT**
- **'Earn the right' to be in the shoe**
- Consider shoe rotation

How to transition into new footwear safely

- **Go slower than you would think** - incremetal changes
- **1 minute more per run** for certain shoes/certain conditions
- Footwear selection is just part of the bigger picture

Injury Risk Reduction & Performance Enhancement

Stretching

'You can't **STRETCH** your way out of a problem you **MOVED** into'

- Injury risk and stretching
- Types of stretching - what to do when
- Where does foam rollering fit in with this?

Strengthening

- Regular strength training **reduces injury risk**
- **Improves athletic performance**
- Builds **robust tissue tolerance** - M.S.Q
- Aim for **x2-3 S+C sessions per week**
- **Run specific**

S+C for Injury Risk Reduction

- **Sport Injuries reduced by 66%**
- **Insidious onset injuries by 50%**

[X2-3 SESSIONS] **OF S+C**

PER WEEK

Review

The effectiveness of exercise interventions to prevent sports injuries: a systematic review and meta-analysis of randomised controlled trials

Jeppe Bo Lauersen,[1] Ditte Marie Bertelsen,[2] Lars Bo Andersen[3,4]

Original article

The effectiveness of a preconditioning programme on preventing running-related injuries in novice runners: a randomised controlled trial

Steef W Bredeweg, Sjouke Zijlstra, Bram Bessem, Ida Buist

Performance benefits of S+C

- 26 Studies evaluated
- All levels of runner
- Male and female

- 1-3 sessions per week (Ave **2-3 per week**)
- **6-12 weeks** average
- **Heavy** (4 x 6RM) and **Strength Endurance** (3-5 x 10-15RM)

Running Economy - Improved Ave 4%

3k Performance - Improved ave 3-6%

Sports Med
DOI 10.1007/s40279-014-0246-y

REVIEW ARTICLE

Strategies to Improve Running Economy

Kyle R. Barnes · Andrew E. Kilding

Abstract Running economy (RE) represents a complex interplay of physiological and biomechanical factors that is typically defined as the energy demand for a given velocity of submaximal running and expressed as the submaximal oxygen uptake (VO_2) at a given running velocity. This review considered a wide range of acute and chronic interventions that have been investigated with respect to improving economy by augmenting one or more components of the metabolic, cardiorespiratory, biomechanical or neuromuscular systems. Improvements in RE have traditionally been achieved through endurance training. Endurance training in runners leads to a wide range of physiological responses, and it is very likely that these characteristics of running training will influence RE. Training history and training volume have been suggested to be important factors in improving RE, while uphill and level-ground high-intensity interval training represent frequently prescribed forms of training that may elicit further enhancements in economy. More recently, research has demonstrated short-term resistance and plyometric training has resulted in enhanced RE. This improvement in RE has been hypothesized to be a result of enhanced neuromuscular characteristics. Altitude acclimatization results in both central and peripheral adaptations that improve oxygen delivery and utilization, mechanisms that potentially could improve RE. Other strategies, such as stretching should not be discounted as a training modality in order to prevent injuries; however, it appears that there is an optimal degree of flexibility and stiffness required to maximize RE. Several nutritional interventions have also received attention for their effects on reducing oxygen demand during exercise, most notably dietary nitrates and caffeine. It is clear that a range of training and passive interventions may improve RE, and researchers should concentrate their investigative efforts on more fully understanding the types and mechanisms that affect RE and the practicality and extent to which RE can be improved outside the laboratory.

Key Points

A range of training and passive interventions such as endurance training, high-intensity interval training, resistance training, training at altitude, stretching and nutritional interventions may improve running economy.

Improvements in running economy may be made by modifying one or more factors that influence metabolic, biomechanical and/or neuromuscular efficiency.

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1 Introduction

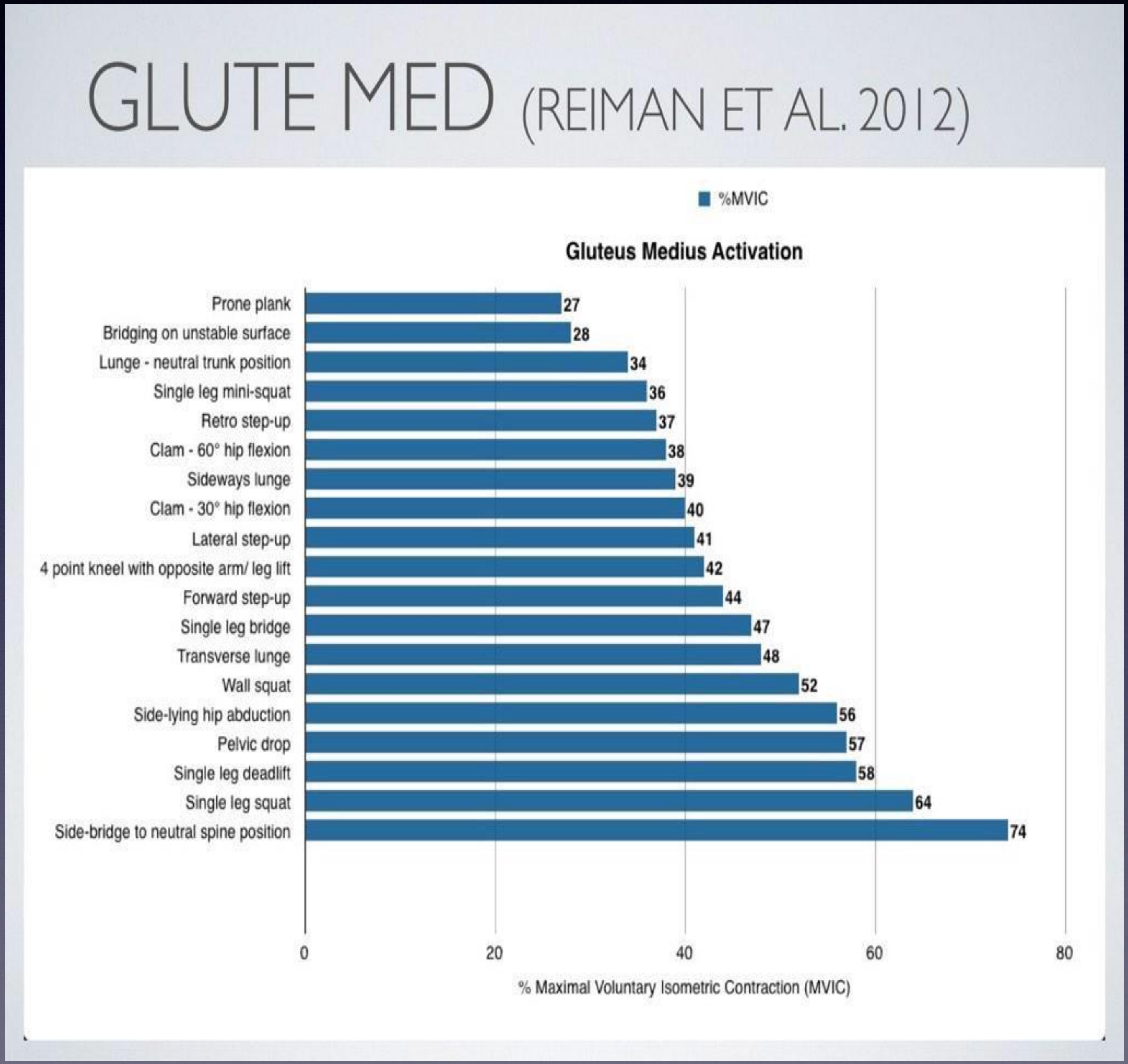
The goal in competitive distance running is to run a given distance in the least time, or at least faster than the next best competitor. A number of physiological attributes contribute to successful distance running performance [1, 2], including (i) both a high cardiac output and a high rate

Published online: 28 August 2014

Gluteus Medius - EMG

<u>5 in 5</u>

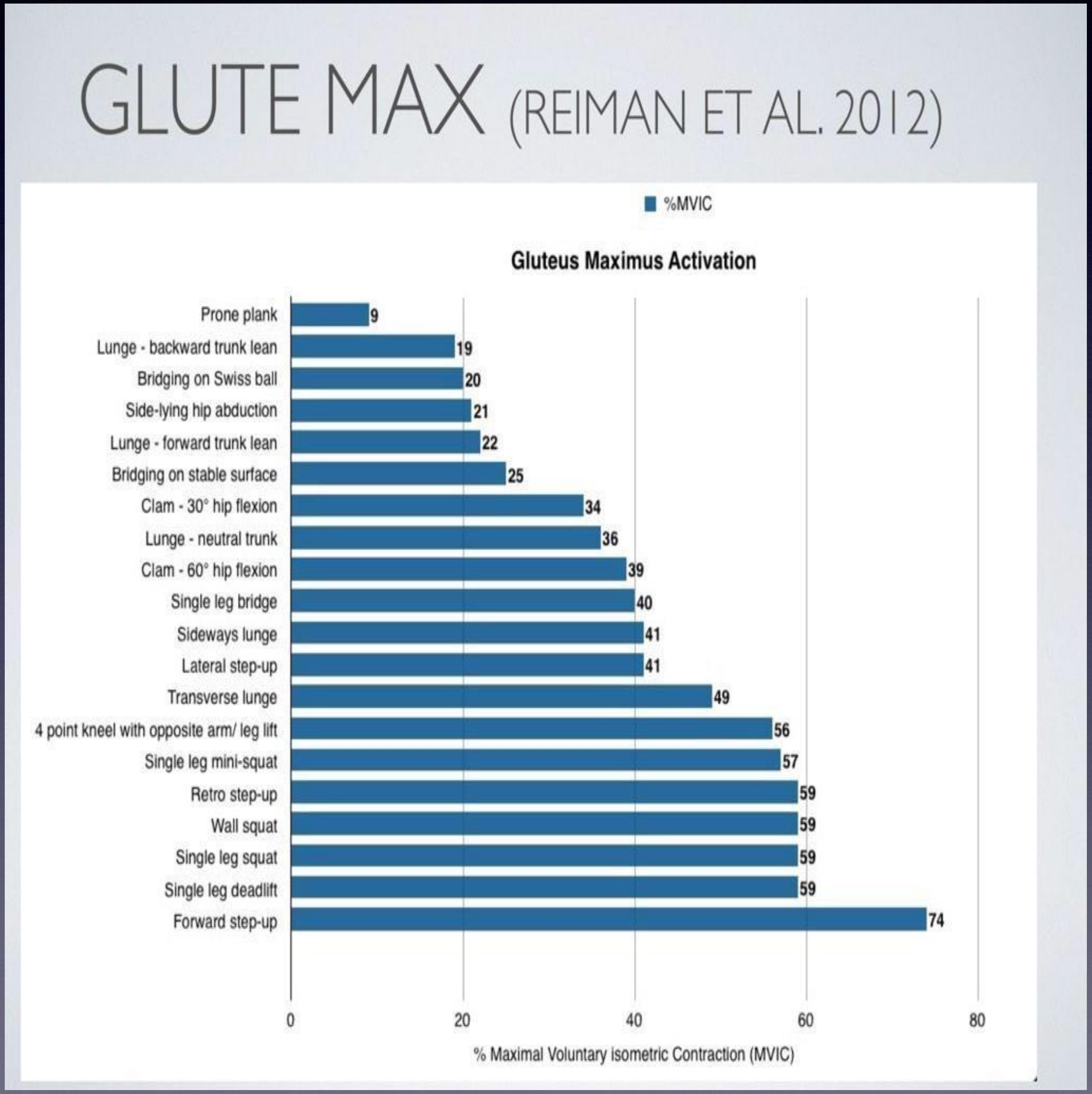
1. Side bridge to neutral
2. SLSq
3. SLDL
4. Hip hitch on step
5. Sidelying hip abduction



Gluteus Maximus - EMG

<u>5 in 5</u>

1. Forward step up
2. SLDL
3. SLSq
4. Wall Squat
5. Bird-Dog



Calf & Ankle

- Develop **<u>strength</u>** - calf raises with eccentric component +/- weight

- Improve single leg **<u>balance</u>** - running specific +/- drills

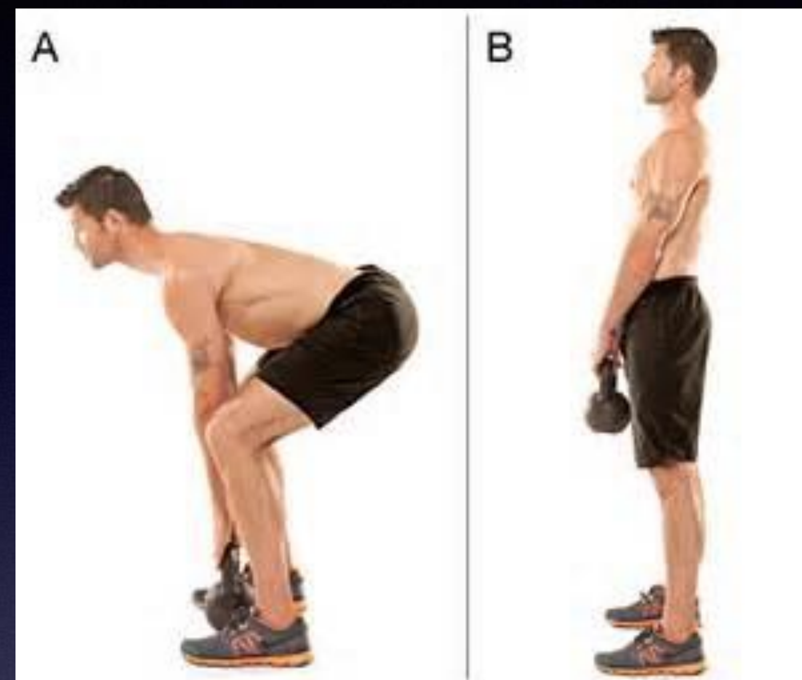
- Develop **<u>SSC</u>** - improve 'reactive stiffness' of calf/achilles with hopping/skipping/ankling

Trunk-Pelvis Control

- Exercise SPECIFICITY and TRANSFER i.e planks
- Standing v non-standing patterns
- Upper and lower body focus? Cross body patterns
- Low and High threshold

Bodyweight Strength Examples

Heavy Strength Training



Evidence Based Information for Runners

- The Running Clinic - Blaise Dubois
- Kinetic Revolution - James Dunne
- The Running Physio - Tom Goom
- Run Research Junkie - Craig Payne

Health benefits of running

There is no MEDICATION in use or development which REDUCES ALL CAUSE MORTALITY as much as regular exercise!

If you run regularly you're ALL CAUSE MORTALITY reduces by 63%

Summary

- Aim for EFFICIENT RUNNING TECHNIQUE for YOU
- GET STRONG and MAINTAIN
- Train SMART & CONSISTENTLY – Develop a TRAINING PLAN
- Develop a RECOVERY ROUTINE

Thank you

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ENJOY YOUR RUNNING !!