Strength and Conditioning for Running: Improving performance & injury prevention

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My coaching background

- Performance strength and conditioning coach for 22 years
- Honours degree in Sports Science & UKA level 3 performance coach (jumps)
- Coached and advised athletes who competed in London and Rio Olympics
- Experienced at providing performance solutions to athletes, semi-pro rugby, professional squash, golfers, academy footballers & international equestrian
- Former Physical Preparation National Coach Mentor/Lead at England Athletics (2011-2018)
- Collaborative work with Physiotherapists, Osteopaths and Sports Physicians to provide end stage rehabilitation & return to sport/play.
- Represented GB Students as a pole vaulter

Strength and Conditioning

- A process of systematic training which is designed to create the capacity for training and a platform for performance

Why?

- Develop the physical qualities required to achieve the technical model
- Reach potential
- High quality movement – earn the right to progress
- Other sports – essential for developing youth athletes
- Injury avoidance – robustness to injury under fatigue
- Muscular imbalances and tightness
- Work capacity

- Self myofascial release
- Longevity
- Fun

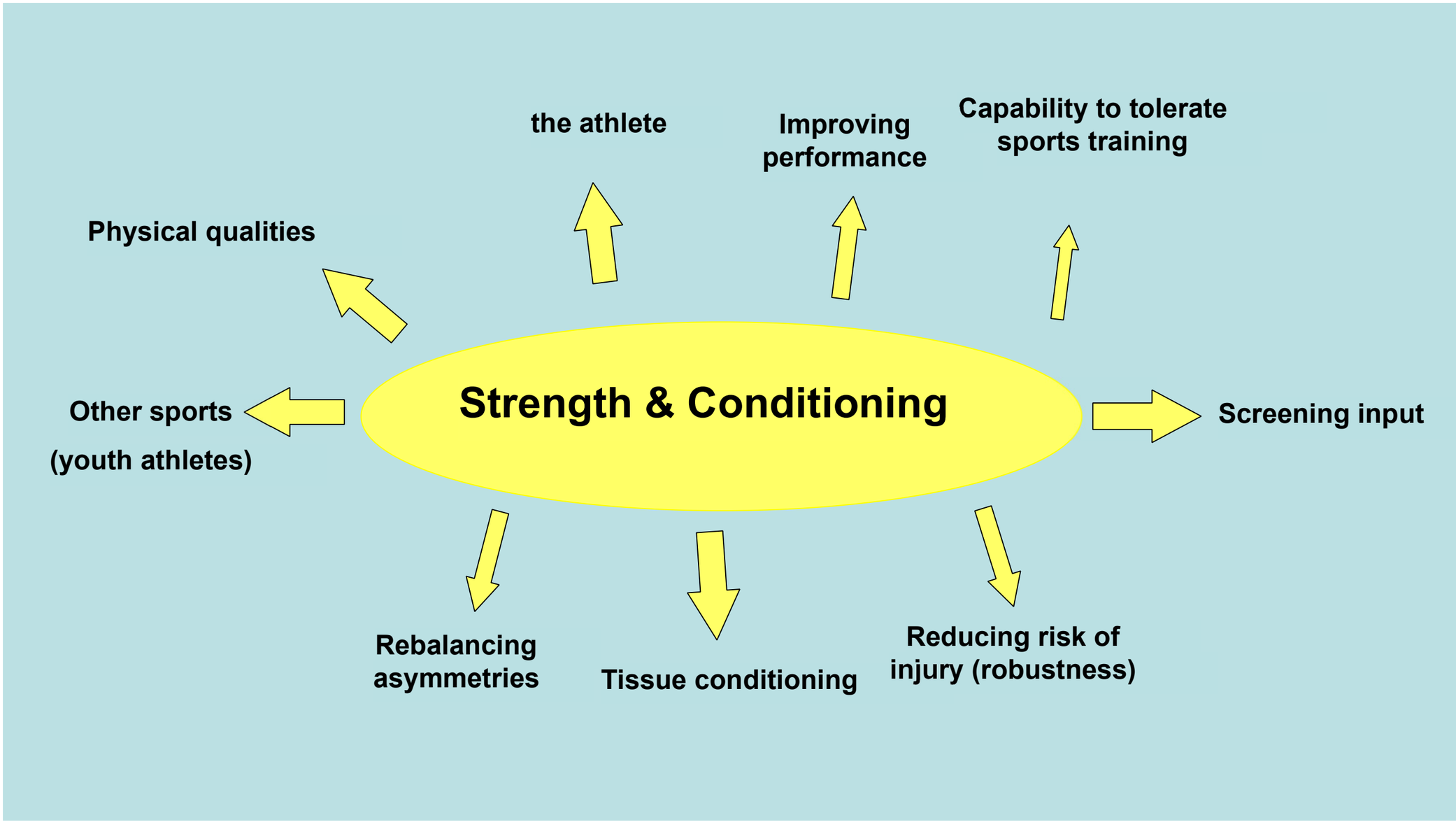
Endurance running

- Key parameters:
  - VO_2 Max, VVO_2
  - Running Economy (RE)
  - Ground Reaction Forces (GRF) 3-4 x BW
  - Ground Contact times 0.2s (closer to 0.3s for non elite)

- Volume of running - 50km/week
  - 2m average stride length

- Equates to 25000 foot contact; 12500/foot
- @3x BW equates to 75000kg

Maintaining health of


Physical qualities
the athlete
Improving performance
Capability to tolerate sports training
Other sports
(youth athletes)
Strength & Conditioning
Screening input
Rebalancing asymmetries
Tissue conditioning
Reducing risk of injury (robustness)

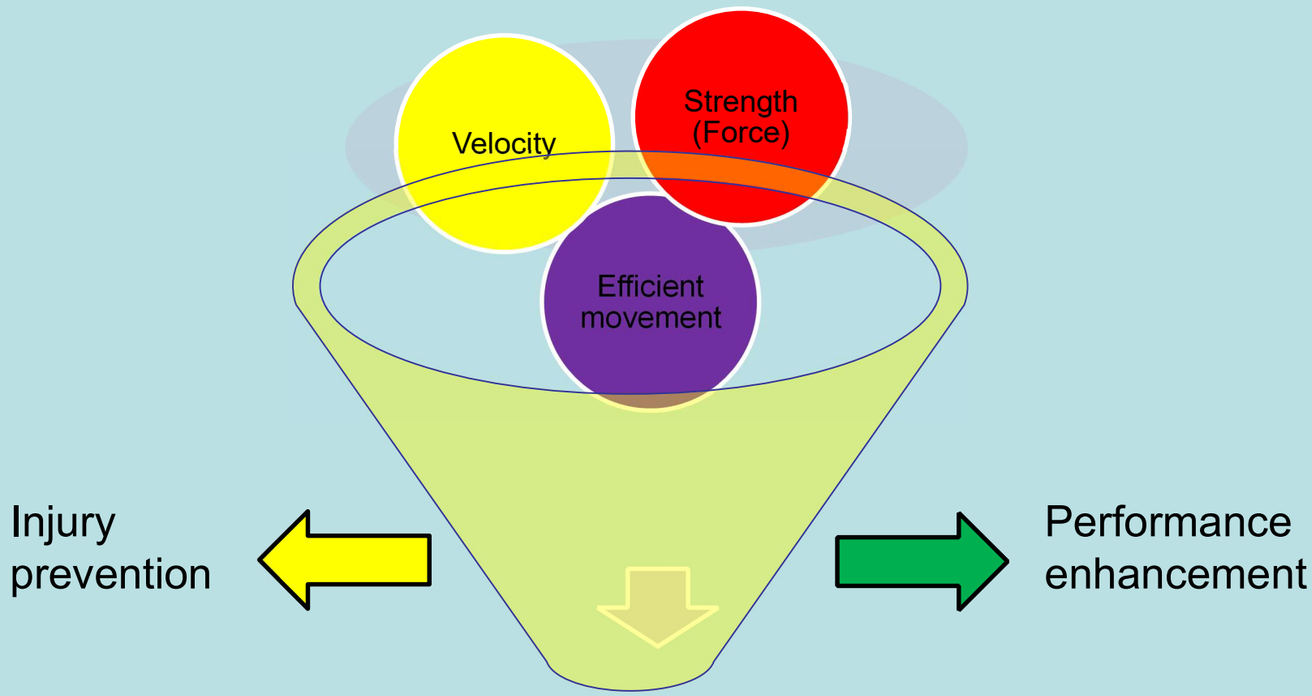
Athletics – Long term development

Event	Age of peak performance Men	Age of peak performance Women
100m	26	25
200m	25	25
1500m	**27**	**29**
5000m	**29**	**30**
Marathon	**31**	**33**
TJ	25	28
Discus	25	25
Hammer	28	*

Ages for Peak Performance in Athletics from World Statistics

*** insufficient data analysed**

How can S&C support successful performance?



Strength and Conditioning

- S&C can help to improve all 3 components which in turn can create a more robust, powerful, faster athlete
- Movement skills are fundamental building blocks for good performance.
- Quality of movement – movement competence
- Without strength, stability, mobility, balance and coordination athletes cannot move efficiently or transfer force efficiently and have a higher risk of injury

Primal Movement Patterns

Squat

Push/pull

Brace/ Rotate

Hinge

Landing

Chek, P. (2000)

Primal Movement Patterns (Underpinning movements)

- Double leg: squat through to jumps
- Single leg: SL squat through to hopping
- Push: press up through to medicine ball chest throws
- Pull: pull-up through to overhead throws
- Rotation/twist: floor through to side throws

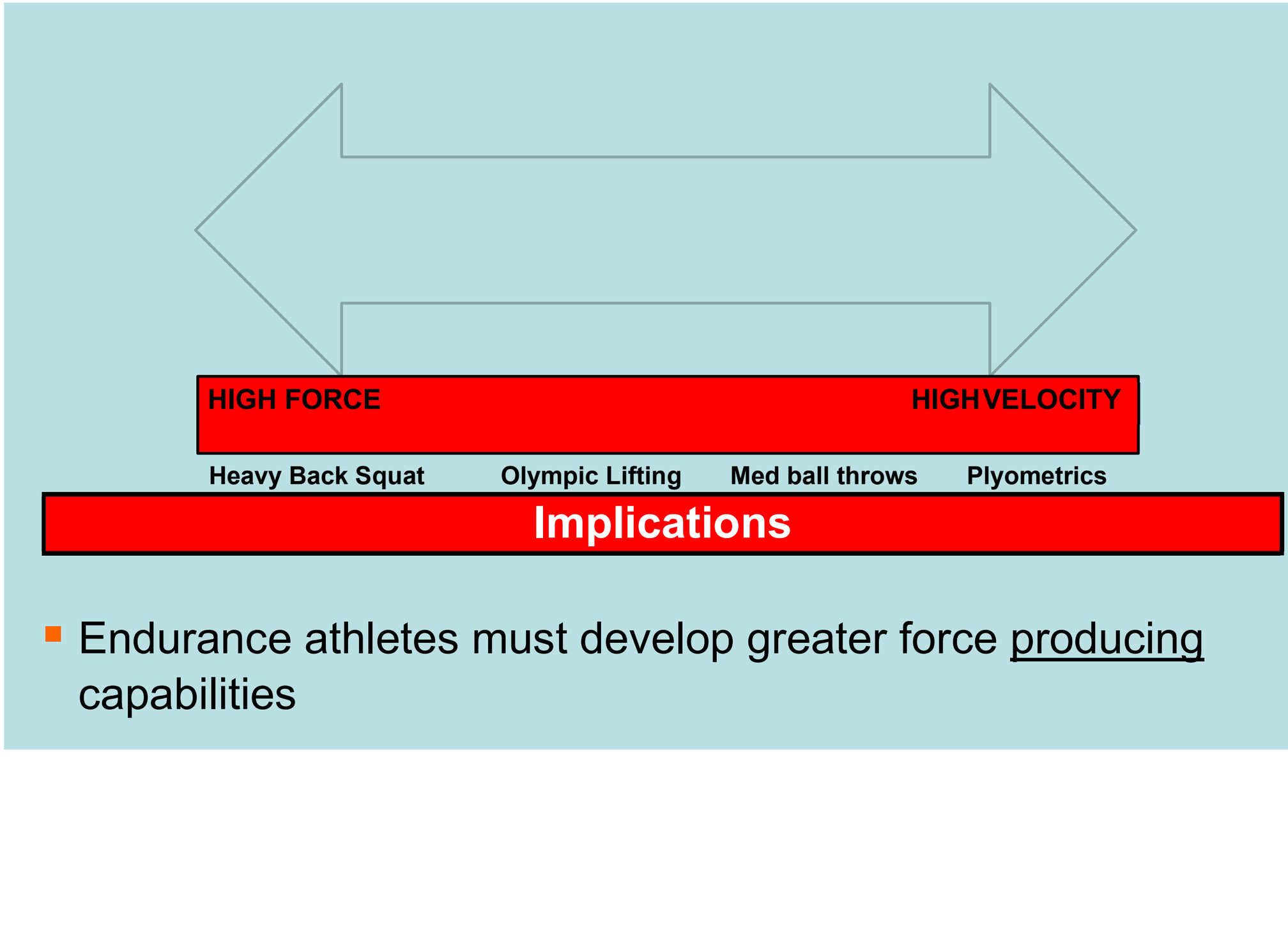
The Role of Strength Training & Transfer to Running

- To optimise the bodies force, power and velocity capabilities specific for the athletes & event

- 10 cross country runners completed 9 weeks of explosive strength training (unloaded jumps & sprints) 5km Running time improved - no change in total volume of work completed between experimental and control group (Paavalainen, et al, 1999)
- Improved running economy & neuromuscular characteristics
- Stance phase limiting factor is the time frame the athlete has to express the force not the magnitude of force (Weyand et al, 2010).
- Better movement → higher force producing capabilities →↑ velocity → Improved running economy

Strength – Speed Continuum

Max strength **Strength speed** **Speed strength** **Max speed**



- Endurance athletes must develop greater force <u>producing</u> capabilities

- Endurance athletes must develop a greater force application capability
- ‘Not about developing maximum strength, but it is about a better quality of force generation’ Zatsiorsky & Kraemer 2006

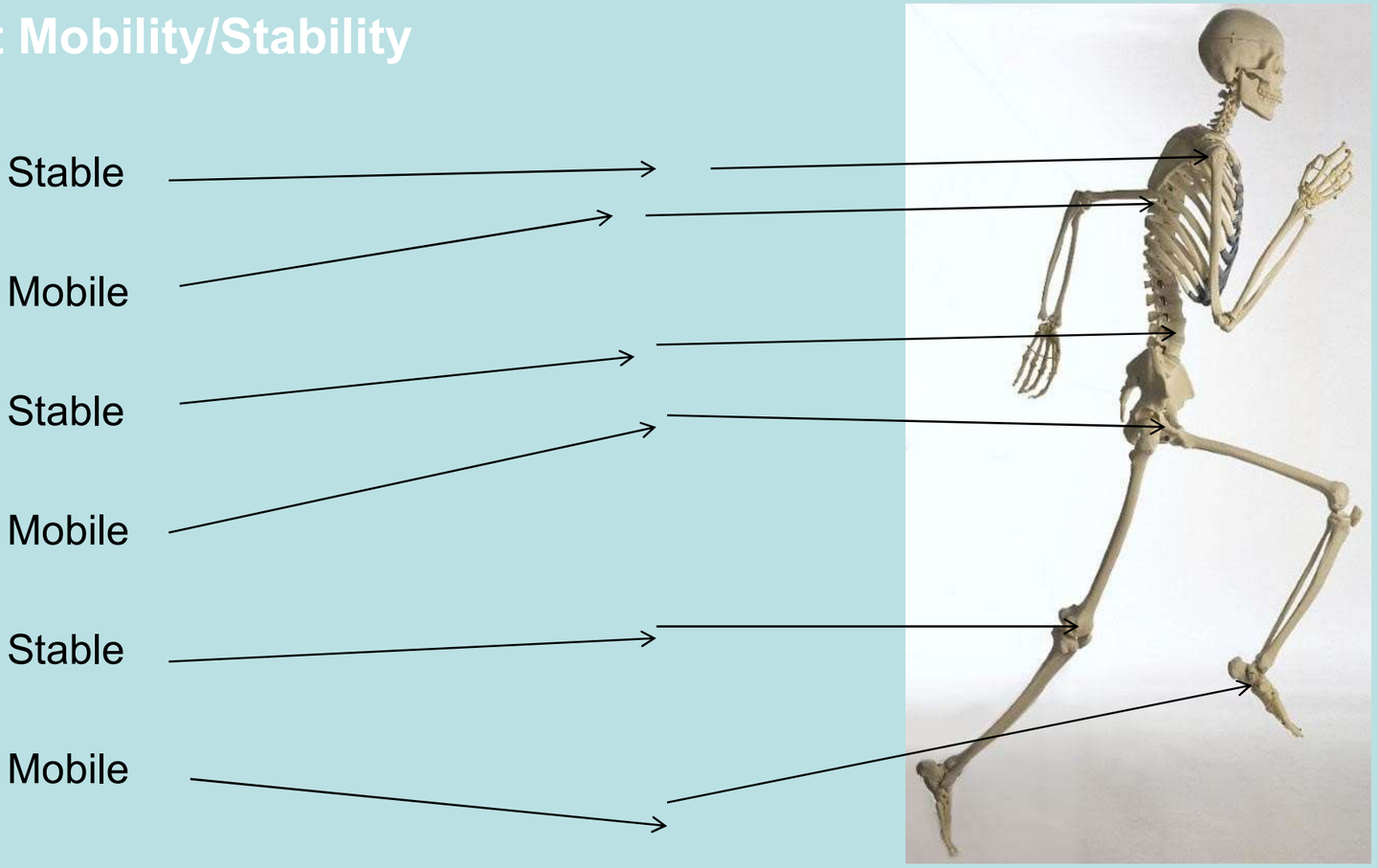
5 Areas of Injury Risk

- Hamstring
- Hip / Groin
- Foot / Ankle

- Lower Leg (shin)
- Lower Back

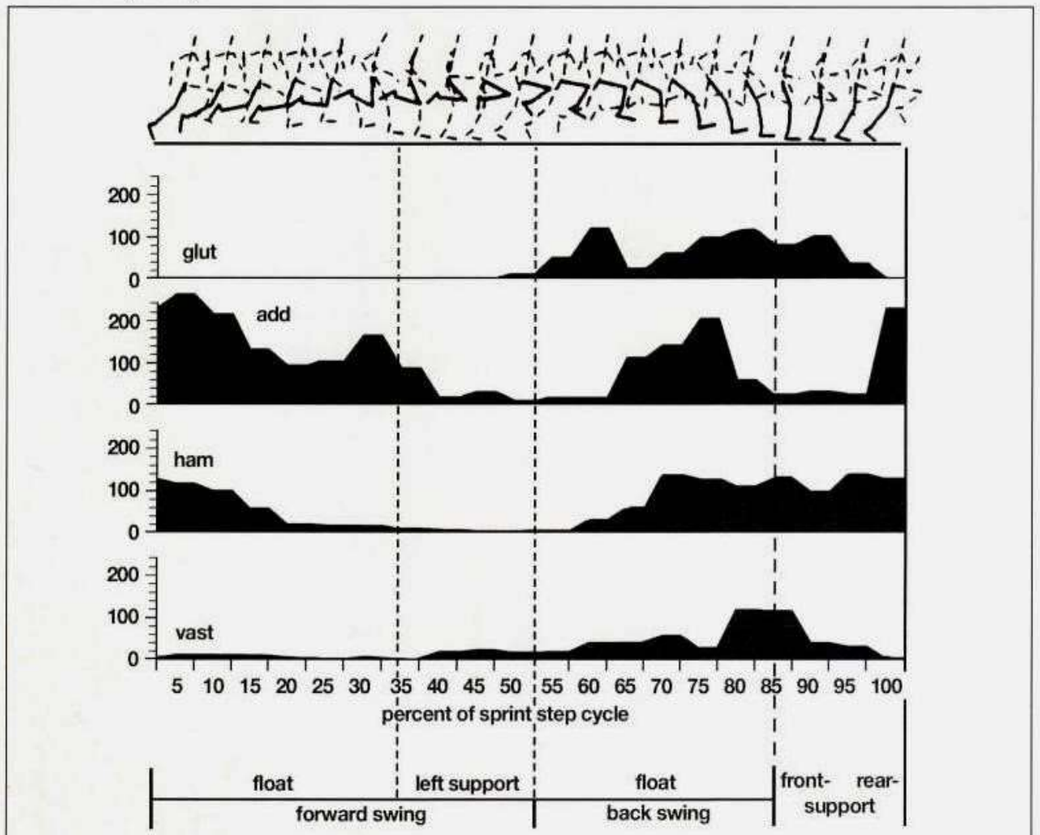
Based on 11 years of research with UKA World Class Talent Programme athletes

Joint Mobility/Stability



EMG analysis of high speed running

Figure 2. EMG Analysis of Muscular Contributions during Sprinting. Adapted from Weimann and Tidow (1995)



Standardized EMG of the sprint stride cycle of Figure 1.

Self-Myofascial Release - Foam Rolling

Self-Myofascial Release Benefits

- Fill in the gaps between deep tissue massage and other soft tissue techniques
- Reduction of scar tissue and adhesions
- Realign collagen fibres
- Target trigger points
- Improved mobility and range of motion
- Improved quality of movement – if correct training is prescribed

Reasons for Assessment/Screening

- Pre-training to decrease tone of overactive muscles
  - Feel good
  - Short term: Problem solving
    - Resolving an injury
    - Reduction injury incidence and predisposition
    - Athletes continue to present major physical limitations

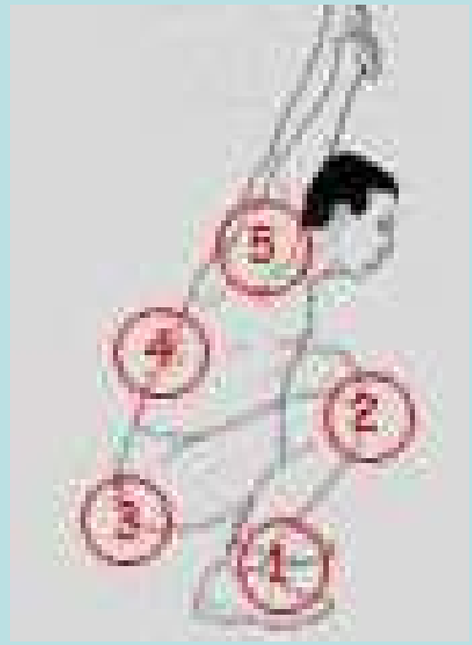
- Long term : Performance enhancement
  - Explicitly link physical qualities and technical qualities
  - Accelerate technical development
  - Longevity of performance and retention

Adapted Functional Movement Screen

- Knee to wall (ankle mobility)
- Overhead squat
- Step-over
- Forward lunge
- Active straight leg raise
- Thoracic rotation

Overhead squat implications

- Limited mobility in the upper torso can be attributed to poor glenohumeral (5) and/or thoracic spine mobility (4).
- Limited mobility in the lower extremity including poor closed-kinetic chain dorsiflexion of the ankle (1) and/or poor flexion of the hip (3) may also cause poor test performance.



Step Over

Considers:

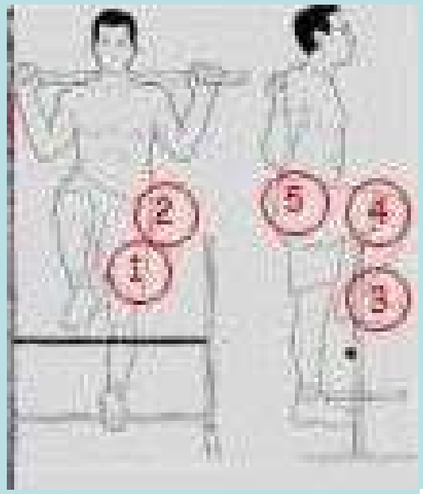
Stance leg hip, knee and ankle stability and range of movement

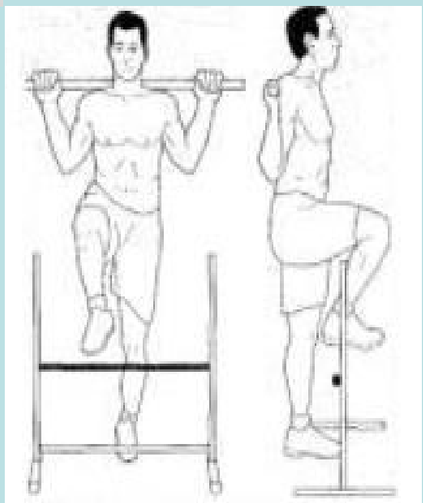
Closed chain hip extension stance leg Open chain hip, knee and ankle flexion of step leg

Issues:

Poor stability of stance leg – weak/tight gluteals 2, collapsing arch of the foot, poor range of movement

Poor mobility of step leg 3,4,5 –





Knee to Wall

- Normal range = 12-15cm

Benefits of throwing Medicine Balls

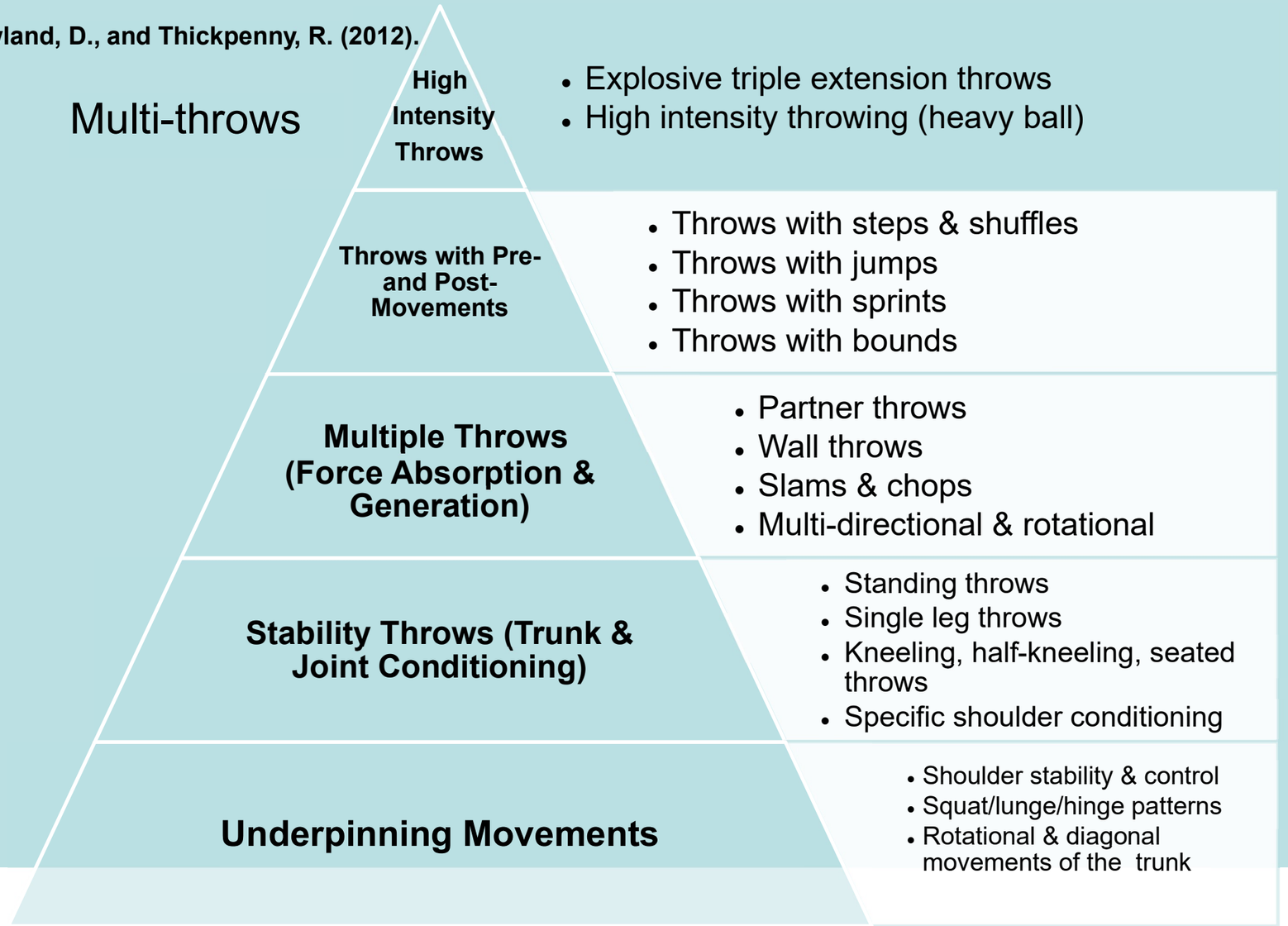
- Develop the essential physical qualities for athletic performance including running
- Ideal for foundational level athletes
- Coordinated triple extension of hip, knee ankle
- Develop force production from proximal to distal via the trunk – trunk conditioning benefits
- High release velocity at completion of movement – manipulate the force-velocity time curve
- Tri-planar movement

- Development of athletic ‘shapes’
- Accessible in a club environment, sports hall or on a field

British Athletics

McKnight, P., Rowland, D., and Thickpenny, R. (2012).

Multi-throws



Plyometrics

- Plyometric exercises are a quick powerful movement using a pre-stretch or countermovement, that involves the stretch-shortening cycle (SSC)
- The Myotatic stretch reflex is a protective mechanism
- Develops the elastic properties of the muscles and MTU
- Upper and lower body exercises can be performed
- Well developed postural strength and joint control before prescribing advanced methods of this training with throwers

- Ability to withstand significant eccentric forces – force absorption →force production
- No pre-existing injuries (particularly knees and Achilles tendon) before attempting jumping type exercises
- Best performed on an even grass surface, sprung floor or heavy rubber gym mats.
- Recruitment of more type IIx fibres so positive implications for power sports and those wanting to engage in complex training

- **Quality** not quantity – always minimum ground contact
- Slow SSC = >250ms; fast SSC = <250ms
- Observe excellent ‘shapes’ and the athlete must ‘earn the right’ to progress

Considerations

- Recommended contacts per session: Beginner (no experience) 80–100

  Intermediate (some experience) 100-140

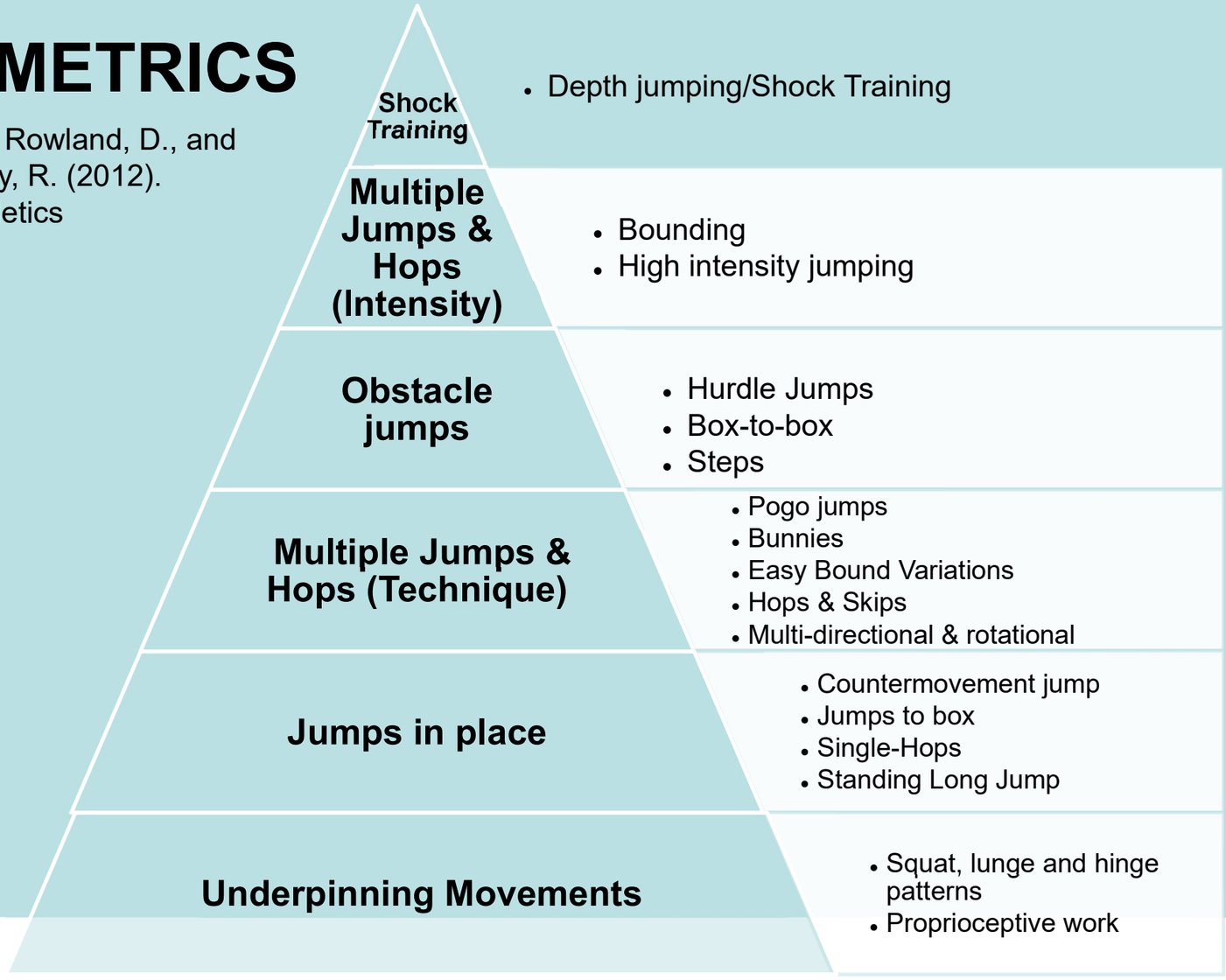
  Advanced (considerable experience) 120-140

(Baechle T., Earle R., 2000)

- FMS tests including overhead squat, lunge and knee to wall (ankle mobility) will indicate movement competence or physical limitations that should be addressed and considered when progressing

PLYOMETRICS

Jarvis, M., Rowland, D., and Thickpenny, R. (2012). British Athletics

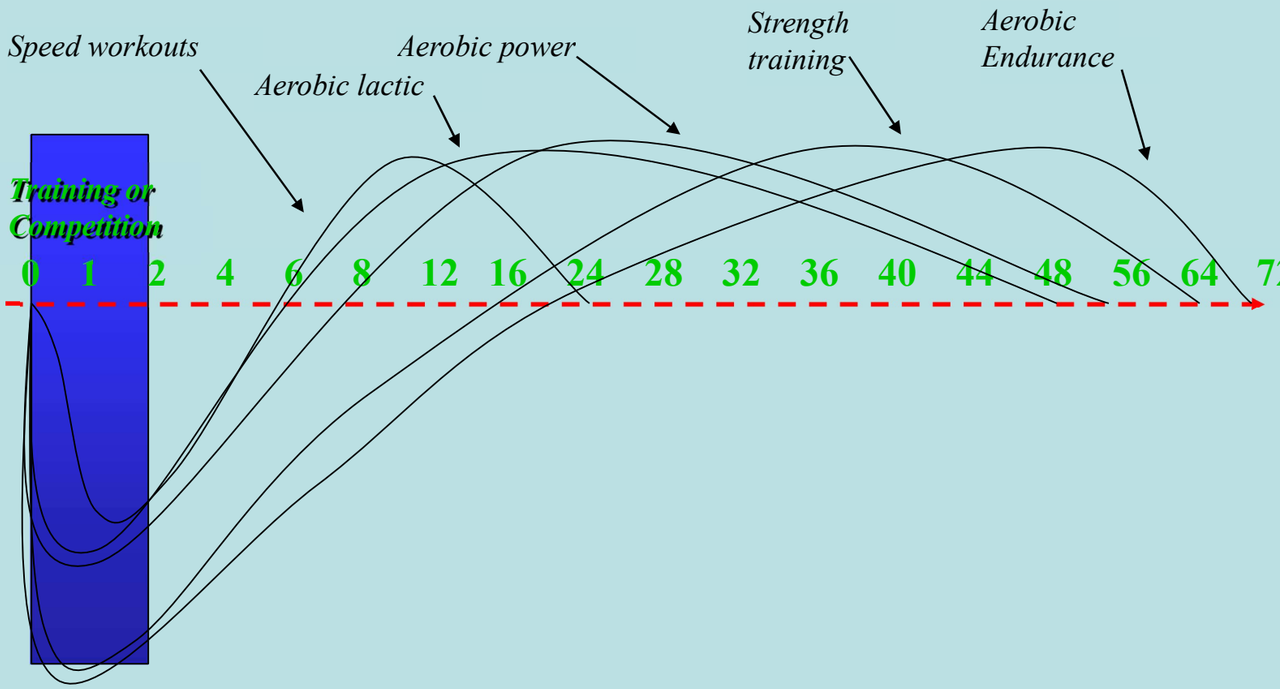


Programming

- A process of systematic training which is designed to create the capacity for training and a platform for performance
- Great sessions don’t work in isolation
- Best programmes are the ones that combine not only the appropriate load but also at the right time with sufficient recovery
- The athlete must earn the physical right to move the programme forwards (Giles, 2004) – physical competence

Training Types	Speed	Aerobic lactic	Aerobic Power	Strength training	Aerobic endurance

From	24	48	48	48	56
To			56		72



Time required for complete recovery (Platanov, 1988)

Beginner/Novice

- Beginner - improve all biomotor abilities
- Beginners tend to respond to any training
- General adaptations occur without substantial fatigue
- Strength gains are principally neural – minimal CSA change
- Beginners cannot train with sufficient load, intensity or volume to elicit fatigue after effects
- But they can develop all of the Fundamental Movement Patterns – prepare them for performance loading

A Practical example for young athletes

- To be good at a movement = plenty of stimulus

- e.g. squat once a week for 12 weeks = 12 stimuli
- Not sufficient for motor development

• Squat as part of warm-up (3 x week) + squat 3 x week for 6 weeks = 36 stimuli (loaded and unloaded)

- Athlete's skill level ↑. Loaded: Med Ball, Powerbag, strength band barbell & KB

•Training loads for children: 50% of their maximum potential is very effective

•The athlete must earn the physical right to move the programme forwards (Giles, 2004).

Reps, sets & volume load

Max Strength	• 1-5 reps per set • 15-25 reps total per exercise
Power	• 2-5 reps per set • 15-30 reps total
Strength Endurance	• 5-8 reps per set • 20-35 reps total
Motor Patterning/ Functional Hypertrophy	• 8-12 reps • 20-35 reps total
Conditioning	• 30-90 seconds per set

Training focus and prescription

Physiological Adaptation	Strength	Endurance	Stability
Intensity of movement	>80% RM/max force if isometric	60-80% RM/ mod isometric force	<30% RM, skill/mvt or recruitment focus
Volume	3-6 sets, 1-6 reps/ 5-10 secs isometric	3-5 sets, 5-10 reps/ > 30-60 secs if isometric	3-4 sets, 20-30 reps/ > 30-60 secs if isometric
Fatigue	Not necessary	Necessary	Necessary

Specific adaptation (if competent movement)	↑ Force capabilities	↑ Strength endurance	Improved sports specific movements

Weekly Microcycle for a Club Endurance Athlete

	MON	TUES	WEDS	THURS	FRI	SATURDAY	SUNDAY
ENERGY SYSTEM	EASY RUN	EXTENSIVE TEMPO	EASY RUN	SPEED ENDURANCE	REST	HILLS	STEADY STATE (Longest run)
PHYSICAL PREP		GENERALSTRENGTH		PLYOMETRICS/ MULTI-THROWS	REST	GENERAL STRENGTH	
WARM-UP	MOVEMENT PATTERNS	HURDLE MOBILITY	FOAM ROLLING	SKIPPING WITH ROPE	REST	FOAM ROLLING & HURDLE MOBILITY	

WARM-DOWN	SPORTS MASSAGE	TRUNK CONDITIONING	STRETCHING		REST	TRUNK CONDITIONING	DEVELOPMENTAL STRETCHING

Weekly Microcycle for a Club Sprinter

	MON	TUESDAY	WED	THURSDAY	FRIDAY	SATURDAY	SUNDAY
CE & SDE WORK		DRILLS/ ACCELERATIONS	REST	DRILLS/SPEED		SPEED ENDURANCE – INTENSIVE TEMPO	REST
SPE WORK	LIFTING – EXPLOSIVE STRENGTH	MULTI-JUMPS/PLYOS	REST	MULTI-THROWS	LIFTING – EXPLOSIVE STRENGTH		REST

GPE: WARM-UP	MOVEMENT PATTERNS	HURDLE MOBILITY	REST	HURDLE MOBILITY		MYOFASCIAL RELEASE & SKIPPING WITH ROPE	REST
GPE: COOL-DOWN		TRUNK CONDITIONING	REST	SPORTS MASSAGE		TRUNK CONDITIONING + SAND PIT FOOT CONDITIONING	REST

Recommended Reading

- Bompa, T.O. (2005). Periodization Training for Sports. Human Kinetics
- Baechle T.R., and Earle R.W. (2000). Essentials of Strength Training & Conditioning. Human Kinetics
- Zatsiorsky, V.M., and Kraemer, W.J. (2006). Science & Practice of Strength Training. Human Kinetics

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- Cardinale, C., Newton, R. and Nosaka, K. (2011). Strength and Conditioning: Biological Principles and Practical Applications. WileyBlackwell.
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