



Injury prevention in team sport: the role of strength and conditioning training

Focus on load monitoring

Ana Carolina Paludo

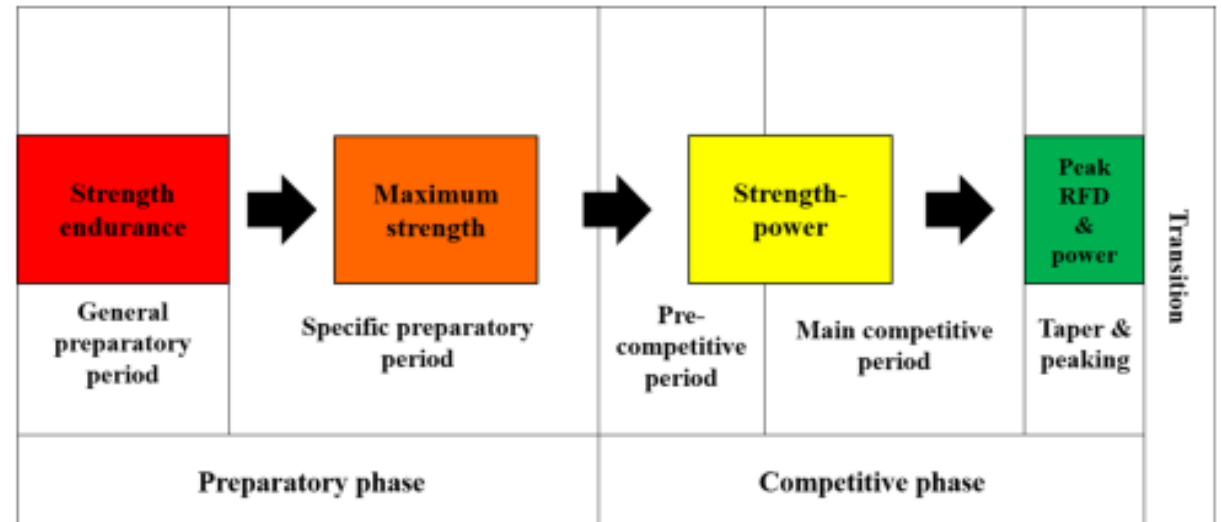
Training Plan - Periodization



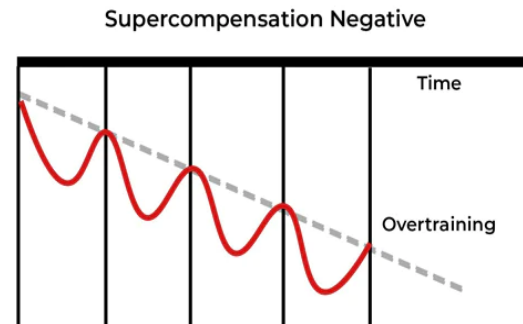
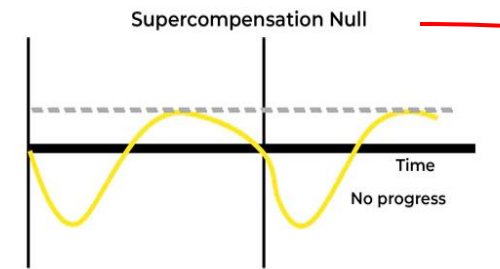
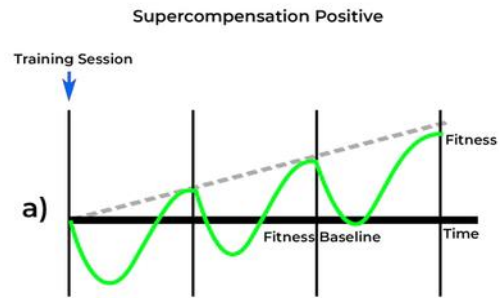
Prepare the team to reach the peak performance
on the target competition

Periodization Phases

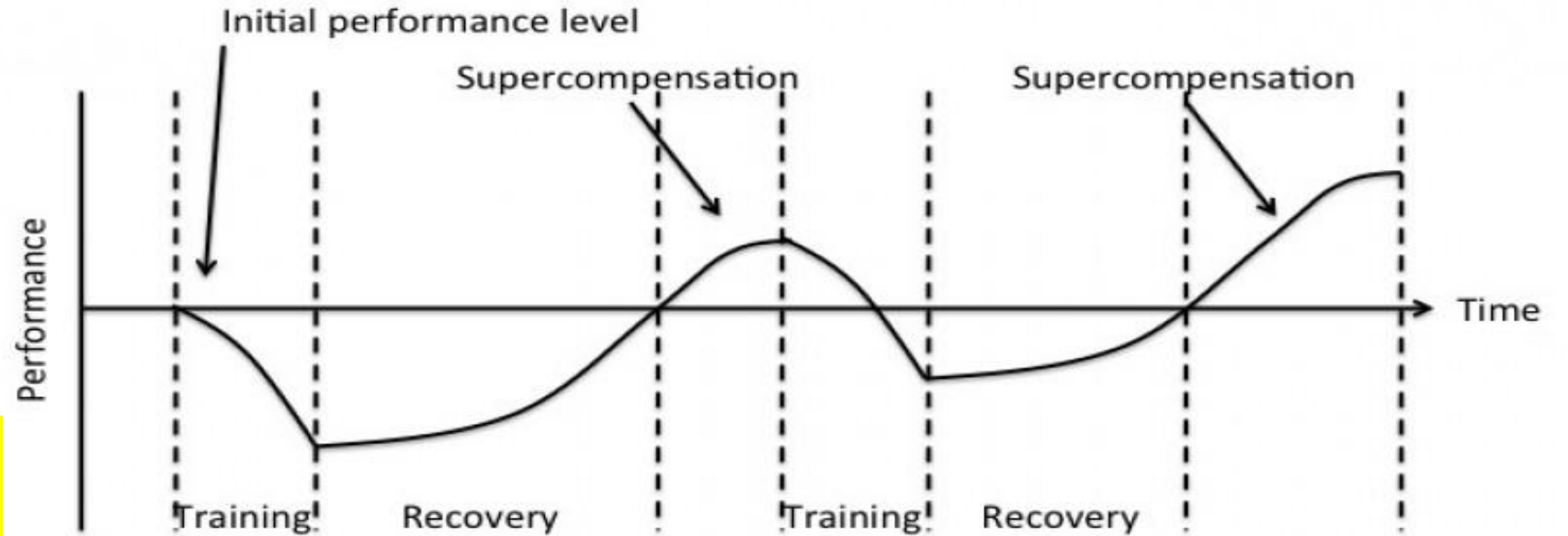
Macrocycle																						
Preparatory Period								Competitive Period								Transition Period						
General Preparation Phase				Specific Preparation Phase				Pre-Competition Phase				Main Competition Phase				Transition Phase						
Mesocycle 1				Mesocycle 2				Mesocycle 3				Mesocycle 4				Mesocycle 5			Mesocycle 6			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Microcycles																						



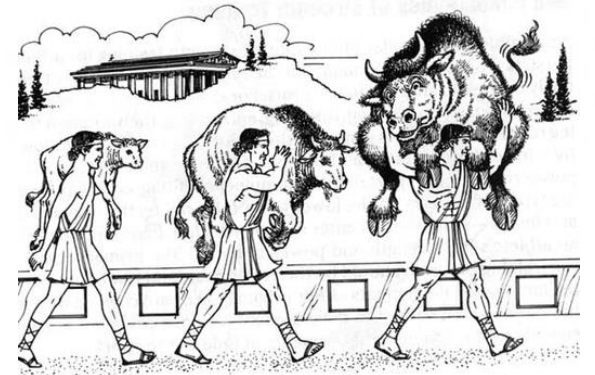
Supercompensation: training dose- response



Risk of injury

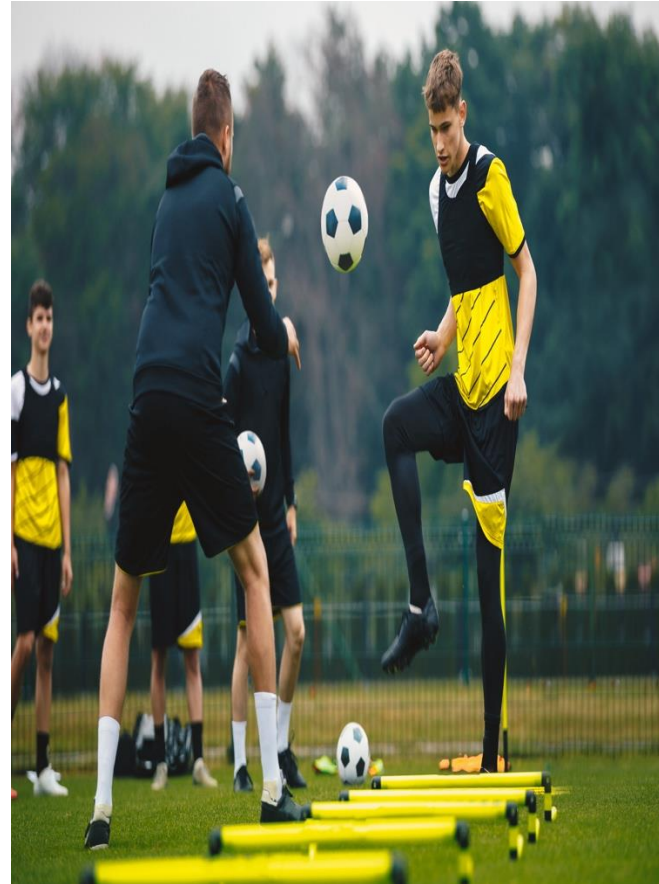


Classic periodization model: A training load followed by recovery results in increased performance (supercompensation).

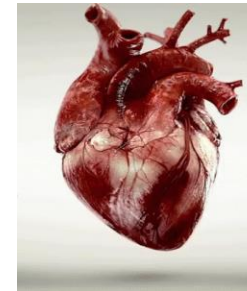


How to verify the training progress?

External Load (imposed)



Internal Load (received/perceived)



Physiological parameters:

- Heart rate, lactate, hormones...

Metrics:

- GPS
- Training (duration, frequency...)

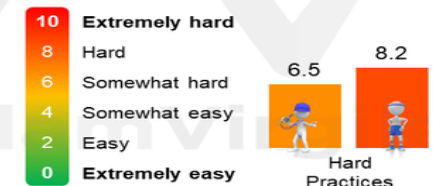
Perceptions:

- Recovery, session intensity (RPE), muscle pain...

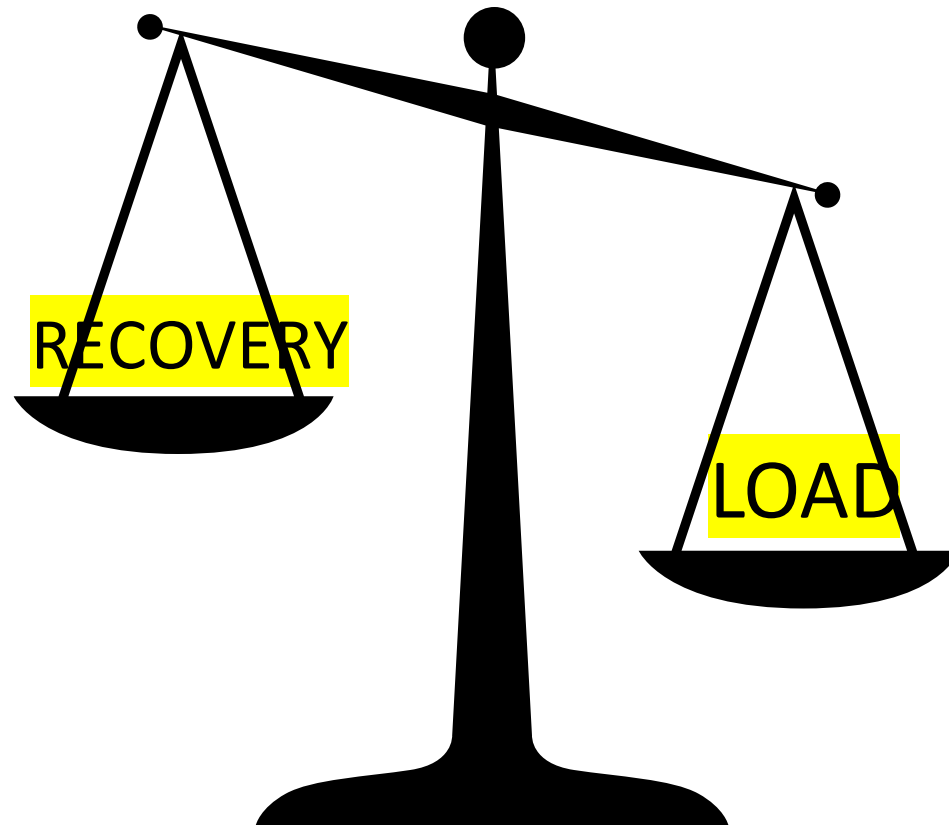
Perceived Athlete Recovery



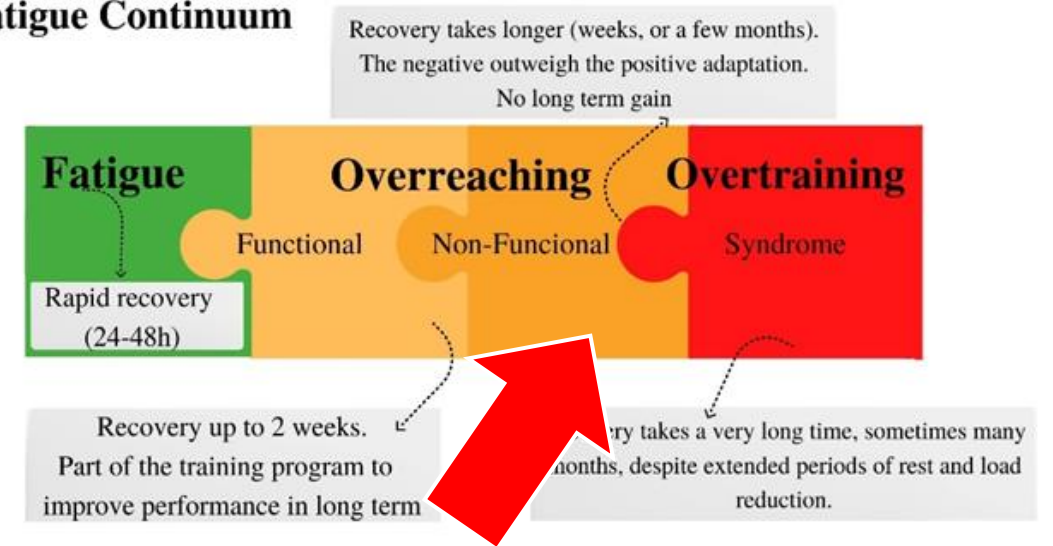
Perceived Session Intensity



Training dose-response



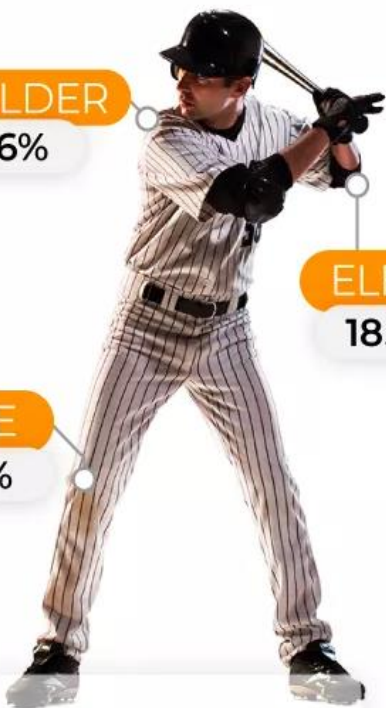
Fatigue Continuum



Injury investigation in team-sports

% of total injuries

SHOULDER
16.16%



ELBOW
18.98%

KNEE
7.65%

Baseball (MLB)

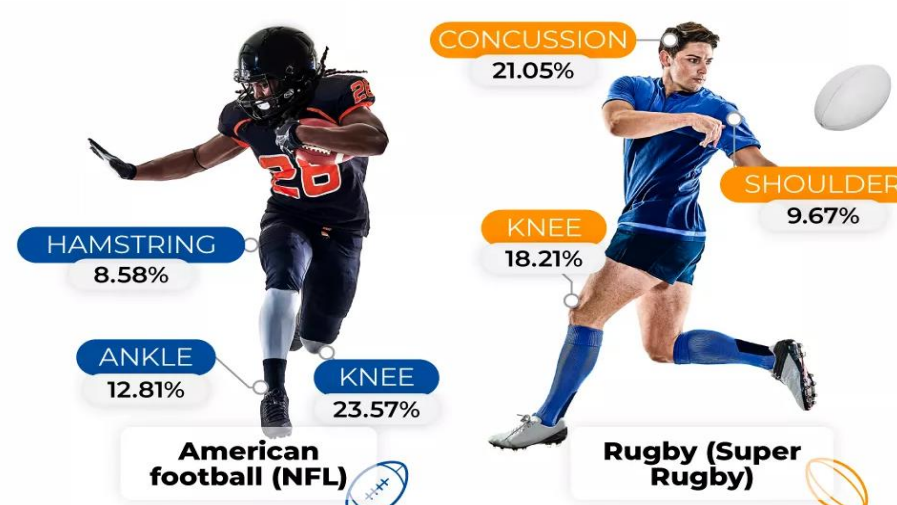
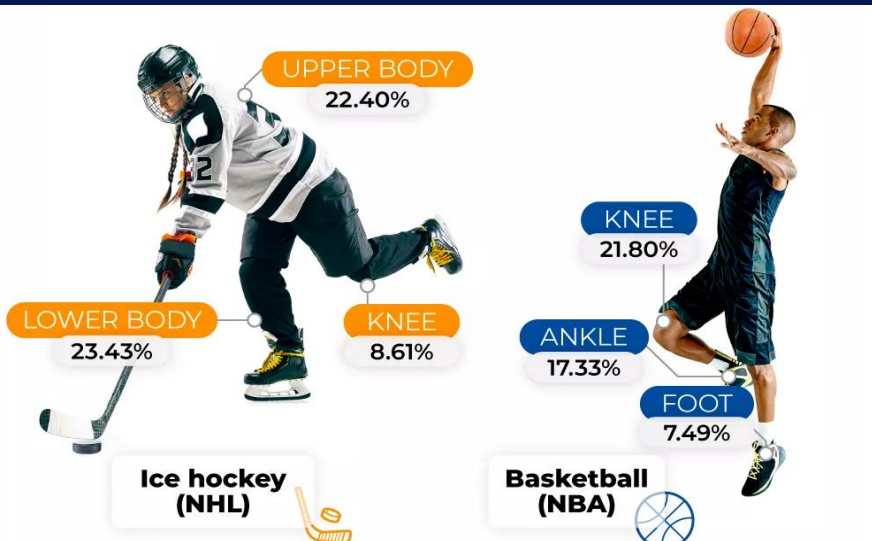
HEAD
11.00%



KNEE
22.01%

HAMSTRING
16.88%

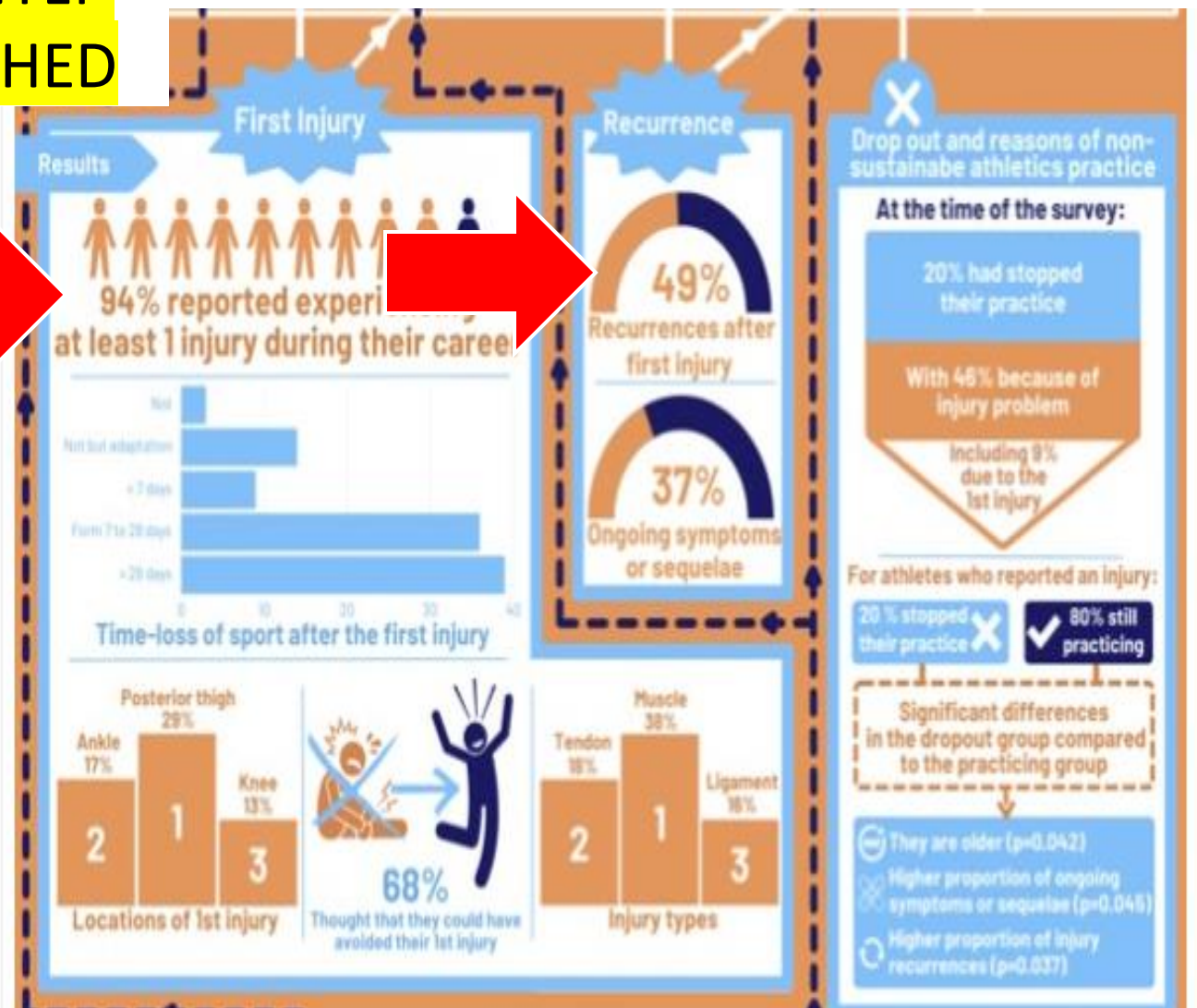
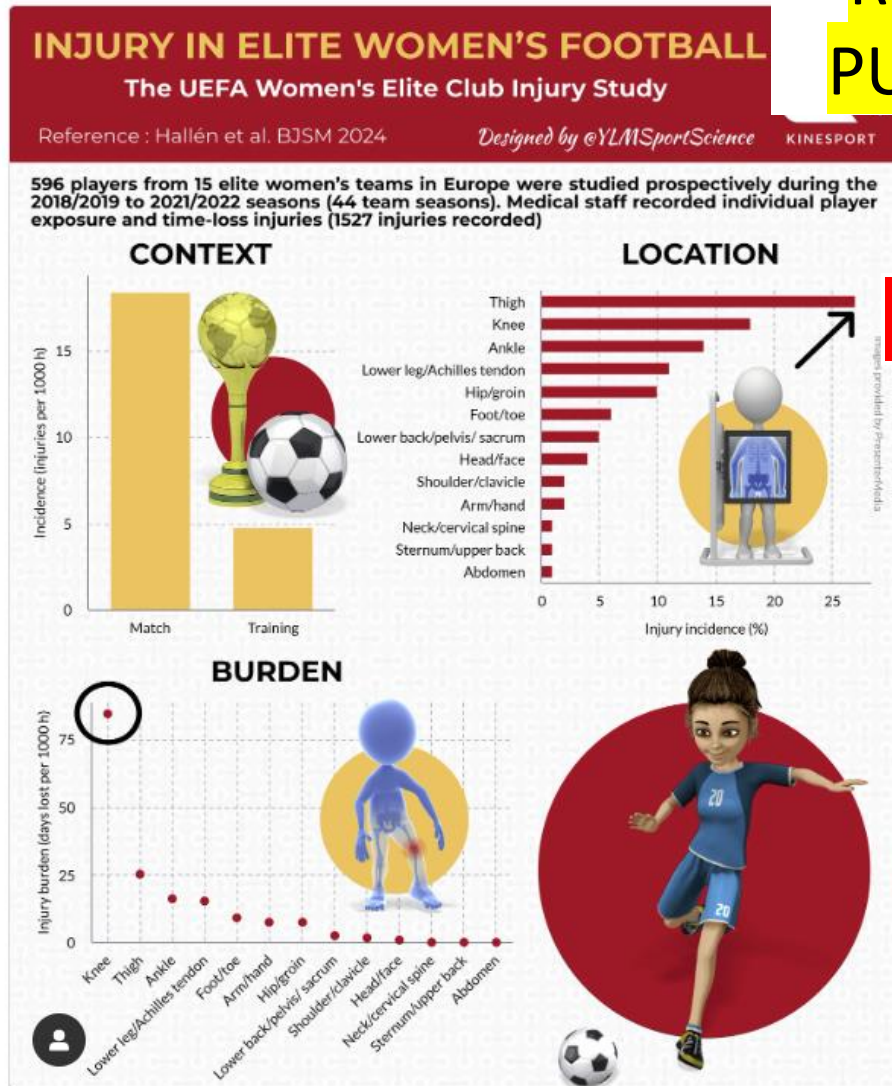
Football (Premier League)



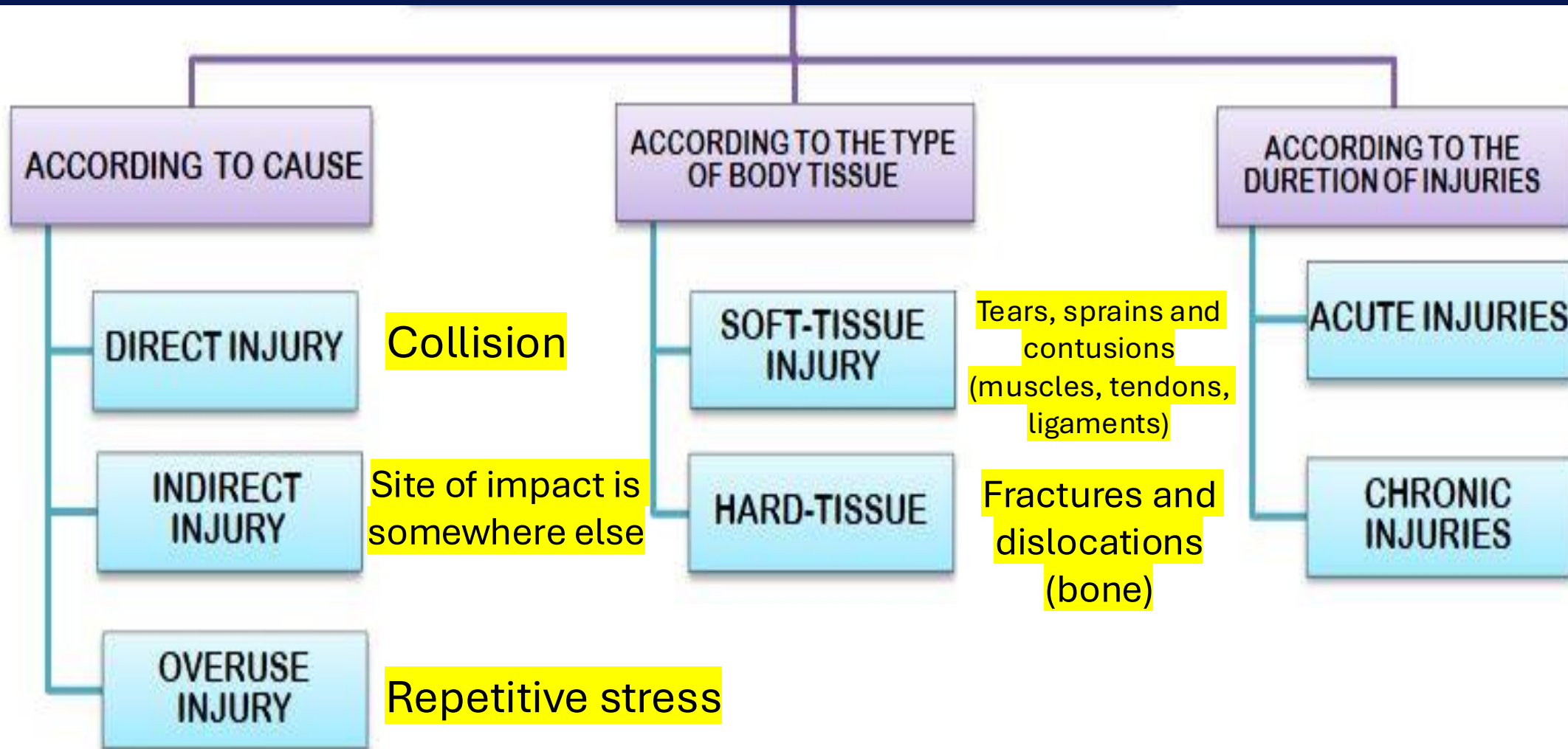
Methodology: Claims.co.uk investigated athlete injury data from reputable sports websites as well as fantasy league injury trackers, and were able to reveal the most common physical injuries in different sports.

Injury investigation in team-sports

RECENTLY
PUBLISHED



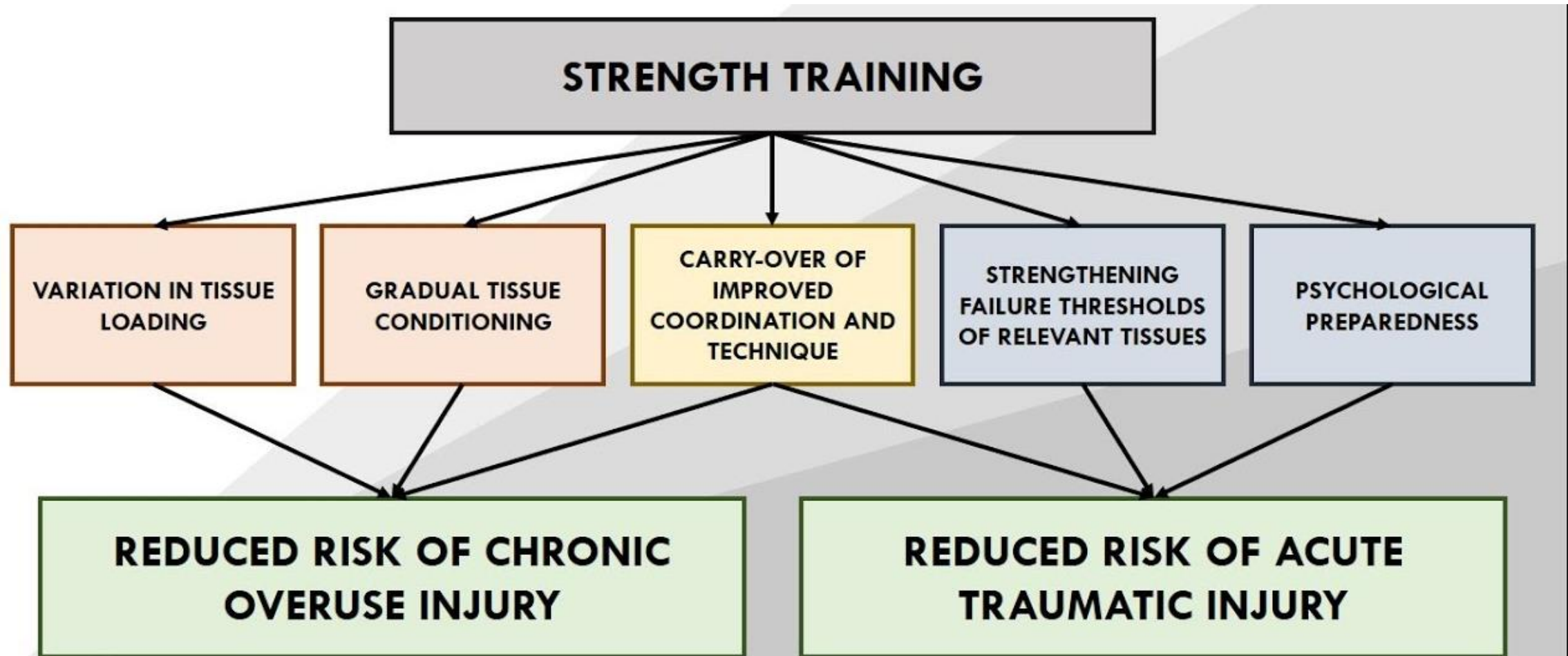
Type of sport injuries



Indirect injury refers to harm or damage that occurs as a result of an event or action but is not directly caused by that event or action itself.




Direct injury refers to harm or damage that occurs immediately as a result of a specific event or action.

Importance of Strength Training



How to prepare a plan to prevent injury ?

Sports Injury Prevention is Complex: We Need to Invest in Better Processes, Not Singular Solutions

Jason C. Tee^{1,2}  · Shaun J. McLaren^{2,3}  · Ben Jones^{2,3,4,5,6,7,8} 

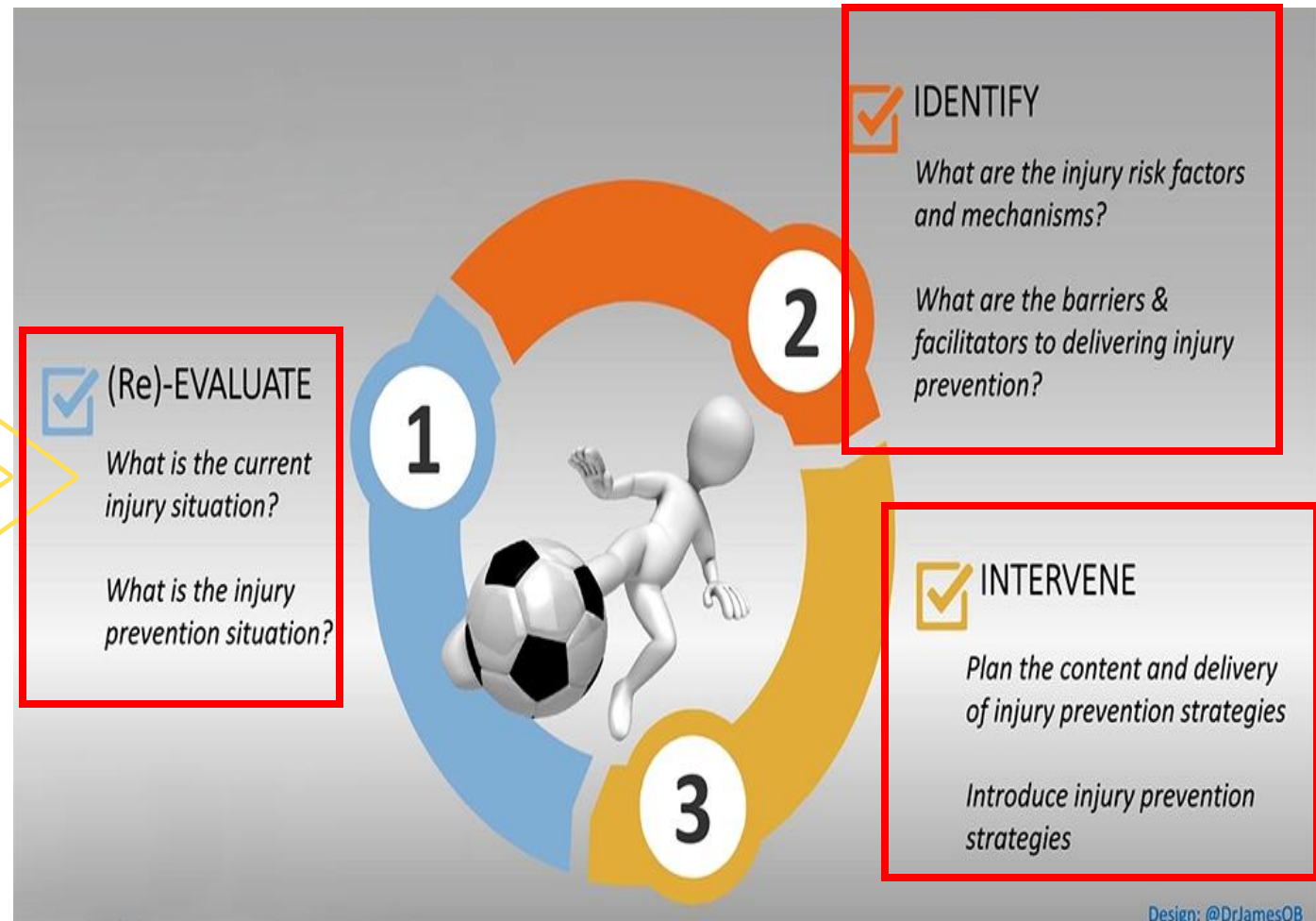
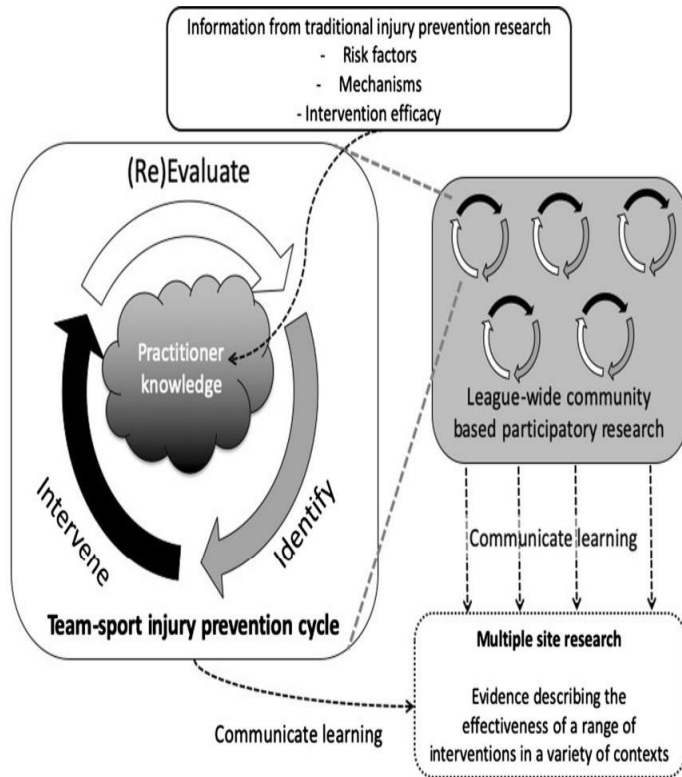


Fig. 2 Utilising the team-sport injury prevention cycle as a feedback loop to inform the continuous development of injury prevention interventions in context

How to prepare a plan to prevent injury ?

1 Athlete injury status

2 Intervention programs – injury prevention

3 Load monitoring- training and recovery

Athlete injury retrospective

Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries

C. W. Fuller¹, J. Ekstrand², A. Junge³, T. E. Andersen⁴, R. Bahr⁴, J. Dvorak³, M. Hägglund², P. McCrory⁵, W. H. Meeuwisse⁶

1A Date of injury: 1B Date of return to full participation:

severity

2A Injured body part

- | | | |
|--|---|--|
| <input type="checkbox"/> head/face | <input type="checkbox"/> shoulder/clavícula | <input type="checkbox"/> hip/groin |
| <input type="checkbox"/> neck/cervical spine | <input type="checkbox"/> upper arm | <input type="checkbox"/> thigh |
| <input type="checkbox"/> sternum/ribs/upper back | <input type="checkbox"/> elbow | <input type="checkbox"/> knee |
| <input type="checkbox"/> abdomen | <input type="checkbox"/> forearm | <input type="checkbox"/> lower leg/Achilles tendon |
| <input type="checkbox"/> low back/sacrum/pelvis | <input type="checkbox"/> wrist | <input type="checkbox"/> ankle |
| | <input type="checkbox"/> hand/finger/thumb | <input type="checkbox"/> foot/toe |

2B Side of body

- | | | |
|--------------------------------|-------------------------------|---|
| <input type="checkbox"/> right | <input type="checkbox"/> left | <input type="checkbox"/> not applicable |
|--------------------------------|-------------------------------|---|

3. Type of injury

- | | | |
|---|--|--|
| <input type="checkbox"/> concussion (with or without haematoma/contusion/loss of consciousness) | <input type="checkbox"/> lesion of meniscus or cartilage | <input type="checkbox"/> bruise |
| <input type="checkbox"/> fracture | <input type="checkbox"/> muscle rupture/strain/tear/cramps | <input type="checkbox"/> abrasion |
| <input type="checkbox"/> other bone injury | <input type="checkbox"/> laceration | <input type="checkbox"/> nerve injury |
| <input type="checkbox"/> dislocation/subluxation | <input type="checkbox"/> tendon injury/rupture/tendinosis/bursitis | <input type="checkbox"/> dental injury |
| <input type="checkbox"/> sprain/ligament injury | | |
| <input type="checkbox"/> other injury (please specify): . . . | | |

type

4. Diagnosis (text or Orchard code):

.....

5. Has the player had a **previous injury** of the same type at the same site (i.e. this injury is a recurrence)?

- | | |
|-----------------------------|------------------------------|
| <input type="checkbox"/> no | <input type="checkbox"/> yes |
|-----------------------------|------------------------------|

If **YES**, specify date of player's return to full participation from the previous injury: . . .

6. Was the injury caused by **overuse** or **trauma**?

- | | |
|----------------------------------|---------------------------------|
| <input type="checkbox"/> overuse | <input type="checkbox"/> trauma |
|----------------------------------|---------------------------------|

recurrence

7. **When** did the injury occur?

- | | |
|-----------------------------------|--------------------------------|
| <input type="checkbox"/> training | <input type="checkbox"/> match |
|-----------------------------------|--------------------------------|

8. Was the injury caused by **contact or collision**?

- | | |
|-----------------------------|---|
| <input type="checkbox"/> no | <input type="checkbox"/> yes, with another player |
| | <input type="checkbox"/> yes, with the ball |
| | <input type="checkbox"/> yes, with other object (specify) . . . |

context

Importance of Strength Training

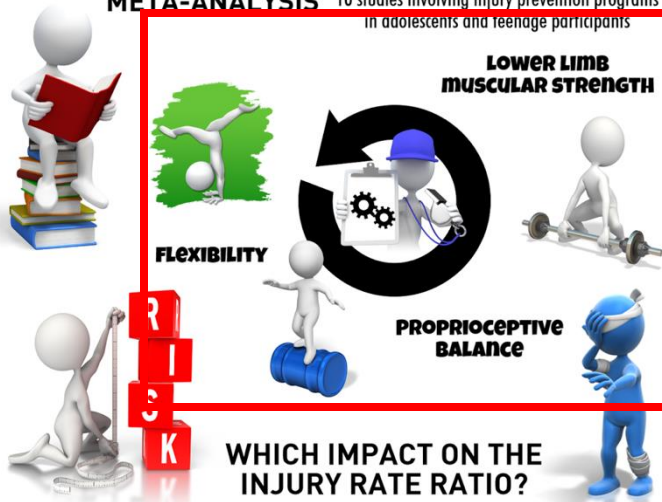
Lauersen, et al. (2014). The Effectiveness of Exercise Interventions to Prevent Sports Injuries: A Systematic Review and Meta-Analysis of Randomised Controlled Trials. *Br J Sports Med*, 48(11), 871-877.



Intervention programs – injury prevention

THE EFFICACY OF INJURY PREVENTION PROGRAMS IN ADOLESCENT TEAM SPORTS

META-ANALYSIS 10 studies involving injury prevention programs in adolescents and teenage participants



-40%

Injury prevention programs reduce the injury rate ratio in adolescent team sport athletes by an estimated 40%

Reference: Soomro et al. AJSM 2015

Designed by eYLMSPortScience

'SPRINT' TO REDUCE THE RISK OF HAMSTRING INJURIES

Reference: Fisher et al. Sports 2022

Designed by eYLMSPortScience



KINESPORT



Sprint! prepare/train the athlete to run/sprint at maximal velocity, individually:

- through a loop of evaluation and intervention/ preparation,
- with progressivity (eg. 'form 1st, load 2nd'), diversity/ variation, regularity and periodisation/ recovery,
- including preparation of the structure/system

To sustain the sprinting constraints, drills and technical skills, and regular exposure to maximal sprints

Plurifactorial and plurimodal individualised approach, including physical, psychological and contextual/sociological approaches, including healthy and safe lifestyle, taking into account the context and the facilitators and barriers for intervention implementation, and with education of the athletes and stakeholders around them



Repair/rehabilitate all injuries, with a sprint-oriented strategy, from early stages and until maximal capabilities are recovered and return to sport is permitted, and continue to monitor that there is no sequel deficiency

Increase capacities of tissues by strengthening, stretching and training sensorimotor control, going from isolated/non-functional to functional exercises



Note/pay attention to pain and/or fatigue and take care of it properly, improve athletes' ability to listen to their bodies, know their capabilities and limits, and learn warning signals to better self-efficacy in their daily practice

Train smartly, individually adapt and monitor the load, increase volume and intensity progressively



PRE-SEASON RUNNING LOADS AND INJURY IN TEAM SPORT

Reference: Fisher et al. Sports 2022

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KINESPORT

- 25 elite team sport players (Gaelic football) were monitored throughout one full season
- They were retrospectively divided into 2 groups depending on their workload during the pre-season



GPS data



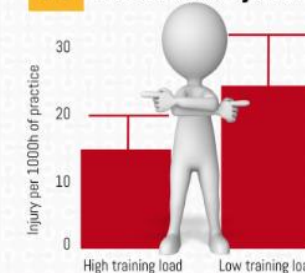
Injury data



High training load
VS
Low training load

RESULTS

A Incidence rate of non-contact injuries



B In-season training load

The High Training Load group was able to sustain greater running loads in the competitive phases of the season both in terms of total distance and high-intensity running

C Body composition

Players who complete a greater proportion of running loads in pre-season altered their body composition levels to more optimal levels

CONCLUSION

These results confirm the importance for team sport players to achieve a good pre-season to reduce the risk of injury, to increase their tolerance to load and to optimize their body composition



Physical test - Asymmetry

Asymmetry Thresholds for Common Screening Tests and Their Effects on Jump Performance in Professional Soccer Players

Paul J. Read, PhD, CSCS*D*; Seán McAuliffe, PhD*; Chris Bishop, PhD†; Jon L. Oliver, PhD‡; Phil Graham-Smith, PhD§; Mohammed Abdulaziz Farooq, PhD, MSc, MPH*

Table 2. Asymmetry Thresholds for Players in Each Quartile

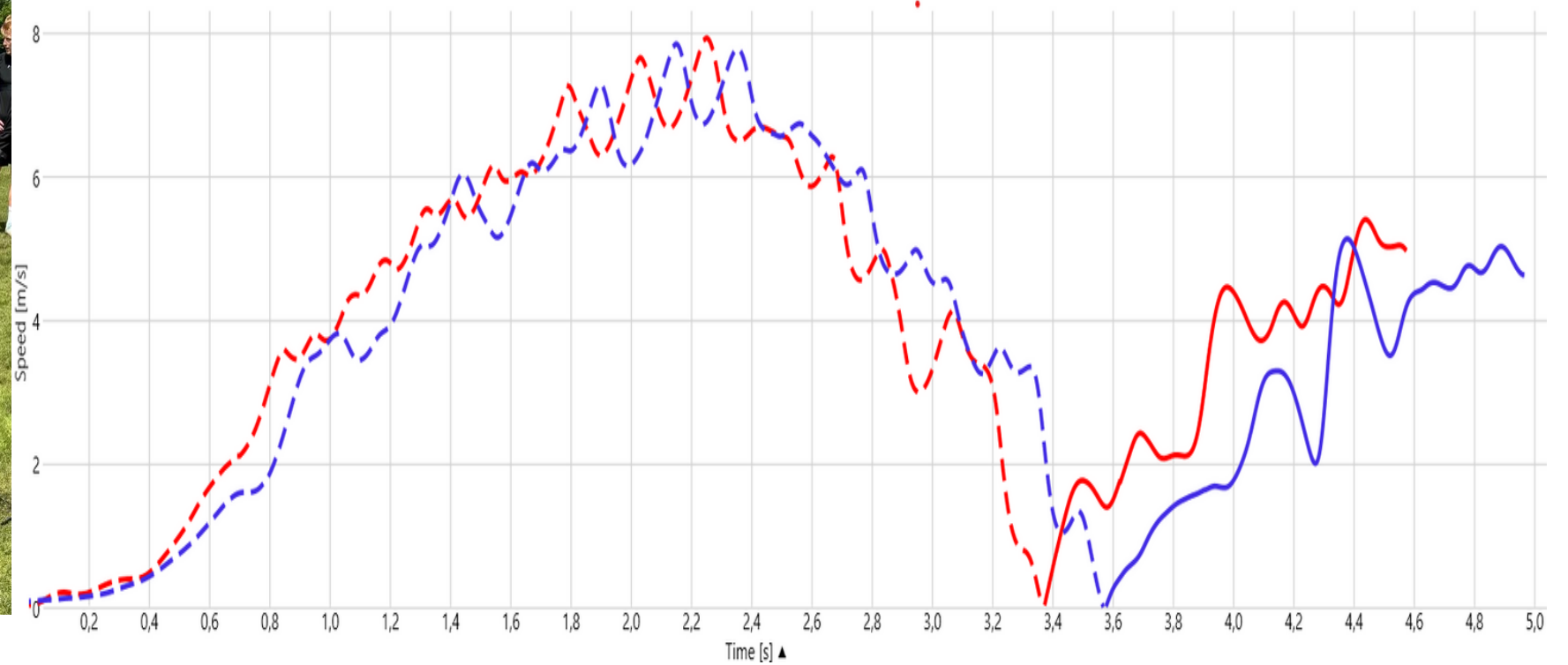
Test Variable	Absolute Asymmetry (%) Quartile			
	Small (Q1)	Moderate (Q2)	Large (Q3)	Very Large (Q4)
Range of motion				
Bent-knee fall-out	≤5.7	5.8–12.5	12.6–20.9	≥21
Hip internal rotation, 90°	≤3.5	3.6–8.9	9.0–16.3	≥16.4
HAM peak knee extension	≤1.3	1.4–3.3	3.4–6.1	≥6.2
Ankle dorsiflexion	≤3.8	3.9–9.1	9.2–18.1	≥18.2
Strength				
QUAD: Concentric, 60°/s	≤4.4	4.5–7.4	7.5–13.4	≥13.5
HAM: Concentric, 60°/s	≤4.3	4.4–7.3	7.4–13.8	≥13.9
HAM: Eccentric, 60°/s	≤4.3	4.4–8.4	8.5–16.7	≥16.8
Functional HAM:QUAD	≤5.2	5.3–11.0	11.1–20.1	≥20.2
Adduction: abduction	≤6.2	6.3–12.7	12.8–19.8	≥19.9
NordBord	≤2.8	2.9–5.1	5.2–8.9	≥9
Eccentric hip adduction	≤3.8	3.9–8.1	8.2–14.1	≥14.2
Eccentric hip abduction	≤3.7	3.8–8.7	8.9–14.5	≥14.6
Jump				
Single-legged countermovement jump, height, cm	≤3.3	3.4–8.7	8.8–14.9	≥15.0
Single-legged countermovement jump, peak force, N	≤1.8	1.9–3.8	3.9–6.3	≥6.4
10-s Hop height, cm	≤4.6	4.7–10.3	10.4–18.0	≥18.1
10-s Hop reactive strength index	≤5.5	5.6–11.7	11.8–20.4	≥20.5

Abbreviations: HAM, hamstrings; NordBord, Nordic hamstrings curl (Vald Performance, Albion, Australia); QUAD, quadriceps



Physical test - Asymmetry

8.77% difference



Load monitoring: training and recovery

Association Between the Acute to Chronic Workload Ratio and Injury Occurrence in Young Male Team Soccer Players: A Preliminary Study

Hamid Arazi¹, Abbas Asadi², Farhood Khalkhali¹, Daniel Boullosa^{3,4}, Anthony C. Hackney⁵, Urs Granacher^{6†} and Hassane Zouhal^{7*†}*

The Influence of Changes in Acute Training Load on Daily Sensitivity of Morning-Measured Fatigue Variables in Elite Soccer Players

Robin T. Thorpe, Anthony J. Strudwick, Martin Buchheit, Greg Atkinson, Barry Drust, and Warren Gregson

Training Load and Its Role in Injury Prevention, Part I: Back to the Future

Franco M. Impellizzeri, PhD^{}; Paolo Menaspà, PhD; Aaron J. Coutts, PhD[†]; Judd Kalkhoven, BSportExSc(Hons)^{*}; Miranda J. Menaspà, M. Sports Physio, FACP[‡]*

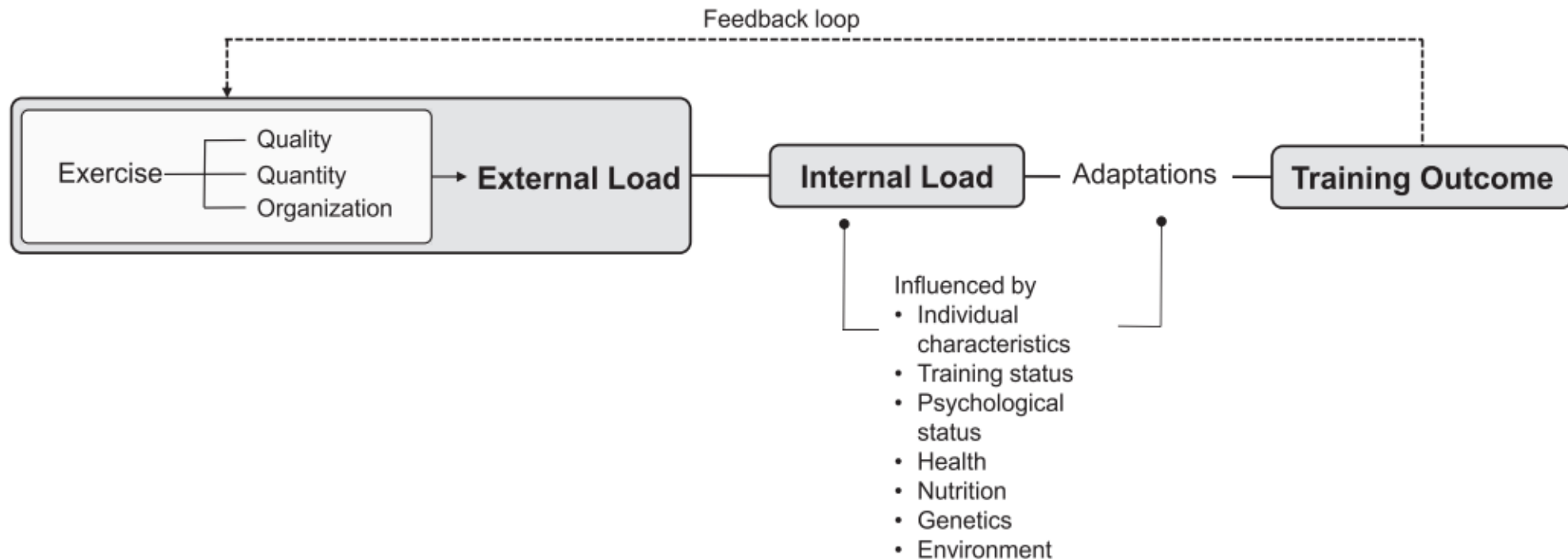
Training Load and Its Role in Injury Prevention, Part 2: Conceptual and Methodologic Pitfalls

Franco M. Impellizzeri, PhD^{}; Alan McCall, PhD[†]; Patrick Ward, PhD[‡]; Luke Bornn, PhD[§]; Aaron J. Coutts, PhD^{*}*

Load monitoring: training and recovery

Training Load and Its Role in Injury Prevention, Part I: Back to the Future

Franco M. Impellizzeri, PhD*; Paolo Menaspà, PhD; Aaron J. Coutts, PhD†;
Judd Kalkhoven, BSportExSc(Hons)*; Miranda J. Menaspà, M. Sports Physio,
FACP‡

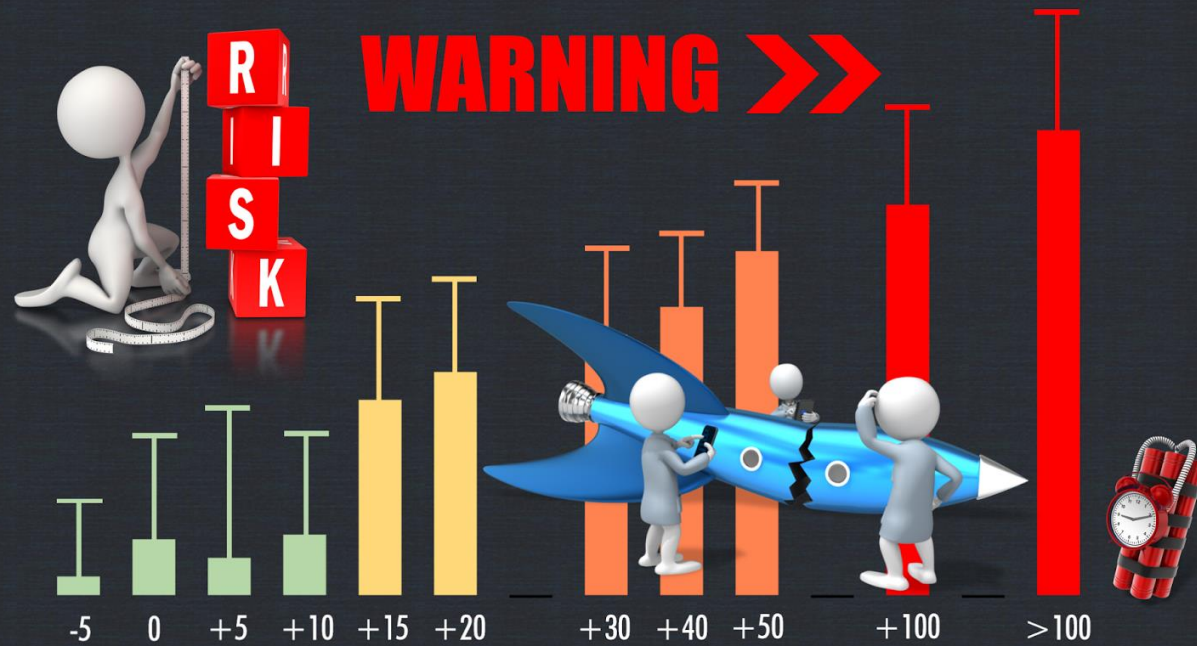


Load monitoring: training and recovery

High training workloads alone do not cause sports injuries: How you get there is the real issue

Data collected from professional rugby league players over three pre-season preparation periods. Loads were measured using session-rating of perceived exertion, and a total of 148 injuries were sustained

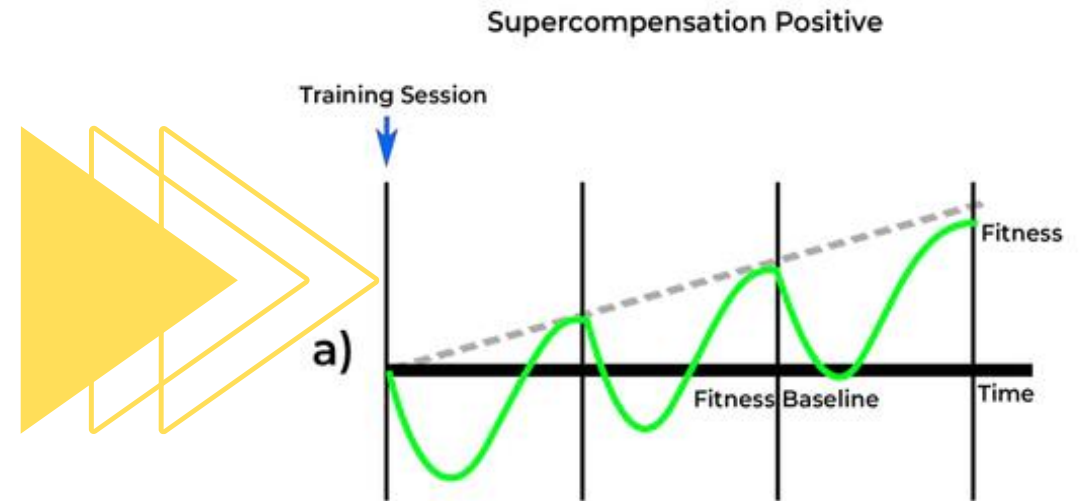
Likelihood of injury (Probability)



Change in training load per week (%)

Reference by Tim J Gabbett, in BJSM, 2016

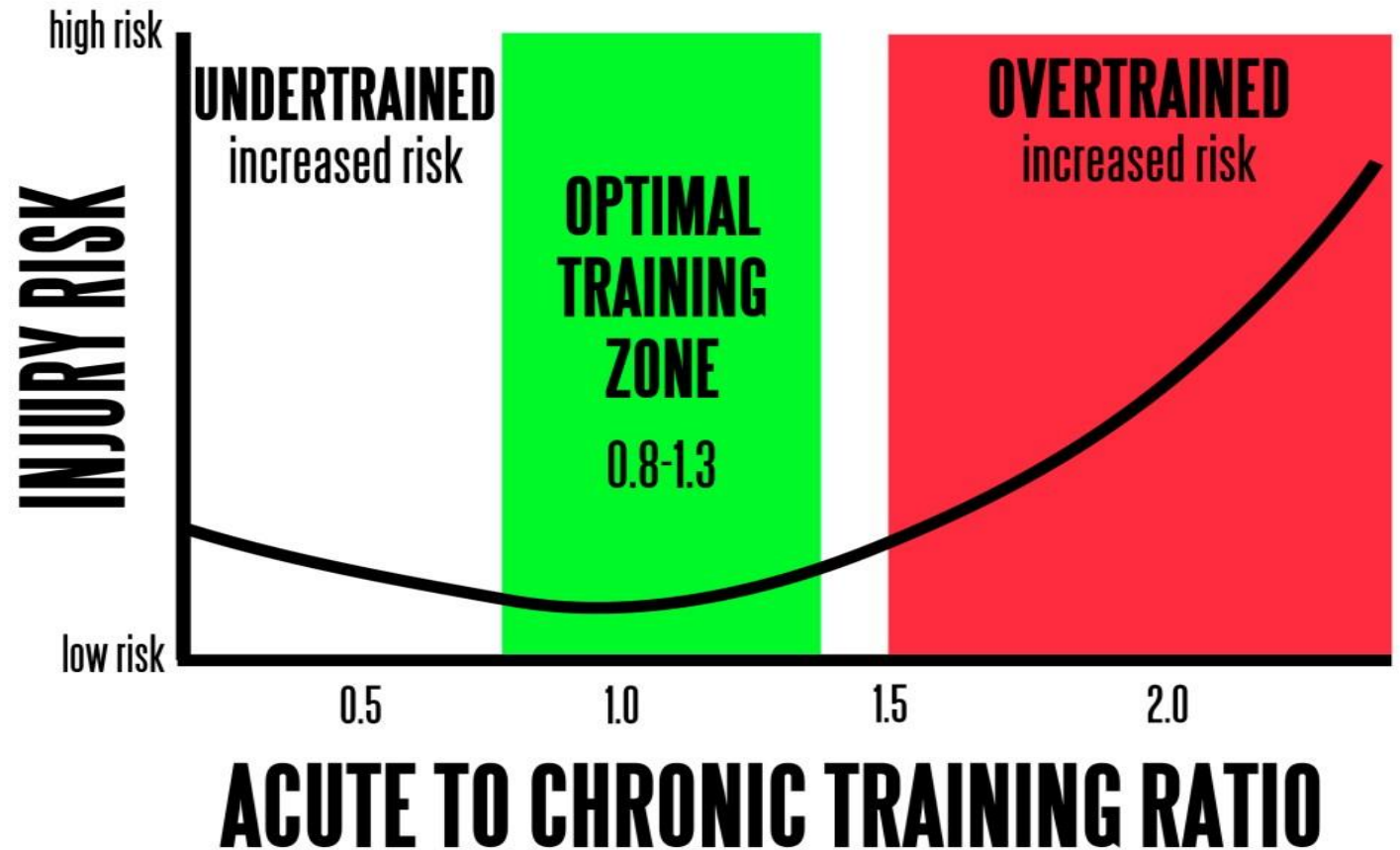
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Load monitoring: training and recovery

Acute:Chronic Workload Ratio

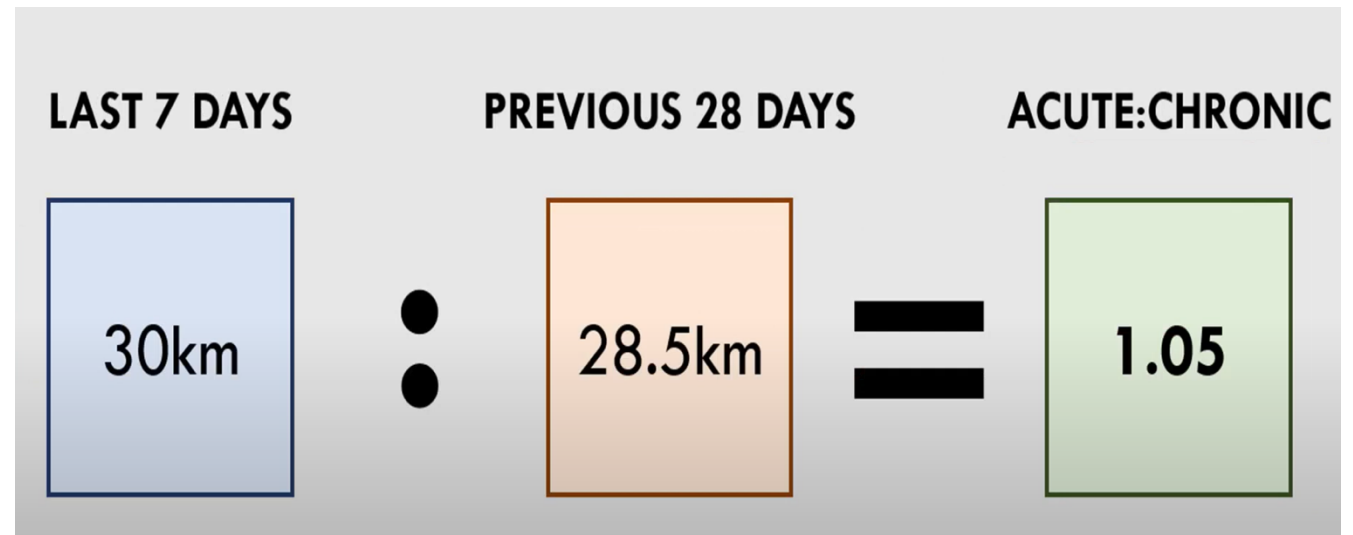
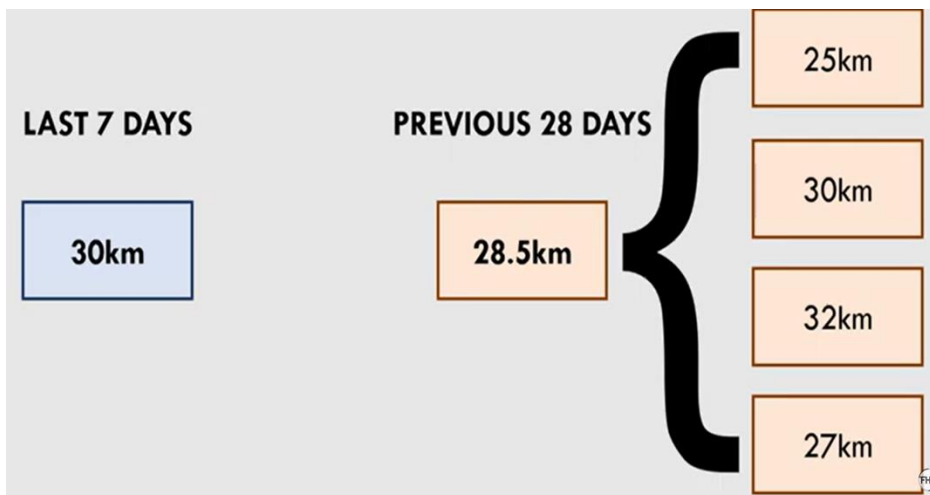
$$ACR = \frac{WL_{Acute}}{WL_{Chronic}}$$



Load monitoring: training and recovery

Acute:Chronic Workload Ratio

$$ACR = \frac{WL_{Acute}}{WL_{Chronic}}$$



Load monitoring: training and recovery

Acute to chronic workload ratio ACWR									
Weeks		Mon	Tue	Wed	Thu	Fri	Sat	Sun	AWL
1	Plan	Rest	Easy run	Cross train	Speed run	Easy run	Easy run	Long run	
	Duration in mins	0	60	45	60	60	60	120	
	RPE	0	4	5	8	4	4	7	
	Load = (RPE x mins)	0	240	225	480	240	240	840	2265
2	Plan	Rest	Easy run	Cross train	Speed run	Easy run	Easy run	Long run	
	Duration in mins	0	60	45	60	60	60	150	
	RPE	0	4	6	6	4	4	8	
	Load = (RPE x mins)	0	240	270	360	240	240	1200	2550

Manipulation of training load

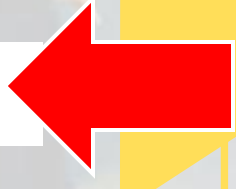
PREPARATION



TRAINING APPLICATION



ATHLETES RESPONSE



INTERPRETATION/ADJUST



Registration



Increase performance, minimize risk of injury

Commercial Platforms

Risk advisor (injury): based on players training variables



KITMAN LABS



LOAD CONTROL



ACTIMET

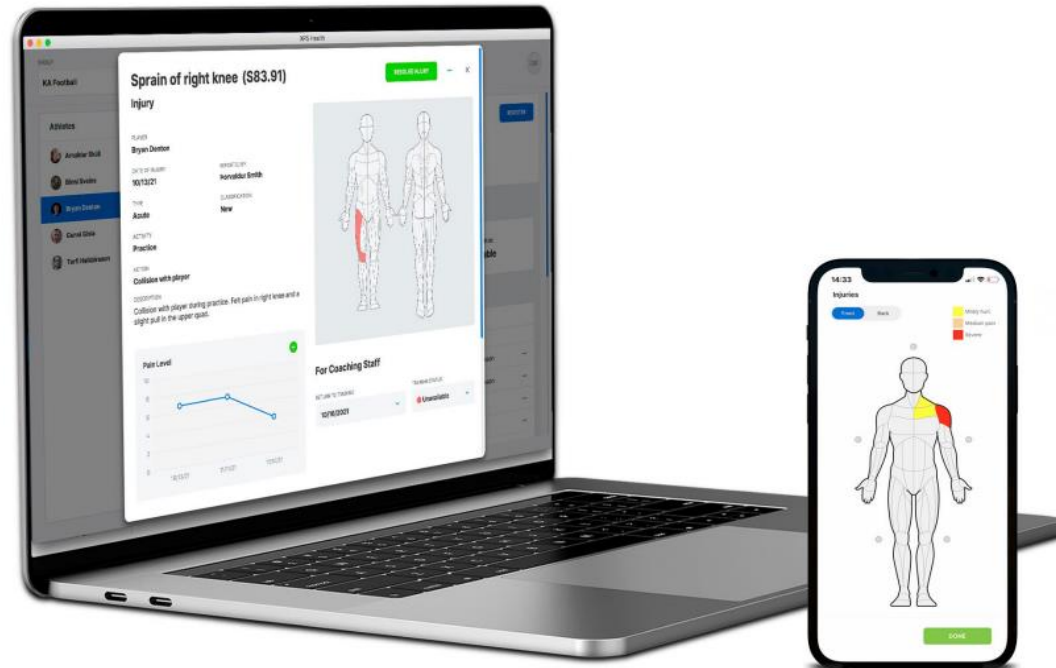
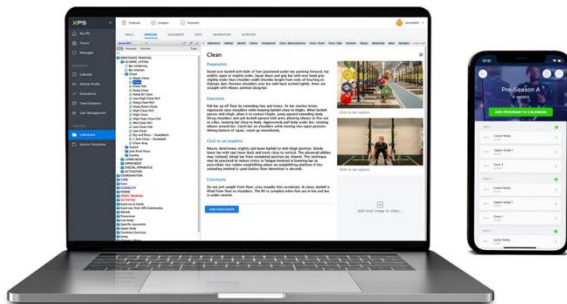
Commercial Platforms

XPS network

Complete software solution for
clubs, coaches and athletes.

Strength & Conditioning

Video library with thousands of exercises.
Get instant feedback on your athlete's progress.



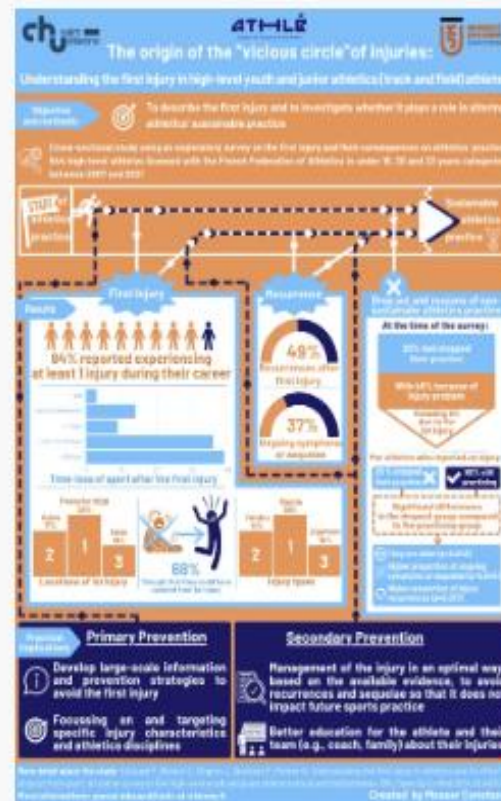
More about injury prevention?

British Journal of
Sports Medicine

Blog | British Journal of
Sports Medicine



BJSM Podcast



The origin of the "vicious circle" of injuries in athletics (track and field)

Posted on April 8, 2024 by jenduncan

Keywords: Injury; epidemiology; injury prevention; injury risk factors; youth; growing. This blog summarises a recently published study to better understand the primary injury in athletes and investigate if it plays a role in their performance and career (1). The main findings of this study are displayed in the attached infographic and portray the main findings [...]

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THANK
YOU



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