The TRAINING ROOM
Sports & Orthopaedic Physical Therapy
Part of the Ivy Rehab Network

Allostatic Load and Precision Medicine in Sports Injuries

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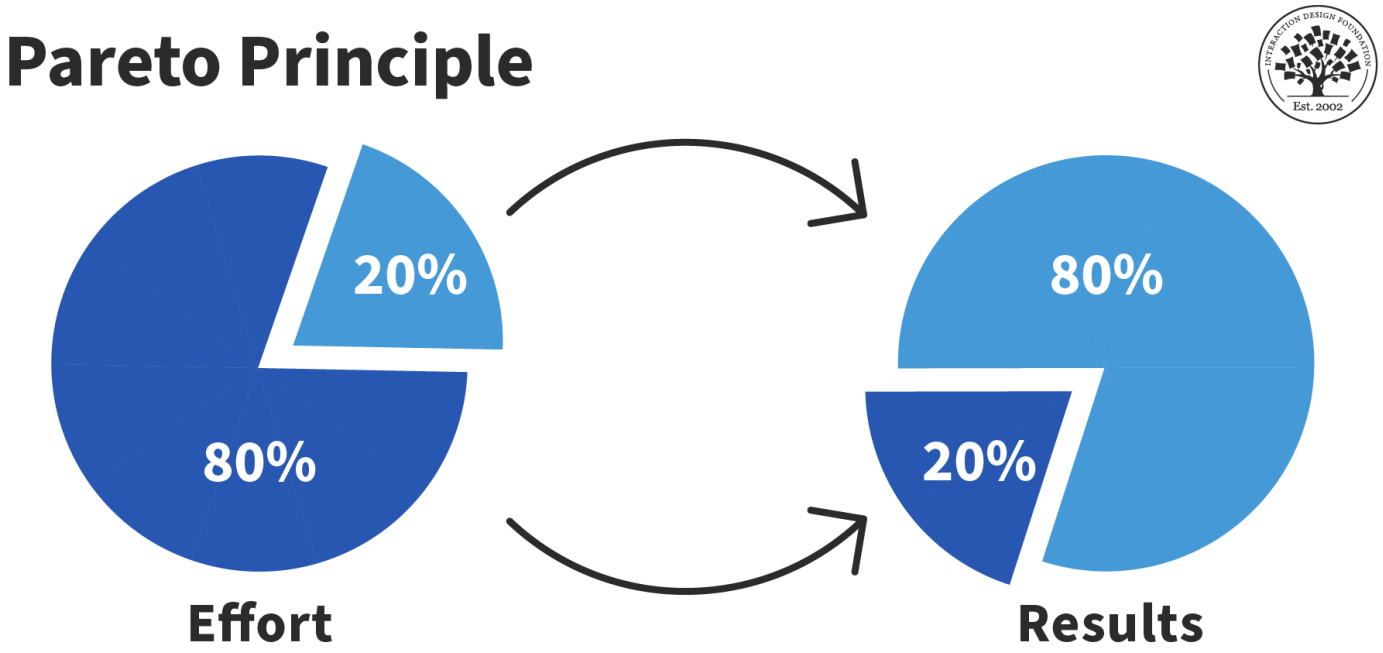
Disclosures…none!

We (Tom, Steve, or The Training Room) have **NO** financial disclosure or conflicts of interest with the material contained in this presentation

Objectives

- Identify the physical, psychological (cognitive, emotional, behavioral, and social), sleep, and diet domains within our patients
- Recognize how each domain can potentially influence our patients' treatment
- Apply appropriate screening tools for each domain suggested within the presentation
- Determine the need to consult with healthcare providers outside our scopes of practice
- Assess the impact of a given domain with tools suggested within the presentation
- Establish best practices/protocols within these domains in our current practice

Introduction...this isn't about the 80%



Precision Medicine

- Optimizing interventions with regards to a patient's unique…
  - Anatomy (ligament laxity, adverse neural tension, positional faults, etc.)
  - Environment (training, field conditions, expectations, etc.)
  - Lifestyle (allostatic load)
- Even in individuals with a high (anatomic) predisposition to (injury), favorable environment and lifestyle factors can lead to substantial reductions in risk
- Focus on factors that optimize patient participation and adherence to healthy athletic behaviors

Severin R, Sabbahi A, Arena R, Phillips SA. Precision Medicine and Physical Therapy: A Healthy Living Medicine Approach for the Next Century. Physical Therapy. 2022; 102(1): 1-9. https://doi.org/10.1093/ptj/pzab253

Allostatic load

- McEwen and Stellar in 1993 introduced the concept of allostatic load as the cost of chronic exposure to fluctuation or heightened neural and neuroendochrine responses resulting from repeated or chronic environmental challenges that an individual reacts to as being particularly stressful.
    - Deriving from the definition of allostasis as the ability of the organism to achieve stability through change, and the view that healthy functioning requires continual adjustments of the internal physiological milieu
- "In life, people face multiple interacting stressors from which they must protect themselves or adapt to a stressor may be “a physical or psychological threat to safety, status, or wellbeing; physical or psychological demands that exceed available resources; an unpredictable change in environment; or an inconsistency between expectations and outcomes.”

  - Rabey and Maloney
- “Allostatic load refers to the cumulative burden of chronic stress and life events. It involves the interaction of different physiological systems at varying degrees of activity. When environmental challenges exceed the individual ability to cope, then allostatic overload ensures.”

  - Guidi et al

McEwen BS, Stellar E. Stress and the Individual: Mechanisms Leading to Disease. *Arch Intern Med.* 1993;153(18):2093–2101. doi:10.1001/archinte.1993.00410180039004

Martin Rabey, Niamh Moloney, “I Don’t Know Why I’ve Got this Pain!” Allostasis as a Possible Explanatory Model, Physical Therapy, Volume 102, Issue 5, May 2022, pzac017, https://doi.org/10.1093/ptj/pzac017

Guidi, Jenny, et al. "Allostatic load and its impact on health: a systematic review." Psychotherapy and psychosomatics 90.1 (2020): 11-27, https://doi.org/10.1159/000510696

The overflowing coffee (stress) cup (capacity)

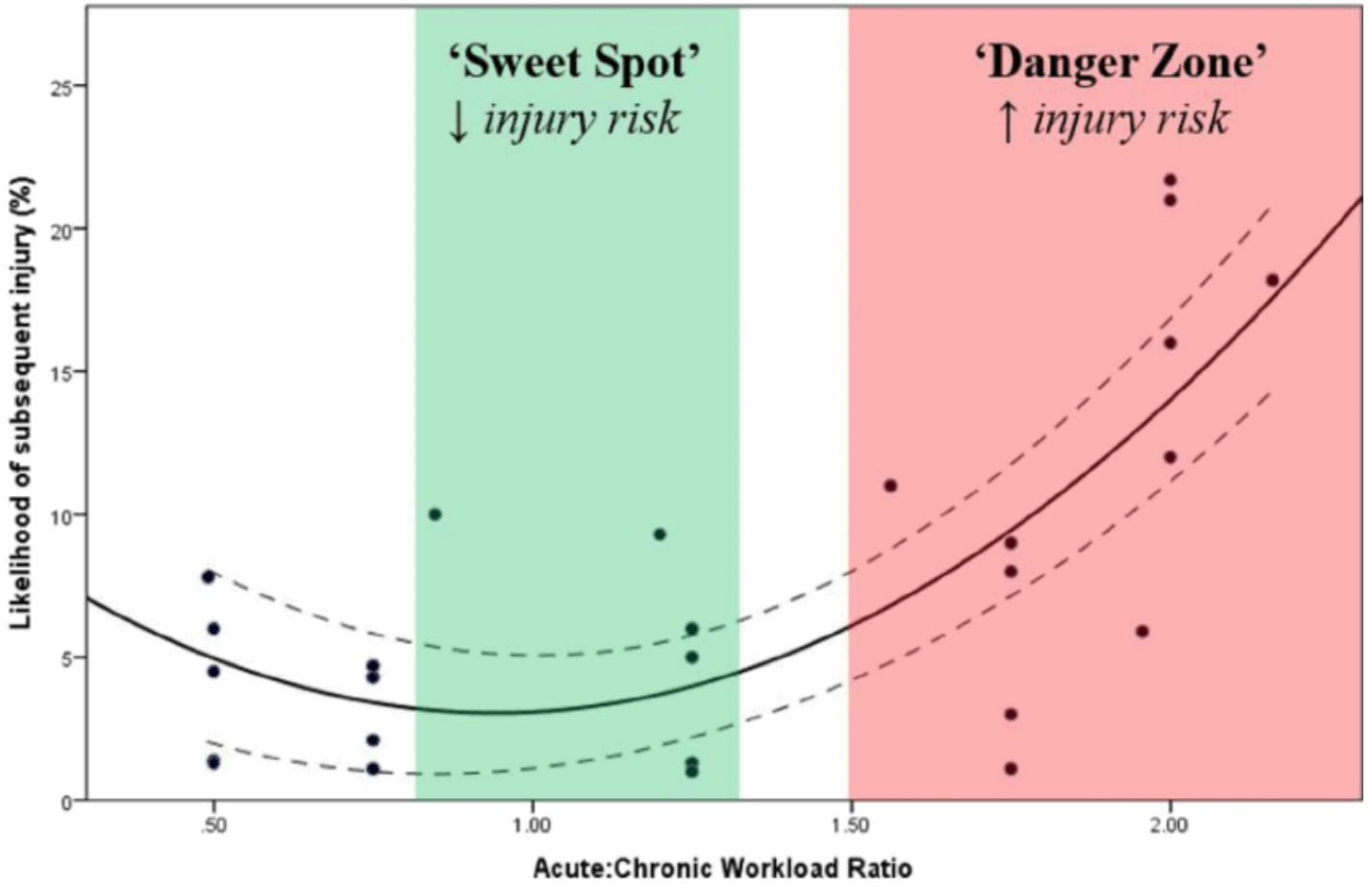
- Physical
- Psychological
- Sleep
- Diet

Short term goals: reduce the coffee in the cup

Long term goals: build a bigger cup

Physical domain: "how do you train?"

Players with a high chronic workload are more resistant to injury with moderate-low through moderate-high (0.85–1.35) acute:chronic workload ratios and less resistant to injury when subjected to ‘spikes’ in acute workload, that is, very-high acute:chronic workload ratios ~1.5



Hulin BT, Gabbett TJ, Lawson DW, et al
The acute:chronic workload ratio predicts injury: high chronic workload may decrease injury risk in elite rugby league players
British Journal of Sports Medicine 2016;50:231-236, https://doi.org/10.1136/bjsports-2015-094817

Psychological domain: sCEBS framework

"(Physical therapists) perform screening for musculoskeletal pain mainly through the use of somatic dimension of pain. Psychological and social dimensions of chronic pain were inadequately covered by (physical therapists). Furthermore, a substantial discrepancy between actual and self-estimated use of biopsychosocial history taking was noted. We strongly recommend full implementation of the SCEBS method in educational programs in physical therapy."

- Oostendorp et al

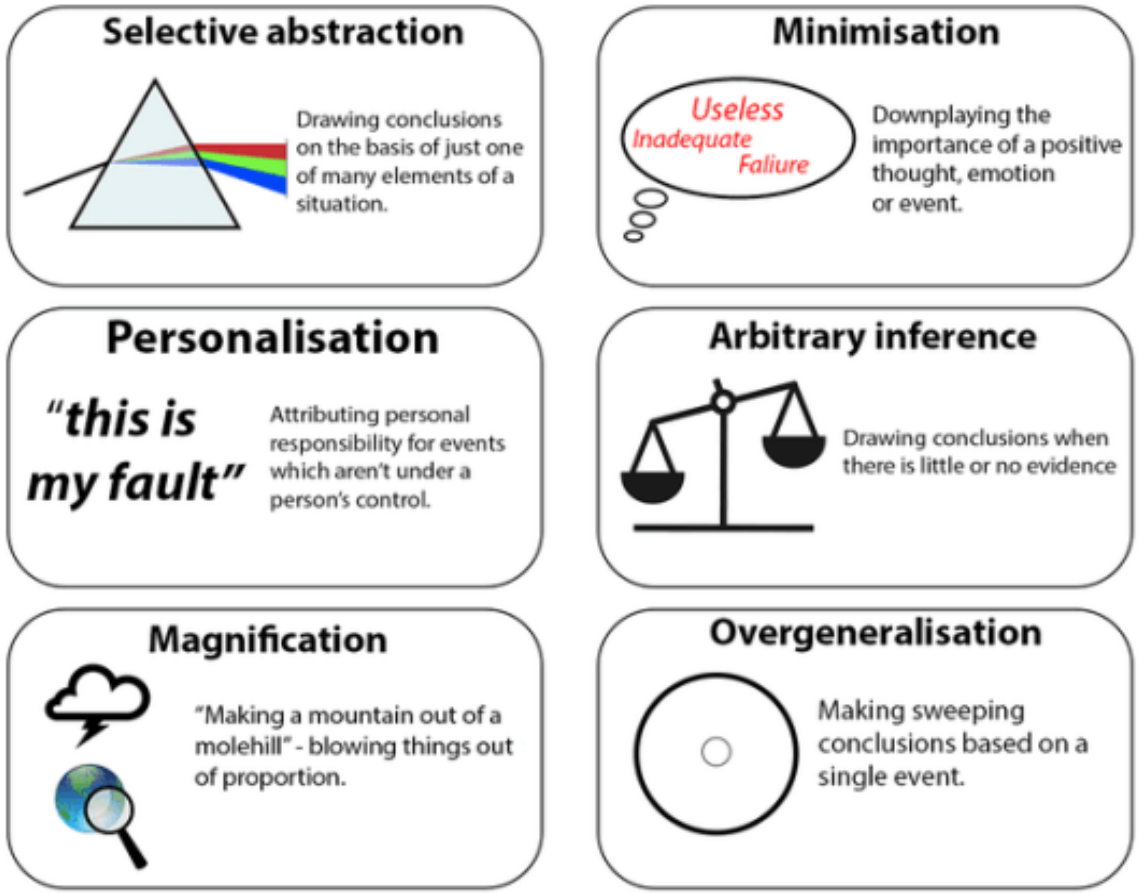
"A significant difference was identified for perceived knowledge…the 3 most commonly missed questions directly related to the 3 least practiced topics: social determinants of health, assessing environmental health factors, and assessing health-related quality of life."

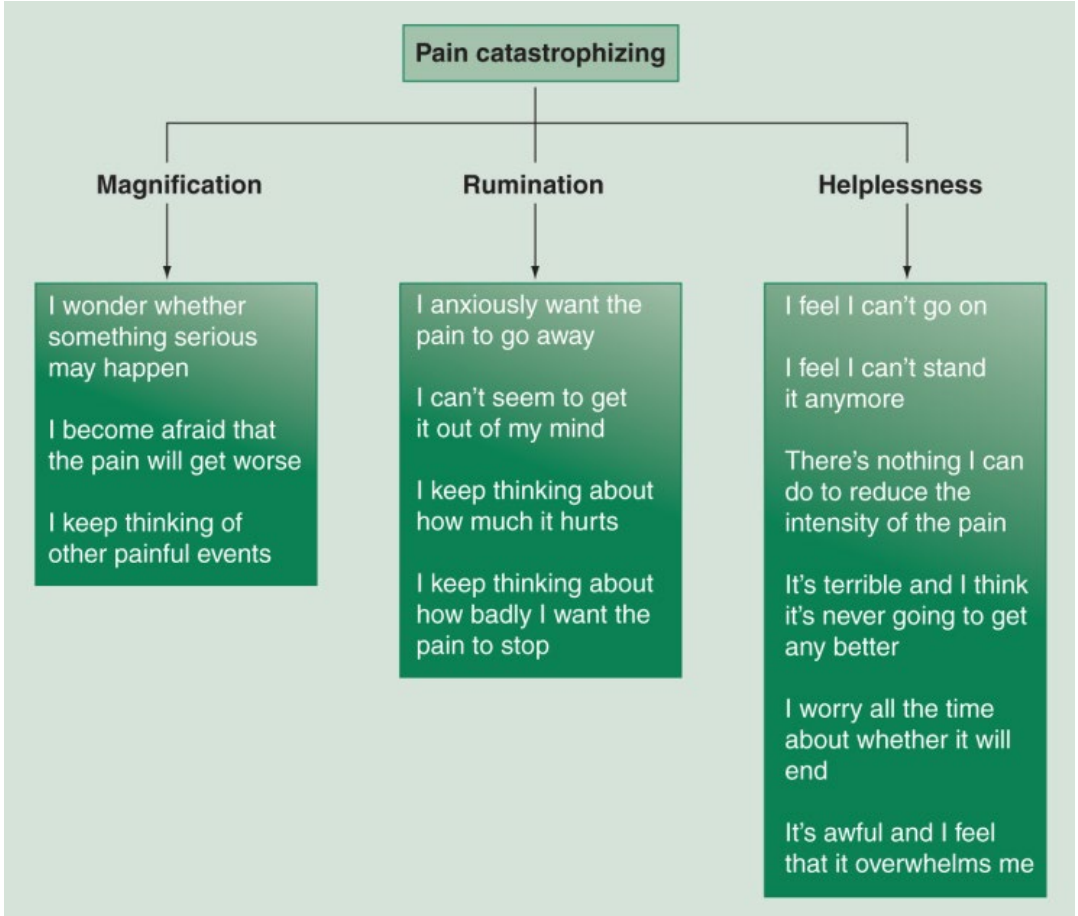
- Winkelmann et al

Oostendorp R, Elvers H, Mikołajewska E, Laekeman M, van Trijffel E, Samwel Han, Duquet W. Manual Physical Therapists' Use of Biopsychosocial History Taking in the Management of Patients with Back or Neck Pain in Clinical Practice. The Scientific World Journal. 2015; 2015(1): 1-8. https://doi.org/10.1155/2015/170463

Winkelmann ZK, Games KE, Rivera MJ, Neil ER, Eberman, LE. Athletic Trainers' Knowledge and Practice Application of Public Health Topics. Athletic Training Education Journal. 2020; 15(4): 308–320. https://doi.org/10.4085/1947-380X-19-047

Cognitive dimension: "what do you think?"



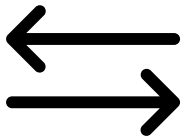


Quartana, Phillip J., Claudia M. Campbell, and Robert R. Edwards. "Pain catastrophizing: a critical review." *Expert review of neurotherapeutics* 9.5 (2009): 745-758. https://pmc.ncbi.nlm.nih.gov/articles/PMC2696024/

Emotional dimension: "how do you feel?"

Behavior dimension: "how do you act?"

Avoidance



Endurance

Social dimension: "who am I?"

I'm not a psychiatrist guys!!!

Resource: OSPRO-YF

- The OSPRO-YF is a concise yellow flag assessment tool that allows for accurate estimates of individual, full-length psychological questionnaire scores for depressive symptoms, anxiety, anger, fear-avoidance beliefs, kinesiophobia, catastrophizing, self-efficacy, and pain acceptance.
- It is designed with an interest in estimating multiple individual psychological questionnaire scores without burdening the patient by completing each full instrument.
- In addition to providing full-length questionnaire score estimates, the OSPRO-YF identifies the presence of yellow flags. A yellow flag is operationally defined as scores that fall in the top quartile for negative psychological questionnaires (e.g. PCS, FABQ, PHQ-9) or bottom quartile for positive psychological questionnaires (e.g. PSEQ, CPAQ and SER).
- The OSPRO-YF comes in 3 forms: 17-items, 10-items, and 7-items with a minimum 85%, 81%, and 75% accuracy, respectively, for identifying yellow flags.
- The OSPRO-YF informs treatment decision-making and facilitates treatment monitoring for patients determined to be at high risk for poor outcomes by existing risk-assessment tools.

https://www.orthopt.org/yf/

Lentz, Trevor A., et al. "Development of a yellow flag assessment tool for orthopaedic physical therapists: results from the optimal screening for prediction of referral and outcome (OSPRO) cohort." *journal of orthopaedic & sports physical therapy* 46.5 (2016): 327-343. https://www.jospt.org/doi/10.2519/jospt.2016.6487

Sleep domain: "how do you sleep?"

- Glucose sensitivity

  Ness, Kelly M., et al. "Two nights of recovery sleep restores the dynamic lipemic response, but not the reduction of insulin sensitivity, induced by five nights of sleep restriction." *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology* 316.6 (2019): R697-R703. https://doi.org/10.1152/ajpregu.00336.2018

- Inflammation & Pain

  Haack, Monika, Elsa Sanchez, and Janet M. Mullington. "Elevated inflammatory markers in response to prolonged sleep restriction are associated with increased pain experience in healthy volunteers." *Sleep* 30.9 (2007): 1145-1152. https://doi.org/10.1093/sleep/30.9.1145

- Mood

  Tomaso, Cara C., Anna B. Johnson, and Timothy D. Nelson. "The effect of sleep deprivation and restriction on mood, emotion, and emotion regulation: three meta-analyses in one." *Sleep* 44.6 (2021): zsaa289 https://doi.org/10.1093/sleep/zsaa289

- Concentration

  Smithies, Tim D., et al. "The effect of sleep restriction on cognitive performance in elite cognitive performers: a systematic review." *Sleep* 44.7 (2021): zsab008. https://doi.org/10.1093/sleep/zsab008

- Resource: Pittsburgh Sleep Quality Index (PSQI)

  Each component score of the PSQI ranges from 0 to 3, with 3 indicating the greatest dysfunction or disturbance. The seven component scores are then summed to obtain a global PSQI score, which ranges from 0 to 21. Higher scores indicate poorer sleep quality, with a score greater than 5 suggesting significant sleep difficulties

  Buysse,D.J., Reynolds,C.F., Monk,T.H., Berman,S.R., & Kupfer,D.J. (1989). The Pittsburgh Sleep Quality Index (PSQI): A new instrument for psychiatric research and practice. Psychiatry Research, 28(2), 193-213. https://doi.org/10.1016/0165-1781(89)90047-4

Nutrition domain: "what do you eat?"

- Inflammation

  Mitali S Mukherjee, Chad Y Han, Shawgi Sukumaran, Christopher L Delaney, Michelle D Miller, Effect of anti-inflammatory diets on inflammation markers in adult human populations: a systematic review of randomized controlled trials, *Nutrition Reviews*, Volume 81, Issue 1, January 2023, Pages 55–74, https://doi.org/10.1093/nutrit/nuac045

- Pain

  Rowena Field, Fereshteh Pourkazemi, Jessica Turton, Kieron Rooney, Dietary Interventions Are Beneficial for Patients with Chronic Pain: A Systematic Review with Meta-Analysis, *Pain Medicine*, Volume 22, Issue 3, March 2021, Pages 694–714, https://doi.org/10.1093/pm/pnaa378

- Mood & Energy Levels

  Breymeyer, Kara L., et al. "Subjective mood and energy levels of healthy weight and overweight/obese healthy adults on high-and low-glycemic load experimental diets." Appetite 107 (2016): 253-259. https://doi.org/10.1016/j.appet.2016.08.008

- Concentration

  Cohen JFW, Gorski MT, Gruber SA, Kurdziel LBF, Rimm EB. The effect of healthy dietary consumption on executive cognitive functioning in children and adolescents: a systematic review. British Journal of Nutrition. 2016;116(6):989-1000. https://doi.org/10.1017/S000711451600287

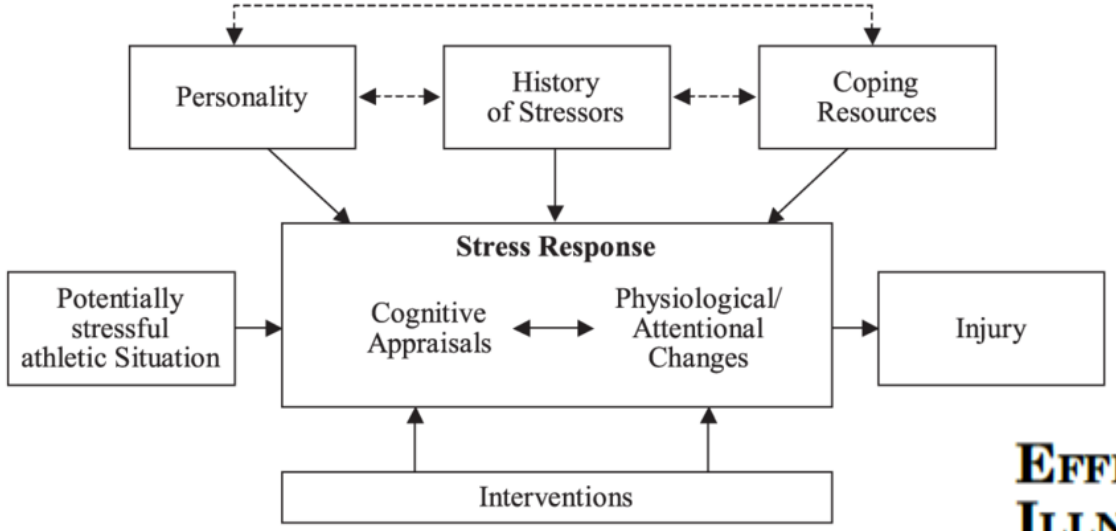
- Resource: Lifestyle Medicine Assessment (LMA)

  Frates, B.; Bonnet, J. P.; Joseph, R. y Peterson, J. A. The Lifestyle Medicine Handbook: An Introduction to the Power of Healthy Habits. 2.ª ed. Monterrey, California: Healthy Learning; 2020 y la AAFP (American Academy Family Physicians)

  https://www.aafp.org/dam/AAFP/documents/patient_care/lifestyle-medicine/windows-lifestyle-combined-instructions.xlsm

The student athlete and stress

- Psychoneuroimmunology – the study of interactions between behavioral, neural/ endocrine function, and immune processes



EFFECT OF PHYSICAL AND ACADEMIC STRESS ON ILLNESS AND INJURY IN DIVISION 1 COLLEGE FOOTBALL PLAYERS

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Departments of [1]Physical Therapy; [2]Athletic Performance; and [3]Health Psychology, University of Missouri, Columbia, Missouri

Effect of Physical and Academic Stress on Illness and Injury in Division 1 College Football Players

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- Stress response is a "bi-directional relationship between cognitive appraisals of the demands, consequences, and resources of the person and situation and physiological and attentional responses associated with stress"

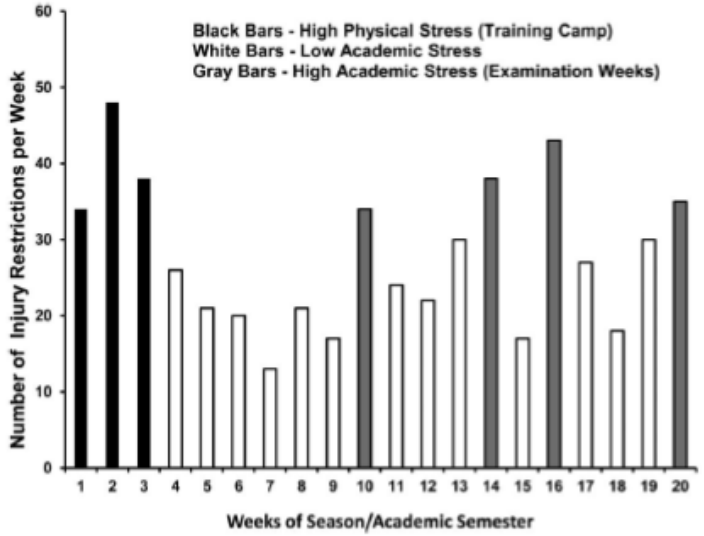


Figure 2. Number of weekly injury restrictions over 20-week athletic season/academic semester.

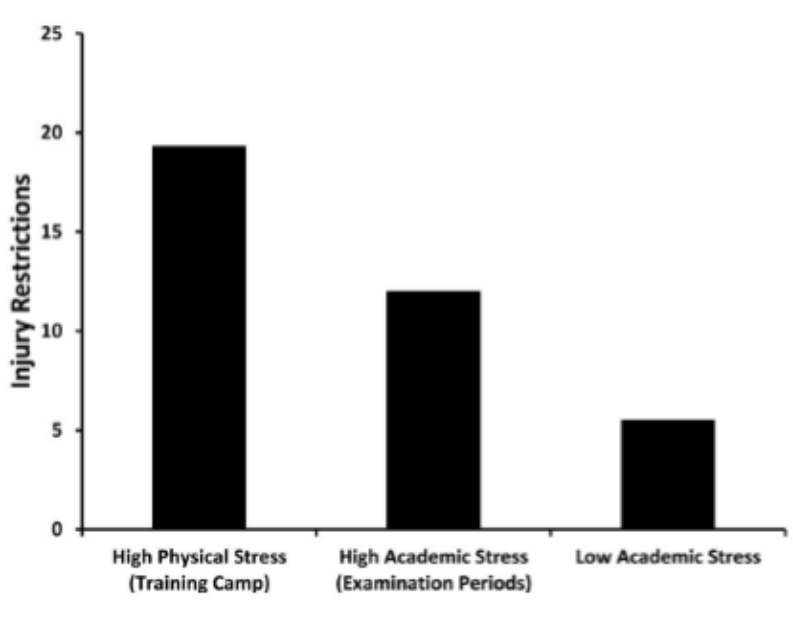


Figure 1. Proportion of injury restrictions (total number of injury restrictions/number of weeks) during physical stress (HPS, 3 weeks), high academic stress (HAS, 4 weeks), and low academic stress (LAS, 1

have happened more than once, indicate the *average* effect across all occurrences.

The events are listed in no particular order, and there are *no* right or wrong answers. Please respond to each event honestly as applies to you.

Note: After checking whether the event had taken place within the past year, respondents marked as follows: extremely negative = −4; negative = −3; moderately negative = −2; somewhat negative = −1; somewhat positive = +1; moderately positive = +2; positive = +3; extremely positive = +4.

1. Marriage
2. Death of mate (boyfriend, girlfriend, spouse, significant other)
3. Major change in sleeping habits (increase or decrease in amount of sleep)
4. Death of close family member(s)
   a. Father
   b. Mother
   c. Brother
   d. Sister
   e. Grandfather
   f. Grandmother
   g. Other
5. Major change in eating habits (increase or decrease in food intake)
6. Death of close friend(s)
7. Outstanding personal achievement
8. Male: mate pregnant
9. Female: becoming pregnant
10. Sexual difficulties
11. Being fired from job
12. Being apart from mate (boy/girlfriend, spouse, etc) due to sport
13. Serious illness or injury of close family member(s)
    a. Father
    b. Mother
    c. Brother
    d. Sister
    e. Grandfather
    f. Grandmother
    g. Other
14. Major change in the number (more or less) of arguments with mate
15. Major personal injury or illness
16. Major change in the frequency (increased or decreased) of social activities due to participation in sport
17. Serious injury or illness of close friend
18. Breaking up with mate (boy/girlfriend, etc)
19. Beginning a new school experience (beginning college, transferring colleges, etc)
20. Engagement
21. Academic probation/ineligibility
22. Being dismissed from dorm or other residence
23. Failing an important exam
24. Major change in relationship with coach (better or worse)
25. Failing a course
26. Major change in the length and/or conditions of practice/training (better or worse)
27. Financial problems concerning school
28. Major change in relationship with family member(s) (better or worse)
29. Conflict with roommate
30. Male: mate having an abortion
31. Female: having an abortion
32. Major change in the amount (more or less) of academic activity (homework, class time, etc)
33. Pressure to gain/lose weight—due to participation in sport
34. Discrimination from teammates/ coaches
35. Major change in relationship(s) with teammate(s) (better or worse)
36. Suspended from team for nonacademic reasons
37. Trouble with academic counselor
38. Major change in use of alcohol/ drugs (increased or decreased)
39. Beginning sexual activity
40. Major change in relationship(s) with friend(s) (better or worse)
41. Recovery from illness/injury/ operation
42. Major change in level of athletic performance in actual competition (better or worse)
43. Divorce or separation of your parents
44. Major change in level of responsibility on team (increased or decreased)
45. Receiving an athletic scholarship
46. Not attaining personal goals in sport
47. Major change in playing status on team
48. Injury to teammates
49. Being absent from school (classes) because of participation in sport
50. Troubles with athletic association and/or athletic director
51. Difficulties with trainer/physician
52. Major change in playing time (playing more or less)—due to injury
53. Major errors/mistakes in actual competition
54. Losing your athletic scholarship
55. No recognition/praise of accomplishments from coaching staff
56. Pressure from family to perform well
57. Loss of confidence due to injury
58. Unable to find a job
59. Change in coaching staff
60. Female: menstrual period/PMS
61. Major change in level of academic performance (doing better or worse)
62. Making career decisions (applying to graduate school, interviewing for jobs, etc)
63. Being cut/dropped from the team
64. Continual poor performance of team
65. Change in graduation schedule
66. Major change in family finances (increased or decreased)
67. Major change in attitude toward sport (like/enjoy more or less)
68. Victim of harassment/abuse (sexual, emotional, physical)
69. Victim of personal attack (rape, robbery, assault, etc)

Other events might have occurred to you in the past year (and affected you in a positive or negative manner) but were not included in this list. If there were such events, please list them below.

70. _____
71. _____
72. _____
73. _____
74. _____

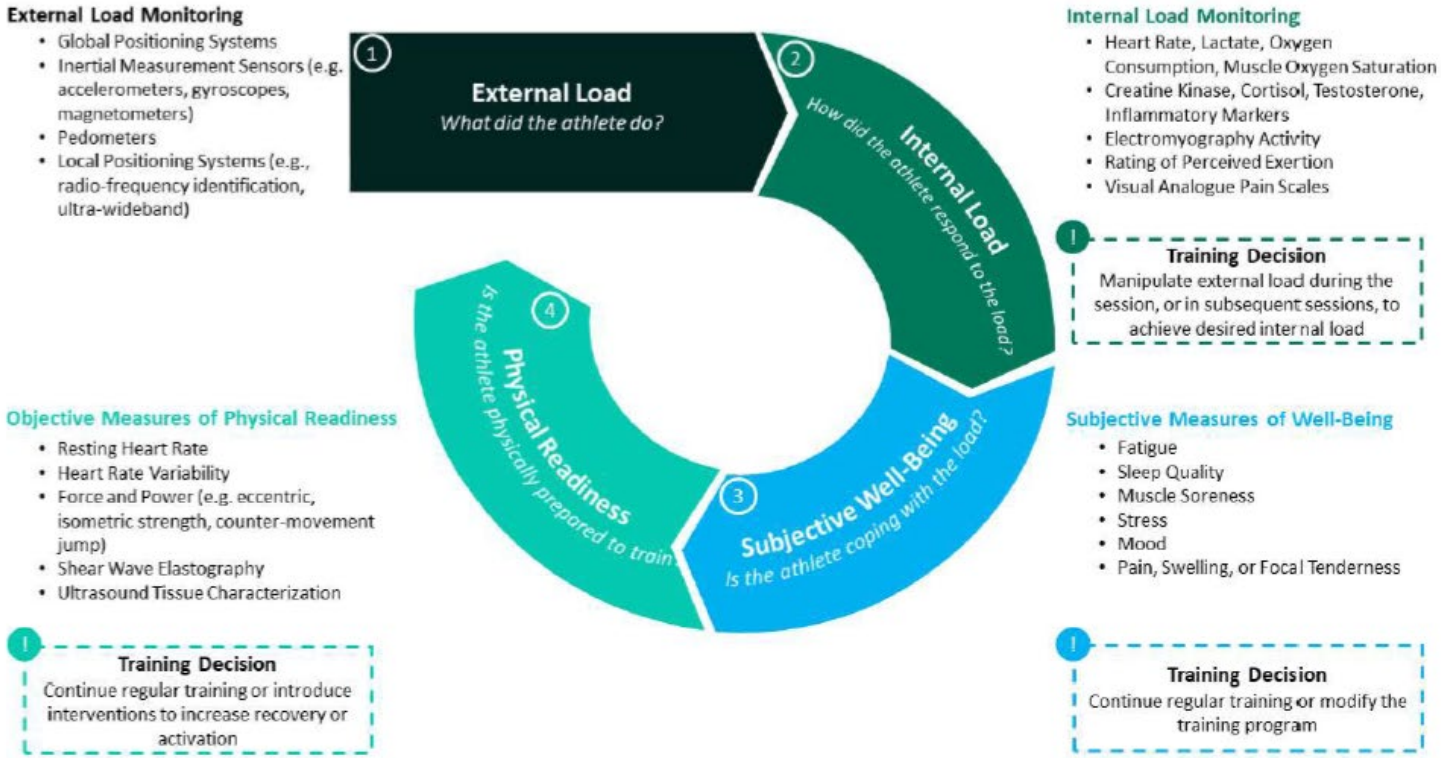
NOTE

For reprints or further details, write Trent A. Petrie, PhD, Department of Psychology, PO Box 13587, University of North Texas, Denton, TX 76203-3587.

REFERENCES

1. Bramwell ST, Masuda M, Wagner NN, Holmes TH. Psychosocial factors in athletic injuries: Development and application of the Social and Athletic Readjustment Rating Scale (SARRS). *J Human Stress.* 1975;1:52–58.
2. Cryan PD, Alles WF. The relationship between stress and college football injuries. *J Sports Med.* 1983;23:52–58.

Fig. 2

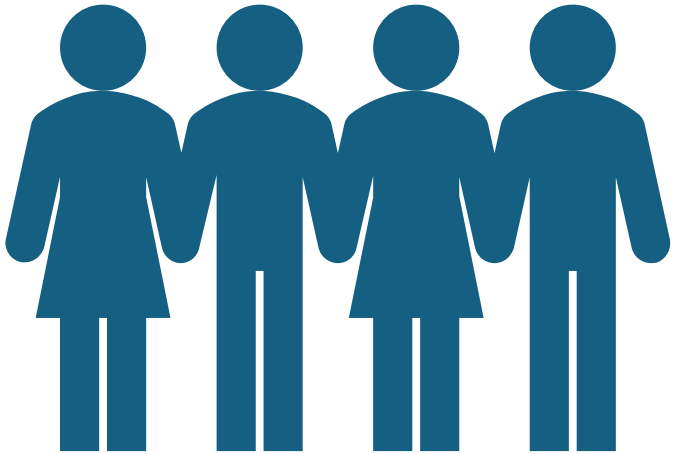

External Load Monitoring
Global Positioning Systems
Inertial Measurement Sensors (e.g. accelerometers, gyroscopes, magnetometers)
Pedometers
Local Positioning Systems (e.g., radio-frequency identification, ultra-wideband)
1
External Load
What did the athlete do?
2
Internal Load
How did the athlete respond to the load?
Internal Load Monitoring
Heart Rate, Lactate, Oxygen Consumption, Muscle Oxygen Saturation
Creatine Kinase, Cortisol, Testosterone, Inflammatory Markers
Electromyography Activity
Rating of Perceived Exertion
Visual Analogue Pain Scales
Training Decision
Manipulate external load during the session, or in subsequent sessions, to achieve desired internal load
3
Subjective Well-Being
Is the athlete coping with the load?
Subjective Measures of Well-Being
Fatigue
Sleep Quality
Muscle Soreness
Stress
Mood
Pain, Swelling, or Focal Tenderness
Training Decision
Continue regular training or modify the training program
4
Physical Readiness
Is the athlete physically prepared to train?
Objective Measures of Physical Readiness
Resting Heart Rate
Heart Rate Variability
Force and Power (e.g. eccentric, isometric strength, counter-movement jump)
Shear Wave Elastography
Ultrasound Tissue Characterization
Training Decision
Continue regular training or introduce interventions to increase recovery or activation

Treat the individual

- How can a busy training room treat everyone as an individual?
    - Control the controllables
    - Educate on possible factors influencing their pathology
    - Create a culture of individual accountability
    - Involve a team
    - Articulate a vision and plan backwards

Creating a team approach to rehab

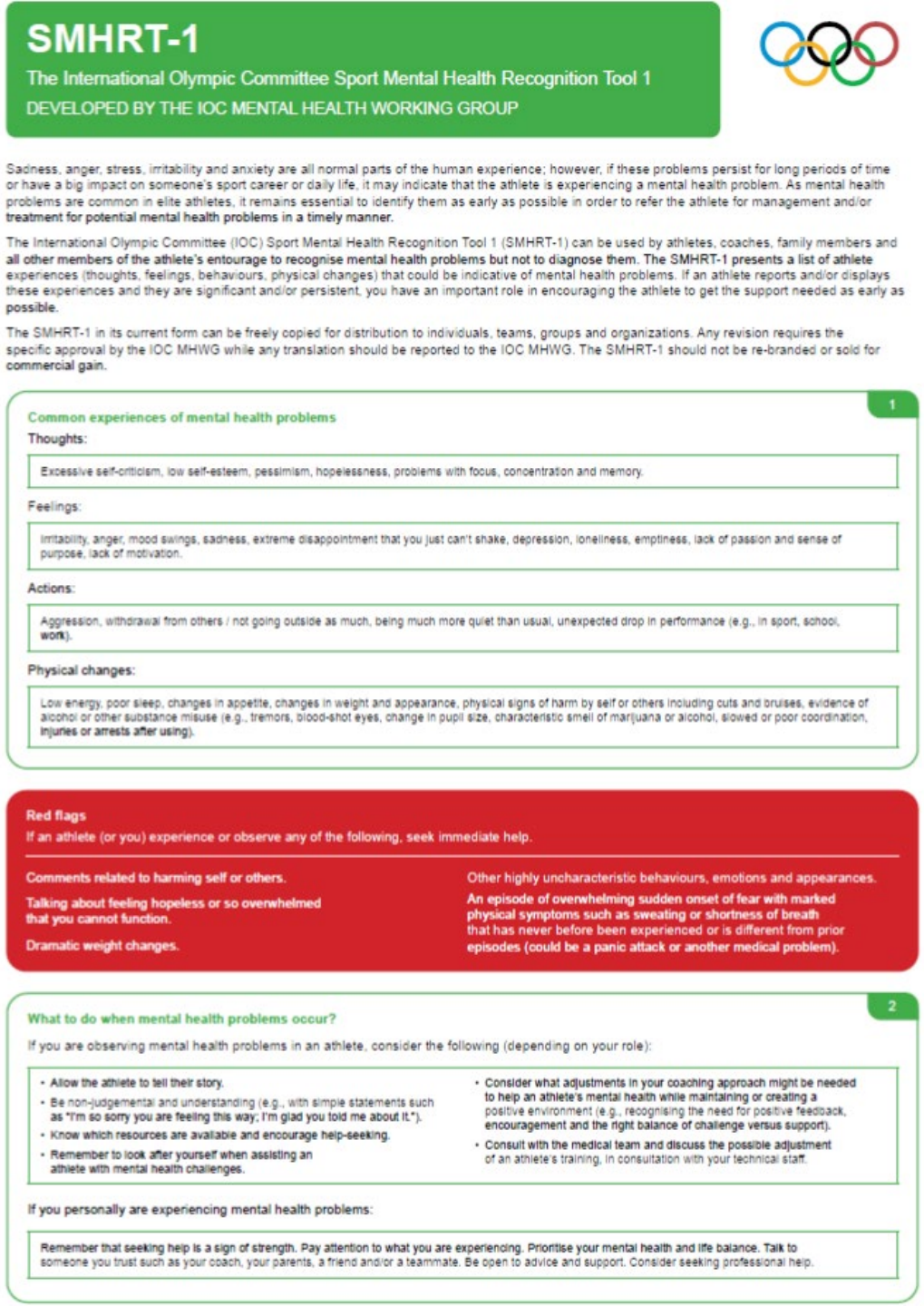
- Characteristics of an effective healthcare team
  - Common purpose
  - Measurable goals
  - Effective leadership
  - Effective communication
  - Good cohesion
  - Mutual respect



Mickan SM, Rodger SA. Effective health care teams: a model of six characteristics developed from shared perceptions. Journal of Interprofessional Care, 2005, 19(4):358– 370.

SMHRT-1

- Mental health recognition tool developed by the International Olympic Committee



SMHRT-1

The International Olympic Committee Sport Mental Health Recognition Tool 1

DEVELOPED BY THE IOC MENTAL HEALTH WORKING GROUP

Sadness, anger, stress, irritability and anxiety are all normal parts of the human experience; however, if these problems persist for long periods of time or have a big impact on someone's sport career or daily life, it may indicate that the athlete is experiencing a mental health problem. As mental health problems are common in elite athletes, it remains essential to identify them as early as possible in order to refer the athlete for management and/or treatment for potential mental health problems in a timely manner.

The International Olympic Committee (IOC) Sport Mental Health Recognition Tool 1 (SMHRT-1) can be used by athletes, coaches, family members and all other members of the athlete's entourage to recognise mental health problems but not to diagnose them. The SMHRT-1 presents a list of athlete experiences (thoughts, feelings, behaviours, physical changes) that could be indicative of mental health problems. If an athlete reports and/or displays these experiences and they are significant and/or persistent, you have an important role in encouraging the athlete to get the support needed as early as possible.

The SMHRT-1 in its current form can be freely copied for distribution to individuals, teams, groups and organizations. Any revision requires the specific approval by the IOC MHWG while any translation should be reported to the IOC MHWG. The SMHRT-1 should not be re-branded or sold for commercial gain.

1

Common experiences of mental health problems

Thoughts:

Excessive self-criticism, low self-esteem, pessimism, hopelessness, problems with focus, concentration and memory.

Feelings:

Irritability, anger, mood swings, sadness, extreme disappointment that you just can't shake, depression, loneliness, emptiness, lack of passion and sense of purpose, lack of motivation.

Actions:

Aggression, withdrawal from others / not going outside as much, being much more quiet than usual, unexpected drop in performance (e.g., in sport, school, work).

Physical changes:

Low energy, poor sleep, changes in appetite, changes in weight and appearance, physical signs of harm by self or others including cuts and bruises, evidence of alcohol or other substance misuse (e.g., tremors, blood-shot eyes, change in pupil size, characteristic smell of marijuana or alcohol, slowed or poor coordination, injuries or arrests after using).

Red flags

If an athlete (or you) experience or observe any of the following, seek immediate help.

- Comments related to harming self or others.
- Talking about feeling hopeless or so overwhelmed that you cannot function.
- Dramatic weight changes.
- Other highly uncharacteristic behaviours, emotions and appearances.
- An episode of overwhelming sudden onset of fear with marked physical symptoms such as sweating or shortness of breath that has never before been experienced or is different from prior episodes (could be a panic attack or another medical problem).

2

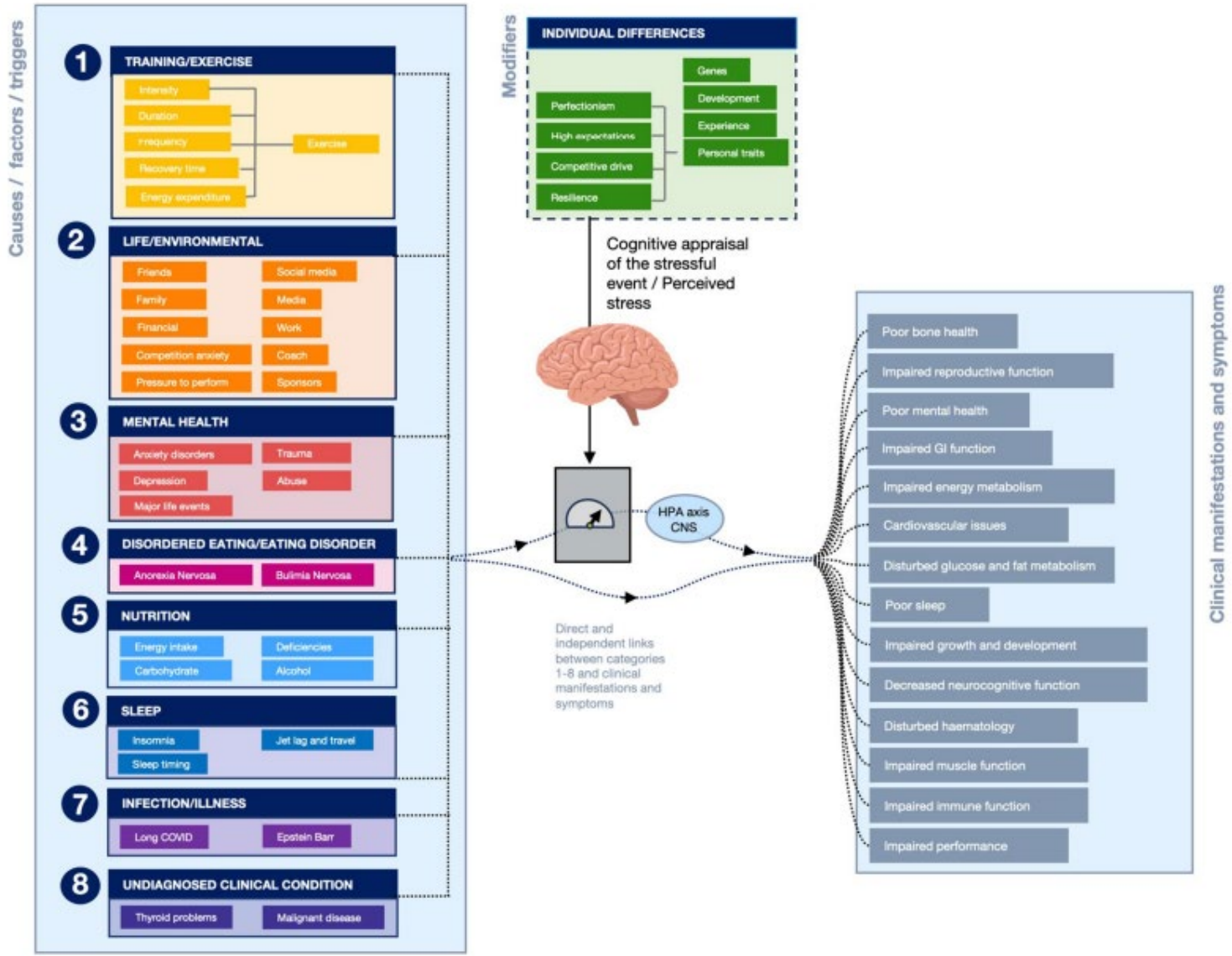
What to do when mental health problems occur?

If you are observing mental health problems in an athlete, consider the following (depending on your role):

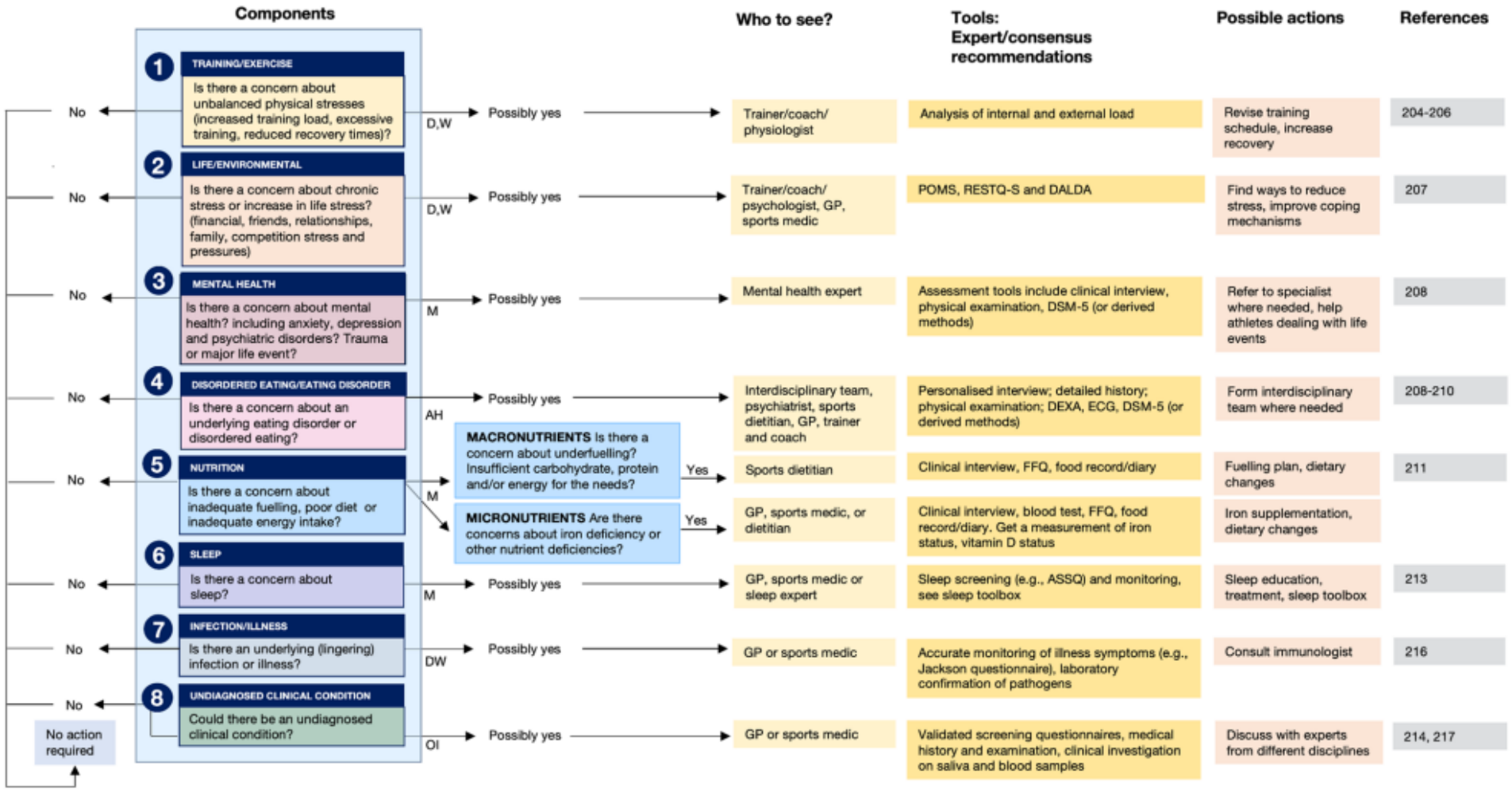
- Allow the athlete to tell their story.
- Be non-judgemental and understanding (e.g., with simple statements such as "I'm so sorry you are feeling this way; I'm glad you told me about it.").
- Know which resources are available and encourage help-seeking.
- Remember to look after yourself when assisting an athlete with mental health challenges.
- Consider what adjustments in your coaching approach might be needed to help an athlete's mental health while maintaining or creating a positive environment (e.g., recognising the need for positive feedback, encouragement and the right balance of challenge versus support).
- Consult with the medical team and discuss the possible adjustment of an athlete's training, in consultation with your technical staff.

If you personally are experiencing mental health problems:

Remember that seeking help is a sign of strength. Pay attention to what you are experiencing. Prioritise your mental health and life balance. Talk to someone you trust such as your coach, your parents, a friend and/or a teammate. Be open to advice and support. Consider seeking professional help.


Causes / factors / triggers
1
TRAINING/EXERCISE
Intensity
Duration
Frequency
Recovery time
Energy expenditure
Exercise
2
LIFE/ENVIRONMENTAL
Friends
Family
Financial
Competition anxiety
Pressure to perform
Social media
Media
Work
Coach
Sponsors
3
MENTAL HEALTH
Anxiety disorders
Depression
Major life events
Trauma
Abuse
4
DISORDERED EATING/EATING DISORDER
Anorexia Nervosa
Bulimia Nervosa
5
NUTRITION
Energy intake
Carbohydrate
Deficiencies
Alcohol
6
SLEEP
Insomnia
Sleep timing
Jet lag and travel
7
INFECTION/ILLNESS
Long COVID
Epstein Barr
8
UNDIAGNOSED CLINICAL CONDITION
Thyroid problems
Malignant disease
Modifiers
INDIVIDUAL DIFFERENCES
Perfectionism
High expectations
Competitive drive
Resilience
Genes
Development
Experience
Personal traits
Cognitive appraisal of the stressful event / Perceived stress
HPA axis CNS
Direct and independent links between categories 1-8 and clinical manifestations and symptoms
Clinical manifestations and symptoms
Poor bone health
Impaired reproductive function
Poor mental health
Impaired GI function
Impaired energy metabolism
Cardiovascular issues
Disturbed glucose and fat metabolism
Poor sleep
Impaired growth and development
Decreased neurocognitive function
Disturbed haematology
Impaired muscle function
Impaired immune function
Impaired performance

Athlete Health and Readiness Checklist



Closing thoughts

- Educate and empower
- Utilize your resources
- Be a good teammate
- Small steps repeated, add up to large distances
- “It’s the little details that are vital. Little things make big things happen.” – John Wooden

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