



@physicaltherapyresearch

RAPID RESEARCH

November 2022

Inside This Week: Over-Training Syndrome in Athletes

- ✓ Hormonal Aspects of Over-Training Syndrome
- ✓ Utility of Blood Markers to Determine Over-Reaching (8 year study)
- ✓ Diagnosing Over-Training Syndrome



HORMONAL ASPECTS OF OVER-TRAINING SYNDROME

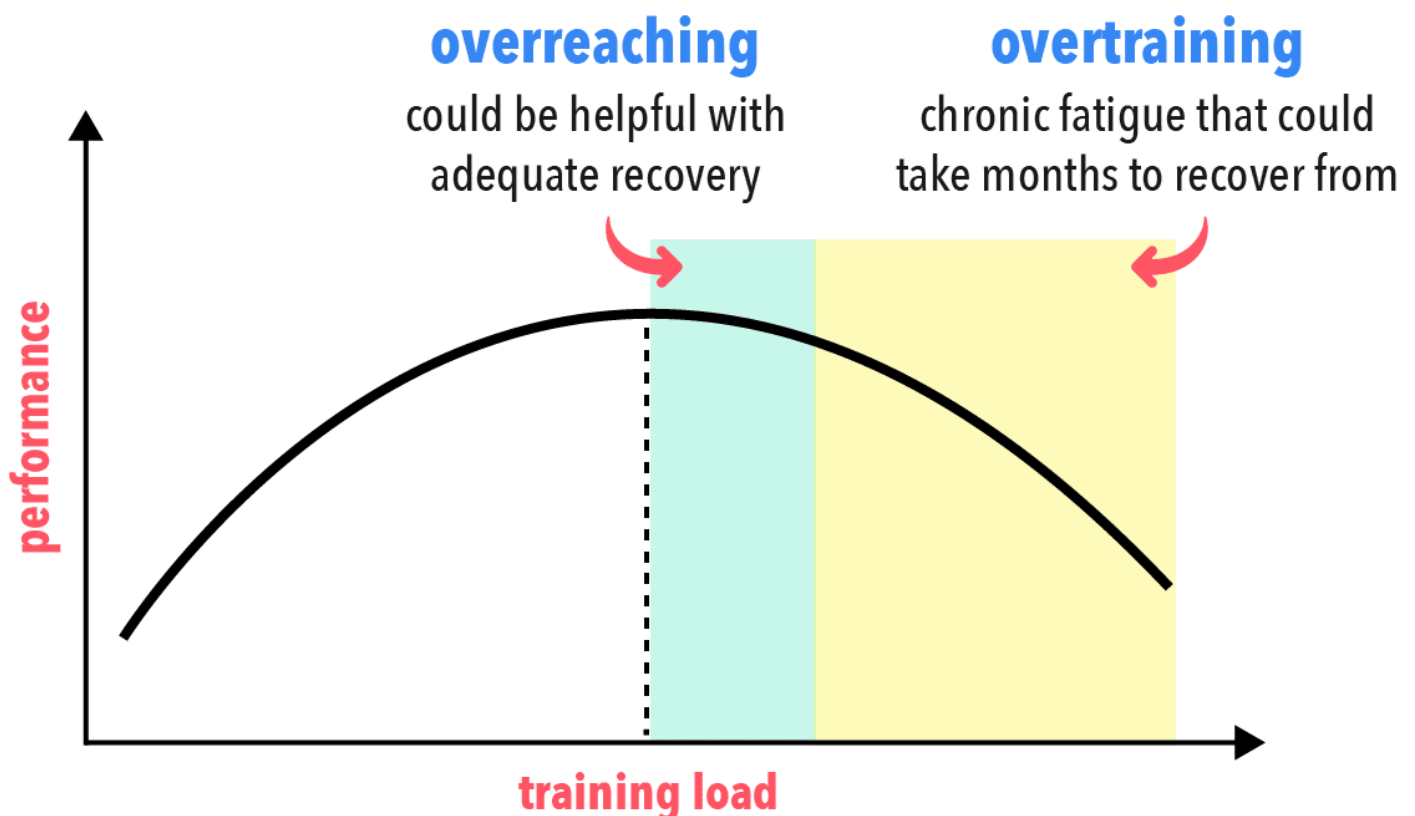
NOVEMBER 2022

[Click for Full Text \(Cadegiani and Kater 2017\)](#)

JBIR 9/11 [81%]



This systematic review determined the most accurate hormonal markers to predict over-training syndrome (OTS), Functional & Non-functional Over-reaching (FOR/NFOR).



KEY FINDINGS

38 studies included, totaling 569 athletes

Basal levels of hormones were mostly normal in athletes with OTS/FOR/NFOR compared with healthy athletes.

Distinctly, stimulation tests, mainly performed in maximal exercise conditions, showed blunted Growth Hormone (GH) & Adrenocorticotrophic hormone (ACTH) responses in OTS/FOR/NFOR athletes.

Cortisol and plasma catecholamines showed conflicting findings and the other hormones responded normally.

14/16 hormones (87.5%) were mostly normal in FOR-induced athletes.

5/12 hormones (41.7%) disclosed mostly normal levels and responses when OTS-affected athletes were analyzed.

MAIN TAKEAWAYS

Acute hormone responses to stimulation tests, such as ACTH and GH, tend to be blunted in OTS/ NFOR/FOR.

Cortisol and plasma catecholamines presented conflicting results.

The dysfunctional responses may demonstrate a relative failure of the hormonal axis.

Basal and resting parameters do not seem to play an accurate tool for OTS/NFOR/FOR diagnosis.

[Click for Full Text](#)
([Tian et al. 2015](#))

UTILITY OF BLOOD MARKERS TO DETERMINE OVER-REACHING

JBIR 10/10 [100%]



This 8-year longitudinal case series determined the incidence of functional overreaching (FOR), nonfunctional overreaching (NFOR), and overtraining syndrome to explore the utility of blood markers for the early detection of overreaching.

Acute Fatigue



- Fatigue
- Soreness
- Slight decrease in mood states
- No change in performance
- 1-2 days to recover
- Should supercompensate

FOR/NFOR



- DECREASE IN PERFORMANCE
- Decrease in max and submax HR
- VERY GRUMPY
- Decrease in lactic acid production
- 1-4 weeks to recover
- Maybe supercompensate?

OTS



- Prolonged maladaptation of several biological, neurochemical and hormonal mechanisms
- May present as chronic fatigue syndrome
- Months-years to recover
- End of career?

KEY FINDINGS

Over an 8-year period, 114 wrestlers were monitored

Main Outcome Measure(s):

Creatine kinase, hemoglobin, testosterone, and cortisol

Incidence:

[FOR] 13 (3.6%) | [NFOR] 23 (6.4%) | [OTS] 2 (0.6%)

Diagnostic Sensitivity:

[FOR] Creatine kinase 38%, Hemoglobin 15%, Testosterone 45%, Cortisol 18%

[NFOR] Creatine kinase 29%, Hemoglobin 33%, Testosterone 26%, Cortisol 35%

Diagnostic Specificity:

Creatine kinase 79%, Hemoglobin 88%, Testosterone 90%, Cortisol 82%

No differences between athletes not diagnosed with FOR/NFOR in:

Creatine kinase, Hemoglobin, Testosterone, or Cortisol

MAIN TAKEAWAYS

Incidence of overtraining was relatively low overall.

Blood variables creatine kinase, hemoglobin, testosterone, and cortisol were not useful markers for the early detection of overreaching.

DIAGNOSING OVER TRAINING SYNDROME

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[Click for Full Text
\(Carrard et al. 2021\)](#)

JBI 10/11 [90%]



This systematic review evaluated the literature to map biomarkers and tools reported in the literature as potentially diagnostic for over training syndrome (OTS).

Markers and tools potentially diagnostic of OTS

EROS-CLINICAL score

- Eating patterns
- POMS subscales

EROS-SIMPLIFIED score

- Eating patterns
- POMS subscales
- Basal hormones

EROS-COMPLETE score

- Eating patterns
- POMS subscales
- Basal hormones
 - Hormonal responses to ITT
- Body composition

OTHERS

- HRV
- Metabolites
- TBE and CPX
- Neurotransmitters
- Immunological and redox parameters
- Telomere length
- EEG
- Psy. questionnaires

If inconclusive result, move to the next score



39 Studies Included

Diagnostic Scores Identified:

EROS-CLINICAL | EROS-SIMPLIFIED | EROS-COMPLETE

(EROS = Endocrine and Metabolic Responses on Overtraining Syndrome)

Other Potential Diagnostics for OTS:

Basal hormones

Neurotransmitter and other metabolite levels

Hormonal responses to stimuli

Psychological questionnaires

Exercise tests and Heart rate variability

Electroencephalography

Immunological and redox parameters

Muscle structure and Body composition

MAIN TAKEAWAYS

Overall quality of evidence available was low as indicated by level 4 rating.

The diversity of the identified markers and tools is in line with the fact that OTS affects multiple body systems.

OTS might be a heterogenous syndrome consisting of different clinical phenotypes.

There is a trend toward combining multiple variables to diagnose OTS. This is demonstrated by the recently developed EROS-CLINICAL, EROS-SIMPLIFIED, and EROS-COMPLETE scores.

GIVE US YOUR FEEDBACK!

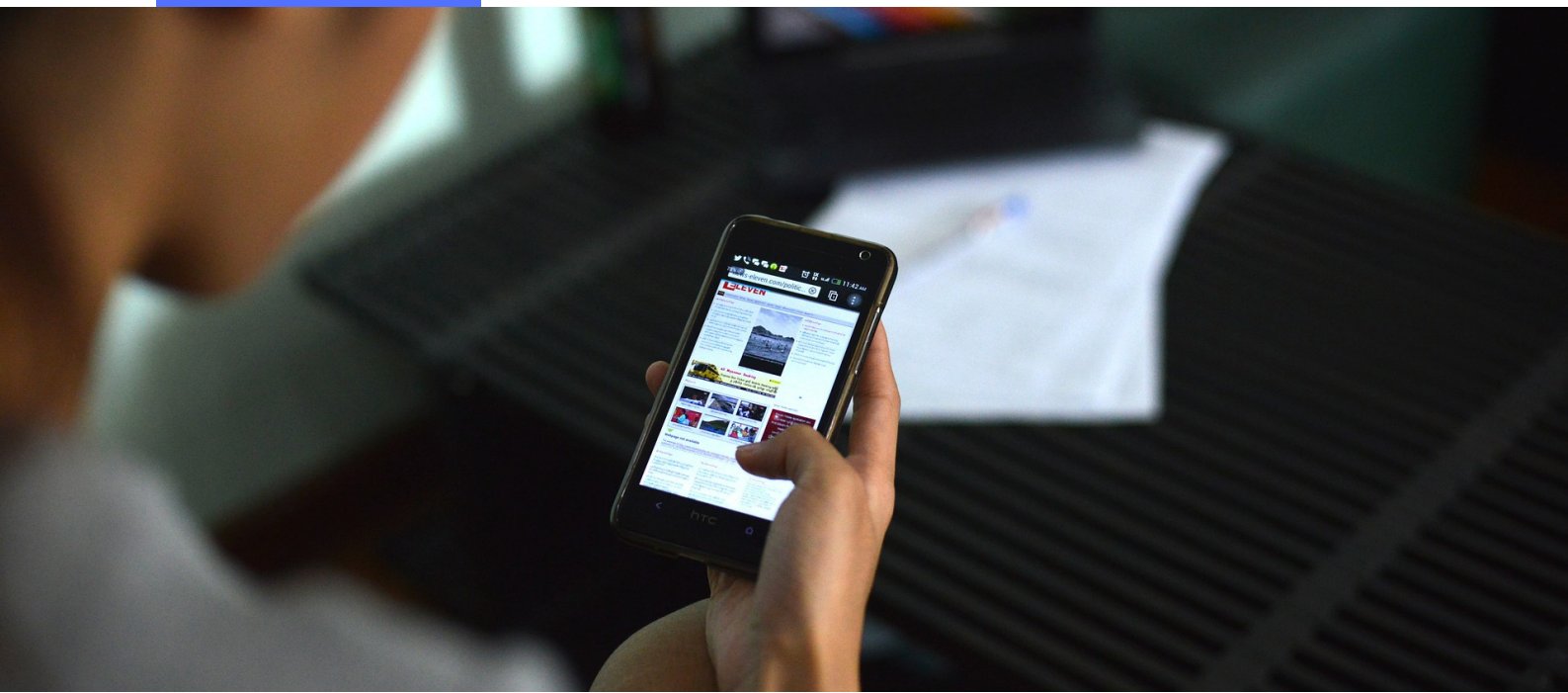
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We are on a mission to make research more accessible, easier to interpret, and quicker to implement.

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We would greatly appreciate any feedback you have, as it helps us continually improve!

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JBI CRITICAL APPRAISAL CHECKLIST FOR SYSTEMATIC REVIEWS AND RESEARCH SYNTHESSES

Author: Cadegiani and Kater Year: 2017

	Yes	No	Unclear	Not applicable
1. Is the review question clearly and explicitly stated?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the inclusion criteria appropriate for the review question?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Was the search strategy appropriate?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Were the sources and resources used to search for studies adequate?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were the criteria for appraising studies appropriate?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Was critical appraisal conducted by two or more reviewers independently?	<input type="checkbox"/>	X	<input type="checkbox"/>	<input type="checkbox"/>
7. Were there methods to minimize errors in data extraction?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Were the methods used to combine studies appropriate?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Was the likelihood of publication bias assessed?	<input type="checkbox"/>	X	<input type="checkbox"/>	<input type="checkbox"/>
10. Were recommendations for policy and/or practice supported by the reported data?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Were the specific directives for new research appropriate?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: 9/11 (81%)

Comments:

Overall, this was a moderate quality systematic review. Many studies were analyzed and the overall findings showed single hormone levels aren't a reliable marker to diagnose or predict OTS. The quality of studies could have been more accurately determined, which leaves some question as to the results and their robustness.

JBI Critical Appraisal Checklist for Case Series

Author Tian et al.

Year 2015

	Yes	No	Unclear	Not applicable
• Were there clear criteria for inclusion in the case series?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Was the condition measured in a standard, reliable way for all participants included in the case series?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Were valid methods used for identification of the condition for all participants included in the case series?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Did the case series have consecutive inclusion of participants?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Did the case series have complete inclusion of participants?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Was there clear reporting of the demographics of the participants in the study?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Was there clear reporting of clinical information of the participants?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Were the outcomes or follow up results of cases clearly reported?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Was there clear reporting of the presenting site(s)/clinic(s) demographic information?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
• Was statistical analysis appropriate?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

Overall, this was a well conducted case series, it was accurate, well tracked, and appropriate data was recorded, giving a clear picture of blood markers and their relation to overtraining/overreaching.

JBI CRITICAL APPRAISAL CHECKLIST FOR SYSTEMATIC REVIEWS AND RESEARCH SYNTHESSES

Author: Carrard et al Year: 2021

	Yes	No	Unclear	Not applicable
1. Is the review question clearly and explicitly stated?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the inclusion criteria appropriate for the review question?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Was the search strategy appropriate?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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10. Were recommendations for policy and/or practice supported by the reported data?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Were the specific directives for new research appropriate?	+	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: 10/11 (90%)

Comments:

Overall, this was a well conducted review, highlighting and summarizing the available evidence, although poor, very well. The quality of research included was poor, but the main takeaway is the amount of markers and diagnostics used to identify overtraining in athletes. This has given rise to new multifaceted tools. A well conducted study with good findings and implications for practice and further research.