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The Effects of Training Load on Injury Rates in an Athletic Population: A Systematic Review.

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Background

- National Center for Health Statistics found “an estimated seven million Americans received medical attention for sports related injuries” in a three-year time period
- One proposed explanation for these injury incidents has been exposure to excessive training loads
- Research has been completed with rugby, soccer and running athletes investigating how training load affects rates of injury

Purpose

The purpose of this study is to complete a systematic review of the current literature concerning how training load effects injury rates in an athletic, adult population.

Methods

A systematic review was completed using the databases CINAHL, PubMed, and Embase.

- Inclusion criteria - English-language works, athletes, injury rates, and workload
- Exclusion criteria - retrospective studies and participants with baseline neurological or musculoskeletal disabilities
- Risk of Bias Assessment - Downs and Black quality checklist

Definitions

- Training load - Either training intensity multiplied by duration or simply training intensity as a stand-alone parameter
- Injury - Two categories: those that required time loss of more than one day and those that did not require time loss

Training Load Measurements Accepted for Data Extraction

- Heart rate, GPS distance, RPE, sport specific skills and conditioning, periodization, hours of training, questionnaires and interviews

Sports Included

- Basketball, running, rowing, rugby and soccer

https://en.wikipedia.org/wiki/Rowing_(sport)

Results

https://en.wikipedia.org/wiki/Belgium_national_rugby_union_team

https://www.flickr.com/photos/tbpressphotography/5449225833

https://www.flickr.com/photos/chrishunkeler/21448730765

Positive Correlation

- Periodization was shown to increase the incidence of overall injuries
- Increased RPE rates were correlated with increased injury rates
- Sport specific training programs decreasing the total hours of training showed a decrease in injury incidence
- Increases in weekly running distance corresponded to an increase in distance related injuries
- Increased time spent at “high” heart rates was correlated with increased injury incidence

PEO[1] Data Table: The following table depicts data collected from various athletic populations, the training load measured in these populations, and how this training load affected injury rates in the population studied.

Author	Population	Exposure	Outcome
Anderson L, et al,	Women's Collegiate basketball players (n=12) in the United States.	Preseason and in-season training loads as measured by questionnaire and RPE[2] after each practice session.	A moderate positive correlation was observed between total weekly training loads and weekly injuries (p=0.01; r=0.675).
Gabbett TJ	Sub-elite rugby players (n=220) in Australia.	Graded sport specific skills and conditioning training program that was increased during preparatory phase and reduced slightly for competitive phase.	A positive correlation between a significant decrease in training duration and load and a significant decrease in injury incidence was observed when comparing 2001 pre-season training sessions to 2003 pre-season training sessions (x^2=44.3, df 2, p<0.001).
Gabbett TJ, et al.	Professional rugby players (n=79) in Australia.	Periodized field, strength, and power training program, with training loads progressively increased in the preparatory phase of the season and reduced during the competitive phase of the season.	The total training load was related to the overall incidence of injury (r=0.82, P<0.01), non-contact field injury incidence (r=0.82, P<0.01), and contact field injury incidence (r=0.80, P<0.01).
ØStergaard Nielsen R, et al.	Healthy adult novice runners (n=873) in Denmark.	Self structured running regimen measured by GPS[3] and classified into one of 3 groups: 10% or regression, 10%-30%, or more than 30%.	Cox regression analysis showed no statistically significant differences in injury rates across the 3 exposure groups. An increased rate of distance-related injuries existed in those who progressed their weekly running distance by more than 30% compared with those who progressed less than 10%.
Owen A L, et al.	Elite, male professional soccer players (n=23) in Europe.	Training loads measured by heart rate in high-intensity zones (HI[4]:85-<90% max) and very-high intensity zones (VHI[5]:>/=90% max).	Significant correlation between total injury incidence and training intensity (T-HI[6]: r=0.57, p=0.005; T-VHI[7]: r=0.568, p=0.005). Significant correlation between training injury incidence and training intensity, but only for T-HI[6] (r=0.48, p=0.02). Low correlations between match injury incidence and training intensity (T-HI[6]: r=0.09, p=0.69; T-VHI[7]: r=0.19, p=0.38). Significant correlation between total traumatic injuries and training intensity (r=0.42, p=0.04 for T-HI[6] and r=0.44, p=0.03 for T-VHI[7]). Greater time spent in T-HI[6] increased odds of sustaining match injury (x^2=7.22, p=0.059)
Wilson F, et al.	Senior male and female international team rowers (n=20) in Ireland.	Training loads measured by telephone interview regarding hours of training and types of training.	No significant correlation was noted between monthly reported training time and mean reported training time and injury rates. Significant relationships were noted between time spent training with heavy weights and injury (r=0.66, p=0.02), monthly egometer time and injury (r=0.75,p=0.01) and time spent on core stability and injury (r=0.68, po=0.01).
Ekstrand J et al.	Members from eleven of the top European football clubs (n=266) as selected by UEFA[8].	Training load measured by training hours and match hours for the teams and individual players.	The World Cup players played more matches during the regular season than the non-World Cup players (46 (13 v 33(16), p<0.001). However, the World Cup players had a lower risk of training injury than non-World Cup players during the season (3.2 vs. 5.5 per 1000 hours of exposure, p<0.01).

[1]Population Exposure Outcome, [2]Rate of Perceived Exertion, [3]Global Positioning System, [4]High Intensity, [5]Very High Intensity , [6]Training spent at high intensity zone, [7]Training at very high intensity zone, [8]Union of European Football Associations

Results

Negative Correlation

- High training loads as measured by heart rate were associated with higher incidences of match injuries as compared to very high training loads
- Higher number of training hours are associated with a lower rates of injury

No Correlation

- No significant correlation between monthly training hours and injury rates

Abrupt Increases in Training Load and Injury Rates

- Large increases in reported RPE levels following periods of low RPE levels were associated with significant spikes in injury rates
- Substantial increases in weekly running distance also corresponded to an increase in running-related injuries as compared to more moderate increases in weekly running distances

Conclusions

The results of this review demonstrate conflicting outcomes regarding training load and injury rates. There is support that increases in training load are associated with increases in injury rates. However, there is also support that increases in training load are associated with decreases in injury rates. It is of note that abrupt increases in training load were associated with increased injury rates.

Clinical Relevance

A trend was noted with abrupt increases in training load and increases in injury rate. However, due to lack of standardization of training load measurements and inconclusive findings, a recommendation cannot be provided regarding specific training load to prevent sport-related injury.

Acknowledgements / References

Acknowledgements
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References

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