Training Load: Evaluating a Novel Framework for Quantifying Mechanical and Metabolic Load in Female Soccer Players

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Introduction

Effective quantification of training load (TL) is crucial for optimizing athletic performance, managing fatigue, and minimizing injury risk. The TL incorporates external loading metrics as an indicator of internal loading responses. Despite the availability of multiple data points, TL has traditionally been summarized into a single value derived from an equation that uses acceleration or weighted sprinting speeds as the dominant variable. This narrowed approach may limit the value of the training load score by excluding stress variables.

Purpose

This study introduces a framework aimed at differentiating mechanical and metabolic stress using acceleration and deceleration metrics. The objective was to observe whether these distinct metrics show correlation between manufacturer-assigned player load and the novel load.

Methods

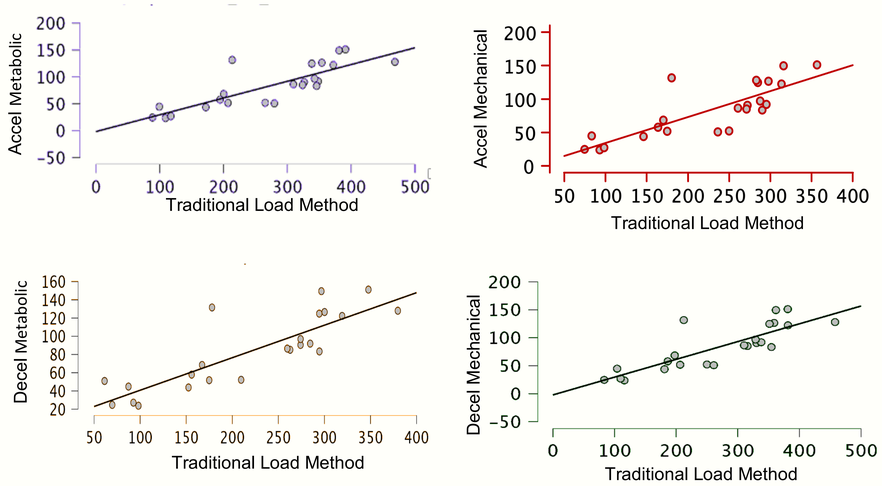
A cross-sectional correlational design was employed using female, NCAA Division II soccer athletes (n=22), monitored across a full competitive season. Data was collected during training and competition using Titan GPS tracking harnesses. Metrics of interest were acceleration/deceleration zones and the manufacturer's calculated player load. Acceleration and deceleration zones were used to calculate a training load score, assigning distinct weights to each zone to estimate mechanical and metabolic loads. Correlation analyses (Pearson's *r*) assessed relationships between traditional GPS player load metrics and our novel metrics. Additionally, ANOVA was conducted to detect positional differences among defenders (n=7), forwards (n=4), midfielders (n=9), and mixed positions (n=2).

Results

Correlation analyses revealed strong, significant relationships between Accel Physiological Load ($r = 0.801$, ($p < 0.001$, 95% [0.580, 0.912]), Decel Physiological Load ($r = 0.884$, $p < 0.001$, 95% [0.662, 0.932]), Accel Mechanical Load ($r = 0.817$, $p < 0.001$, 95% [0.611, 0.920]), Decel Mechanical Load ($r = 0.832$, $p < 0.001$, 95% [0.638, 0.926]), and Total Combined Load ($r = 0.840$, $p < 0.001$, 95% [0.655, 0.930]) and the traditional method.

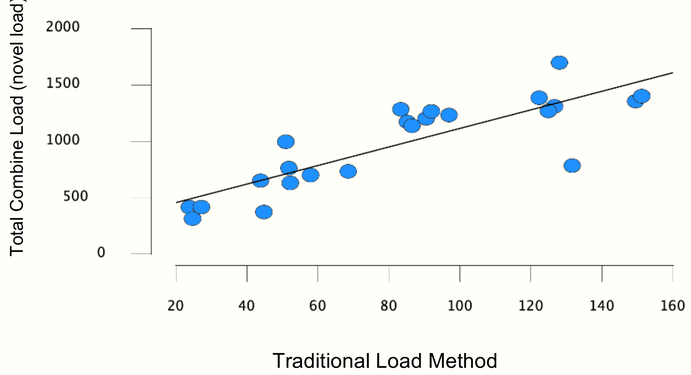
Graphs

Correlation Plat Graphs for Accel./ Decel. Components and Manufacture load



Variable	Pearson's r	p-value	95% CI (Lower – Upper)
Accel–Phys Load	0.826	< .001	0.628 – 0.924
Decel–Phys Load	0.844	< .001	0.662 – 0.932
Accel–Mechanical Load	0.817	< .001	0.611 – 0.920
Decel–Mechanical Load	0.832	< .001	0.638 – 0.926
Load per Distance	0.565	0.005	0.200 – 0.793
Load per Time	0.769	< .001	0.523 – 0.897
Total Combined Load	0.840	< .001	0.655 – 0.930

Correlation Plot Graph Between Novel and Traditional Load Data



Conclusion

The novel approach to training load demonstrated strong statistical correlations with the traditional method across both individual players, suggesting the traditional and novel metrics can be used comparably in data analysis. Despite its theoretical benefits and the comparable usefulness, the novel approach requires additional effort to compute, which may limit its practicality.

Practical Application

A clearer interpretation and usefulness of the training load metric is needed. Distinguishing between the types of stress experienced by players could offer meaningful insight for coaches and players in determining appropriate training and recovery strategies.

Sources

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Presenter

Abstract