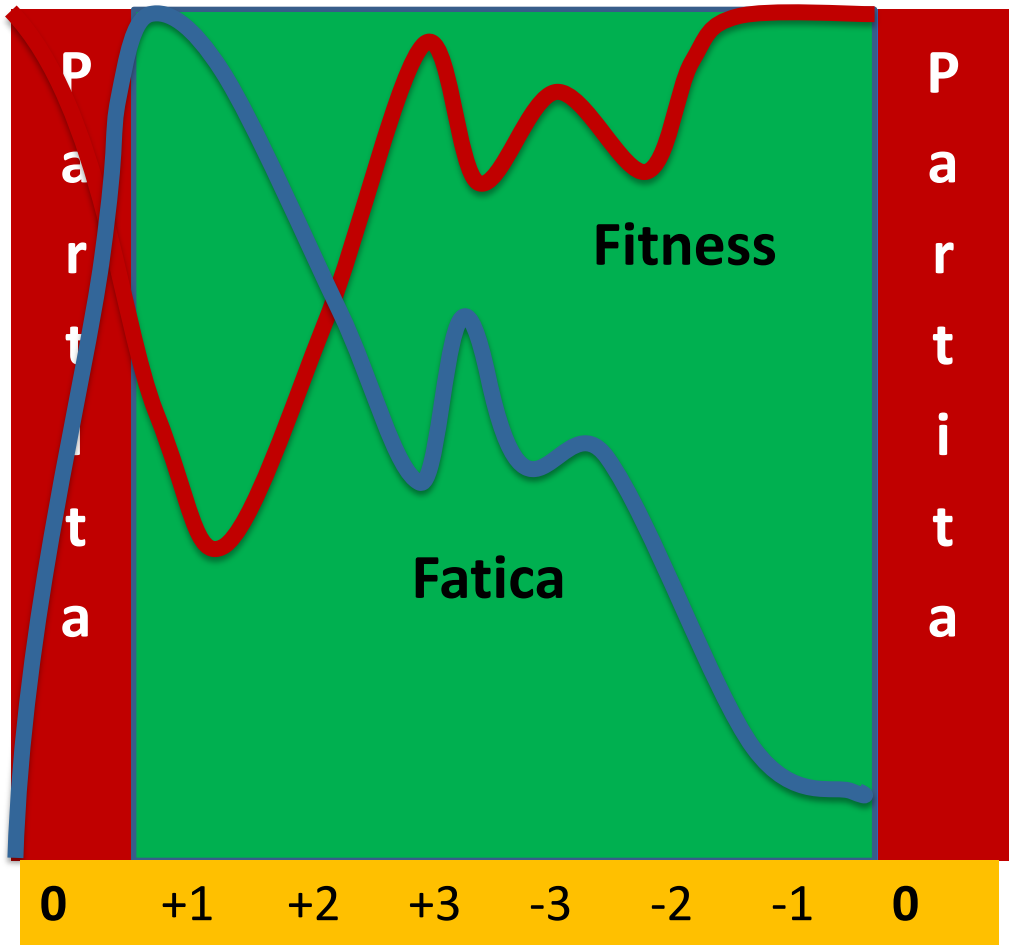
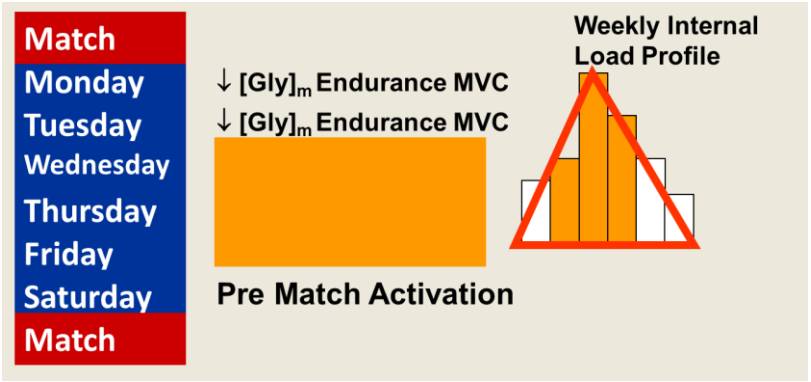
Il Carico di Allenamento nel Calcio

Carlo Castagna PhD

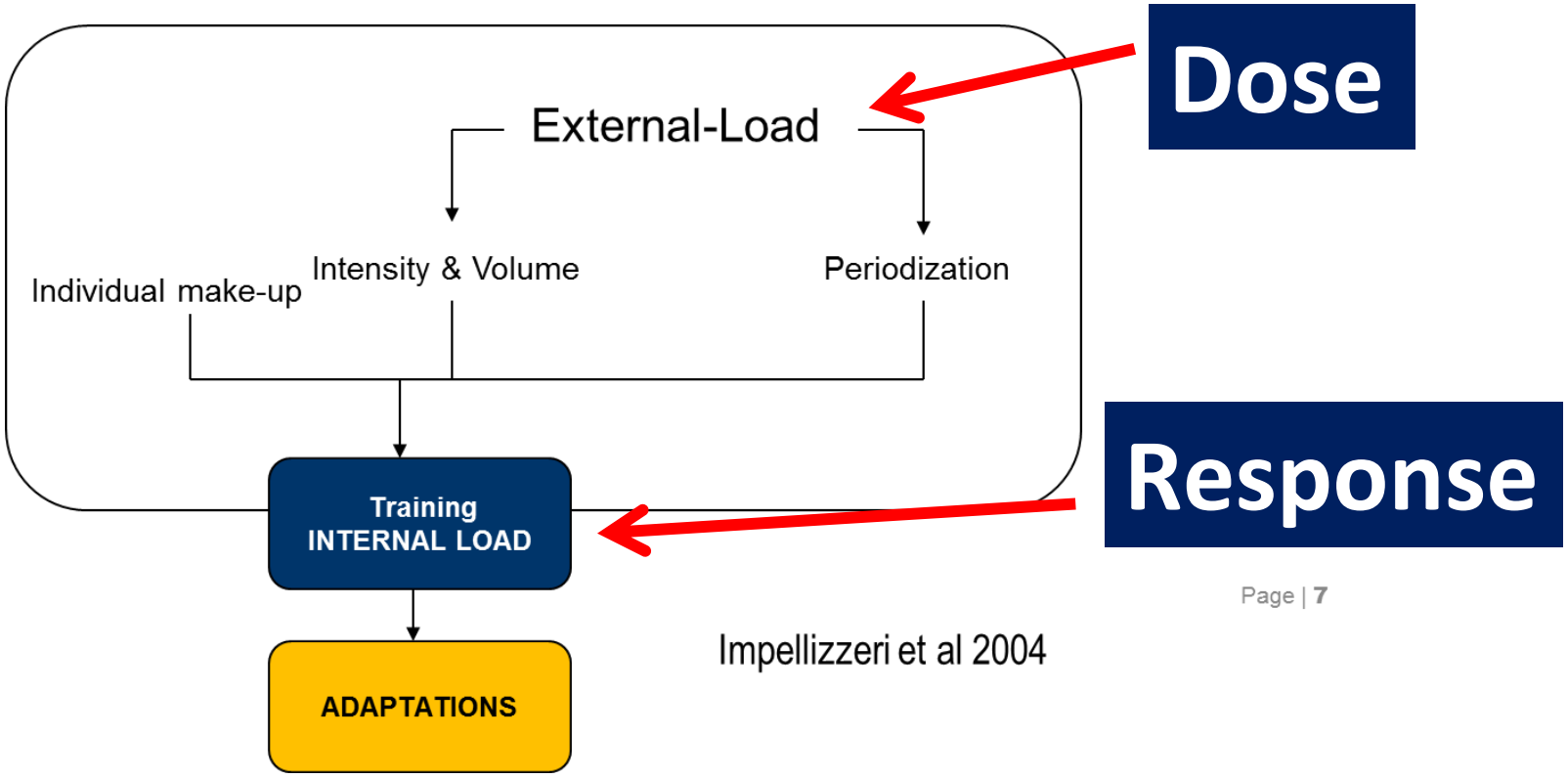
UNIVERSITA' degli STUDI di ROMA
TOR VERGATA

Microciclo Funzionale





La Dinamica del Carico



Impellizzeri et al 2004

Internal *vs* External Load

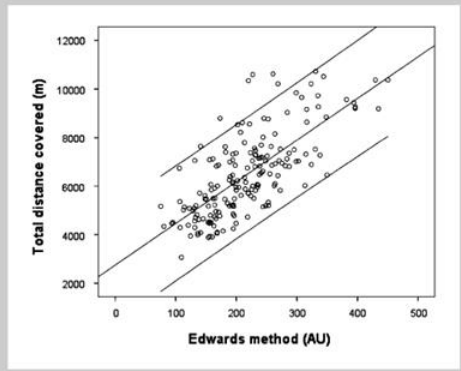


Figure 1. Relationship between the Edwards indicator and the total distance covered for the 210 recordings made ($r = 0.72$; $p < 0.01$). "AU" is arbitrary unit.

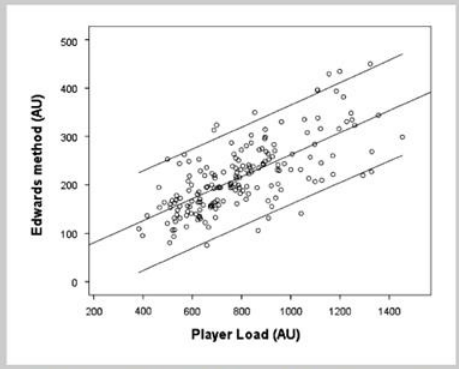


Figure 2. Relationship between player load (determined by accelerometry) and the training load indicator obtained via the Edwards method for the 210 recordings made ($r = 0.70$; $p < 0.01$). "AU" is arbitrary unit.

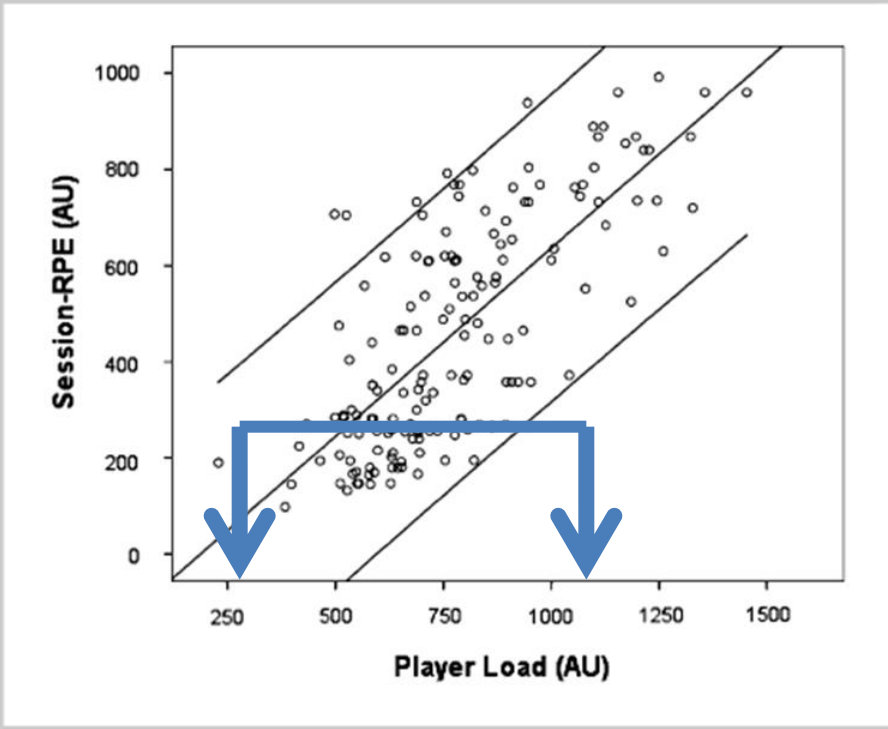


Figure 4. Relationship between player load (determined by accelerometry) and the session-rating of perceived exertion indicator for the 210 recordings made ($r = 0.74$; $p < 0.01$). "AU" is arbitrary unit.

The Internal-Load in Football

Training-Load Analysis

$$\sum_{i=1}^{n} t_i = D\sum_{i=1}^{n}(\Delta \mathrm{HR}_r)_i \cdot y_i$$

$$\Delta \mathrm{HR}_r = \frac{HR_i - HR_{rest}}{HR_{max} - HR_{rest}}$$

$$y_i = B \cdot e^{C\,(\Delta \mathrm{HR}_r)_i}$$

Manzi e coll. 2013

INDIVIDUAL TRAINING-LOAD AND AEROBIC-FITNESS VARIABLES IN PREMIERSHIP SOCCER PLAYERS DURING THE PRECOMPETITIVE SEASON

VINCENZO MANZI,[1] ANTONIO BOVENZI,[2] MARIA FRANCO IMPELLIZZERI,[3] IVAN CARMINATI,[4] AND CARLO CASTAGNA[1,5]

[1]Football Training and Biomechanics Lab, Italian Football Association (FIGC), Technical Department, Coverciano (Florence), Italy; [2]University of Florence, Florence, Italy; [3]Neuromuscular Research Laboratory, Schulthess Clinic, Zurich, Switzerland; [4]Manchester City Football Club, Manchester, United Kingdom; and [5]Marche Regional School of Sport, Italian Olympic Committee (CONI), Ancona, Italy

ABSTRACT

Manzi, V., Bovenzi, A., Impellizzeri, MF., Carminati, I., and Castagna, C. Individual training-load and aerobic-fitness variables in premiership soccer players during the precompetitive season. J Strength Cond Res 27(3): 631–636, 2013—The aim of this study was to examine the association between individual measures of internal training load (training impulse [TRIMPi]) and aerobic-fitness and performance variables in premiership male soccer players. Eighteen Premiership soccer players (age: 26.4 ± 3.2 years, height: 182 ± 5.0 cm, body mass: 79.9 ± 5.5 kg) performed treadmill tests for V_{O_2}max and ventilatory threshold (VT) and speed at blood-lactate concentration of 4 mmol·L^{-1} (S4) on separate days pre and post 8 weeks of training (preseason). The Yo-Yo intermittent recovery test (Yo-Yo IR1) performance was assessed pre and post preseason training as well. The TRIMPi was calculated using individual lactate and heart-rate profiles and assessed in each training session (r = 900). The results showed that TRIMPi was large to very large associated with percentage changes in V_{O_2}max (r = 0.77; p = 0.002), VT (r = 0.78, p = 0.002), S4

INTRODUCTION

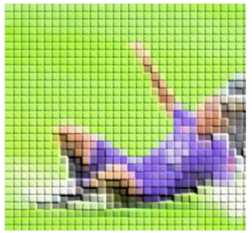
The training adaptations are the result of the interplay of a number of structured physiological perturbations imposed on athletes during the training process (6,19,35). The individual responses to training are related to athletes' individual fitness level and proportional to the magnitude of the provided training load (TL) (21). As a result, the quantification of the individual response to a given TL is vital to profile training-related adaptive processes (7,22).

Recently, a number of studies have examined the individual training responses using heart rate (HR)–based methods (6,17–19,22). Manzi et al. (17) showed that with a fully individualized approach, it was possible to accurately track fitness improvements during mainly aerobic-training sessions in endurance athletes.

In team sports, players are mainly submitted to group training sessions aiming to develop team physical fitness and technical-tactical skills (18). The potential for differentiated training responses from scheduled team training sessions may significantly challenge the assumed importance of train-

Research Design

Professional PLayersn=18



8 Weeks

Manzi e coll. 2013

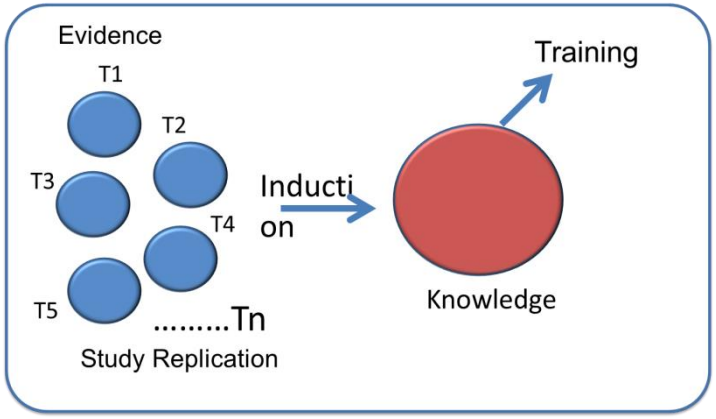
Dose-Response

TRIMPi= mX+q

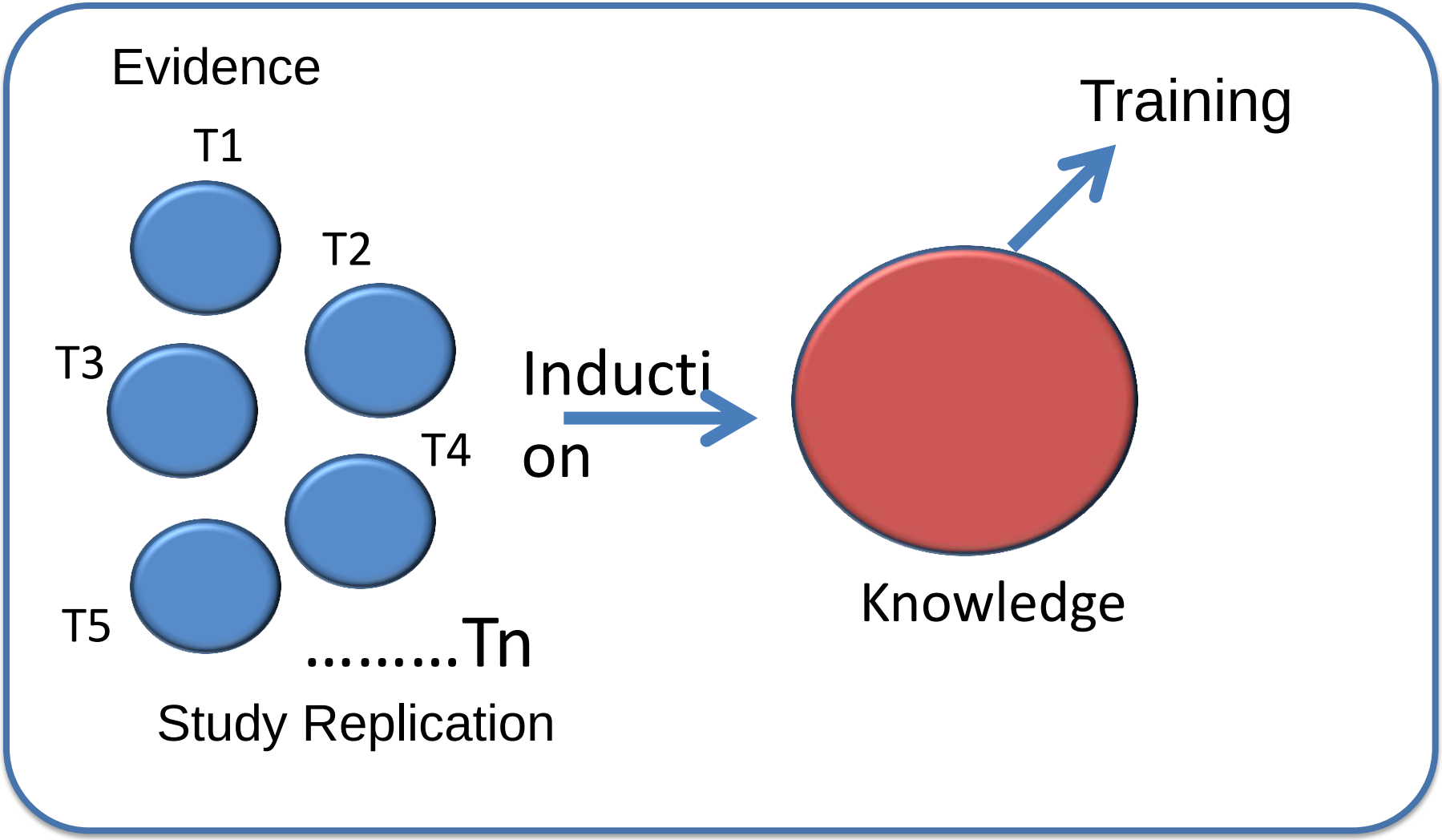
- **S4 → 454 AU**
- **VO_2max → 498 AU**
- **VO_2VT → 415 AU**
- **Yo-Yo IR1 → 510 AU**

Manzi e coll *2013*

Team-Studies Philosophy



Team-Studies Philosophy



Team-Studies: HR Validity

Heart Rate Monitoring

Training Intensities:

Low	HR< S2
Mean	S2< HR<S4
High	HR>S4

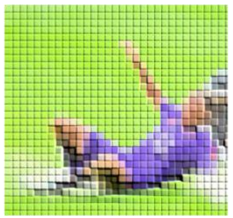
Castagna et al. 2011, 2013

Heart Rate Monitoring

Results:

- Training Load (%time):

Low	74%
Medium	19%
High	7%



Castagna et al. 2013

Dose-Response

- Relevance of HR>90% FC_{max}
- High-Intensity 6-8% weekly Training Load
- HR monitoring Longitudinal Validity
- Effect on Aerobic Fitness

Internal *vs* External Load

Relationship Between Indicators of Training Load in Soccer Players

David Casamichana,[1] Julen Castellano,[1] Julio Calleja-Gonzalez,[1] Jaime San Román,[1] and Carlo Castagna[2]

[1]*Faculty of Physical Activity and Sport Sciences, University of the Basque Country (EHU/UPV), Vitoria-Gasteiz, Spain; and* [2]*Football Training and Biomechanics Laboratory, Italian Football Federation (FIGC), Technical Department, Coverciano (Florence), Italy*

Abstract

Casamichana, D, Castellano, J, Calleja-Gonzalez, J, San Román, J, and Castagna, C. Relationship between indicators of training load in soccer players. *J Strength Cond Res* 27(2): 369–374, 2013–This study examined the relationship between work load indicators used to quantify full training sessions in soccer. The participants were 28 semiprofessional male soccer players age 22.9 ± 4.2 years, height 177 ± 5 cm, body mass 73.6 ± 4.4 kg. Players' physical and physiological work load was monitored over 44 training sessions using global positioning system devices (10 Hz) and heart rate, respectively. After each training session, players' training perceived-exertion (rating of perceived exertion [RPE]) was assessed using the Borg CR-10 scale. Players' internal training load was assessed using the session-RPE and the Edwards methods. Total distance, distances covered at arbitrary selected high-intensity speed zones (≥18 and 21 km·h^{-1}), bout frequency at speed >18 and 21 km·h^{-1}, and work:rest ratio during training drills were considered as signs of physical work load. Furthermore, player load assumed as reflection of total center-of-mass acceleration was considered as representative of players' external load. Very-large association of player load with Edwards and session-RPE methods was found. Total distance covered was large to very large associated with Player Load, Session-RPE, and Edwards methods. The findings of this study provided evidence for the safe use of session-RPE, Edwards methods, and Players Load as valid indicators of training responses in soccer.

Key Words association football, training control, session-RPE, heart rate, GPS technology

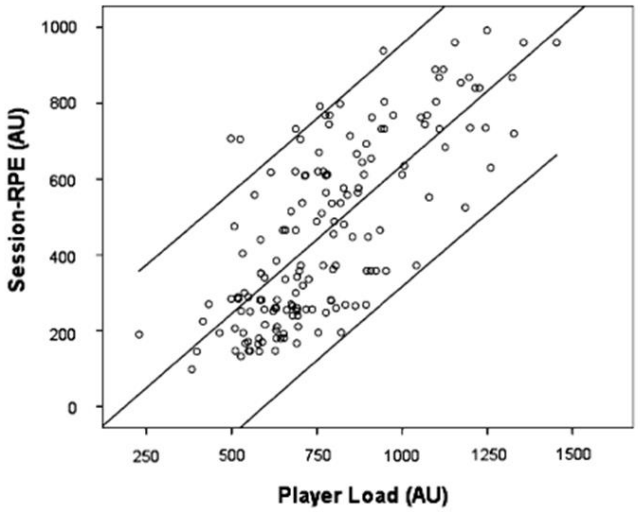
Introduction

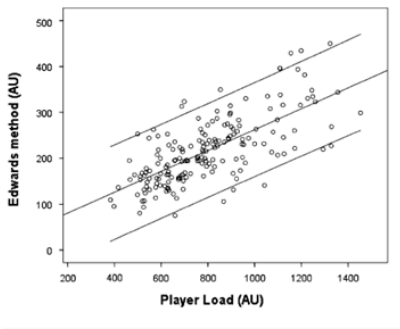
To develop physical fitness and team skills, an extensive use of group training (i.e., specific training) drills is considered in soccer (13). Specific training in soccer assumes the form of small-sided games using different number of players, pitch dimensions, and game rules to promote the requested adaptations (21). Team-skill training load (TL) quantification is of importance when the objective is to evaluate magnitude compliance between planned and performed training drills. This enables TL to be modulated according to seasonal training aims. This assumes value as efficient training prescription is work load dependent (29).

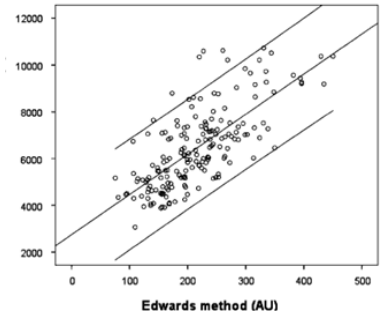
In soccer, the individual training response (internal load) to a given imposed training program (external load) may result in being different among players, and consequently, training individualization may result problematic (12). Therefore, the development of valid methods for TL assessment is paramount in soccer because extreme training responses may result in training maladaptations and injuries (17,18).

With the aim to profile the internal load, a number of methods have been proposed using effort perception or heart-rate (HR) responses to training (3). Recently, the session–rating of perceived exertion method (sRPE) has been the object of studies that examined its validity assuming as construct HR methods (24), which has been correlated with other internal and external TL (8).

Despite the practical interest provided by these studies, a conclusive response as per sRPE method criterion validity is yet to be reported in soccer. Indeed, HR methods were based on theoretical construct and consequently cannot be considered as TL gold-standard criteria.







External Load: Metabolic Power

Aerobic Fitness Ecological Validity in Elite Soccer Players: A Metabolic Power Approach

Vincenzo Manzi,[1] Franco Impellizzeri,[2] and Carlo Castagna[1]

[1]Technical Department, Football Training and Biomechanics Laboratory, Italian Football Association (FIGC), Florence, Italy; and [2]Neuromuscular Research Laboratory, Schulthess Clinic, Zurich, Switzerland

Table 2. Correlation matrix of the resulting associations among aerobic fitness and the metabolic power categori considered.*

Variables ($W \cdot kg^{-1}$)	$\dot{V}O_2max$	$\dot{V}O_2VT$	$\%\dot{V}O_2VT$	Maximal Aerobic Speed	V_{L4}
>20	0.68† (0.30–0.88)	0.83‡ (0.58–0.94)	0.62† (0.20–0.85)	0.72§ (0.36–0.89)	0.73‡ (0.58–0.94)
>35	0.63† (0.22–0.85)	0.79‡ (0.50–0.92)	0.64† (0.23–0.86)	0.64† (0.23–0.86)	0.67† (0.50–0.92)
>55	0.55§ (0.10–0.81)	0.72† (0.37–0.89)	0.65† (0.24–0.86)	0.52§ (0.05–0.80)	0.56§ (0.37–0.89)

*Data are reported as coefficient of correlation and 95% confidence intervals.
†$p < 0.01$.
‡$p < 0.001$.
§$p < 0.05$.

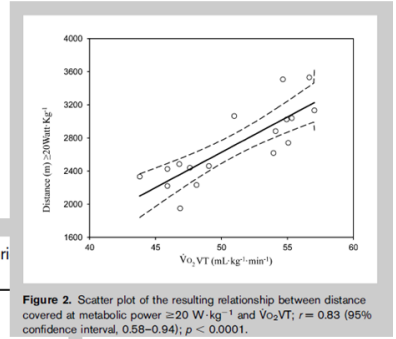


Figure 2. Scatter plot of the resulting relationship between distance covered at metabolic power ≥20 $W \cdot kg^{-1}$ and $\dot{V}O_2VT$; $r = 0.83$ (95% confidence interval, 0.58–0.94); $p < 0.0001$.

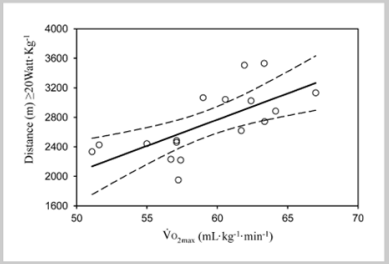
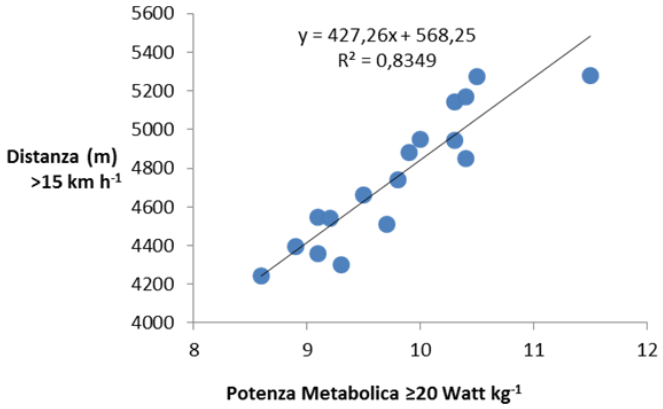


Figure 1. Scatter plot of the resulting relationship between distance covered at metabolic power ≥20 $W \cdot kg^{-1}$ and $\dot{V}O_2max$; $r = 0.68$ (95% confidence interval, 0.30–0.88); $p = 0.0024$.



External Load: Metabolic Power

Il Carico Interno ed Esterno nel controllo del 3v3: Studio di un caso.

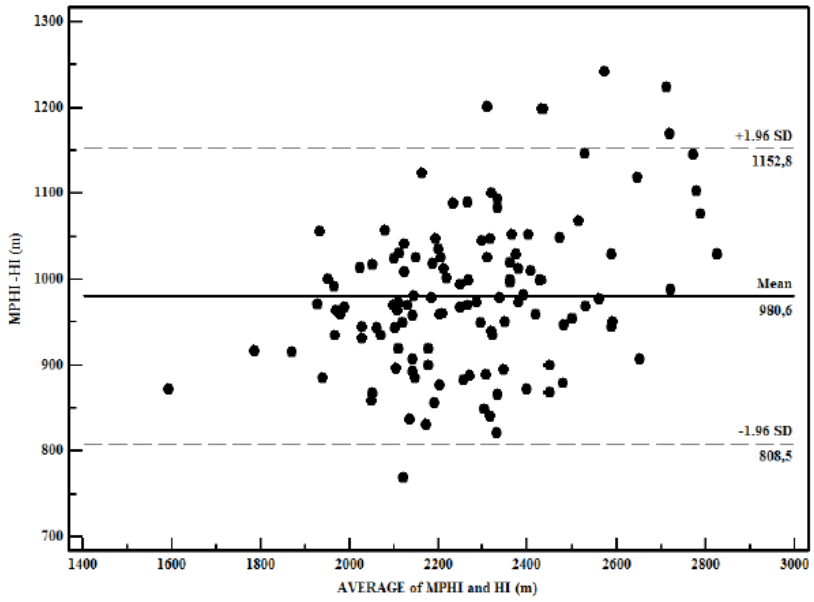
Carlo Castagna, Vincenzo Manzi 2013

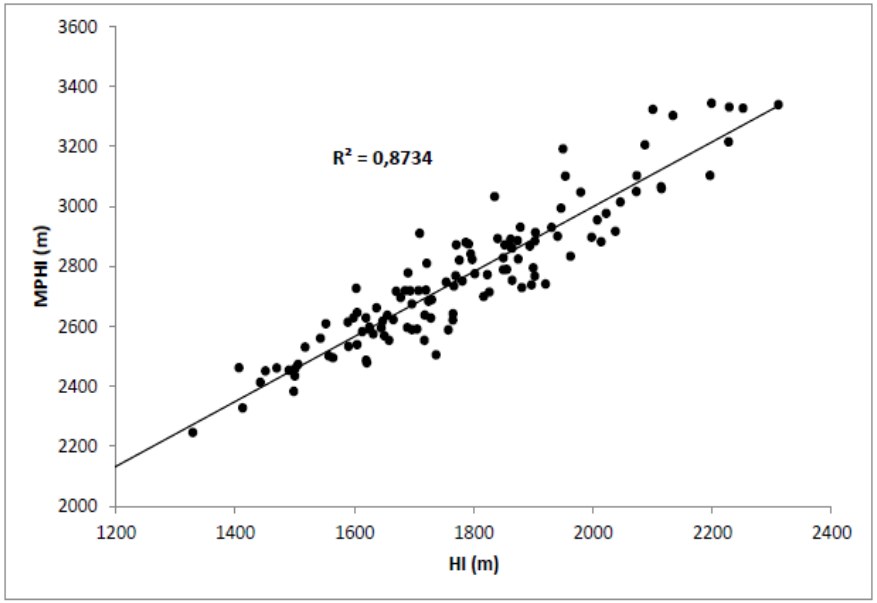
RISULTATI

- Distanza 721±60 metri
- PM 11.2±1.1 Watt·kg^{-1}
- VO_2 47.2±8.1 ml·kg^{-1}·min^{-1} (80±10%)
- Stima VO_2 33±3 ml·kg^{-1}·min^{-1} (56±7.4%)
- Lattato 3.7±2.4 mmol·l^{-1}

External Load: Metabolic Power

- HI Speed *vs* HI-MP (20watt kg^{-1})
- Almost Perfect Association





Castagna et al 2016

Conclusioni

- Importanza Carico Interno
- Controllo della Variabilità
- Verifica del Carico Esterno
- Ripetibilità
- Validità
- Sostenibilità

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