Emerging Approaches in Analysis and Evaluation in Sports Science

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Abstract
It is not an easy task to analyze individual's performances, especially in team sports. There are numerous variables to be measured and considered to accurate analysis. Training, warm-up, motivation methods, strategies, procedures then can be arranged accordingly. Studies in sports sciences do not generally converge on a single global (optimum) solution, where instead various findings contribute for perpetual advances. In this review, research studies, recent approaches, and limitations are discussed. Moreover, future studies, trending approaches, and new performance analysis techniques are also discussed.

Keywords: Sports Science; Training, Stress; Gps; Physiological signals

Introduction
Quantifying the training and competitive match loads of players in sports can be performed in various ways not limited to kinematic, perceptual, psychological or physiological monitoring methods. These approaches provide supplementary data for trainers, however, the analysis procedure is generally challenging depending on the external conditions or individual differences between players or athletes. The collected raw data of these methods are large distinct datasets and they still cannot indicate a global solution or outcome for determining training load, injury risk/condition, performance evaluation. The main reason for this failure is the lack of quantifying the key aspects of human body movement with the difficulty of contact team sports. Rather than the traditional practitioner and trainer approaches, in recent years technological advances contributing to the analysis such as physiological recordings, video recordings and Global Position Systems as the most popular.

Analysis and Evaluation Methods
During the last decade, many research studies implemented to understand the effect of different mechanisms on performance.

Effect of music
There is a sharp increase in the number of studies which examined the relation between music and physical activity. Researchers have demonstrated the efficacy of music in aerobic performance, and positive effects of music on the athlete's performance [1-3]. On the contrary, other studies also reported no significant positive relation [4]. These studies focus on music exposure during warm-up and recovery as a motivation, arousal or relaxing tool [2,3]. There are no strong evidence indicating the relation between music type (instrumental or vocal, various beat per minutes value of the song etc.) and performance. Still, a detailed and well-designed study is necessary to unveil the effects of music on player performance.

Warm-up routines
The warm-up is implemented to increase muscle temperature that will yield as an increase in blood flow and optimized metabolic responses [5,6]. Optimized muscle temperature level will not only prevent fatigue but also improves training and competition performance [5,7]. Warm-up routine strategies are popular research topics whereas many studies approve performance optimization is achieved [5-8]. Silva et. Al's [9] review show that in real-world application of warm-up strategies is dependent on individual experiences rather than scientific findings [6,8]. In team sports games, players should be able to do explosive efforts in short period of time as jumps, tackles, sprints having a high amount of velocity and direction changes [10,11]. Silva also reported nineteen articles for strategies for warm-up, up to 60 combinations of warm-ups. These studies compared the applied warm-up routines as follows:
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Risk of injury

Injuries are arguably the primary risk factor for both elite and potential elite players. Missing proper training and competition prevents performance improvement of players and possibly an obstacle in between a long and high level professional career. For this reason, many studies examine causes of injury and risk parameters. Low energy availability, defined as a relative energy deficiency, may increase the risk of bone stress injuries [17, 18]. Bone stress injuries resulting of low energy availability underline the dangers of excessive amount of training and competition, especially when combined with inadequate recovery [18, 19].

Technological advances

In the last decade, technology has begun to contribute our daily life even more. Thus, it is obvious that emerging devices are also used in sports. By Goal line technology in football, hawk eye technology in tennis, Gps devices, wearable sensor systems, video analysis, sports clothing design technological advances are getting more involved in every field of different sports. Especially for athletes and swimmers high budget projects try to provide comfort as well as additional performance. In these studies, shoe properties such as mass, midsole compliance, resilience, and longitudinal bending stiffness are observed as in close relation with dissipated energy during running [20-22]. However, achieved energy savings due to running shoe properties are negligibly small [23]. For every 100 g of added mass per shoe, the energetic cost of running increases by 1.0%, so shoe manufacturers try to design superlight shoes day by day.

Discussion

Considering the results of available studies in literature, intentions for future studies should focus on limitations that authors mentioned. Yet, current knowledge on warm-up effects are limited. Long-term studies, establishing various warm-up procedures during or off-season, may answer correlation between physical performance and physiological, mental or biomechanical variables. By understanding these relations, it can be possible to identify the physiological variable characteristics of desired task performance. Recently this approach has growing interest due to technological advances, as wearable sensor, Gps data. Many Gps device requires personalization which will also help to assess individual difference and offer personalized warm-up or training program development. Small changes detected in physiological signals may result as applying specific warm-up strategies that differ between players. Thus, each player may respond better to the corresponding program provided. Birrer suggest applied sports psychologists should first address the psychological requirements of the sport prior PST program implementations, considering the level of the athlete. As previously discussed, D also underlines the importance of individual differences and PST techniques are not universally applicable without considering these differences. Moreover, there are several methodological variations reported depending on warm-up intensity, duration, recovery time, and type. As Helgerud et. al mentioned [24], it is imperative for team sports practitioners to monitor, external demands and physiological responses of players during training but especially during
competition. This process has currently been facilitated by time-
motion analysis, such as semi-automated camera and statistical
systems or by the use of micro-electronics devices). Given their
good reliability [25,26], portability, micro-technology devices are
now the preferred method of motion-tracking despite their
limitation in contact sports caused by collisions, tackling conditions
[27-31]. GPS devices provide covered distances, significant sprints
or particular movements in discrete zones in the sports field
[32]. The outputs of these commercial devices feature triaxial
accelerometers sampling at generally 100 Hz which is more than
adequate. Such These embedded accelerometers measure g-force
and acceleration in the sum of multiple dimensions as orthogonal
axes (anterioposterior (x), mediolateral (y) and vertical (z)) [33].
Accelerometer output then can be used to quantify the change of
g-force both in magnitude and direction during accelerating
and decelerating movements [30,33-35]. However, estimation
metabolic power and energy expenditure of Gps devices and visual
tracking systems still do not provide sufficient knowledge and
should be explored further in detail.

We comment that electrophysiological signals like EDA, ST,
HR should be integrated with Gps devices. HR correlation with
oxygen consumption during steady-state submaximal exercise are
known as improved blood circulation results as oxygen demand in
the muscles. Regression analysis have been used to estimate the
energy consumption players [30,36,37]. The main problem of these
estimation calculation is that the only available data is obtained
in indoor recordings and yet generally during off-season or off
competition time interval. The contact nature of many team sports
is not possible to take into account. With the integration of wearable
sensor in Gps system will significantly contribute the gap in many
studies. Not only performance or energy dissipation estimation,
as in most sports, the injury rate is greater in competition than
practice. Risk indicator determination will also be more accurate
with the change of direction in studies mentioned above. Another
generalization problem of reported findings in team sports is that
independent and single research studies, limit the applicability to
alternative team sports or different conditions or group of players.

Conclusion

We believe obtaining larger datasets and having wider
collaborations of different expertise group such as medical
doctors, trainer, practitioners, analysts, engineers, statisticians will
significantly improve the understanding and analysis of findings.
Integration of physiological signals, mental and psychological
analysis, muscular, Gps-based electronics systems output combined
with the experience of expert trainers may decrease injury risks,
enhance performance and improve elite player development.
Rather than the integration, investigation of these distinct expertise
areas individually does not provide satisfactory outcomes. Current
studies support this comment as there are numerous parameters
and variables need to be considered and blind approaches ignoring
remaining aspects result in contradictory findings.

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