

Technical staff structure, planning methods, methodological practices and load management in soccer

Estructura de los cuerpos técnicos, métodos de planificación, prácticas metodológicas y gestión de la carga en fútbol

Alejandro Romero-Caballero, Daniel Varela-Olalla, Ignacio Collado-Lázaro, Darío Álvarez-Salvador
Universidad Autónoma de Madrid (Spain)

Abstract. Soccer performance depends on several interrelated factors regarding technical, tactical, physical and psychological areas. Over the last decades there was an increase in match congestion. The increased match frequency and the associated injury risk have highlighted the importance of physical condition, increasing the need to implement new training methodologies with a special focus on load and fatigue management, as well as non-specific complementary training. The main objective of this study was to provide information on the structure and characteristics of the technical staffs, the methodological training practices, as well as the workload and fatigue control methods used in soccer, examining possible differences based on gender, category and competitive level. 190 soccer teams from 20 different countries participated in the study, by answering a survey. The results reveal that there are differences in the structure of the technical staff, the planning models, the methodology and the workload control depending on the category and the competitive level. Gender only appears as a discriminating variable, in relation to the most used complementary training contents. The weekly microcycle is the preferred planning model (80.89%), regardless the competitive level. However, in lower categories, medium and long term periodization are also used (23.80%). The weekly volume of complementary training increases as category ($p=0.000$) and competitive level ($p=0.000$) does. Strength training is the most used non-specific content (84.89%). However, its importance is reduced in lower categories (38.5%). Load and fatigue control are only extended among teams of superior category ($p=0.000$) and competitive level ($p=0.000$).

Key Words: Football, Workload, Periodization, Methodology.

Resumen. El rendimiento en fútbol depende de varios factores interrelacionados entre los que encontramos las áreas técnica, táctica, física y psicológica. Durante las últimas décadas ha existido un aumento en la congestión de partidos. La mayor frecuencia de partidos y el riesgo de lesión asociado han puesto de manifiesto la importancia de la condición física, aumentando la necesidad de implementar nuevas metodologías de entrenamiento con especial énfasis en el manejo de la carga y la fatiga, así como entrenamientos complementarios. El objetivo principal de este estudio fue brindar información sobre la estructura y características de los cuerpos técnicos y las prácticas metodológicas de entrenamiento, así como los métodos de control de la carga de trabajo y la fatiga utilizados en el fútbol, examinando posibles diferencias por género, categoría y nivel competitivo. 190 equipos de fútbol de 20 países diferentes participaron en el estudio, respondiendo a una encuesta. Los resultados revelan que existen diferencias en la estructura de los cuerpos técnicos, los modelos de planificación, la metodología y el control de la carga de entrenamientos y partidos según la categoría y el nivel competitivo. El género solo aparece como variable discriminante en relación con los contenidos complementarios de entrenamiento más utilizados. El microciclo semanal es el modelo de planificación preferido (80.89%), independientemente del nivel competitivo. Sin embargo, en categorías inferiores también se utiliza la periodización a medio y largo plazo (23.80%). El volumen semanal de entrenamiento complementario aumenta a medida que lo hace la categoría ($p<.001$) y el nivel competitivo ($p<.001$). El entrenamiento de fuerza es el contenido de entrenamiento complementario más utilizado (84.89%). Sin embargo, su importancia se reduce en categorías inferiores (38.5%). El control de la carga y la fatiga solo se extiende entre equipos de categoría y nivel competitivo superior ($p<.001$).

Palabras clave: Fútbol, Gestión de la carga, Periodización, Metodología.

Introduction

Soccer is the world's most popular sport (Keen, 2018). According to FIFA data in 2015, Haugen & Seiler (2015) state that there were approximately 265 million players and 5 million referees and officials actively involved (4% of the world population).

It is well known that soccer performance depends on several interrelated factors regarding technical,

tactical, physical and psychological areas, highlighting the great influence of physical capacity on technical performance, tactical choices and injury frequency (Stolen, Chamari, Castagna, & Wisløff, 2005). Over the last decades there was an increase in match congestion, with players being required to play competitive matches with rest intervals of only 48-72h in different moments of the season (Bengtsson, Ekstrand, Waldén, & Häggglund, 2018). This recent prospective study of 133170 matches showed an increased injury rate during competition when an interval of less than 6 days was observed between two consecutive match days. Another study that analyzed injury rates during different periods of

congestion found that physical and technical performance was not affected when playing two matches per week, but there was a significant increase in injuries during matches, compared to non-congested periods. (Dellal, Lago-Peñas, Rey, Chamari, & Orhant, 2015).

The increased match frequency and the risk of injury associated with the shorter rest time between them have highlighted the importance of physical condition, increasing the need to implement new training methodologies that show an interest in responding effectively to the specific needs of athletes, based on the implementation of training programs with a high compatibility with the dynamics of the competition itself (Vales-Vázquez, Gayo, Fernández, & Quintela, 2017). These training methodologies are implemented with a special focus on load and fatigue (physical and mental) management (García-Calvo, González-Ponce, Ponce, Tomé-Lourido, & Vales Vázquez, 2019; Muñoz-López, Nakamura, & Naranjo Orellana, 2021; Jones, Griffiths, & Mellalieu, 2017), as well as non-specific complementary training.

Traditionally, fatigue has been defined as an exercise-induced impairment of muscle function leading to a reduction in maximum voluntary muscle strength (Carroll, Taylor, & Gandevia, 2017). A more complete taxonomy has recently been proposed whereby fatigue can be seen as a symptom comprising two interdependent attributes, one of which is «performance fatigability» which comprises alteration in muscle activation (i.e. voluntary activation) and in contractile function (i.e. calcium kinetics), and the other is «perceived fatigue» comprising homeostatic changes (i.e. dehydration) and psychological state (i.e. arousal) (Enoka, & Duchateau, 2016). According to these authors, fatigue is affected by the rate of change in both attributes due to the demands of the task being performed, highlighting the need to evaluate physiological, subjective, psychological, technical and tactical changes, which measure fatigue on more than one level, taking into account muscle performance (muscle function), exercise performance (whole-body exercise abilities) and competition performance (sports abilities during games or practice) (Knicker, Renshaw, Oldham, & Cairns, 2011).

Fatigue and associated reductions in performance appear to occur in three stages during games: after intense periods of activity during the game, in the early phase of the second half and towards the end of the game (Mohr, Krstrup, & Bangsbo, 2005). Decrements in performance after high-intensity actions during the

game may be related to fatigue due to phosphocreatine (PCr) depletion and metabolic and electrical alterations in muscle cells. Likewise, performance declines at the beginning of the second half appear to be mediated by lower muscle temperature. Finally, the decrease in fatigue and performance at the end of the game could be explained by the depletion of glycogen stores, dehydration or hyperthermia (Mohr et al., 2005).

In soccer, some external load indicators seem to be a good option to monitor training, as they may be related to injury risk (Jaspers et al., 2018). Currently, different variables are used to control load and fatigue, such as training volume, intensity, duration, type, repeated and maximum efforts as markers of external load; and rating of perceived exertion, fatigue and recovery along with heart rate measures, biochemistry, hormone and body composition analysis as internal load markers, among others (Halson, 2014). Internal and external load can be analyzed using different biomechanical and physiological methods, which facilitate the monitoring process (Vanrenterghem, Nedergaard, Robinson, & Drust, 2017). According to several authors, it is important to develop an effective monitoring system in which key steps could be: 1) identify purpose, limitations and appropriate variables for target outcomes, 2) selecting the methods that will be used to analyze data, 3) determining meaningful changes in variables and efficient methods to detect them, 4) selecting the most important information obtained during monitoring process (Thornton, Delaney, Duthie, & Dascombe, 2019).

However, in contemporary practice there seems to be no universally adopted approach for training load monitoring and quantification in high-level soccer. The perceived impact of monitoring on reducing the risk of injury and improving performance is less than expected, and professionals highlight insufficient human resources, low acceptance of coaches, and low sensitivity of field measurements as factors (Akenhead & Nassis, 2016).

In addition to load and fatigue management, complementary (non-specific) training is another important piece of the puzzle for injury risk reducing. Strength training can currently be considered the most effective method in this regard, as it shows to reduce in more than half (H» 66%) of sports injuries in a dose-response fashion by which a 10% increase in strength training volume reduced injury risk by more than four percentage points (Lauersen, Andersen, & Andersen, 2018). Furthermore, compared to other methods, such as proprioceptive training or stretching, it has shown

significantly better results, reducing sports injuries to less than one third (Lauersen, Bertelsen, & Andersen, 2014). Finally, strength training has also been shown to be effective in improving the physical performance of soccer in actions such as sprinting and jumping (Pareja-Blanco, Sánchez-Medina, Suárez-Arrones, & González-Badillo, 2017; Styles, Matthews, & Comfort, 2016). Some studies have also shown the effectiveness of strength training, heavy sled training and sprint training in increasing physical capacities and reducing the risk of injury (Mendiguchia et al., 2020; Morin et al., 2017).

Due to the limited time available to prepare for competition matches, the integration of technical, tactical and conditional content within training sessions has gained popularity in recent years (Romero-Caballero, & Campos-Vázquez, 2020). Currently, short-term planning based on the weekly microcycle seems to be the most widely used planning method in soccer. Methodologies such as the structured microcycle (Martín-García, Díaz, Bradley, Morera, & Casamichana, 2018) or tactical periodization (Delgado-Bordonau, & Mendez-Villanueva, 2012) are framed within this structure. Especially the latter is based on the need to maintain a regular pattern respecting the alternation in the training recovery demands. In this context, the match day is followed by two recovery days; then three acquisition days (physical components training), prioritizing strength (first day), endurance (second day) and speed (third day), and finally a recovery-activation day is performed. Therefore, there are no two days in a given week demanding the same physical fitness component (Delgado-Bordonau, & Mendez-Villanueva, 2012). Another alternative that has been shown to have positive effects for team sports, particularly in soccer, is block periodization. In it, the development of different physical capacities is organized into three different blocks focused on high-intensity aerobic and gym-based strength training (first accumulation block), speed endurance (second transmutation block) and speed (third realization block) (Mallo, 2011).

However, from our point of view, except for a few isolated studies (Akenhead & Nassis, 2016), there is still no solid scientific evidence to report on the most widely used planning models, the chosen training methodologies or the workload control methods in soccer, especially at non-professional levels. In this way, the objective of this study was to provide information on the structure and characteristics of the technical staffs, the methodological training practices, as well as the workload and fatigue control methods used in soccer,

analyzing possible differences based on gender, category and competitive level.

Method

Participants

190 soccer teams from 20 different countries (Argentina, Australia, Azerbaijan, Chile, China, Colombia, Ecuador, Spain, United States of America, Finland, France, Mexico, Monaco, Norway, Portugal, United Kingdom, Dominican Republic, Serbia, Switzerland and Vietnam), represented through any member of the technical staff (63.7% physical trainer, 26.8% head coach, 6.8% assistant coach, 1.1% psychologist, 1.1% physiotherapist, 0.5% medical services) participated in the study.

30 of the respondents work in female teams (15.8%) and 160 in male teams (84.2%). In relation to the competitive level of the teams represented, the 9.5% competed at a locally, 40.5% at a regionally, 37.9% at a nationally and 12.1% internationally level. The distribution according to category and competitive level is reflected in Table 1. All participants voluntarily agreed to participate in the study in accordance with the Declaration of Helsinki.

Table 1.
Sample distribution according to category and competitive level.

Category	Competitive Level	Percentage
U12 n=17 (8.9%)	Local	41.2%
	Regional	35.3%
	National	5.9%
	International	17.6%
U14 n=17 (8.9%)	Local	29.4%
	Regional	58.8%
	National	5.9%
	International	5.9%
U16 n=25 (13.2%)	Local	12%
	Regional	72%
	National	12%
	International	4%
U19 n=36 (18.9%)	Local	2.8%
	Regional	47.2%
	National	44.4%
	International	5.6%
Senior n=95 (50%)	Local	2.1%
	Regional	27.4%
	National	53.7%
	International	16.8%

Measures and Procedures

The survey (available as an attachment) contained 30 questions relating to technical staff structure, planning and work model description, and load management methods. After the survey design, and with the aim of carrying out a small piloting, it was distributed to 10 soccer strength and conditioning coaches. Subsequently, the appropriate translations were made to have the survey available in both Spanish and English versions, with the aim of expanding the target sample. For the e-

survey design, the online platform Qualtrics XM (Utah, United States of America) was used. The distribution was carried out in two ways. In order to access high-level competitive teams, the survey was sent individually to more than 50 coaches and physical trainers from professional clubs, through social networks or email. This same procedure was replicated with practitioners from non-professional clubs to which we had access thanks to our contact book. On the other hand, in order to expand the sample, it was promoted through social networks and mailing lists, facilitating the link to the survey.

Statistical Analysis

The Chi Square test was used to compare the results depending on the sport. In the variables «level of training», «frequency of non-specific training» and «time dedicated to non-specific training» a one-way ANOVA was used. In both cases, the Bonferroni post hoc test was used to analyze the possible existence of significant differences between groups. To compare the variables «number of components of the technical staff», «frequency of non-specific training» and «time dedicated to non-specific training», a T Student test was used to compare according to gender. After verifying that there were no significant differences depending on the country in the studied items, no distinction was made according to this variable for the analysis. For gender comparisons, only the national senior teams were used (38 male teams and 13 female teams).

Results

Technical staff: structure and characteristics

As it is observed in table 2, there are significant differences in the number of the technical staff members depending on the competitive level ($p=0.000$). Conversely there are no significant differences when compared according to gender ($p=0.184$).

Something similar occurs with the academic level. While we found significant differences in the comparison based on competitive level ($p=0.000$), these do not appear when analyzed according to gender ($p=0.869$). At a local and regional level workers with a higher sports technician or basic university degree predominate. At the national and international levels, the most common is to find professionals with a university master's degree.

The head coach is present in 100% of the technical staff. In the rest of the staff positions we found significant differences depending on competitive level (table 2) and also depending on the category (Table 3).

Table 2.

Technical staff structure according to competitive level (mean±sd or percentage)					
Staff Number	Local	Regional	National	International	p
Position	2.72±2.16 _a	4.26±4.54 _a	6.60±3.28 _b	12.39±8.54 _c	0.000***
Coach	100%	100%	100%	100%	1.000
Assistant	72.2% _a	94.8% _b	93.1% _b	95.7% _b	0.011*
Physical Trainer	50% _a	74% _b	97.2% _c	91.3% _c	0.000***
Physiotherapist	11.1% _a	24.7% _a	76.4% _b	87% _b	0.000***
Rehab. Coach	11.1% _a	28.6% _a	45.8% _b	69.6% _b	0.000***
Medical Services	5.6% _a	7.8% _a	40.3% _b	78.3% _c	0.000***
Nutritionist	5.6% _a	9.1% _a	27.8% _b	60.9% _c	0.000***
Psychologist	5.6% _a	13% _a	29.2% _b	34.8% _b	0.011*

The mean values in the same line that do not share the same subscript differ significantly ($p < .05$). *** $p < .001$, ** $p < .01$, * $p < .05$

Table 3.

Positions present in the staff according to category						
Position	U12	U14	U16	U19	Senior	p
Coach	100%	100%	100%	100%	100%	1.000
Assistant	82.4%	88.2%	100%	91.7%	92.6%	0.313
Physical Trainer	41.2% _a	41.2% _a	84% _b	91.7% _b	93.7% _b	0.000***
Physiotherapist	23.5% _a	11.8% _a	24% _a	38.9% _a	73.7% _b	0.000***
Rehab. Coach	23.5% _{ab}	11.8% _b	24% _{ab}	36.1% _{ab}	50.5% _c	0.005**
Medical Services	17.6% _{ab}	11.8% _{ab}	16% _{ab}	13.9% _b	42.1% _a	0.001**
Nutritionist	11.8% _a	11.8% _a	4% _a	22.2% _a	30.5% _a	0.029*
Psychologist	17.6%	11.8%	12%	25%	24.2%	0.534

The mean values in the same line that do not share the same subscript differ significantly ($p < .05$). *** $p < .001$, ** $p < .01$, * $p < .05$

Regarding the degree of communication with the external personal trainers, no statistically significant differences were found based on the competitive level ($p=0.773$). In all cases more than 80% of the respondents affirm that communication is very rare or non-existent.

Planning models and methodology

86.8% of the teams use a single planning model during the season, 7.4% use two and there are 5.8% of the respondents who affirm that they do not use any specific one. Next, the most used models can be seen depending on the category and the competitive level (Table 4). There are no relevant differences according to gender.

Table 4.

Planning models according to category and competitive level						
Models	U12	U14	U16	U19	Senior	p
Classic	11.8%	0%	12%	0%	5.3%	0.155
Block	11.8%	17.6%	8%	5.6%	3.2%	0.178
ATR	0%	5.9%	8%	5.6%	5.3%	0.855
Microcycle	64.7% _a	82.4% _{ab}	76% _{ab}	94.4% _b	86.3% _{ab}	0.053
Other	0%	0%	0%	0%	2.1% _b	0.732
	Local	Regional	National	International	p	
Classic	11.1%	5.2%	4.2%	4.3%	0.694	
Block	16.7%	7.8%	2.8%	4.3%	0.157	
ATR	5.6%	5.2%	5.6%	4.3%	0.997	
Microcycle	61.1% _a	85.7% _{ab}	84.7% _{ab}	95.7% _b	0.022*	
Other	0%	0%	1.4%	4.3%	0.323	

The mean values in the same line that do not share the same subscript differ significantly ($p < .05$). * $p < .05$

We found statistically significant differences in frequency and total volume of non-specific training, both as a function of category ($p=0.000$) and as a function of competitive level ($p=0.000$). While U12, U14 and U16 teams typically include this type of training about one time per week and between 10 to 20 minutes, U19 and senior teams generally include it at least 2-3 times per week, with a total weekly volume between 40 and 60 minutes. Similarly, teams with a local and regional competitive level do not do it more than one time a

week during 10 to 20 minutes on average, while teams that compete nationally and internationally generally include it more than 3 times a week, and between 20 and 30 minutes each session.

All women's teams claim to do non-specific complementary training at least once a week. In addition, 46.2% include that work in all training sessions. However, there are no statistically significant differences between the male and female teams in this section ($p = 0.111$).

Among the 9 teams that never include non-specific training, the main reason is lack of time (70%). 20% affirm that they have no reason not to incorporate them and 10% cite other reasons but did not specify which ones they were.

Table 5 shows the main reasons why non-specific training sessions are incorporated, depending on the category. No significant differences were found for this variable based on the competitive level ($p = 0.089$ - 0.892).

Table 5.

Reasons to carry out non-specific training depending on the category						
Reasons	U12	U14	U16	U19	Senior	p
Injury	76.9%	78.6%	91.7%	91.4%	94.7%	0.114
Performance	30.8%	92.9%	83.3%	68.6%	83%	0.000***
Variety	38.5%	14.3%	16.7%	14.3%	7.4%	0.033*
Other	0%	7.1%	0%	0%	2.1%	0.419

The mean values in the same line that do not share the same subscript differ significantly ($p < .05$). *** $p < .001$, ** $p < .01$, * $p < .05$

A total of 31.1% of the respondents consider that the time dedicated to non-specific training is insufficient. The main reasons for not increasing it are reflected in figure 1.

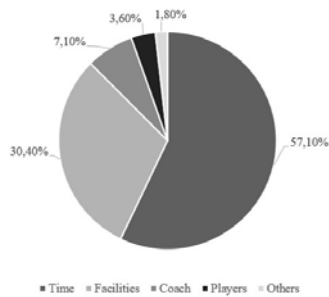


Figure 1. Reasons why non-specific training time does not increase

Table 6.

Contents of non-specific training according to category and competitive level						
Content	U12	U14	U16	U19	Senior	p
Strength	38.5%	85.7%	95.8%	97.1%	95.7%	0.000***
Flexibility	46.2%	7.1%	12.5%	11.4%	16%	0.035*
Endurance	15.4%	28.6%	29.2%	5.7%	10.6%	0.040*
ROM	46.2%	71.4%	50%	80%	68.1%	0.075
Mov. Quality	69.2%	64.3%	37.5%	62.9%	60.6%	0.229
Speed	30.8%	28.6%	45.8%	25.7%	28.7%	0.525
Other	7.7%	0%	4.2%	0%	3.2%	0.593
	Local	Regional	National	International		p
Strength	83.3%	92%	94.4%	81.8%		0.236
Flexibility	33.3%	13.3%	15.5%	18.2%		0.369
Endurance	25%	18.7%	7%	13.6%		0.141
ROM	33.3%	61.3%	71.8%	86.4%		0.009**
Mov. Quality	50%	45.3%	69%	77.3%		0.007**
Speed	50%	34.7%	25.4%	22.7%		0.233
Other	8.3%	2.7%	1.4%	4.5%		0.547

The mean values in the same line that do not share the same subscript differ significantly ($p < .05$). *** $p < .001$, ** $p < .01$, * $p < .05$

There are statistically significant differences in the main contents of non-specific training depending on the category and the competitive level (Table 6). In relation to gender, we only found statistically significant differences in movement quality, which is incorporated in 92.3% of cases in women's teams and only in 59.5% of men's ($p = 0.029$).

Workload control

We found statistically significant differences in load control both according to category and according to competitive level (Table 7). However, these do not appear according to gender ($p = 0.639$).

Table 7.

Loads control according to category and competitive level						
Load Type	U12	U14	U16	U19	Senior	p
General	35.3%	58.8%	80%	86.1%	85.3%	0.000***
Strength	23.5%	52.9%	76%	75%	77.9%	0.646
Training	23.5%	47.1%	76%	80.6%	83.2%	0.011*
Competition	35.3%	47.1%	72%	75%	74.7%	0.825
	Local	Regional	National	International		p
General	38.9%	74%	88.9%	87%		0.000***
Strength	33.3%	67.5%	79.2%	78.3%		0.805
Training	27.8%	64.9%	88.9%	87%		0.001**
Competition	33.3%	61%	79.2%	87%		0.218

The mean values in the same line that do not share the same subscript differ significantly ($p < .05$). *** $p < .001$, ** $p < .01$, * $p < .05$

Of the 70 teams that claim not to control workloads, 67.1% of them don't do it due to lack of technical and economic resources, 24.3% because they do not consider it important and the remaining 8.6% associate it with a coach decision.

Among the teams that control workloads, we found significant differences depending on the competitive level in the methods used to control strength training, specific training, and competition loads (Table 8).

Table 8.

Strength, specific training and competition workload control methods according to competitive level						
Strength training	Local	Regional	National	International		p
Encoder	0%	3.6%	15.9%	73.7%		0.000***
Accelerometer	0%	5.4%	11.1%	47.4%		0.000***
App	16.7%	17.9%	38.1%	26.3%		0.090
RPE	83.3%	89.3%	84.1%	84.2%		0.855
EC/RIR	16.7%	19.6%	25.4%	26.3%		0.846
Biochemical	0%	0%	1.6%	26.3%		0.000***
Video	0%	19.6%	28.6%	47.4%		0.071
Other	0%	1.8%	1.6%	5.3%		0.760
Specific training	Local	Regional	National	International		p
GPS/LPS	0%	18%	59.4%	95%		0.000***
Accelerometer	0%	6%	12.5%	40%		0.002**
Potentiometer	0%	4%	0%	10%		0.117
Heart Rate	0%	8%	31.3%	75%		0.000***
RPE	80%	92%	92.2%	75%		0.131
Biochemical	0%	2%	4.7%	15%		0.145
Radar	0%	2%	0%	35%		0.000***
Tactical Scales	20%	14%	14.1%	15%		0.986
Video	0%	24%	37.5%	65%		0.004**
Competition	Local	Regional	National	International		p
GPS/LPS	0%	17%	66.7%	95%		0.000***
Accelerometer	0%	2.1%	8.8%	30%		0.003**
Potentiometer	0%	0%	1.8%	5%		0.488
Heart Rate	0%	10.6%	22.8%	35%		0.062
RPE	83.3%	85.1%	78.9%	70%		0.553
Biochemical	0%	0%	0%	15%		0.001**
Video	33.3%	42.6%	35.1%	60%		0.265

The mean values in the same line that do not share the same subscript differ significantly ($p < .05$). *** $p < .001$, ** $p < .01$, * $p < .05$

We also found significant differences in relation to fatigue control depending on the competitive level ($p = 0.001$). While the majority of teams at the local and regional level do not control fatigue -only 16.7% and 48.1%, respectively-, the teams that compete nationally (73.6%) and, above all, those that do so internationally (87%), mainly control fatigue. Although there are notable differences in fatigue control also depending on the category (17.6% U12, 35.3% U14, 56% U16, 58.3% U19 and 72.6% senior), these differences are not statistically significant ($p = 0.061$), only trends. We also did not find relevant differences in this variable according to gender ($p = 0.782$).

As we can see in Table 9, the competitive level also seems to be a discriminating factor when analyzing the methods used to control fatigue.

Table 9.

Methods for fatigue monitoring according to the competitive level

Methods	Local	Regional	National	International	p
Wellness	100% _{ab}	64.9% _b	90.6% _a	75% _{ab}	0.019*
Fatigue Scales	33.3% _{ab}	51.4% _b	22.6% _a	35% _{ab}	0.047*
Biochemical	0% _a	2.7% _a	9.4% _{ab}	40% _b	0.000***
Jump Test	33.3%	37.8%	28.3%	40%	0.722
Isometric	0% _a	0% _a	0% _a	10% _b	0.024*
HRV	0%	13.5%	13.2%	30%	0.246

The mean values in the same line that do not share the same subscript differ significantly ($p < .05$). *** $p < .001$, * $p < .05$

92.1% of the teams that control workloads or fatigue state that they would like to be able to use other methods for these purposes. The main reasons for not doing so are represented in figure 2.

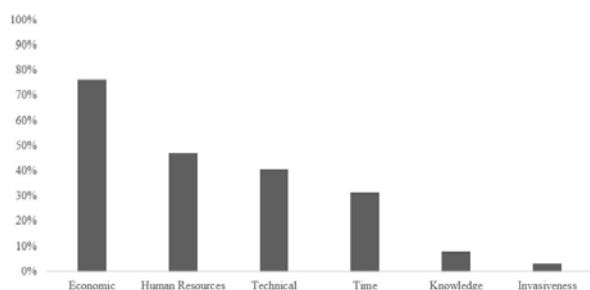


Figure 2. Reasons for not using other control methods

Discussion

The results of the survey reveal that there are differences in the structure of the technical staff, the planning models, the methodology and the workload control depending on the category and the competitive level. Gender only appears as a discriminating variable, in relation to the most used non-specific training contents.

We can see how the structure of the technical staff is broader as the competitive level rises. This seems quite logical considering that the teams with the highest competitive level are those with the greatest economic

potential, and therefore can afford to have more professionals on the payroll, both players and coaching staff. Furthermore, it seems reasonable that the quality of these professionals is also higher as the competitive level increases, as it happens with the players (Milanovic, 2005). One of the variables that could explain the quality of the technical staff is the academic level, which, according to the results of this study, is higher at the national and international levels than in regional or local teams.

The weekly microcycle is the most widely used planning model regardless of category or competitive level. These results agree with previous publications, which highlighted the relevance of short-term planning in this sport (Delgado-Bordonau, & Mendez-Villanueva, 2012; Martín-García et al., 2018) However, the role of classic and block periodization increases in lower categories (U12, U14 and U16). This fact could be linked to the formative nature of sport at these ages, an area in which medium and long-term planning seems to be an interesting strategy (Lloyd et al., 2015).

On the other hand, the non-specific training volume also differs depending on the category and the competitive level. According to a recent meta-analysis, the volume of complementary training with the greatest preventive effect is between 30 and 60 minutes per week, with an optimal distribution in 2 or 3 sessions per week (Steib, Rahlf, Pfeifer, & Zech, 2017). Only U19 and senior teams, as well as those with competitive national or international levels, could be close to these values.

Injury prevention and performance improvement are the primary reasons for incorporating non-specific complementary training. However, in the U12 category, there seems to be a greater concern for giving variety to training, even greater than optimizing performance, something that does not occur in higher categories. In relation to the most common contents of complementary training, strength training stands out above the rest in general. These results seem to go hand in hand with what has been established by different studies, which highlight the importance of muscular strength to reduce the risk of injury (Lauersen et al., 2018), with evidence of a magnitude greater than that shown by other contents such as flexibility, balance or agility (De la Motte, Gribbin, Lisman, Murphy, & Deuster, 2017). However, in the U12 category, increases the importance of contents such as movement quality, flexibility and mobility, to the detriment of strength training. Although some authors have highlighted the

U12 category as an interesting moment for mobility work, this should not mean a reduction in content related to strength, which should be the main physical quality throughout the youth athletic development (Lloyd et al., 2015). We also found significant differences in this section according to gender. Women's teams tend to work on movement quality to a greater extent than men's teams. To our knowledge, there is little scientific evidence to explain these differences in the content selection based on sex. In fact, the results of a meta-analysis revealed significant differences in strength and endurance between men and women but found no differences in relation to the movement quality (Courtright, McCormick, Postlethwaite, Reeves, & Mount, 2013).

Load control has emerged in recent years as one of the main strategies to reduce the risk of injury (Eckard, Padua, Hearn, Pexa, & Frank, 2018). The results of the survey corroborate that the loads are controlled in a generalized way from the U16 category and at a competitive level higher than the regional one. In contrast, there are few U14 or local competitive level teams that control workloads. There are also differences in the methods used to carry out load control. In relation to strength training, for example, the use of the rating of perceived exertion (RPE) stands out in all cases. However, other instruments such as the encoder or accelerometers, as well as the measurement of biochemical variables, are only reserved for international level teams. Something similar occurs in the control of the specific training load. GPS/LPS devices, accelerometers, heart rate monitors, radar or video cameras are mainly used by national and, especially, international teams. This same phenomenon is repeated during the control of competition loads. While RPE remains stable as one of the most widely used methods in all teams, only those with higher competitive levels can have general access to GPS/LPS, accelerometers, or the measurement of biochemical variables. On the other hand, similar to what was published by Akenhead & Nassis (2016), RPE and heart rate monitors are much more used by international teams in training than in games, while GPS/LPS are maintained as the most used methods in both cases.

Finally, fatigue has also been associated with injury risk from the scientific literature (Thorpe, Atkinson, Drust, & Gregson, 2017). In our study, similar to what happened with the workload control, there are differences depending on the competitive level. While it is a common practice for teams with high competitive

levels, only 16.7% of local teams control fatigue. Likewise, differences appear depending on the competitive level in the methods used to control fatigue, with national or international teams monitoring biochemical or biomechanical variables, while regional and local teams mainly resort to subjective wellness scales and recovery questionnaires.

Conclusions

In conclusion the results of the present study reveal the existence of differences in the structure of the technical staff, the planning models, the methodology and the workload control depending on the competitive level and, although to a lesser extent, also depending on the category. Gender does not seem to be a discriminating variable in most of the analyzed items. More specifically, we can conclude that the weekly microcycle is the preferred planning model by most teams, regardless of their competitive level. However, in lower categories, medium and long term periodization is also used. The volume of non-specific complementary training is, in general, less than that recommended to reduce the risk of injury in lower category (U12, U14 and U16) and competitive level (local and regional) teams. Strength training is the most used non-specific content in general. However, its importance is reduced in lower categories. Load and fatigue control is only extended among teams of superior category and competitive level, while in U12 category and local competitive levels most of the teams do not control loads or fatigue.

One of the limitations of the study is that we use criteria of convenience and ease of access to the sample for distribution, not being able to access all professional clubs, for example. In addition, there are imbalances in the sample related to category, competitive level and gender. In future works it would be interesting to achieve a more homogeneous distribution in these sections.

Practical applications

In accordance with the recommendations of the most current scientific evidence, the volume of complementary training should be increased in categories U12, U14 and U16 to reduce the risk of injury.

Strength training should form the basis of complementary training at all ages. The lower use of

this content in lower categories contradicts the scientific evidence.

The ease in the application and the usefulness of the subjective methods of workload control (i.e., RPE) and fatigue (i.e., Wellness questionnaire) should constitute, in our opinion, sufficient reasons to increase their use among all teams, despite category or competitive level.

Acknowledgments

We would like to thank all the participating clubs and technical staffs for their collaboration by responding to our survey.

References

- Akenhead, R., & Nassis, G. P. (2016). Training load and player monitoring in high-level football: current practice and perceptions. *International Journal of Sports Physiology and Performance, 11*(5), 587-593.
- Bengtsson, H., Ekstrand, J., Waldén, M., & Häggglund, M. (2018). Muscle injury rate in professional football is higher in matches played within 5 days since the previous match: a 14-year prospective study with more than 130 000 match observations. *British Journal of Sports Medicine, 52*(17), 1116-1122.
- Carroll, T. J., Taylor, J. L., & Gandevia, S. C. (2017). Recovery of central and peripheral neuromuscular fatigue after exercise. *Journal of Applied Physiology, 122*(5), 1068-1076.
- Courtright, S. H., McCormick, B. W., Postlethwaite, B. E., Reeves, C. J., & Mount, M. K. (2013). A meta-analysis of sex differences in physical ability: Revised estimates and strategies for reducing differences in selection contexts. *Journal of Applied Psychology, 98*(4), 623.
- De la Motte, S. J., Gribbin, T. C., Lisman, P., Murphy, K., & Deuster, P. A. (2017). Systematic review of the association between physical fitness and musculoskeletal injury risk: Part 2—Muscular endurance and muscular strength. *The Journal of Strength & Conditioning Research, 31*(11), 3218-3234.
- Delgado-Bordonau, J. L. & Mendez-Villanueva, A. (2012). Tactical periodization: Mourinho's best-kept secret. *Soccer Journal, 57*(3), 29-34.
- Dellal, A., Lago-Peñas, C., Rey, E., Chamari, K., & Orhant, E. (2015). The effects of a congested fixture period on physical performance, technical activity and injury rate during matches in a professional soccer team. *British Journal of Sports Medicine, 49*(6), 390-394.
- Eckard, T. G., Padua, D. A., Hearn, D. W., Pexa, B. S., & Frank, B. S. (2018). The relationship between training load and injury in athletes: a systematic review. *Sports Medicine, 48*(8), 1929-1961.
- Enoka, R. M., & Duchateau, J. (2016). Translating fatigue to human performance. *Medicine and Science in Sports and Exercise, 48*(11), 2228.
- García-Calvo, T., González-Ponce, I., Ponce, J. C., Tomé-Lourido, D., & Vales Vázquez, Á. (2019). Incidencia del sistema de puntuación de las tareas sobre la carga mental del entrenamiento en fútbol. *Revista de Psicología del Deporte, 28*(2), 79-86.
- Halson, S. L. (2014). Monitoring training load to understand fatigue in athletes. *Sports Medicine, 44*(2), 139-147.
- Haugen, T., & Seiler, S. (2015). Physical and physiological testing of soccer players: why, what and how should we measure?. *Sportscience, 19*, 10-27.
- Jaspers, A., Kuyvenhoven, J. P., Staes, F., Frencken, W. G., Helsen, W. F., & Brink, M. S. (2018). Examination of the external and internal load indicators' association with overuse injuries in professional soccer players. *Journal of Science and Medicine in Sport, 21*(6), 579-585.
- Jones, C. M., Griffiths, P. C., & Mellalieu, S. D. (2017). Training load and fatigue marker associations with injury and illness: a systematic review of longitudinal studies. *Sports Medicine, 47*(5), 943-974.
- Keen, R. (2018). Nutrition-Related Considerations in Soccer: A Review. *American Journal of Orthopedics, 47*(12).
- Knicker, A. J., Renshaw, I., Oldham, A. R., & Cairns, S. P. (2011). Interactive processes link the multiple symptoms of fatigue in sport competition. *Sports Medicine, 41*(4), 307-328.
- Lauersen, J. B., Andersen, T. E., & Andersen, L. B. (2018). Strength training as superior, dose-dependent and safe prevention of acute and overuse sports injuries: a systematic review, qualitative analysis and meta-analysis. *British Journal of Sports Medicine, 52*(24), 1557-1563.
- Lauersen, J. B., Bertelsen, D. M., & Andersen, L. B. (2014). The effectiveness of exercise interventions to prevent sports injuries: a systematic review and meta-analysis of randomised controlled trials. *British Journal of Sports Medicine, 48*(11), 871-877.
- Lloyd, R. S., Oliver, J. L., Faigenbaum, A. D., Howard, R., Croix, M. B. D. S., Williams, C. A., ... & Myer, G. D. (2015). Long-term athletic development-part

- 1: a pathway for all youth. *The Journal of Strength & Conditioning Research*, 29(5), 1439-1450.
- Mallo, J. (2011). Effect of block periodization on performance in competition in a soccer team during four consecutive seasons: A case study. *International Journal of Performance Analysis in Sport*, 11(3), 476-485.
- Martín-García, A., Díaz, A. G., Bradley, P. S., Morera, F., & Casamichana, D. (2018). Quantification of a professional football team's external load using a microcycle structure. *The Journal of Strength & Conditioning Research*, 32(12), 3511-3518.
- Mendiguchia, J., Conceição, F., Edouard, P., Fonseca, M., Pereira, R., Lopes, H., ... & Jiménez-Reyes, P. (2020). Sprint versus isolated eccentric training: Comparative effects on hamstring architecture and performance in soccer players. *PLoS One*, 15(2), e0228283.
- Milanovic, B. (2005). Globalization and goals: does soccer show the way?. *Review of International Political Economy*, 12(5), 829-850.
- Mohr, M., Krstrup, P., & Bangsbo, J. (2005). Fatigue in soccer: a brief review. *Journal of Sports Sciences*, 23(6), 593-599.
- Morin, J. B., Petrakos, G., Jiménez-Reyes, P., Brown, S. R., Samozino, P., & Cross, M. R. (2017). Very-heavy sled training for improving horizontal-force output in soccer players. *International Journal of Sports Physiology and Performance*, 12(6), 840-844.
- Muñoz-López, A., Nakamura, F., & Naranjo Orellana, J. (2021). Soccer matches but not training sessions disturb cardiac-autonomic regulation during national soccer team training camps. *Research Quarterly for Exercise and Sport*, 92(1), 43-51.
- Pareja-Blanco, F., Sánchez-Medina, L., Suárez-Arrones, L., & González-Badillo, J. J. (2017). Effects of velocity loss during resistance training on performance in professional soccer players. *International Journal of Sports Physiology and Performance*, 12(4), 512-519.
- Romero-Caballero, A., & Campos-Vázquez, M. Á. (2020). Relación entre indicadores de carga interna en un juego reducido 3x3 en jóvenes futbolistas. *Retos*, 37(37), 152-159.
- Steib, S., Rahlf, A. L., Pfeifer, K., & Zech, A. (2017). Dose-response relationship of neuromuscular training for injury prevention in youth athletes: A meta-analysis. *Frontiers in Physiology*, 8, 920.
- Stølen, T., Chamari, K., Castagna, C., & Wisløff, U. (2005). Physiology of soccer. *Sports Medicine*, 35(6), 501-536.
- Styles, W. J., Matthews, M. J., & Comfort, P. (2016). Effects of strength training on squat and sprint performance in soccer players. *The Journal of Strength & Conditioning Research*, 30(6), 1534-1539.
- Thornton, H. R., Delaney, J. A., Duthie, G. M., & Dascombe, B. J. (2019). Developing athlete monitoring systems in team sports: data analysis and visualization. *International Journal of Sports Physiology and Performance*, 14(6), 698-705.
- Thorpe, R. T., Atkinson, G., Drust, B., & Gregson, W. (2017). Monitoring fatigue status in elite team-sport athletes: implications for practice. *International Journal of Sports Physiology and Performance*, 12(s2), S2-27.
- Vales-Vázquez, A., Gayo, A. A., Fernández, C. A., & Quintela, J. T. (2017). Comparación del grado de especificidad de dos microciclos de entrenamiento en fútbol correspondientes a un equipo profesional ya un equipo en formación. *Retos: Nuevas Tendencias en Educación Física, Deporte y Recreación*, (32), 14-18.
- Vanrenterghem, J., Nedergaard, N. J., Robinson, M. A., & Drust, B. (2017). Training load monitoring in team sports: a novel framework separating physiological and biomechanical load-adaptation pathways. *Sports Medicine*, 47(11), 2135-2142.

