Recovery strategies for sports performance in the spanish professional basketball league (ACB)

Estrategias de recuperación para el rendimiento deportivo en la liga española de baloncesto profesional (ACB)

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Abstract

This study aimed to describe the recovery strategies used by the Spanish professional basketball teams playing in the "Liga ACB." Data from all teams during the 2019-2020 season (n = 18), and the team promoted for the season 2020-2021 were collected using a six-section online survey. Protocols, timings, and recovery strategies employed differed among teams. However, natural and physical recovery strategies such as sleep/nap, food/fluid replacement, active field, or gym-based cool-downs, use of supplementation, active or passive stretching, cold/ice bath/shower/immersion, massage, and foam-rolling were the most used among seventeen teams (>89%). Food and fluid replacement, showed a higher presence in the recovery protocols after competition and practice, always used by thirteen or more teams (~70%). The design and supervision of recovery are multidisciplinary tasks in 74% of the teams. Only two teams (11%) acknowledged not periodizing or individualizing recovery, while the other seventeen used these procedures regularly, considering different parameters, being previous injuries a factor always present. Teams not reaching the playoffs used a higher number of recovery strategies on average. This study provides a real vision of how the "Liga ACB" teams use recovery protocols, and pertinent contextual information that may be used for coaches and practitioners to tailor them.

Key words: recovery methods, professional players, survey, team sports, questionnaire.

Resumen

El presente estudio tuvo como objetivo describir las estrategias de recuperación utilizadas por los equipos de baloncesto profesionales españoles que participan en la "Liga ACB". Se recogieron datos de todos los equipos durante la temporada 2019-2020 (n = 18) y del equipo ascendido para la temporada 2020-2021 mediante una encuesta en línea con seis secciones. Los protocolos, tiempos y estrategias de recuperación empleados difirieron entre equipos. Las estrategias de recuperación físicas y naturales, son los más utilizados por diecisiete equipos (> 89%). La alimentación y reposición de líquidos mostró mayor presencia en los protocolos de recuperación después de las competiciones y entrenamientos, siempre utilizada por trece o más equipos (~ 70%). El diseño y supervisión de la recuperación fue una tarea multidisciplinar en el 74% de los equipos. Solo dos equipos (11%) reconocieron no planificar o individualizar la recuperación, mientras que los otros diecisiete lo hacían considerando diferentes parámetros, siendo las lesiones previas un factor siempre presente. Los equipos que no llegaron a los "playoff" utilizaron más estrategias de recuperación de promedio. Este estudio proporciona una visión real de cómo los equipos de la "Liga ACB" implementan los protocolos de recuperación y aporta información contextual pertinente.

Palabras clave: métodos de recuperación, jugadores profesionales, encuesta, deporte de equipo, cuestionario.

Introduction

Performance in team sports as basketball, is the expression of complex, dynamic, multi-dimensional, and interactive processes (Calleja-González et al. 2018) affected by intrinsic and extrinsic factors parameters (Cormery et al. 2007). These processes are only sustainable if the stress and fatigue produced by practice, competition, and personal life are balanced with adequate time for recovery (Delextrat et al. 2012), which may refer to short-term, mid-term, or long-term restoration and can be divided in active, passive and proactive approaches (Kellmann et al. 2018). However, a required time based on concrete time frames for recovery may differ within and between the different organismic systems of the human body and a clear categorization cannot be provided due to intra and interindividual variability of this process (Kellmann et al. 2018). During the last years, top-level basketball teams are competing more than ever, with an increasingly condensed game schedule (Esteves et al. 2020). Players from top teams must deal with concurrent national and international club championships in addition to national teams qualifiers windows tournaments (FIBA, 2021), with, on average, a game every 2.5 days (Ben Abdelkrim et al. 2007). Besides, the new rules introduced in 2000 by the International Basketball Federation (FIBA) (FIBA, 2020), and adopted by the national federations, have had a substantial effect on the game, including more cardiac efforts (Ben Abdelkrim et al. 2007), larger total time spent in high-intensity activities and a higher number of actions per game (Terrados et al. 2019). Recovery should be now regarded as a multifaceted, physiological, and psychological restorative process relative to time (Delextrat et al. 2012) with time-constraints and game intensity play a relevant role in acute and chronic adaptations. However, the interests of using recovery in different performance markers are varied depending on the marker assessed and the physiological benefit expected (Altarriba-Bartes et al. 2020). Thus, fatigue is related to the specific demands of every sport and recovery processes should be tailored to those specific responses (Calleja-González et al. 2016). If recovery is insufficient, it could initiate a cascade of disadvantageous conditions such as under-recovery, functional overreaching, non-functional overreaching or overtraining syndrome (Jentjens & Jeukendrup, 2003), being the balance between "happiness and wellness" presented as an exciting challenge in the future in high-performance sports (Calleja-González et al. 2018). Thus, in the upcoming years, it will be essential to individualize (Moreno et al. 2015) and optimize recovery given that professional players are spending more time using a wide array of recovery techniques than they do practicing (Bishop et al. 2008), while traveling (Calleja-Gonzalez et al. 2020) after a single game (Clarke & Noon, 2019) or during congested schedules playing multiple games per week (Howle et al. 2019).

Full restoration of organic and psychological parameters has been attributed to an optimal recovery (Barnett, 2006). Nevertheless, recovery from competition or training is dependent on the type of exercise, and it is necessary then to understand the specific mechanisms of fatigue and the influence of external factors (Calleja-González et al. 2019). In this sense, physiological tests could be a useful tool for coaches to monitor stress and recovery balance in male and female basketball players during different periods of the season (di Fronso et al. 2013). The most characteristic demands placed on team sports players during practice and games are fast and short accelerations, decelerations, explosive change of direction, jumps, and several contacts among players that could create trauma (McKeag, 2003). Therefore, monitoring training and recovery concurrently with the rate of perceived exertion (RPE) method and total quality recovery (TQR) scale, combined with other physiological parameters (Haddad et al. 2017), is recommended for designing training schedules in basketball (Sansone et al. 2020) although they present some limitations in their practical application due to the influence of contextual factors in the reporting (Brito et al. 2016; Foster et al. 2020). Moreover, players are also characterized by a large muscle mass (Nikolaidis et al. 2015) and body size (Zarić et al. 2020), which could influence their performance (Ferioli et al. 2018) and consequently their recovery profile. Different methods used to enhance recovery have been analyzed during the last decades (Montgomery et al. 2008). The evidence says that their use depends on the type of activity performed, the time available until the next training session or competitive event, and the equipment, coaching, and medical staff available. Recommendations for specific post-exercise recovery, using methods verified by scientific investigations, are available for basketball (Calleja-González et al. 2016). Thus, hydrotherapy, active recovery, sleep, stretching, compression garments, massage, contrast, cold water immersion, and ergogenic aids are among the most commonly used strategies in these professional settings (Altarriba-Bartes, et al. 2020; Terrados et al. 2019). However, high-quality scientific research specific to the area of recovery in basketball is still needed (Delextrat et al. 2013, 2018).

Nowadays, sports recovery is prescribed based on the type of activity, the time between practices or competitions, and medical staff availability (Calleja-González et al. 2016). But when talking about the most appropriate protocols to enhance recovery, science is still trying to gather a greater understanding of physiology related to performance change, recovery approaches, and relevant factors contributing to players' diverse physiological approaches (Stephens et al. 2017).

Many post-exercise recovery possibilities for basketball players exist (Calleja-González et al. 2016), and it is generally recognized that professional players are using them. However, to the best of the authors' knowledge, there is not much research surveying the methods used by professional basketball teams under different circumstances. Therefore, the main goal of this investigation was to describe the recovery strategies used during the whole competitive period by the "Liga ACB" (Spanish first division) teams. It is hypothesized that most clubs use diverse recovery strategies, with the physical ones likely being among the most popular ones. It is also hypothesized that a multidisciplinary team designs and supervises these recovery procedures in professional basketball settings.

Methods

Participants

All eighteen professional Spanish teams who played in the "Liga ACB" (Spanish first division) during the season 2019-2020 and the team promoted to that competition for the season 2020-2021 were included in the study. This professional competition is considered by many experts among the best basketball leagues in the world (Euroleague, 2013; Martin, 2012). Teams were composed of 14 ± 1 players (with a total of 258 professional basketball players) who used to train between 4 and 9 (range) sessions per week (6.37 ± 1.67 sessions), with a total of 11.47 ± 3.52 hours on average of practice per week and played 1-2 games per week (1.63 ± 0.50 games), with a total of 90.53 ± 61.14 minutes of competition on average every week. Teams were contacted (via e-mail or phone) to participate in this study and responded to the survey once. Medical or performance staff members (fitness coaches, team physician, or strength and conditioning coaches) contacts were obtained through "Asociación Española de Preparadores Físicos de Baloncesto" (ASEPREB), the official Spanish Strength & Conditioning basketball coaches association (https://www.asepreb.com/).

Ethics approval and consent to participate

The study was approved by ~~a local~~ the Research Ethics Committee of the University of Vic-Central University of Catalonia (registration number: 87/2019) and was designed respecting the principles of the Declaration of Helsinki and its later amendments (Hellmann et al., 2014; WMA, 2013). Participants received all the information detailing the study aims in advance. Participants' rights were preserved, asking for voluntary participation, and giving the possibility to withdraw at any moment.

Study design

The study followed a cross-sectional design using non-probabilistic sampling. An online Ad-hoc survey was explicitly deployed to determine the use of recovery strategies by Spanish professional basketball first division teams, consisting of a combination of questions using checkboxes, Likert scales, and open-ended, free-text responses. The authors designed the first draft of the survey. A pilot test of the survey was performed by three professional teams not included in the study who volunteered to participate.

The design was based on previously published surveys on recovery strategies (Altarriba-Bartes, et al. 2020; Crowther et al. 2017; Venter et al. 2009). The survey was available online from 21/03/2020 to 26/08/2020 when the last team answered. It comprises the six sections described in the following paragraph, and it took an estimated time of 15 minutes to be completed.

Data collection method

The survey considered six sections; the first section asked about the teams' demographics (team name and number of players per team) and their level of participation (number and duration of weekly training sessions and games). The following sections consisted of specific questions regarding the use of recovery strategies or methods after games (second section), after preseason practices (third section), and after in-season practices (fourth section). In each of these sections, participants had to indicate how many players used every strategy ("all of them," "more than 50%", or "less than 50%" of the total of the team) and the frequency of use (always, sometimes, rarely, never, based on players' perception). The list of recovery strategies was elaborated following two proposals (Crowther et al. 2017; Venter et al. 2009), included:

- Natural strategies: active field or gym based, active pool-based, active or passive stretching, sleep/nap, food or fluid replacement, and supplement use.

- Physical strategies: cryotherapy or cooling methods (cold/ice bath/shower/immersion and ice pack/vest application), contrast temperature therapy (contrast bath/shower/immersion and sauna), heat methods (heat pack application), compression garments (C.G.), massage, foam rolling and liniment or gel/cream application.
- Psychological strategies: progressive muscle relaxation and imagery/prayer/music.
- Complementary/alternative strategies: reflexology or acupuncture, and medication use.
- Other strategies.

In this section's last question, participants were invited to add other strategies used but not mentioned in the survey, using an open category labeled "other strategies."

The fifth section provided a deeper understanding of the use of the recovery strategies in each team/club. Check listing was used to ask for the moment of the first use, the number of times that the strategy was performed from the end of a game/training session until the following one, periodization or planning, the combination of different recovery strategies, and the obligation or non-obligation to use them. Furthermore, questions about preparation/design and supervision responsibility, personalization for players, the location where strategies took place, and the main reason for choice were asked using a checklist. However, to include all other options if they did not find the proper one, an open-labeled "other" (specify) option was added.

The sixth section included questions complementary information about the use/or not of recovery strategies in the club youth teams and economic and logistic resources. Participants not using recovery strategies in their day-to-day practices in the previous sections were redirected straight to this section. After that, their participation in the survey concluded.

Statistical analysis

Absolute and relative frequencies for the categorical variables, measures of central tendency (mean), and dispersion [standard deviation (SD), Range] for continuous variables were calculated. Data normality was checked using the Shapiro-Wilk test and Q-Q plots. An Independent Samples T-Test was used to find significant differences between the number of strategies used and team's competitive performance when they were clustered into playoff teams (n = 12) vs. non-playoff teams (n = 6). The promoted team was not included in this analysis. The assumption of homogeneity of variance was determined using the Test for Equality of Variances (Levene's). Qualitative terms were assigned to determine the observed frequencies' magnitude as follows: All = 100% of teams; Most = ≥75%; Majority = 55 to 75%; Approximately half = ~50%; Approximately a third = ~30%; Minority = <30% (Starling & Lambert, 2018). Data were extracted from the online survey (Google forms®) to a spreadsheet (Microsoft® Excel for Mac, version 16.40). After codifying all the responses, analyses and plots were performed using R (R 3.5.1 GUI 1.70, R Foundation for Statistical Computing, Austria) and using JASP for Mac (Version 0.13.1, University of Amsterdam, The Netherlands). Quantitative, Likert, data were analyzed using the 'Likert' (Bryer & Speerschneider, 2016) package in R version 3.6.1 (R CoreTeam, 2019).

Results

All the teams contacted in the study completed the survey (100% response rate). Eighteen teams (95%; most) used recovery strategies at some point during the season. There is only one team (5%; minority) that did not propose any strategy after competition and practices, neither in preseason nor in-season. After the competition, the minority of the teams (21%; n = 4) used recovery strategies for all the players of the squad or less than a half of the players (11%; minority), while the majority of them (63%; n = 12) used recovery strategies by more than half of the players of the squad. Following preseason training, approximately a third of the teams (37%; n = 7) used recovery strategies for all the squad players, and approximately a half (53%; n = 10) were used for more than half of the squad. Only one team (5%; minority) reported that the use of recovery strategies was followed by less than half of the players during this period. Recovery strategies after in-season practices were used for all the squad players in three teams (16%; minority) or more than half of the squad players in most of them, fifteen teams (79%).

The use of recovery strategies differed among teams (Table 1). The most utilized recovery strategies (used by most of the teams [~90%; n = 17] were sleep/nap, food/fluid replacement, cold/ice bath/shower/immersion, massage, active field, or gym-based cool-downs, use of supplementation, active or passive stretching, massage, and foam rolling. Natural recovery strategies were the most used among teams (>89%), apart from pool-based cool-downs (16%; n = 3). Physical recovery strategies, such as cold/ice contrast bath/shower/immersion, massage, and foam rolling, were also used by most teams (>89%). In contrast, sauna and heat pack application from physical, imagery/prayer/music

Table 1. Recovery strategies undertaken by all Spanish ACB teams.

Recovery strategy		Do you use these recovery strategies?			
		Yes		No	
		n	%	n	%
Natural	Active field or gym based	17	89	2	11
	Active pool-based	3	16	16	84
	Active or passive stretching	17	89	2	11
	Sleep/Nap	17	89	2	11
	Food/Fluid replacement	17	89	2	11
	Supplement use	18	95	1	5
Physical	Cold/Ice Bath/Shower/Immersion	17	89	2	11
	Ice pack/vest application	10	53	9	47
	Contrast Bath/Shower/Immersion	11	58	8	42
	Sauna	3	16	16	84
	Heat pack application	3	16	16	84
	Compression garments	15	79	4	21
	Massage	17	89	2	11
	Foam rolling	18	95	1	5
	Liniment or gel/Cream application	7	37	12	63
Psychological	Progressive muscle relaxation	9	47	10	53
	Imagery/Prayer/Music	4	21	15	79
Complementary/Alternative	Reflexology/Acupuncture	4	21	15	79
	Medication use	7	37	12	63
Other	Other	5	26	14	74

from psychological, and reflexology/acupuncture from alternative recovery strategies were the least popular among the teams (<21%; minority).

The use of recovery strategies after the competition and after practices, preseason and in-season, are summarized in Figure 1, Figure 2, and Figure 3, respectively.

Some of the other non-usual strategies not mentioned in the survey but proposed by the teams were: vibration massage, vibration plates, cold compression wraps, ice compression therapy, or oxygen therapy.

Periodization, individualization/personalization, frequency, time of first use, and combination of recovery strategies after practice or competition during the season are summarized in Table 2.

Parameters used to individualize or personalize recovery strategies are summarized in Table 3.

No significant differences were found using the Independent Samples T-Test between the number of strategies used and competitive performance when teams were clustered into playoff Vs. non-playoff teams [t (16) = 0.577, p = 0.572]. The teams not reaching the playoffs in our sample used, on average, a higher number of recovery strategies (M = 13.3, SD = 4.3) than those who achieved more competitive success at the end of the season, playoff teams (M = 12.0, SD = 4.7) (Figure 4).

Recovery strategies of most teams (74%; n = 14) were designed and supervised by different professionals (members of the medical and technical staff) and not only by one specific profile. Four teams (21%; minority) reported that the strength and conditioning coach was the only responsible for preparing/designing these protocols and supervising them, and in other four teams were in concordance with the physiotherapist.

The majority of the teams (63%; n = 12) acknowledged that the prescribed parameters were based on scientific evidence about recovery, while a minority (21%) followed expert opinion (n = 2) or players' beliefs (n = 2).

Players' recovery strategies usage was optional in seven teams (37%; approximately a third), while for the other twelve (63%; majority), it was mandatory. Thirteen teams (68%; majority) used their facilities to recover; the other six (32%; approximately a third) admitted that logistics and the economic resources of the club were not enough, which was the main reason not to use some or any of the strategies in four of them.

Eleven teams (58%; majority) confirmed that their academy teams also used recovery strategies. Only one team (5%; minority) used the same ones as the first team while the other ten (53%; approximately half) opted for different protocols for different reasons such as cost, logistics, resources, club structure, ethical concerns, or schedule.

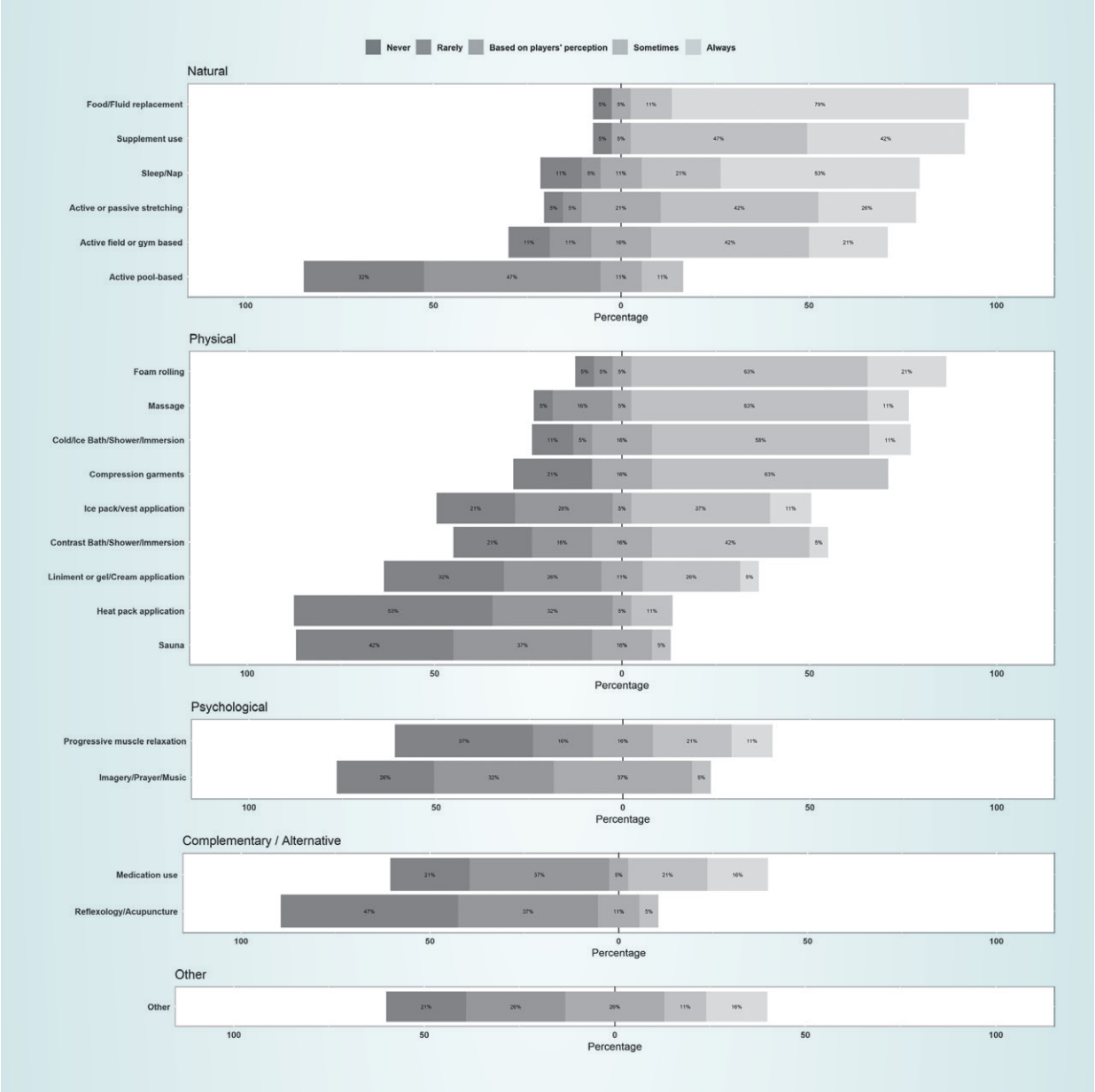

Figure 1. Recovery strategies undertaken by all Spanish first division professional teams after the competition. The information is presented using diverging bars to facilitate the comparison of multiple categories by showing the contrast between numerical values in every category.

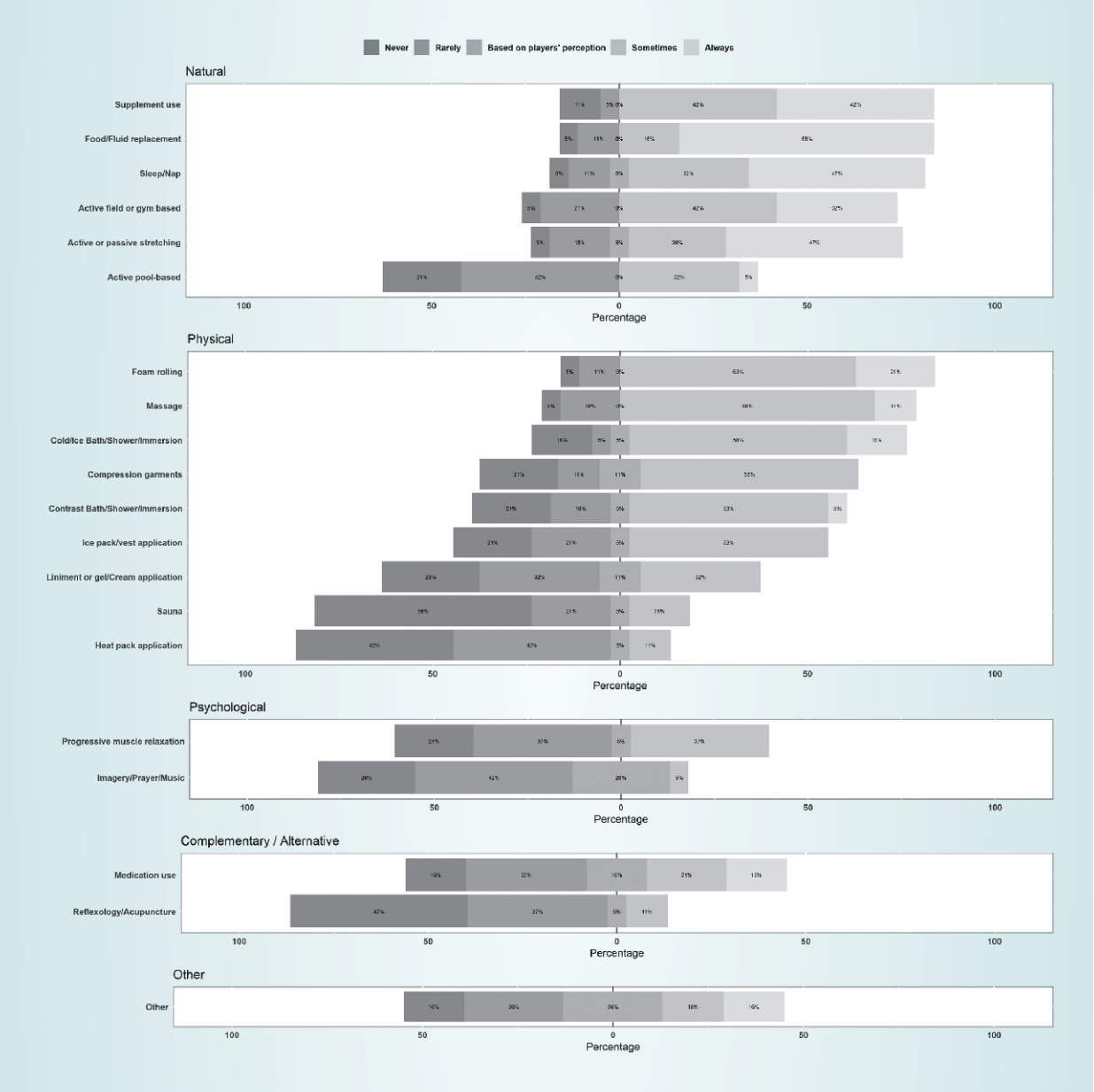

Figure 2. Recovery strategies undertaken by all Spanish first division professional teams after preseason training sessions. The information is presented using diverging bars to facilitate the comparison of multiple categories by showing the contrast between numerical values in every category.

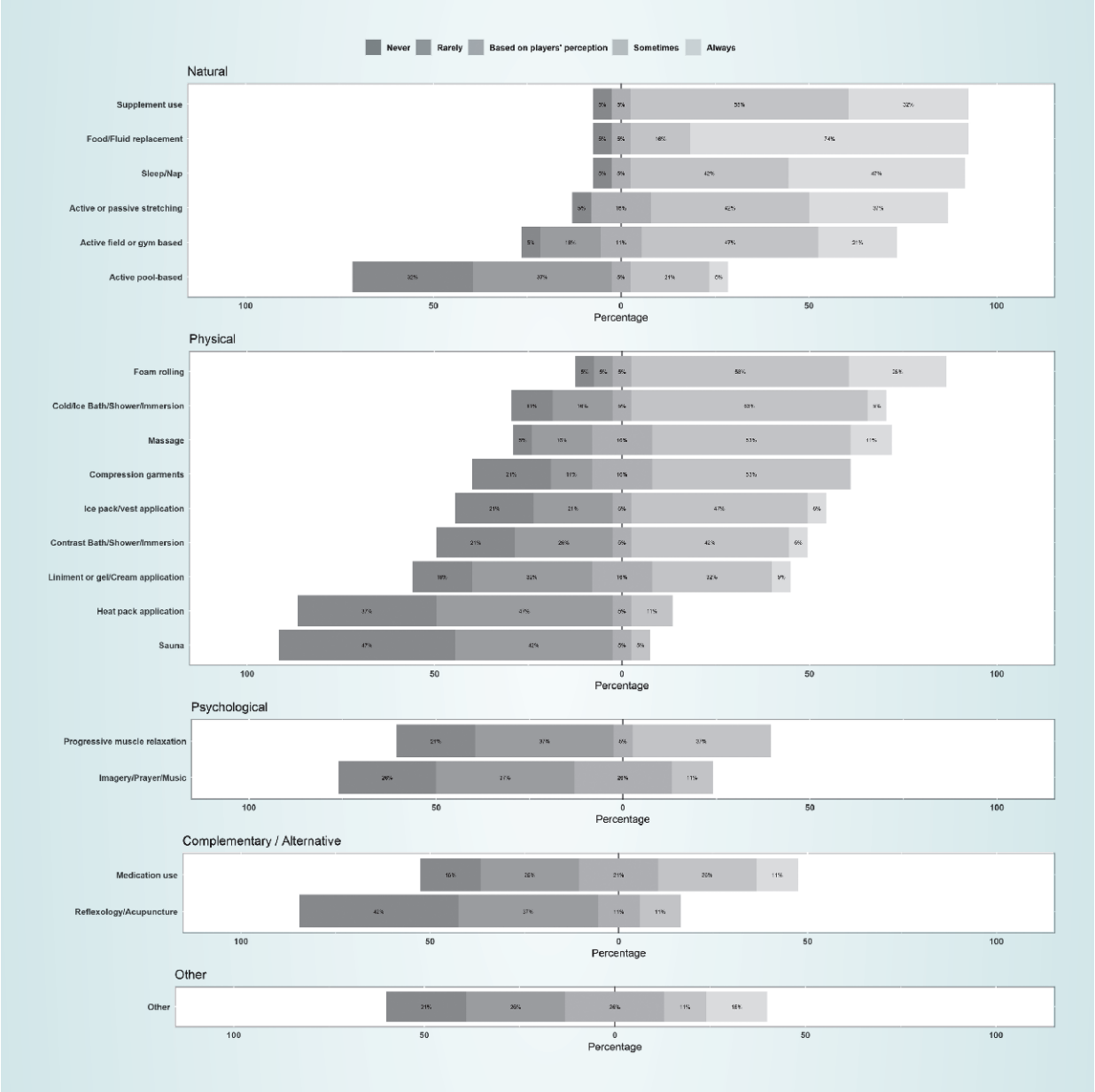

Figure 3. Recovery strategies undertaken by all Spanish first division professional teams after in-season training sessions. The information is presented using diverging bars to facilitate the comparison of multiple categories by showing the contrast between numerical values in every category.

Table 2. Periodization, individualization, frequency, time of first use and combination of recovery strategies after practice or competition during the season.

Do you periodize the recovery strategies?	Yes, according to the microcycle (week)		Yes, according to the mesocycle		Yes, according to the period of the season		No	
	n	%	n	%	n	%	n	%
	12	63	2	11	3	16	2	11
Do you individualize/personalize the recovery strategies?	**Yes, according to one or two parameters**		**Yes, according to three or four parameters**		**Yes, according to more than four parameters**		**No**	
	n	%	n	%	n	%	n	%
	3	16	5	26	9	47	2	11
What is the frequency of use between efforts?	**Once**		**More than once**		**Based on players' perception**		**Never**	
	n	%	n	%	n	%	n	%
	4	21	5	26	9	47	1	5
When do you use the recovery strategies for the first time after an effort?	**In less than 2 hours**		**Within 2-12 hours**		**Within 12-24 hours**		**Never**	
	n	%	n	%	n	%	n	%
	14	74	1	5	3	16	1	5
Do you combine different recovery strategies?	**Yes, following a specific order**		**Yes, not following a specific order**		**No**			
	n	%	n	%	n	%		
	16	84	2	11	1	5		

Table 3. Parameters used to individualize or personalize recovery strategies

	Do you individualize/personalize according to these parameters			
	Yes		No	
	n	%	n	%
Age	15	79	4	21
Maturation	5	26	14	74
Experience	13	68	6	32
Previous injuries	17	89	2	11
Ethnicity	6	32	13	68
Limb dominance	7	37	12	63
Others	10	53	9	47

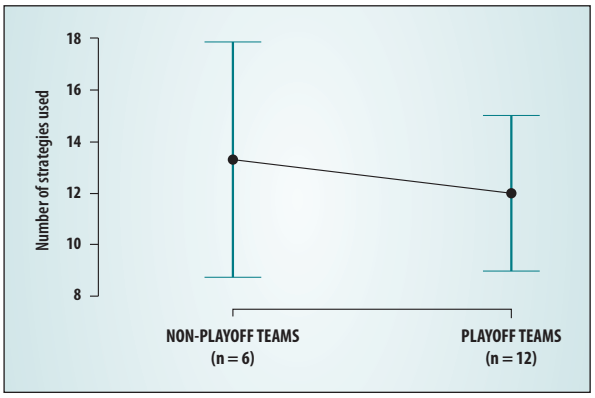

Figure 4. Use of strategies by teams clustered according to their competitive development.

Discussion

The use of recovery strategies by elite athletes is a focus of interest in current sports science research. Based on the present information, this is the first descriptive study analyzing the use of these strategies in "Liga ACB." In the results obtained, it can be observed that the use of recovery strategies is completely generalized in this league, with a single exception. One team admitted not to use any strategy systematically within their mandatory activities. However, from our perspective, it is more than likely that some of their players use some strategies by their initiative moved by habits acquired in other teams, their perception (Crowther et al. 2017; Venter, 2014), or result of their experience working with personal strength and conditioning coaches.

Another significant trend observed in our data is that all the teams have reported wide use of recovery strategies, but it is not generalized, with teams using many of them and others using a reduced group of techniques (Crowther et al. 2017). This use seems not to have any association with competitive performance (playoff vs. non-playoff teams), showing that recovery processes are complex, multifaceted, and not dependent on the use of one particular strategy (Calleja-González et al. 2018; Halson, 2015).

Optimizing recovery-stress state in athletes can determine sporting success or failure (Kellmann, 2010). Kellmann's "scissors-model" of the interrelation of stress-states and recovery demands proposes that increased levels of stress are only detrimental if the athlete does not engage in adequate recovery (Kellmann, 2010). Therefore, it is recommended to continuously

monitor both during the training process (Kellmann et al. 2001). However, time used to recover was not taken into account in this questionnaire, due to recovery is specific and depends on individual appraisal as well as is closely tied to situational conditions (Kellmann, 2010). Moreover, there is no scientific evidence supporting that spending more time using recovery strategies enhances performance.

When reporting the use of specific recovery strategies, the number of teams with more than half of the players of their squad employing at least one of these techniques is similar after a competition (63%), preseason (53%), and in-season practices (79%). However, it is noteworthy, that this percentage is lower in the preseason when teams usually have more congested weekly schedules with several two-a-days (two practices the same day) and friendly games. In these periods, strategies with more evidence promoting acute effects on recovery should present higher adherence (Mujika et al. 2018). When training sessions were analyzed, more players used recovery strategies after preseason practices than after the sessions conducted in-season. It seems clear then that in teams reporting frequent use of recovery strategies, players are allowed to use them ad libitum. Perhaps the reasons that drive players to higher compliance levels in-season are the physiological and psychological benefits arising from the use of those strategies when more chronic fatigue is accumulated.

Additionally, we should also consider that not every player will perceive equal gains when recovering, as intraindividual variability plays a relevant role (Calleja-González et al. 2018). Another vital element to analyze when talking about a player's recovery preferences is the player's availability. Although we are talking about professional players, our practical experience teaches us that these athletes show a higher predisposition to work after practices and games when they play on the road or stay in hotels between games. A similar situation occurs during the preseason. According to data obtained in this study, seven teams (37%; approximately a third) confirmed the use of recovery strategies by all squad players after preseason training sessions, while only three of them (16%; minority) used by the whole team after in-season ones. Moreover, and from all twenty strategies proposed in the study, only five of them (sleep/nap, fluid replacement, use of supplements, liniment/gel/cream application, and imagery/prayer music) were more used after in-season training than preseason when analyzing "always" or "sometimes" in their answers. This predisposition also changes depending on the outcome of the games, which should also be considered when understanding the presented values.

Natural strategies were used by the teams in our sample more than the physical, psychological, or complementary ones. Access to these strategies and ease of use are probably the main reasons explaining this finding. There is only one exception in this group of techniques, active recovery using a swimming pool. Apparently, and according to some authors (Bahnert et al. 2013), restricted access to sports facilities that have their pool is the primary factor explaining a reduced use. Teams have reported regular use of similar nature strategies, which leads us to think that there is no select reason why this particular technique is not used. Regarding the use of food and fluids replacement, those strategies were regularly used by all teams. They had the highest adherence levels observed in our study after competitions and practices, making it clear that these nutritional strategies are widely accepted in professional team sport environments for their effect on performance and recovery (Holway & Spriet, 2011; Koopman et al. 2005; Mujika & Burke, 2010).

Among the physical strategies, four of them were used by most teams participating in the study. Thus, cold/ice bath/shower/immersion (89%), compression garments (79%), massage (89%), and foam rolling (95%) show a high preference. Massage has scarce scientific evidence backing its application in recovery (Poppendieck et al. 2016). However, its ease of use, practicality, and the fact that it can be implemented playing home or away, leads staffs to use it regularly. Thus, the penetration of this technique in professional settings seems high (Halson, 2015).

Fatigue in basketball is a combination of physical and mental efforts (Alarcón et al. 2017), and consequently, optimal recovery should follow an holistic approach in order to restore organic and psychological parameters (Barnett, 2006). Mental fatigue is the cumulative result of mental effort over time, and its appearance and manifestations show certain parallelism with those of physical fatigue (Baumeister et al. 2007). Mental fatigue is a crucial regulator of technical performance in basketball players, affecting them negatively (Alarcón et al. 2017; Moreira et al. 2018), and modulating endocrine and autonomic responses (Moreira et al. 2018). Psychological and mental recovery techniques should be considered to return to baseline levels or minimize its adverse effects. Although the use of psychological techniques such as progressive muscle relaxation or imagery/prayer/music is not difficult to adopt and does not imply equipment or specific facilities, the number of teams using them in Spanish first division professional basketball is relatively low. Many of the teams do not have a full-time psychologist in their staff, and maybe other staff members do not feel comfortable using these

techniques that can be perceived as domain specific. On the other hand, it is also true that only some of these techniques have proven their effectiveness on performance recovery (Pelka et al. 2016), making it difficult to determine what techniques to adopt if we are seeking for meaningful effects.

Complementary/alternative strategies showed a low level of adherence in our data. A minority of the teams (21%) admitted they use reflexology/acupuncture. Similar rates (22%) were found by other authors (Venter et al. 2009). Some studies show lower HR_{max}, $VO_{2max,}$ and blood lactic acid in male elite basketball compared to control and sham acupuncture groups (Lin et al. 2009). Additionally, beneficial effects on cardiac parasympathetic reactivity and sympathovagal balance in collegiate football players using reflexology after a repeated sprint ability test have been reported (Chen et al. 2019). However, the use of these techniques requires training that is not generalized in basketball medical staffs. In the case of acupuncture, specific equipment is also needed, and according to White (White, 1998), athletes only use this strategy when conventional treatments fail. In the case of medication, approximately a third of the teams (37%) reported its usage. However, Spanish healthcare regulations only allow the prescription of certain drugs that can help the athletes recover (such as non-steroidal anti-inflammatory drugs) by certified medical doctors (M.D.). To the best of our knowledge, not all the teams participating in the "Liga ACB" have a full-time M.D. working with the team, limiting then, the implementation of this strategy.

In this scientific work, teams were also asked about the parameters used to individualize or personalize recovery strategies. Age (79%), player experience (68%), and previous injuries (89%) were the options more selected. It is evident that these factors are relevant in the implementation of different techniques; however, it caught our attention that other factors such as maturation (26%), limb dominance (37%), or ethnicity (32%) were not factors so considered. In the Spanish professional basketball league, the number of foreign players is significant, and some studies identify African American players as populations prone to muscle injuries in anatomic regions such as the hamstrings (Liu et al. 2012; Opar et al. 2012). It seems interesting then that professional basketball teams consider these characteristics into their individualized recovery approaches.

Thus, this study highlights trends in some of the best basketball teams' recovery practices in the world. Almost all the Spanish "Liga ACB" basketball teams use some form of recovery protocol; however, there is no general agreement on the strategies, the moments where they are applied, or the number of players using them in different moments competitive season. When contrasted with current scientific research available on the matter, the information reported by the different staff members shows an existing gap between theory and practice (Greenway et al. 2019). This highlights the complexity of promoting meaningful recovery in professional settings and the need for an individualized, personalized (Moreno et al. 2015), periodized, and probably more evidence-based approach.

Limitations

The present study shows some limitations that should be taken into account. The work has surveyed different staff members who have responsibilities regarding sports recovery. The fact that the "Liga ACB" players did not answer the survey prevents knowing if they use one or another strategy at a particular level or know the degree of compliance to the strategies applied without direct supervision. Nor can we know, in the cases where strategies are used ad libitum, what drives them to use them at one particular moment or another. It would also be interesting to divide the in-season period into smaller sections to ask about potential differences in the strategies used at the different points in the season, with potentially more players adhering to the use of recovery strategies when there is more accumulated chronic fatigue. Finally, in the questions regarding the use of supplementation, the type of ergogenic substances used, and the timings of use were not studied. Something similar happens with the compression techniques since different methodologies use the same physiological principle but with different technological development levels, and respondents were not asked to specify in this regard.

Conclusion

To our knowledge, this is the first study to investigate the use of post-exercise recovery strategies by elite Spanish basketball teams in Spain. In our results, natural strategies were more used than the physical, psychological, or complementary ones. However, active pool recovery (natural strategy) was scarcely used, while foam rolling (physical strategy) was the most used along with supplement intake. The economic cost, ease of use, and access to specific facilities probably explain these findings. Food and fluid replacement and foam rolling were regularly used by all teams and had the highest

adherence levels after competitions and practices. A significant number of players adopted recovery strategies after preseason training, but this number decreased after in-season practices or games. The majority of the teams apply recovery strategies within the first two hours after the efforts, and most of them individualize these protocols, being injury record the parameter mostly considered. Teams not reaching the playoffs used on average a higher number of recovery strategies than those who achieved better competitive success at the end of the season.

Except for one team, all Spanish first division basketball teams use recovery strategies for with their players. However, there is no general agreement on the ones employed, nor the parameters used to apply them. Despite the limited scientific evidence, some of these recovery methods are continuously used. Our advice is that the prescription and application of these strategies should be based on science and applied knowledge, following the parameters described in literature backed up with high evidence levels.

Future investigations

The contextualization of scientific research is an essential aspect, and studies that approximate high-performance sports' actual practice are necessary to improve the field. Future research could examine the strategies used in different leagues and championships, female athletes, and different competitive levels. Studies surveying the players themselves on using the methods proposed by their staff, and their perception of them are also necessary to reduce the gap between theory and practice in sports recovery.

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