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RESEARCH ARTICLE

Load monitoring, strength training, and recovery in futsal: Practitioners' perspectives

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ABSTRACT

This study aimed to describe the current practices in futsal regarding a variety of topics related to performance and injury risk mitigation. Thirty-seven coaches from Spain and Portugal completed a questionnaire consisting of 28 closed questions organized in four categories: a) background information; b) training load (TL) monitoring and assessment of players' physical qualities; c) strength training (ST) practices; and d) recovery (REC) methods. The results showed that coaches varied in experience (1–8 years) and age (from 20 years to >50 years). Overall, 97.3% of the participants declared monitoring TL, with rating of perceived exertion, heart rate monitors, and wearable technology being used by 86.5%, 40.5%, and 37.8%, respectively. Neuromuscular and strength testing are the most common practices to evaluate performance and fatigue during the season. ST is a significant component of futsal, being performed 3 times/week during the pre- and in-season. ST is prescribed via %1RM – XRM (59.5%), velocity-based training (21.7%), repetitions in reserve (18.9%), until failure (10.8%), and circuit training (2.7%). 'Better Monitoring', 'More Individualized', 'Better Facilities', 'More Staff', and 'More Time' were the main aspects to improve ST. Multiple post-match REC strategies are used, with durations ranging from 0–15 to 16–30 min independently of game location.

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KEYWORDS
Team-sports; five-a-side soccer; performance

Introduction

Futsal is a high-intensity intermittent sport, in which players are exposed to considerable physiological, neuromuscular, and biochemical stress during the game (Spyrou et al. 2020). Match-play data indicate that futsal players cover a total distance of ~4000 m, of which ~675 m are spent running (12–18 km · h^{-1}) and ~130 m sprinting (>18 km · h^{-1}), perform ~70 high-intensity accelerations and decelerations and complete ~170 changes of direction (Ribeiro et al. 2020; Spyrou et al. 2021). In addition, a recent study (Illa et al. 2020) reported that, during a training microcyle, elite futsal players may encounter very high demanding scenarios in terms of locomotor and velocity metrics, reaching values similar to those observed in match-play. As such, not only competition load but also the load players experience in training should be closely monitored.

Strength and conditioning coaches (S&Cc) use training load (TL) as an essential tool to prepare tailor-made training plans and control the volume and intensity of the training sessions (Eckard et al. 2018). The consensus statement of the International Olympic Committee on load in sports and the risk of injury states that a successful TL monitoring system is fundamental to ensure adaptation to stress, maximize physical performance, and possibly minimize the risk of injury (Soligard et al. 2016). The load can be considered as either internal, defined as the physiological or psychological stress imposed on the athlete (i.e., rate of perceived exertion [RPE], heart rate [HR]), or external, the objectively measured work performed [e.g., distance covered, number of accelerations or running speed]) (Halson 2014). Both internal and external load metrics are commonly used for managing the TL in team-sports (Halson 2014; Phibbs et al. 2017). However, when it comes to futsal, it is unclear which methods are the most utilized by current S&Cc from professional teams to monitor the TL and player's physical capacities over the season.

Another important strategy commonly used by S&Cc to reduce injuries in sports (Lauersen et al. 2014, 2018) and enhance physical performance (Rønnestad and Mujika 2014) is strength training (ST), due to its well-documented benefits. For example, Case et al. (2020) found that the maximum pre-season relative back squat strength differed between injured and uninjured males (i.e., football) and female athletes (i.e., softball and volleyball), with significantly lower values found in athletes that sustained an injury during the season. Rønnestad et al. (2011) observed that a weekly ST was enough to maintain strength, sprint, and jump ability during the competitive season, whereas completing only one ST session every second week resulted in a reduction in strength and 40 m sprint performance in professional soccer players. In futsal, Torres-Torrelo et al. (2018) concluded that light load and low volume ST performed twice a week (as a complement to specific futsal training) led to improvements in physical performance, further supporting the importance of training for strength development during the season. Still, to date, little is known concerning ST and its characteristics (i.e., session duration, frequency, and exercise prescription) during normal (e.g., one game/week) and congested (e.g., two or more games/

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week) weeks in futsal. Thus, understanding the ST practices from professional S&Cc may provide important information to other practitioners regarding the training characteristics, methods, and programming strategies currently being used in real-world scenarios.

Futsal competition, as shown in different studies (Spyrou et al. 2020; Nemčić and Calleja-González 2021), produces significant post-match acute and residual physiological, neuromuscular, and biochemical alterations. Neuromuscular capabilities (e.g., peak force) and biochemical variables (e.g., creatine kinase and testosterone/cortisol ratio) may change significantly following match-play (Milioni et al. 2016; Bekris et al. 2022), despite the fact that, in futsal, the number of substitutions is unlimited. Hence, recovery (REC) plays a crucial role when preparing players to cope with the stress they are submitted to during the competitive season. In team-sports, REC methods can be focused on physiological (i.e., active REC, rest, and sleep), physical (i.e., water immersion, contrast therapy, stretching, and massage), psychological, and nutritional (i.e., supplements, nutrition) aspects (Calleja-González et al. 2016). Nevertheless, literature on the REC strategies used in futsal is scarce, especially in terms of the methods employed, its frequency and duration, and the different practices according to game location (i.e., 'home' or 'away') (Nemčić and Calleja-González 2021).

Considering that futsal is an emerging team-sport and that there is still a paucity of research on several important topics (e.g., TL and fatigue monitoring, physical preparation, and REC), characterizing the way S&Cc work in real-world contexts is of interest. This valuable information may allow determining the current strengths, weaknesses, and opportunities for improvement to further develop futsal science and practice. Therefore, the present qualitative study aimed at describing the practices of futsal S&Cc considering 1) the TL monitoring and player's physical capacity evaluation practices across the season; 2) the characteristics and prescription of ST during normal and congested weeks; and 3) the REC strategies and methods following 'home' or 'away' games. There was no leading hypothesis, and the questionnaire was designed to answer the three main research questions declared above.

Material and methods

Study design

An exploratory study was designed to provide descriptive information about TL monitoring, players' performance and fatigue assessment practices, and ST and REC strategies in professional futsal. Data were collected from S&Cc working in Spain and Portugal.

Participants

Thirty-seven male S&Cc (age range: 20 to >50 years; professional experience range: 1 to >8 years), working in the 1st, 2nd, or 2ndB divisions from Spain (n = 24) and Portugal (n = 13), volunteered to take part in the study. According to the inclusion criteria, S&Cc should: a) work in the men's 1st, 2nd, or 2ndB divisions and women's 1st division and b) answer all the questions of the survey successfully. Data were excluded if S&Cc: a) did not work in the above-mentioned divisions or worked exclusively within the club's academy (i.e., youth categories) and b) did not complete the survey or completed it only partially. All participants were informed of the benefits and risks of participating, and informed consent was obtained before undertaking the questionnaire, with the approval of Local Ethics Committee with the registration number CE072008.

Procedures

All S&Cc were contacted electronically to introduce the study and present the informed consent needed to participate in the anonymous online survey. The questionnaire, adapted from previous research (Taylor et al. 2012; Akenhead and Nassis 2016; Starling and Lambert 2018; Griffin et al. 2021) and developed using Google Forms, was sent by email with a web link created with the mentioned platform. The data were collected from February 2021 to April 2021. Responses were screened to determine potential duplicates and questionable answers, such as untruthful, unrealistic, or unfinished responses. The survey consisted of four sections: a) background information (four questions); b) TL monitoring and assessment of players' performance and fatigue (five questions); c) ST practices (thirteen questions); and d) REC methods (six questions). All questions (n = 28) were closed, providing respondents with a predetermined set of answers that included a comment box 'other' in the majority of them. Most questions allowed more than one response because coaches could report using multiple methods. Hence, some questions had more responses than others. Pilot testing of the survey was conducted by all the authors, then by two practitioners (S&Cc) to avoid ambiguity of terms and ensure its validity for use with this population.

Statistical analysis

Statistical analysis was performed using the Jamovi Statistical package (2020; version 1:8). Responses were analyzed using frequency analysis for each question and presented as absolute frequencies and percentages. Mean ± standard deviation (SD) was calculated for a single question: *'The importance of strength in futsal'* as a 1–5 Likert scale (1 = not very important, 5 = extremely important) was used. Thematic analysis was conducted according to Braun and Clarkes' guidelines (Braun and Clarke 2006), previously used in sport science surveys (Crowley et al. 2018; Griffin et al. 2021), with the following six phases: a) familiarization with the data; b) generating initial codes; c) searching for themes; d) reviewing themes; e) defining and naming themes; and f) producing the report.

Results

Coaches' background information

Thirty-seven coaches completed the survey. From the total sample, 76.6% (n = 25) reported working in their respective country's men's 1st Division, 5.4% (n = 2) 2nd Division, 10.8% (n = 4) 2ndB Division, and 16.2% (n = 6) indicated coaching in

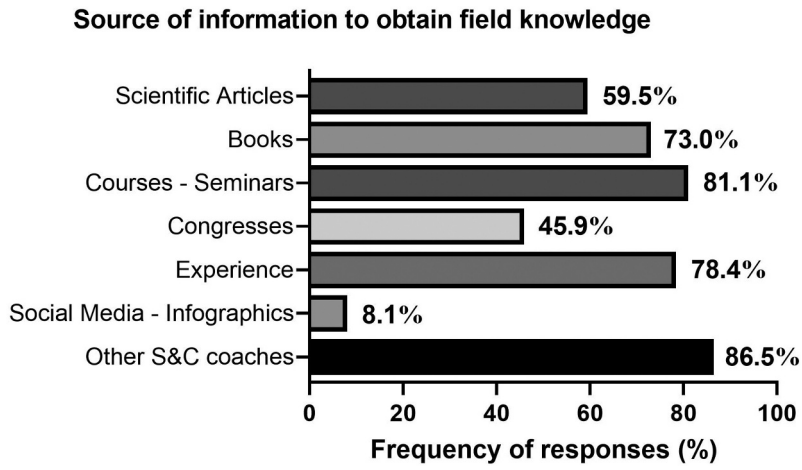

Figure 1. The percentage of the respondents answering the type of resources used to obtain information about their field of knowledge. S&C: strength and conditioning

women's 1st Division. Regarding age, 35.1% of the practitioners were 30–39 years old, 29.7% were 20–29 years old, 24.3% were 40–49, and 10.8% were >50 years old. Considering coaching experience, 43.2% of S&Cc declared working in futsal >8 years, 35.1% between 4 and 7 years, 13.5% between 1 and 3 years, and 8.1% had only 1 year of experience. Finally, when answering the question '*From what type of sources do you obtain information related to your area of expertise?*', the three most frequent responses were 'Other S&C coach' (86.5%), 'Courses-Seminars' (81.1%), and 'Experience' (78.4%), as shown in Figure 1.

Monitoring practices

Figure 2 outlines the tests and time-periods used for player's performance and fatigue evaluation during the season. S&Cc reported assessing body composition (81.1%), vertical jump ability (72.9%), muscular strength (70.3%),

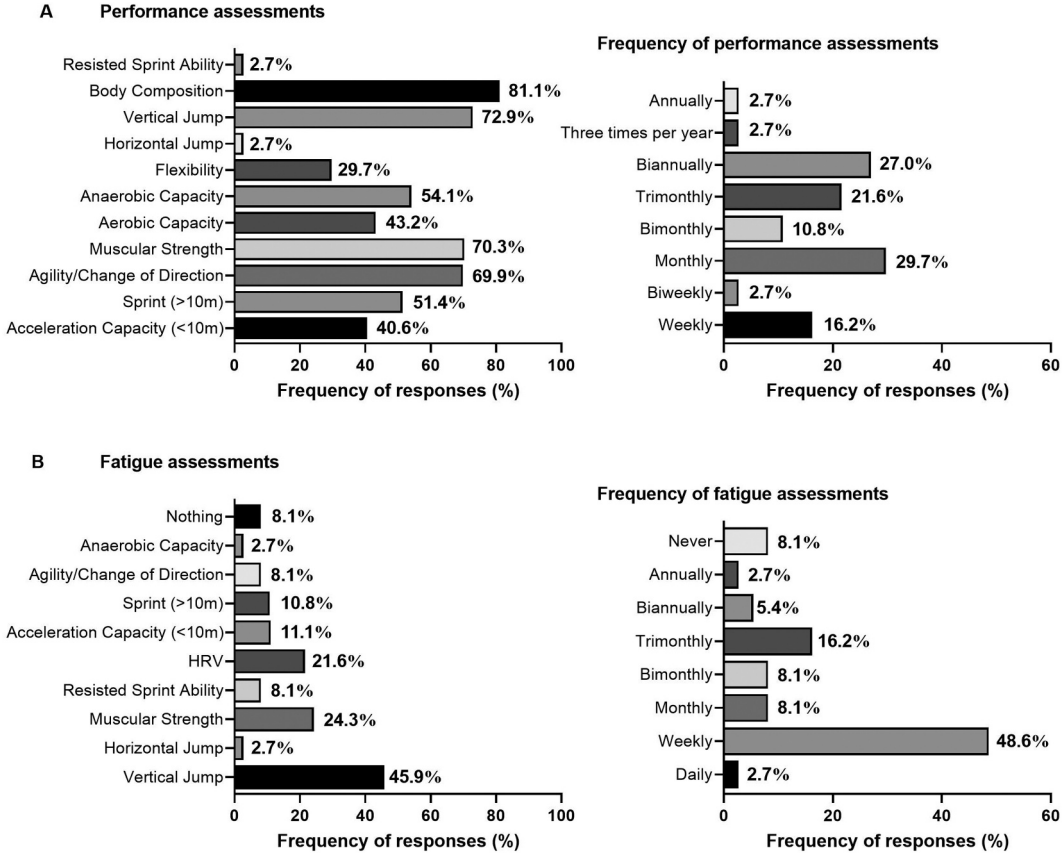

Figure 2. A) The percentage of the respondents answering the tests, and time-interval for player's performance assessment. B) The percentage of the respondents answering the tests and time-interval of player's fatigue assessment.

change of direction-agility (69.9%), anaerobic capacity (54.1%), sprint (>10 m) (51.4%), aerobic capacity (43.2%), acceleration ability (<10 m) (40.6%), and flexibility (27.0%), in testing sessions organized on a monthly (29.7%), biannually (27.0%), trimonthly (21.6%), weekly (16.2%), or bimonthly (10.8%) basis. Regarding player's fatigue, vertical jump ability (45.9%), muscular strength (24.3%), and HR variability (21.6%) were commonly used, being tested weekly (48.6%), trimonthly (16.2%), monthly (8.1%), or bimonthly (8.1%). The most common method for recording TL was RPE (86.5%) followed by external workload monitoring with wearable tracking system (Global Positioning System [GPS]/accelerometer) (37.8%), HR (40.5%), Acute-Chronic Workload ratio (37.8%), and Total Quality Recovery Scale – Wellness (10.8%). Only one (2.7%) S&Cc reported not monitoring TL.

Strength training

Figure 3 depicts the frequency and the duration of ST during pre-season and in-season. Overall, ST was considered as 'extremely important' (4.8 ± 0.4) in futsal. During normal weeks, S&Cc reported completing the first ST on the morning of Match-day (MD) + 2 (43.2%), followed by the afternoon of MD + 1 (16.2%) or morning of MD + 3 (16.2%), and afternoon of MD + 3 (13.5%). Most ST sessions were reported to last 16–30 min (45.9%), followed by 31–45 min (29.7%), 46–60 min (16.2%), 0–15 min (2.7%), 61–75 min (2.7%), and >76 min (2.7%), and focused on full-body training (i.e., upper and lower limbs) (73.0%) and core (67.6%) exercises. During congested periods, 18.9% of the S&Cc reported not prescribing ST. Among those who do, most indicated that ST is performed in the morning of MD + 2 (27.9%), afternoon of MD + 1 (16.2%) or MD + 2 (16.2%), morning of MD + 1 (10.8%), and morning or afternoon of MD + 3 (2.7%). In congested periods, ST sessions last between 16–30 min (45.9%), 0–15 min (24.3%), 31–45 min (18.9%), 46–60 min (8.1%), and 61–75 min (2.7%). The training session is centered on core (62.2%) and full-body (45.9%) exercises.

Concerning ST prescription, the most used method reported was %1RM – XRM (59.5%), followed by velocity-based training (21.7%), repetitions in reserve (18.9%), until failure (10.8%), and circuit training (2.7%). Finally, the main aspects to improve related to ST, as reported by the S&Cc, were as follows: '*Better Monitoring*' (73.5%), '*More Individualized*' (62.2%), '*Better Facilities*' (55.6%), '*More Staff*' (35.1%), and '*More Time*' (10.8%).

Recovery practices

Figure 4 summarizes the REC methods, moment of the application, and duration after 'home' and 'away' competitions. Following 'home' matches, foam roller (78.4%), active REC (76.6%), nutrition (67.7%), water immersion (64.9%), stretching (51.4%), and supplements (51.4%) were the main REC strategies. These were utilized after the match (54.1%), or afternoon MD + 1 (40.5%), and lasted 16–30 min (56.8%), or 31–45 min (29.7%). Regarding 'away' matches, nutrition (67.6%), foam roller (55.9%), supplements (55.9%), and stretching (55.6%) are the main strategies used by S&Cc. The most frequent moments of application were reported to be after the match (43.2%), and

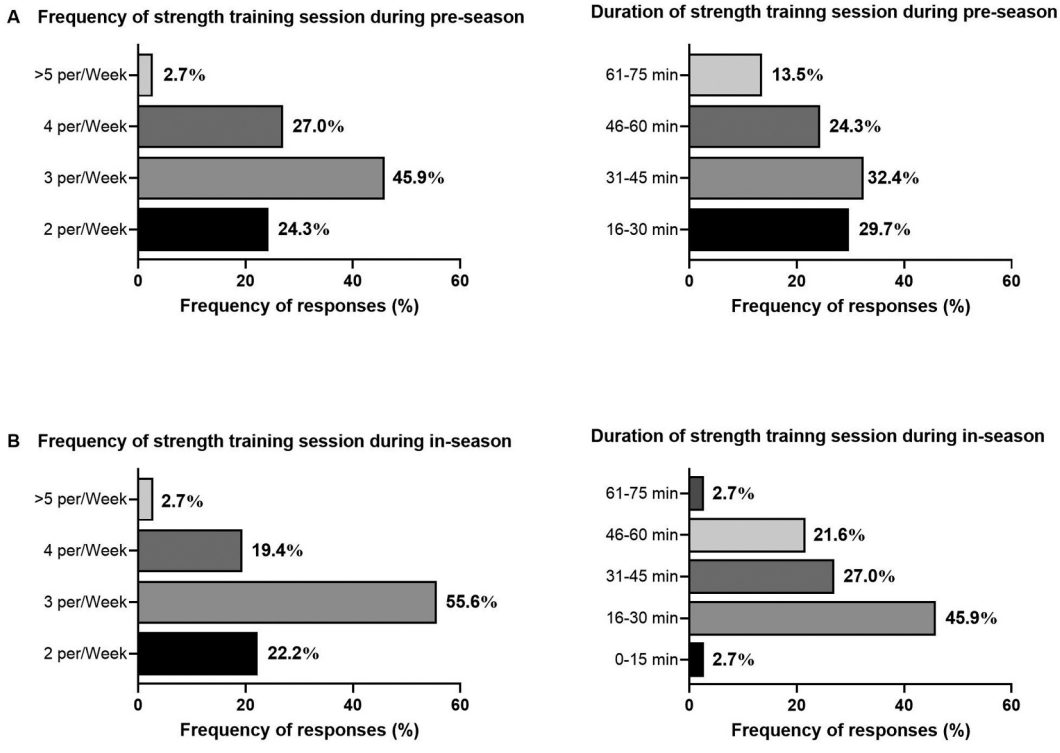

Figure 3. A) The percentage of the respondents answering the frequency and time range of the strength training during the pre-season. B) The percentage of the respondents answering the frequency and time range of the strength training during the in-season. HRV: heart rate variability

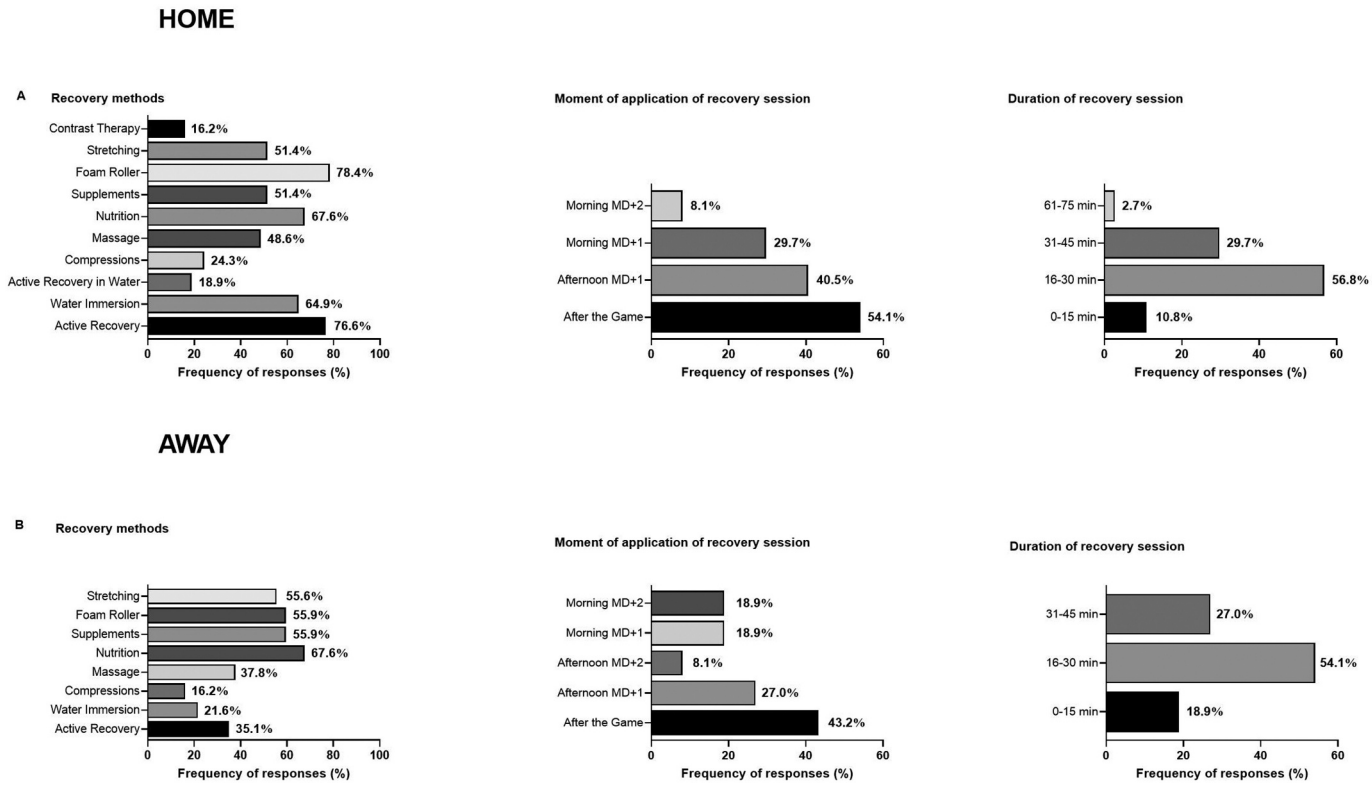

Figure 4. A) The percentage of the respondents answering the methods, moment of the application, and time range of the recovery session after a game at 'home'. B) The percentage of the respondents answering the methods, moment of the application, and time range of the recovery session after a game at 'away'. MD: match-day.

afternoon MD + 1 (27.0%), with durations of 16–30 min (54.1%) and 31–45 min (27.0%).

Discussion

To the best of authors´ knowledge, this is the first study to describe the TL monitoring and physical performance assessment practices and the characteristics of ST and REC strategies in professional futsal. As such, the present findings allow an overview of the current performance and injury mitigation strategies adopted by S&Cc in Spain and Portugal. The main results were as follows: a) virtually all coaches reported monitoring TL, most of them through the use of subjective tools; b) neuromuscular and strength measurements are among the strategies that practitioners utilize to evaluate performance and monitor fatigue; c) ST plays a crucial role in physical preparation in futsal and a typical ST session program consists of 3 sessions per week during the pre- and in-season; and d) multiple REC strategies (i.e., foam roller, stretching, nutritional, and supplementation strategies) are used following 'home' and 'away' matches.

Of note, the vast majority (97.3%) of the S&Cc from Portugal and Spain reported monitoring TL (either internal or external) in professional futsal, which is in line with previous studies in high-level football and rugby clubs (Akenhead and Nassis 2016; Griffin et al. 2021). The most common method of recording TL was the RPE with 86.5%, followed by HR and GPS/accelerometry systems that were used by 40.5% and 37.8%, respectively. Interestingly, these results contrast with those obtained in professional soccer, where the majority of coaches reported collecting HR data and GPS/accelerometry and only a few utilized RPE and other subjective variables (Akenhead and Nassis 2016; Loturco et al. 2022). A possible explanation may be related to the fact that the use of GPS technology is inoperable in indoor sports (Torres-Ronda et al. 2022), and that local positioning systems must be installed in the team's facilities, which limits its application in, for example, 'away' games. As a consequence, the use of wearable tracking systems is somehow limited in futsal (i.e., it is not possible to obtain distance or velocity metrics), as only accelerometry data can be analyzed (Torres-Ronda et al. 2022). Another potential factor explaining the differences between futsal and soccer with respect to TL monitoring is related to the economic disparities between both sports since HR and GPS/accelerometry wearable technology are expensive (hence, more difficult to implement in futsal) and RPE is a 'low cost' solution. In support of this notion, a previous study (Griffin et al. 2021) in amateur rugby union found that the most common method to record TL was, indeed, RPE. From a practical perspective, the present results reinforce that, even in the absence of abundant economic resources, monitoring TL during the season is possible (and recommended), as shown by the high percentage of S&Cc that reported using subjective variables (e.g., RPE).

Considering player's physical capacities testing across the season, S&Cc generally evaluate body composition (81.1%), vertical jump ability (72.9%), muscular strength (70.3%), change of direction-agility (69.9%), followed by anaerobic capacity (54.1%) sprint (>10 m) (51.4%), aerobic capacity (43.2%), and

acceleration ability (<10 m) (40.6%) (Figure 2). These tests are usually conducted monthly (29.7%), biannually (27.0%), trimonthly (21.6%), weekly (16.2%), and bimonthly (10.8%). Regarding player's fatigue, S&Cc reported conducting assessments mostly every week (Figure 2) with vertical jump height, muscular strength, and HR variability being the variables most commonly tested. Remarkably, it seems that neuromuscular and strength capacity evaluations are used to evaluate both performance and fatigue during the season with different frequency between practitioners in futsal. These results are in line with previous research (Taylor et al. 2012; McGuigan et al. 2021) that have demonstrated that jump tests, strength measurements, and sport-specific assessment protocols are commonly used in other team-sports, implemented on a weekly or monthly basis. Noteworthy, other studies (Akenhead and Nassis 2016; Starling and Lambert 2018) presented that S&Cc implement questionnaires or GPS/accelerometry systems to manage performance and fatigue status, which contrasts with the present investigation where these methods were reported to be used to control TL and not evaluate player's physical capacities. In applied settings, and according to the current practices in professional futsal, it appears that S&Cc consider that evaluating players' physical capacities during the season is valuable and allows for adjustments in the training plan to be made accordingly.

When inquired about ST, all practitioners reported it to be a significant and highly important training component in futsal (i.e., 4.8 ± 0.4 out of 5). Previous studies have confirmed the positive effects of ST on physical capacities in futsal (Torres-Torrelo et al. 2017, 2018; Marques et al. 2019). Specifically, Marques et al. (2019) found significant improvements in physical performance (i.e., countermovement jump height, sprint time, *T*-Test time, kicking ball speed, and maximum strength in leg-press) following two weekly ST sessions complementing specific futsal training. In the present study, S&Cc reported prescribing ST mainly 3 times/week (55.6%), with sessions lasting 31–45 min (32.4%), 16–30 min (29.7%), or 46–60 (24.3%) in the pre-season. During in-season, practitioners declared performing 3 weekly ST sessions (45.9%), but with shorter durations (16–30 min, 45.9%; 31–45 min, 27.0%; and 46–60, 21.6%) (Figure 3), most likely due to the limited time to dedicate to the development of physical qualities during the training week. A novel aspect within this investigation was related to how S&Cc vary their ST practices depending on the competitive calendar (i.e., normal vs. congested weeks). Interestingly, the first ST during a normal week is performed mostly on the morning of MD + 2 (43.3%) and comprises both lower and upper body lifts (73%) and core (67.6%) exercises. During congested periods, short (i.e., 16–30 min, 45.9% or 0–15 min, 24.3%) ST sessions focused on the core musculature (62.2%) and (to a lesser extent when compared to normal weeks) lower and upper limb exercises (45.9%) are executed in the morning of MD + 2 (27.9%). However, these results should be interpreted cautiously as they are mainly anecdotal evidence, and more research is needed on the effects of ST on players´ performance and REC profile during normal and congested weeks in futsal.

Considering the REC methods in futsal, current evidence-based knowledge is poor (Nemčić and Calleja-González 2021) as only few studies have investigated this topic (Tessitore et al. 2008; Wilke et al. 2019; Nunes et al. 2020; Rahimi et al. 2020). Nevertheless, and although their results should be interpreted with caution due to some of the parameters used to evaluate REC, Rahimi et al. (2020) found that utilizing foam rollers resulted in superior REC effects as assessed by subjective variables, and physical performance when compared to passive REC. Furthermore, Tessitore et al. (2008) analyzed the effects of immediate postgame REC interventions (i.e., seated rest, supine electrostimulation, low-intensity land exercises, and water exercises), and found no significant differences among REC interventions for anaerobic indicators, hormonal responses, muscle pain, and players' perceptions of REC (i.e., questionnaires). Regarding the results obtained herein, it seems that S&Cc adjust REC approaches depending on the game location (i.e., 'home' versus 'away'). Precisely, active REC, water immersion, and massage therapy appear to be more utilized following 'home' games when compared to 'away' (76.6% vs 35.1%; 64.9% vs 21.6%; 48.6% vs 37.8%, respectively). However, foam roller, stretching, nutritional, and supplementation strategies are independent of the game location as the percentages of each do not differ greatly. Of note, REC sessions are mainly taking place after the game (43.2% and 54.1% following 'home' and 'away' games, respectively) or on the afternoon of MD + 1 ('home': 40.5%; 'away': 27%) and last 15–30 min (Figure 4). Nevertheless, more research on the effects of different REC methods on futsal players and their individual response is warranted.

Whilst this is the first study to investigate the coaches' methods for monitoring TL, player's physical capacities, and the programming of ST and REC sessions, it is not without limitations. It is important to acknowledge that the results are based solely on the beliefs, experiences, or training philosophy of S&Cc and that different staff members (e.g., physiotherapists, nutritionists, etc.), who are directly involved in injury risk mitigation and REC strategies were not included. Furthermore, players did not participate in the survey, which limits access to important information such as whether they use further assistance on REC or physical preparation in their own time, outside club's facilities. These findings should not be generalized, as the data were collected only from practitioners working in Spain and Portugal and must be applied with caution due to the plethora of contextual factors (i.e., international and national tournaments, club's philosophy, etc.), team's resources, and players' individuality (e.g., sex or training background) that may have influenced the results. Still, describing coaches' perceptions and practices about the topics addressed herein is certainly vital for helping the futsal community understand its strengths, weaknesses, and opportunities for improvement in terms of TL, fatigue monitoring, physical preparation, and REC.

This study provides a comprehensive insight into the TL monitoring, players' physical capacity assessment, and the characteristics of ST and REC practices in futsal in Spain and Portugal. All coaches reported monitoring TL, most of them through the use of subjective tools (e.g., RPE). As such, following the practices already implemented in other sports, futsal teams should provide more financial and technical support, to allow hiring more staff members and acquiring, for example, HR or GPS/accelerometry systems, in order to optimize training monitoring and

prescription. Neuromuscular and strength measurements are among the strategies that practitioners utilize to evaluate performance and fatigue. From an applied perspective, S&Cc should integrate tests in the training sessions to frequently obtain information on their athletes' performance/fatigue status. ST plays a crucial role in physical preparation in futsal. A typical ST session program consists of 3 sessions per week during the pre- and in-season, focused on upper and lower limb exercises and core strengthening. A possible solution employed by coaches to ensure that this training frequency is met is to reduce the duration of the ST sessions during the competitive phase of the season. Lastly, multiple REC strategies (i.e., foam roller, stretching, nutritional, and supplementation strategies) are used following 'home' and 'away' matches. In applied settings, S&Cc are advised to implement the above-mentioned REC strategies independently of the game location.

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