

# Perceptions and use of recovery strategies in water polo players and coaches: a worldwide survey

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The objective of this study was to assess the perceived usefulness, actual use and limitations for the application of recovery strategies among water polo (WP) players and their coaches around the world. A total of 231 WP players and 76 coaches representing all continents, both genders and all levels of competition, completed a freely accessible online survey. This was divided into three sections: sociodemographic data (8 questions), importance of perceived usefulness of recovery strategies (3 questions), and actual use of recovery methods (6 questions). The majority of players and coaches considered recovery strategies as very important (52.4% and 59.2%, respectively) and posttraining session (28.1% and 26.5%) were the most frequently used times. The most selected reasons to justify their use were to reduce the injury risk (30.4% and 26.9%) and the most limitation to the use of recovery strategies

were that they are too time-consuming (34.9% and 29%). In the case of the players, stretching were the strategies perceived as most useful and used (12.7% and 18.1%); and in the case of the coaches, it was active recovery (11.2% and 15%). The present study suggests a degree of discrepancy between the scientific literature and the research participants' perceptions and usages of recovery methods. This information may be of interest for coaches and technical staff of WP teams to look for appropriate recovery strategies for the improvement of their players' performance.

**Keywords:** Team sports, Recovery methods, Team management, Questionnaire, Athletes

## INTRODUCTION

Periodization of the different training loads based on magnitude and specificity, seems to induce to a better improvement in performance (Kataoka et al., 2021; Miloski et al., 2016; Suchomel et al., 2018), however, accumulation of fatigue or incomplete recovery, influences negatively on performance as well (Alba-Jiménez et al., 2022). In team sports, players are exposed systematically to new stimuli (trainings or competitions) before they fully recover (Querido et al., 2022). Among team sports, water polo (WP) is a highly demanding water-based contact sport that requires intense bursts of sprint swimming, constant technical-tactical events (Per-

azzetti et al., 2023a; Perazzetti et al., 2023d) and frequent changes of direction, with incomplete recovery periods (Barrenetxea-García et al., 2023; Botonis et al., 2019). Therefore, optimal recovery strategies are essential to avoid long-term fatigue and adverse consequences such as poor performance or injury (Altarriba-Bartes et al., 2020). The most popular methods to improve recovery in team sports are ergo-nutrition, active recovery, hydrotherapy, massage techniques, compression garments, cryotherapy, foam rolling, sleep strategies, and psychological implements (Calleja-González et al., 2016; Querido et al., 2022; Rose et al., 2017; Wiewelhoeve et al., 2019). Nevertheless, in WP, there is still very scarce literature about that topic (Barrenetxea-García et al., 2022; Barrenetxea-

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García et al., 2023; Barrenetxea-García et al., 2024; Botonis et al., 2024; Botonis and Toubekis, 2023) and only a very limited number of studies have specifically analyzed the effectiveness of any recovery strategy throughout interventions in WP (Barrenetxea-García et al., 2022; Barrenetxea-García et al., 2024; Botonis and Toubekis, 2023). This reality turns it very difficult to make specific recommendations derived from scientific evidence, and generally the guidance of recovery is made by trends and sensations (Altarriba-Bartes et al., 2021; Simjanovic et al., 2009).

In soccer, team sports players, and in particular basketball, the most used recovery strategies have been already described (Altarriba-Bartes et al., 2021; Crowther et al., 2017; Pernigoni et al., 2022). In addition, the authors, identified a gap between scientific evidence regarding the effectiveness of the different strategies and the perceived effectiveness of these different strategies by the athletes and coaches. It seems that the selection of recovery strategy is made by its availability, the easy-to-implement and the athlete's sensations rather than the evidence of its strategy, and there is no consensus on the protocols and the timings of their application (Altarriba-Bartes et al., 2021; Crowther et al., 2017). Consequently, the evaluation of recovery strategies in WP employed in different contexts could provide useful information to analyze and describe the reality, and help coaching staff to develop and make more evident recommendations in daily practice. Therefore, the main purpose of this descriptive international survey study was to assess recovery strategies and the perceived usefulness and limitations among WP players and coaches worldwide.

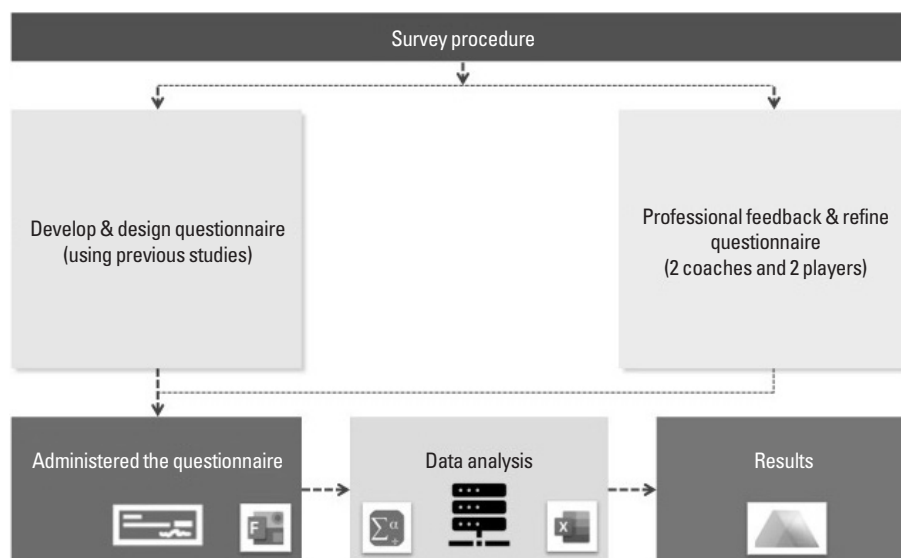
## MATERIALS AND METHODS

### Design

A pilot version of the survey was administered to two coaches and two players who had solid experience in the sport before distribution (12 and 15 years, respectively). For data collection, a freely accessible online questionnaire was developed using Microsoft Forms with descriptive design (<https://forms.office.com/r/BQckk1NCv3>) and different question options: combination of multiple choice, Likert scales, checkboxes and open-ended free-text responses. Subsequently, the survey was sent by email, telephone and social networks, in the same way as used by other authors (Calleja-González et al., 2021; Pernigoni et al., 2022; Perazzetti et al., 2023b) (Fig. 1). The survey was available online for 2 months (from 2 October to 2 December 2023) and was completed in a maximum of 8 min. The data obtained were treated with the utmost confidentiality and scientific rigor, their use being restricted by the guidelines for research projects following the required scientific method, complying with Organic Law 15/1999 on Personal Data Protection. The study was approved by the Human Research Ethics Committee of the University of Basque Country (Ref. M10\_2023\_192) and was adjusted to the Code of Ethics of the World Medical Association (2013).

### Subjects

A total of 307 WP players ( $n = 231$ ; male:  $n = 112$ , female:  $n = 119$ ) and technical staff members (strength and conditioning coach,



**Fig. 1.** Worldwide survey procedure.

n = 30; head of performance, n = 36; sport scientist, n = 4; data scientist, n = 1; other, n = 5; total, n = 76), representing all continents worldwide (Asia, Africa, Europe, North America, South America, and Oceania) and all levels of competition, completed a freely accessible online questionnaire, related to the perception of the importance and actual use of different recovery strategies. The sample size was adequate compared to previous similar studies (Altarriba-Bartes et al., 2021; Calleja-González et al., 2021; Field et al., 2021; Pernigoni et al., 2022). All participants were adequately informed, participated voluntarily and anonymously.

## Methods

The survey was divided into three sections: sociodemographic data (8 questions), importance of perceived usefulness of recovery strategies (3 questions), and actual use of recovery methods (6 questions). An adapted survey, previously defined and validated by Pernigoni et al. (2022) in basketball, was adapted to WP environment and used. Thus, each of the sections identified and determined the following variables:

- Section 1 - Sociodemographic data: In the first section, information on age, gender, experience, academic studies, competitive level of the team, gender and the participant's role in the team were recorded.
- Section 2 - Perceived usefulness: The second section focused on research whether the participant perceives recovery strategies as important, analyzing the basis for this assumption and the strategies that considers having a beneficial effect.
- Section 3 - Actual use: In the third section, questions were asked about the frequency, timing, location and type of recovery interventions applied by the participant, as well as possible limitations that prevent them from using one or more of these strategies.

The questions used in the survey are shown in the Supplementary material.

## Statistical analysis

Statistical analysis data were extracted from the online survey (Microsoft Forms) into a spreadsheet (Microsoft Excel 2019). Data are presented as mean  $\pm$  standard deviation. Normality of the data was analyzed by Kolmogorov–Smirnov test ( $> 50$ ). Absolute and relative frequencies were used for categorical variables, and qualitative terms were used to characterize observed frequencies as follows: all = 100% of participants; most,  $\geq 75\%$ ; majority, 55%–75%; about half,  $\sim 50\%$ ; about one-third,  $\sim 30\%$ ; minority,  $< 30\%$  (Altarriba-Bartes et al., 2021; Pernigoni et al., 2022; Starling and

Lambert, 2018). Descriptive statistics were performed using IBM SPSS Statistics ver. 25.0 (IBM Co., Armonk, NY, USA) and graphs were plotted using GraphPad Prism 9 (GraphPad Software Inc., La Jolla, CA, USA).

## RESULTS

The majority of players (n = 131, 56.7%) players surveyed were under 21 years of age; half of the respondents were female (n = 119, 51.5%) and male (n = 112, 48.5%); had sport experience between 5 and 10 years (n = 99, 42%); were students (n = 174, 75.3%); were from Europe (n = 202, 87.4%); and were part of a first division team (n = 108, 46.8%). In the case of the coaches, one-third were between 31 and 40 years of age (n = 24, 31.6%); the majority were male (n = 70, 27.1%); work experience between 5 and 10 years, and between 11 and 15 years for approximately one-third (n = 20, 26.3%; n = 18, 23.7%; respectively); were degrees in other disciplines (n = 21, 27.6%); most were from Europe (n = 63, 82.9%); work with male teams (n = 54, 71.9%); and one-third were part of a territorial division team (n = 28, 36.8%). Table 1 details the sociodemographic characteristics of the WP players and coaches.

The importance, objectives, frequency, timing, location and limitations of the use of recovery strategies in WP players and coaches are shown in Tables 2–4. The majority of players and coaches considered recovery strategies as very important (n = 121, 52.4%; n = 45, 59.2%; respectively). The most selected reasons to justify their use were to reduce the injury risk (n = 200, 30.4%; n = 62, 26.9%; respectively) and to improve the performance capability in the following training session or competition (n = 162, 24.6%; n = 57, 24.7%; respectively). The most prominent frequencies of use of recovery strategies were rarely (n = 66, 28.6%) and occasionally (n = 61, 26.4%) in players; and occasionally (n = 23, 30.3%) and sometimes (n = 14, 18.4%) in coaches. The most frequently used times were posttraining session (n = 131, 28.1%; n = 44, 26.5%; respectively) and post-game (n = 126, 27%; n = 43, 25.9%; respectively); and the most frequently used places were in the sports hall or in the gym (n = 159, 49.7%; n = 64, 57.1%; respectively) and at home (n = 125, 39.1%; n = 25, 21.3%; respectively). The most frequently observed limitations to the use of recovery strategies were that they are too time-consuming (n = 132, 34.9%; n = 40, 29%; respectively) and there are no available devices or facilities to implement those strategies (n = 99, 26.2%; n = 42, 30.4%; respectively).

The frequencies for perceived usefulness and actual use are shown in Fig. 2 (players) and Fig. 3 (coaches). In the case of the players,

**Table 1.** Sociodemographic characteristics of water polo players (n=231) and coaches (n=76)

Variable	Players	Coaches
Age (yr)		
<21	131 (56.7)	3 (3.9)
21–30	81 (35.1)	15 (19.7)
31–40	16 (6.9)	24 (31.6)
41–50	1 (0.4)	19 (25)
51–60	2 (0.9)	9 (11.8)
>60	0 (0)	6 (7.9)
Gender		
Female	119 (51.5)	6 (7.9)
Male	112 (48.5)	70 (92.1)
Experience		
<5	30 (13.0)	14 (18.4)
5–10	99 (42.0)	20 (26.3)
11–15	71 (30.7)	18 (23.7)
16–20	21 (9.1)	10 (13.2)
>20	10 (4.3)	13 (13.2)
Qualification		
No degree	174 (75.3)	7 (9.2)
NCSA, CSCS, other certification	1 (0.4)	14 (18.4)
Bachelor in Sport Science or Physical Exercise	9 (3.9)	14 (18.4)
Master degree in Sport Science or Physical Exercise	4 (1.7)	11 (14.5)
PhD in Sport Science or Physical Exercise or similar	0 (0)	9 (11.8)
Degrees in other disciplines	43 (18.6)	21 (27.6)
Other	0 (0)	0 (0)
Continent		
Europe	202 (87.4)	63 (82.9)
Africa	11 (4.8)	3 (3.9)
North America	7 (3.0)	4 (5.3)
South America	3 (1.3)	4 (5.3)
Asia	0 (0)	0 (0)
Oceania	8 (3.5)	2 (2.6)
Are/Were you working with male or female athletes?		
Female	-	22 (28.9)
Male	-	54 (71.9)
Level		
First division club	108 (46.8)	20 (26.3)
Second division club	14 (6.5)	8 (10.5)
Third division club	4 (1.7)	0 (0)
Territorial division club	49 (21.2)	28 (36.8)
National senior team	21 (9.1)	1 (1.3)
National team of different categories except senior	3 (1.3)	3 (3.9)
Team of different categories except senior	31 (13.4)	16 (21.1)

Values are presented as number (%).

NCSA, National Strength and Conditioning Association; CSCS, Certified Strength and Conditioning Specialists.

stretching (n = 175, 12.7%), massage (n = 152, 11.1%), active recovery (n = 119, 8.7%), and cold baths (n = 111, 8.1%) were the strategies perceived as most useful. The strategies most frequently used were stretching (n = 178, 18.1%), active recovery (n = 110, 11.2%), massage (n = 107, 10.9%), and foam rolling (n = 78, 8%). As for the coaches, active recovery (n = 57, 11.2%), massage (n = 48, 9.4%), stretching (n = 45, 8.8%), and cold baths (n = 31, 6.1%) were the strategies perceived as most useful. The strategies most frequently used were active recovery (n = 51, 15%), stretching (n = 47, 13.8%), pool recovery (n = 37, 10.9%), and foam rolling (n = 28, 8.2%).

## DISCUSSION

This global descriptive survey was designed to evaluate how recovery strategies are perceived, utilized, and constrained among WP players and WP coaches worldwide. The main findings of the study were that there is a notable inconsistency between participants' perception of the importance of recovery strategies and their actual use, as well as a lack of knowledge on the topic based on the scientific literature.

Even if most participants acknowledged the significance of recovery strategies in WP, sometimes a considerable number of respondents demonstrated the utilization of outdated methods not aligned with the current scientific evidence. This confirms a lack of adherence to established recovery practices within this aquatic discipline (Barrenetxea-García et al., 2022). The participants' primary reasons for using recovery strategies were mainly to minimize the risk of injuries and enhance performance capabilities in subsequent training sessions or competitions. These results align with early previous research in basketball (Pernigoni et al., 2022), where participants provided similar answers. In our study WP players exhibited infrequent utilization of recovery strategies, with rare occurrences being the most prevalent. Similarly, WP coaches reported occasional and sometimes usage. This kind of approach to recovery activities is not optimal for reaping the benefits of these strategies, given that several studies in other sports suggest that the use of recovery strategies and athlete monitoring should be consistently performed within the weekly microcycle (Padrón-Cabo et al., 2024; Wiewelhove et al., 2016; Wilke et al., 2020). Similarly, maintaining a daily and weekly record of player's load is a crucial monitoring tool for coaches, allowing them to assess players' stress levels and adaptive responses (Barrenetxea-García et al., 2024; Perazzetti et al., 2023c). These deficiencies in WP could be attributed to a lack of usefulness of scientific information, a

**Table 2.** Importance, objectives, frequency, timing, location and limitations of the use of recovery strategies in water polo players (n = 231)

Level	First division club	Second division club	Third division club	Territorial division club	National senior team	National team of different categories except senior	Team of different categories except senior	All
Do you believe that recovery strategies are important in your context?								
Not important at all	1 (0.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.4)
Of little importance	2 (1.9)	1 (6.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (1.3)
Of average importance	8 (7.4)	4 (26.7)	0 (0)	9 (18.4)	2 (9.5)	0 (0)	5 (16.1)	28 (12.1)
Very important	58 (53.7)	10 (66.7)	4 (100)	26 (53.1)	9 (42.9)	1 (33.3)	13 (41.9)	121 (52.4)
Extremely important	39 (36.1)	0 (0)	0 (0)	14 (28.6)	10 (47.6)	2 (66.7)	13 (41.9)	78 (33.8)
If you believe that recovery strategies are important, why are they important?								
To reduce the injury risk	95 (30.5)	13 (32.5)	4 (33.3)	44 (32.4)	18 (28.6)	2 (28.6)	24 (27.0)	200 (30.4)
To decrease the cumulative fatigue	63 (20.3)	11 (27.5)	2 (16.7)	30 (22.1)	15 (23.8)	2 (28.6)	23 (25.8)	146 (22.2)
To decrease the chance of overtraining	29 (9.3)	3 (7.5)	2 (16.7)	12 (8.8)	9 (14.3)	0 (0)	7 (7.9)	62 (9.4)
To improve the performance capability in the following training sesión or competition	81 (26.0)	8 (20.0)	4 (33.3)	34 (25.0)	13 (20.6)	2 (28.6)	20 (22.5)	162 (24.6)
To improve psychological wellbeing	37 (11.9)	4 (10.0)	0 (0)	14 (10.3)	7 (11.1)	0 (0)	10 (11.2)	72 (10.9)
To induce placebo effect on the players	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1.1)	2 (0.3)
Because of players like recovery strategies	4 (1.3)	1 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (0.8)
To improve social recovery	1 (0.3)	0 (0)	0 (0)	2 (1.5)	1 (1.6)	1 (14.3)	4 (4.5)	9 (1.4)
Other	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
How often do you use recovery strategies in your team?								
Never	6 (5.6)	1 (6.7)	0 (0)	8 (16.3)	1 (4.8)	0 (0)	6 (19.4)	22 (9.5)
Rarely, in less than 10% of the sessions	30 (27.8)	5 (33.3)	1 (25.0)	18 (36.7)	5 (23.8)	1 (33.3)	6 (19.4)	66 (28.6)
Occasionally, in about 30% of the sessions	29 (26.9)	5 (33.3)	2 (50.0)	9 (18.4)	5 (23.8)	2 (66.7)	9 (29.0)	61 (26.4)
Sometimes, in about 50% of the sessions	16 (14.8)	2 (13.3)	1 (25.0)	4 (8.2)	5 (23.8)	0 (0)	5 (16.1)	33 (14.3)
Frequently, in about 70% of the sessions	12 (11.1)	2 (13.3)	0 (0)	5 (10.2)	4 (19.0)	0 (0)	3 (9.7)	26 (11.3)
Usually, in about 90% of the sessions	9 (8.3)	0 (0)	0 (0)	4 (8.2)	1 (4.8)	0 (0)	0 (0)	14 (6.1)
Every time	6 (5.6)	0 (0)	0 (0)	1 (2.0)	0 (0)	0 (0)	2 (6.5)	9 (3.9)
When do you apply recovery strategies?								
Pregame	33 (14.3)	2 (10.0)	1 (12.5)	10 (12.3)	8 (15.1)	0 (0)	13 (20.6)	67 (14.4)
Pretraining session	31 (13.4)	2 (10.0)	0 (0)	5 (6.2)	6 (11.3)	0 (0)	9 (13.2)	53 (11.4)
Postgame	60 (26.0)	4 (20.0)	3 (37.5)	27 (33.3)	13 (24.5)	1 (14.3)	18 (26.5)	126 (27.0)
Posttraining session	60 (26.0)	6 (30.0)	4 (50.0)	26 (32.1)	16 (30.2)	2 (28.6)	17 (25.0)	131 (28.1)
In separate sessions	23 (10.0)	4 (20.0)	0 (0)	6 (7.4)	3 (5.7)	1 (14.3)	1 (1.5)	38 (8.1)
When travelling	21 (9.1)	2 (10.0)	0 (0)	2 (2.5)	6 (11.3)	3 (42.9)	4 (5.9)	38 (8.1)
Never	3 (1.3)	0 (0)	0 (0)	5 (6.2)	1 (1.9)	0 (0)	4 (5.9)	13 (2.8)
Other	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Where do you usually apply recovery strategies?								
In the sports hall or in the gym	80 (48.5)	8 (44.4)	3 (60.0)	28 (47.5)	16 (57.1)	2 (50.0)	22 (53.7)	159 (49.7)
At home	63 (38.2)	8 (44.4)	2 (40.0)	26 (44.1)	6 (21.4)	1 (25.0)	19 (46.3)	125 (39.1)
At hotel	14 (8.5)	0 (0)	0 (0)	4 (6.8)	4 (14.3)	1 (25.0)	0 (0)	23 (7.2)
On the road (on the bus, on the plane, etc.)	6 (3.6)	0 (0)	0 (0)	0 (0)	1 (3.6)	0 (0)	0 (0)	7 (2.2)
Other	2 (1.2)	2 (11.1)	0 (0)	1 (1.7)	1 (3.6)	0 (0)	0 (0)	6 (1.9)
What prevents you from using the recovery strategies that you would like to adopt?								
They are too expensive	52 (29.4)	7 (25.9)	1 (12.5)	15 (19.5)	7 (22.6)	1 (16.7)	14 (26.9)	97 (25.7)
They are too time-consuming	59 (33.3)	7 (25.9)	4 (50.0)	27 (35.1)	12 (38.7)	2 (33.3)	21 (40.4)	132 (34.9)
They are not well accepted by players or coaches	15 (8.5)	3 (11.1)	1 (12.5)	7 (9.1)	2 (6.5)	1 (16.7)	2 (3.8)	31 (8.2)
There are no available devices or facilities to implement those strategies	42 (23.7)	8 (29.6)	2 (25.0)	24 (31.2)	9 (29.0)	2 (33.3)	12 (32.1)	99 (26.2)
Their effects are not sufficiently studied in the scientific literature	3 (1.7)	1 (3.7)	0 (0)	2 (2.6)	1 (3.2)	0 (0)	2 (3.8)	9 (2.4)
Other	6 (3.4)	1 (3.7)	0 (0)	2 (2.6)	0 (0)	0 (0)	1 (1.9)	10 (2.6)

Values are presented as number (%).

**Table 3.** Importance, objectives, frequency, timing, location, and limitations of the use of recovery strategies in water polo coaches (n= 76)

Level	First division club	Second division club	Third division club	Territorial division club	National senior team	National team of different categories except senior	Team of different categories except senior	All
Do you believe that recovery strategies are important in your context?								
Not important at all	0 (0)	0 (0)	-	0 (0)	0 (0)	0 (0)	1 (6.3)	1 (1.0)
Of little importance	0 (0)	0 (0)	-	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Of average importance	0 (0)	1 (12.5)	-	1 (3.6)	0 (0)	1 (33.3)	0 (0)	3 (3.9)
Very important	11 (55.0)	4 (50.0)	-	19 (67.9)	1 (100)	2 (66.7)	8 (50.0)	45 (59.2)
Extremely important	9 (45.0)	3 (37.5)	-	8 (28.6)	0 (0)	0 (0)	7 (43.8)	27 (35.5)
If you believe that recovery strategies are important, why are they important?								
To reduce the injury risk	16 (28.1)	5 (20.8)	-	23 (28.0)	1 (33.3)	2 (22.2)	15 (31.3)	62 (26.9)
To decrease the cumulative fatigue	13 (22.8)	6 (25.0)	-	16 (19.5)	0 (0)	1 (11.1)	4 (8.3)	40 (17.3)
To decrease the chance of overtraining	9 (15.8)	2 (8.3)	-	7 (8.5)	1 (33.3)	2 (22.2)	15 (31.5)	36 (15.6)
To improve the performance capability in the following training sesión or competition	13 (22.8)	7 (29.2)	-	20 (24.4)	1 (33.3)	3 (33.3)	13 (27.1)	57 (24.7)
To improve psychological wellbeing	5 (8.8)	2 (8.3)	-	14 (17.1)	0 (0)	1 (11.1)	8 (16.7)	30 (13)
To induce placebo effect on the players	1 (1.8)	1 (4.2)	-	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.9)
Because of players like recovery strategies	0 (0)	0 (0)	-	1 (1.2)	0 (0)	0 (0)	0 (0)	1 (0.4)
To improve social recovery	0 (0)	1 (4.2)	-	1 (1.2)	0 (0)	0 (0)	1 (2.1)	3 (1.3)
Other	0 (0)	0 (0)	-	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
How often do you use recovery strategies in your team?								
Never	1 (5.0)	0 (0)	-	3 (10.7)	0 (0)	0 (0)	1 (6.3)	5 (6.6)
Rarely, in less than 10% of the sessions	1 (5.0)	1 (12.5)	-	8 (28.6)	0 (0)	0 (0)	3 (18.8)	13 (17.1)
Occasionally, in about 30% of the sessions	3 (15.0)	3 (37.5)	-	10 (35.7)	0 (0)	2 (66.7)	5 (31.3)	23 (30.3)
Sometimes, in about 50% of the sessions	6 (30.0)	1 (12.5)	-	3 (10.7)	1 (100)	0 (0)	3 (18.8)	14 (18.4)
Frequently, in about 70% of the sessions	4 (20.0)	3 (37.5)	-	4 (14.3)	0 (0)	0 (0)	2 (12.5)	13 (17.1)
Usually, in about 90% of the sessions	3 (15.0)	0 (0)	-	0 (0)	0 (0)	0 (0)	1 (6.3)	4 (5.3)
Every time	2 (10.0)	0 (0)	-	0 (0)	0 (0)	1 (33.3)	1 (6.3)	4 (5.3)
When do you apply recovery strategies?								
Pregame	9 (17.6)	0 (0)	-	4 (7.4)	1 (20.0)	0 (0)	4 (11.1)	18 (10.8)
Pretraining session	6 (11.8)	0 (0)	-	6 (11.1)	1 (20.0)	0 (0)	4 (11.1)	17 (10.2)
Postgame	12 (23.5)	3 (21.4)	-	16 (29.6)	1 (20.0)	3 (42.9)	8 (22.2)	43 (25.9)
Posttraining session	11 (21.6)	5 (35.7)	-	16 (29.6)	1 (20.0)	1 (14.3)	10 (27.8)	44 (26.5)
In separate sessions	7 (13.7)	4 (28.6)	-	4 (7.4)	0 (0)	2 (28.6)	6 (16.7)	23 (13.9)
When travelling	5 (9.8)	2 (14.3)	-	6 (11.1)	1 (20.0)	1 (14.3)	2 (5.6)	17 (10.2)
Never	0 (0)	0 (0)	-	2 (3.7)	0 (0)	0 (0)	1 (2.8)	3 (1.8)
Other	1 (2.0)	0 (0)	-	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.6)
Where do you usually apply recovery strategies?								
In the sports hall or in the gym	18 (72.0)	7 (53.8)	-	21 (48.8)	1 (50.0)	3 (42.9)	14 (65.2)	64 (57.1)
At home	5 (20.0)	3 (23.1)	-	13 (30.2)	1 (50.0)	0 (0)	3 (13.0)	25 (21.3)
At hotel	1 (4.0)	2 (15.4)	-	8 (18.6)	0 (0)	3 (42.9)	4 (17.4)	18 (16.8)
On the road (on the bus, on the plane, etc.)	0 (0)	1 (7.7)	-	1 (2.3)	0 (0)	1 (14.3)	1 (4.3)	4 (3.6)
Other	1 (4.0)	0 (0)	-	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.9)
What prevents you from using the recovery strategies that you would like to adopt?								
They are too expensive	7 (20.0)	3 (23.1)	-	15 (27.3)	1 (50.0)	0 (0)	5 (17.2)	31 (22.5)
They are too time-consuming	11 (32.4)	4 (30.8)	-	14 (25.5)	0 (0)	2 (40.0)	9 (31.0)	40 (29.0)
They are not well accepted by players or coaches	4 (11.8)	1 (7.7)	-	6 (10.9)	0 (0)	0 (0)	5 (17.2)	16 (11.6)
There are no available devices or facilities to implement those strategies	11 (32.4)	2 (15.4)	-	18 (32.7)	1 (50.0)	3 (60.0)	7 (24.1)	42 (30.4)
Their effects are not sufficiently studied in the scientific literature	1 (2.9)	2 (15.4)	-	2 (3.6)	0 (0)	0 (0)	2 (6.9)	7 (5.1)
Other	0 (0)	1 (7.7)	-	0 (0)	0 (0)	0 (0)	1 (3.4)	2 (1.4)

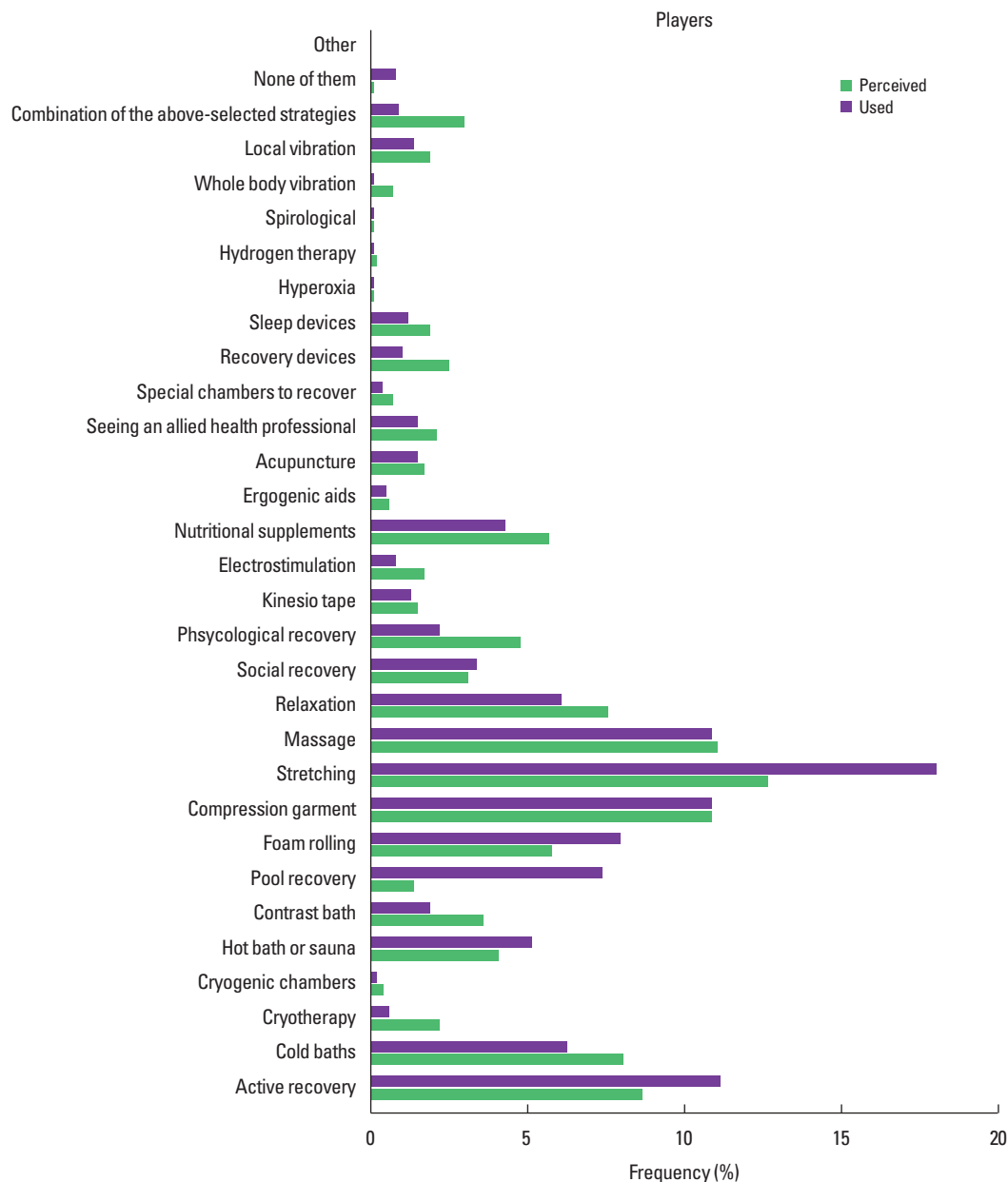
Values are presented as number (%).

**Table 4.** Pearson correlations between the importance of the use of recovery strategies and the frequency of their use in water polo male and female players and coaches

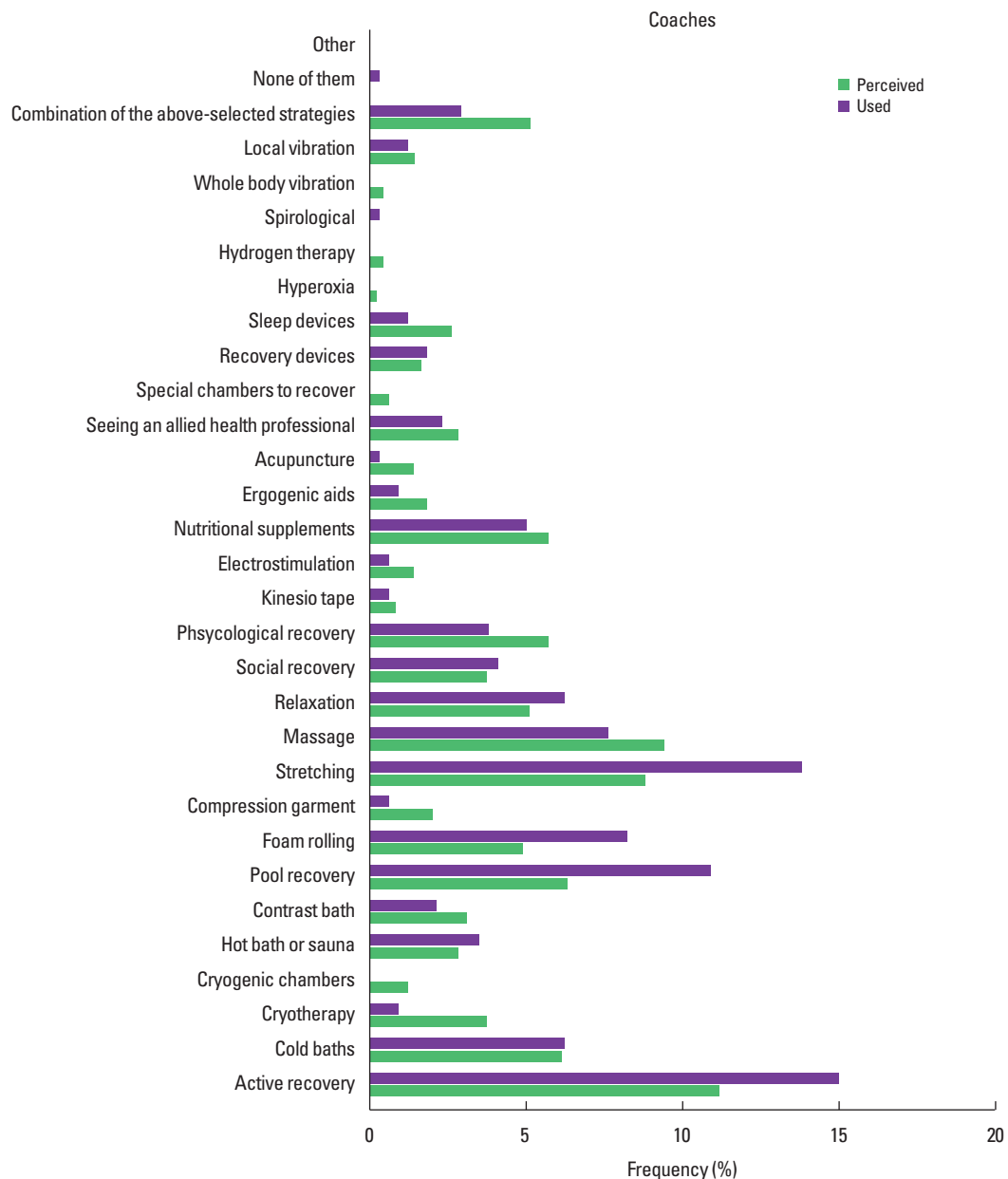
Variable	<i>r</i>	<i>r</i> magnitude	<i>P</i> -value
All players	0.291	Very weak	0.000
Male players	0.365	Low	0.000
Female players	0.218	Very weak	0.017
All coaches	0.219	Very weak	0.057
Male coaches	0.216	Very weak	0.073
Female coaches	0.620	Moderate	0.189

limited number of coaches with a sports science background (Perazzetti et al., 2023b), and frequently inadequate training facilities (Reverter-Masía et al., 2012).

In the rare instances where recovery strategies are implemented by WP practitioners, our findings indicated that they were typically applied posttraining sessions and games. As previously showcased in various team sports (Calleja-González et al., 2018; Calleja-González et al., 2019; Nemčić and Calleja-González, 2021), the implementation of specific recovery strategies immediately



**Fig. 2.** Reported relative frequencies for perceived usefulness and actual use of recovery strategies in water polo players.



**Fig. 3.** Reported relative frequencies for perceived usefulness and actual use of recovery strategies in water polo coaches.

posttraining brings about significant benefits for the players (Tessitore et al., 2007; Tessitore et al., 2008). Despite this, participants demonstrated a lack of habit to organize training sessions that included recovery strategies. A lack of specific knowledge on this topic indicates a deficiency in this area, particularly among coaches (Calleja-González et al., 2021). Indeed, several studies have emphasized the importance of using recovery modalities between training sessions (Barnett, 2006; Laborde et al., 2024).

Examining the pooled data, participants identified the follow-

ing as the most useful recovery strategies among others: stretching; massage; active recovery; and cold baths. Regarding stretching, even if for long period of time scientific literature has consistently advocated it as a postexercise recovery method, last studies indicated there were not always positive effects associated with stretching in terms of postexercise recovery (Afonso et al., 2021; Dupuy et al., 2018; Herbert et al., 2011). This observation again indicates a lack of sufficient knowledge on this topic between both WP players and coaches. At the contrary, regarding massage strat-



egy the participants' answers were in line with scientific literature, which stated that is an advantageous method for perceptual measures of recovery (Delextrat et al., 2014) and for a better flexibility and evolution of muscle soreness (Davis et al., 2020). At once, active recovery, which is considered an excellent recovery strategy for the stimulation of reduction of blood lactate concentration and creatine kinase levels (Gu et al., 2021) and cold bath, which has been demonstrated to improve the level of perceived relaxation (Ahokas et al., 2019), appear to be well-known recovery strategies both by WP players (Barrenetxea-García et al., 2022) and coaches.

Regarding the usage, players predominantly answered to most utilize stretching, active recovery, massage, and foam rolling, whereas coaches most frequently employed stretching, active recovery, pool recovery, and foam rolling. Team sport players of all competition levels frequently use stretching, which can be attributed to several factors such as its self-administered nature, accessibility and ease of use and widespread use in the fitness and sports industries (Nuzzo, 2020). In addition, stretching may be done in a small space and doesn't require any complex equipment. This could explain the reason why the majority part of WP participants answered to use this strategy more than other. On the other hand, the great use of active recovery indicated by the respondents is a positive trend in line with previous studies demonstrated that following exercise, wellbeing status and muscle discomfort may benefit from active recovery (Ortiz et al., 2019).

Concerning massage, it seems to be also used at international level by elite athletes (Crowther et al., 2017). Clearly, this strategy could be used only by elite level of WP practitioners since it implies the presence of a massage therapist or physiotherapist in the staff or a wide budget from the club to send players to an external professional. This is maybe the reason why WP coaches didn't include this method as the most used during their job. Instead, WP coaches indicated pool recovery as one of the most used strategies for recovery, which, according to our knowledge, was not present in previous research on WP. Among the most intriguing findings of our study, it was observed that both WP coaches and players identified the use of foam rolling as one of the most employed recovery methodologies. This is notable finding, considering that it was not perceived as important in the previous question of the current survey and in a previous study conducted by Barrenetxea-García et al. (2024), it has been demonstrated that it does not impact the recovery of WP athletes more than a passive recovery, but rather exclusively influences players' joint range of motion, preventing injury risks. Unfortunately, in line with previous study on basketball (Pernigoni et al., 2022), although recovery methods

that are costly and need specialized facilities are frequently seen to be beneficial, even though there is no scientific proof to justify some of these strategies, it was anticipated that they would be employed infrequently by WP practitioners.

Our research suggests a degree of discrepancy between the scientific literature and the research participants' perceptions and usages of recovery methods, as other authors observed (Altarriba-Bartes et al., 2021; Crowther et al., 2017; Field et al., 2021; Pernigoni et al., 2022). This study could be useful especially for WP coaches, since they may influence those WP players who eventually become coaches and strength and conditioning coaches in the future. Previous research has demonstrated that coaches' perception of recovery strategies may be influenced by previous knowledge, based on their personal experiences as players (Simjanovic et al., 2009). Therefore, it is crucial to reduce the gap between scientific evidence and coaches' perceptions to improve player recovery and performance, and to share validated information. For this purpose, the coaching staff should rely on scientific research to offer effective recovery strategies to their players, as well as maintain close and collaborative communication between the different agents involved (Crowther et al., 2017; Field et al., 2021; Németh et al., 2024; Pernigoni et al., 2022). It has also been shown that the practice of sports coaching education is related to the level of popularity of a sport (Németh et al., 2024), consequently, the professionalization of sports coaching should be enhanced (Németh et al., 2024). Further research should be conducted to increase knowledge, to develop accessible and easy instruments to provide general protocols for sport teams, and to promote players education on this topic (Altarriba-Bartes et al., 2021; Pernigoni et al., 2022).

The study also presents certain limitations. While descriptive statistics illustrate the study results categorized by WP players and coaches, these variables were not thoroughly examined for more in-depth statistical analysis to confirm or refute differences both groups. Additionally, distinctions in responses between male and female participants were not considered. Moreover, the survey does not take into account the training diary of the players with their respective rest days per week. Nevertheless, to our knowledge, it is the first study on this topic in WP, involving a large number of participants around the world, different performance levels, and both genders. Future research could explore the same inquiries exclusively within teams that include an athletic trainer on the coaching staff, as described in football (Calleja-González et al., 2021), considering that they typically adopt a more professional and specialized approach compared to head coaches. Nevertheless,

further research is essential in the realm of recovery within the WP, enabling coaches and WP practitioners to develop more specific and practical recommendations.

In summary, the study showed that the importance of tailoring interventions to address specific challenges and preferences within the diverse landscape of WP players and coaching staff. Participants demonstrated an inconsistency between their perception of the importance of recovery strategies and the frequency of their utilization. Particularly noteworthy are the results provided by coaches, as they play a crucial role in instructing and leading WP players towards a better understanding of this important topic. Indeed, a limited understanding of recovery strategies by coaches could result in the adoption of incorrect approaches, elevating the risk of overtraining and injuries in WP players and imparting inaccurate knowledge to them.

## SUPPLEMENTARY MATERIAL

Supplementary material can be found via <https://doi.org/10.12965/jer.2448214.107>.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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