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RECOVERY PRACTICES OF SLOVENIAN SPORT CLIMBERS

STRATEGIJE OKREVANJA SLOVENSKIH ŠPORTNIH PLEZALCEV

ABSTRACT

Post-exercise recovery interventions enable athletes to overcome greater training loads and thereby enhancing their performance. Post-exercise recovery strategies serve to optimize recovery, help lower performance decline and prevent overtraining. The purpose of this study was to examine the current practices and attitudes towards post-exercise recovery among Slovenian sport climbers. 339 sports climbers from Slovenia (186 males, 153 females), consisting of 330 recreational sport climbers and 9 competitive sport climbers completed an online survey which was active from February to May 2022. The most common recovery strategies among sport climbers are sleep/rest (84%) and stretching (77%). A significant proportion of sport climbers (87%) reported sleeping duration below the recommended amount of sleep. Personal opinions notably influence the choice of recovery strategies (6 out of 9 competitive sport climbers and 71% of recreational sport climbers). Our findings reveal discrepancies between individual beliefs regarding the effectiveness of specific strategies and their practical implementation. Competitive sport climbers have more individualized recovery strategies ($p = 0.012$) and use a greater number of recovery strategies ($p = 0.005$). Even though that such recovery practices of sport climbers are often in conflict with the literature, we can conclude that sport climbers recover solidly. This data may suggest that recovery does not play a major role in sport climbing performance.

Keywords: recovery, recovery strategies, sport climbing, sport performance

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IZVLEČEK

Intervencije za izboljšanje okrevanje po vadbi omogočajo športnikom, da premagajo večje trenažne obremenitve in s tem izboljšajo svojo zmogljivost. Strategije okrevanja po vadbi so namenjene izboljšanju okrevanja, pripomorejo k nižjemu padcu zmogljivosti in preprečevanju pretreniranosti. Namen te raziskave je bil ugotoviti kakšne strategije okrevanja uporabljajo slovenski športni plezalci in kakšen je njihov odnos do faze okrevanja. 339 športnih plezalcev iz Slovenije (186 moških, 153 žensk), od katerih je bilo 330 rekreativnih športnih plezalcev in 9 tekmovalnih plezalcev je izpolnilo spletno anketo, ki je bila aktivna od februarja do maja 2022. Najpogostejši strategiji okrevanja med športnimi plezalci sta spanje/počitek (84%) in raztezanje (77%). Velik delež športnih plezalcev (87%) spi manj od priporočene količine spanja. Osebno mnenje pomembno vpliva na izbiro strategij okrevanja (6 od 9 tekmovalnih športnih plezalcev in 71% rekreativnih plezalcev). Ugotovitve raziskave kažejo na neskladja med prepričanji glede učinkovitosti posameznih strategij in njihove praktične uporabe. Tekmovalni športni plezalci imajo v primerjavi z rekreativnimi športnimi plezalci strategije okrevanja bolj individualizirane ($p = 0{,}012$) in uporabljajo večje število strategij okrevanja ($p = 0{,}005$). Čeprav so strategije okrevanja športnih plezalcev pogosto v nasprotju z literaturo, lahko zaključimo, da športni plezalci okrevajo solidno. Ti podatki morda nakazujejo, da okrevanje pri športnem plezanju ne igra pomembne vloge.

Ključne besede: okrevanje, strategije okrevanja, športno plezanje, športna zmogljivost

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https://doi.org/10.52165/kinsi.29.3.135-152

INTRODUCTION

The traditional meaning of sport climbing pertains to the act of climbing, either on natural rock formations or artificial climbing walls, utilizing fixed anchors for safety. Competitive sport climbing, as defined by the International Federation of Sport Climbing (IFSC), encompasses the ascent of artificial routes involving lead climbing, speed climbing, and bouldering. Sport climbing is a young but increasingly popular sport featured on the Olympic Games for the first time in Tokyo 2020 (Heyman et al., 2009). Despite its growing popularity, there is very limited research available describing its demands and athletes' practices and is so far an understudied sports discipline (Lutter et al., 2019). As a competitive sport, climbing consists of three disciplines: lead climbing, bouldering and speed climbing all differing in duration and thus intensity (Lutter et al., 2021). Within all disciplines, the primary objective is to successfully complete the route by reaching a predetermined top without falling (Jones & Johnson, 2016).

Climbing consists of isometric and dynamic movement patterns of varying durations, interspersed with periods of rest (Bertuzzi et al., 2007; Watts, 2004). Predictors of climbing performance are based on climbing discipline and sex. In competitive bouldering, climbing performance is determined by hip flexibility, lower limb power and upper limb power, maximum strength, and strength endurance (Winkler et al., 2023). For competitive lead climbing, climbing performance is determined by upper limb strength, finger flexor endurance, lower limb power, upper limb power and maximal strength, motor planning abilities, core endurance and coordination (Winkler et al., 2023). However, it is also often that climbers do not reach the top due to a suboptimal technical move, occurring either due to a lack of technical skills or poor concentration due to fatigue.

Factors affecting fatigue during isometric contractions of forearms are oxidative capacity, substrate level rephosphorylation, metabolic economy (Sirikul et al., 2007) and changes in the excitation-contraction coupling (Place et al., 2009). Neuromuscular fatigue onset is associated with an alteration in central and peripheral mechanisms (alteration in neuromuscular transmission, muscle action potential, excitation-contraction coupling, contractile mechanisms, accumulation of inorganic phosphate and by a fall in adenosine triphosphate reserves) (Boyas & Guével, 2011). The cause of fatigue in climbing therefore depends on many factors, but above all, it is determined by climbing discipline and route-setting style (Winkler et al., 2023). The goal of recovery is to eliminate the causes of fatigue, so choosing recovery strategies in sport climbing can be challenging.

Competitions in sport climbing take place over several consecutive days (even up to 5 days). To ensure optimal readiness for each match/training session, it is essential to provide the most ideal conditions for recovery (Reilly & Ekblom, 2005; Shell et al., 2020). Post-exercise recovery interventions by reducing the pain, fatigue and recovery time between training sessions enable athletes to overcome greater training loads and at the same time, their purpose is to prevent overtraining and reduce the risk of injury (Ortiz et al., 2019; Meeusen et al., 2013; Shell et al., 2020).

Recovery after training and competition is an integral part of the athlete's training process (Beck et al., 2015) and athletes' practices are well described within the literature (Shell et al., 2020; Tavares et al., 2017; Altarriba-Bartes et al., 2021; Murray et al., 2018) yet there is lack of research on practices of sports climbers.

To reveal deeper insights of recovery in sport climbing, there is a need to analyze recovery strategies sport climbers currently use. Therefore, the main aim of the study was to report the use of recovery strategies by Slovenian sport climbers, one of the strongest climbing nations, which is also confirmed by the high ranking according to the IFSC ranking (https://www.ifsc-climbing.org/index.php/world-competition/ranking).

METHODS

Participants

The sample for analysis consisted of 339 sports climbers from Slovenia: 186 males (55%) and 153 females (45%), of which 79% belonged to the age group between 21 and 40 years. On average, they had been climbing for 8.6 years (±11.5). We divided sport climbers into competitive sport climbers (those who take part in competitions) and recreational sport climbers (those who climb for their own pleasure). There were 330 recreational sport climbers (97.3%) and 9 competitive sport climbers (2.7%).

We also classified them according to their abilities using the IRCRA scale (Draper et al., 2015), with which we classified males and females into 5 quality groups: lower grade, intermediate, advanced, elite and higher elite (Table 1 for males and Table 2 for females, respectively). A climber's classification was determined by the highest level of difficulty they successfully tackled in a sport climbing route or boulder problem within the last two years.

Table 1. Ability grouping (IRCRA score, French/sport climbing scale and font scale) – males. The % of the overall males' sample and the number of subjects (in brackets).

Ability group (IRCRA score)	French/sport climbing scale	Font scale	% (n)
Lower grade (1–9)	≤ 5	≤ 2	2,7 % (5)
Intermediate (10–17)	5+ - 7a	3 - 6B	45,2 % (84)
Advanced (18–23)	7a+ - 8a	6B+ - 7B+	37,1 % (69)
Elite (24–27)	8a+ - 8c	7C - 8A+	12,4 % (23)
Higher elite (28–32)	≥ 8c+	≥ 8B	2,7 % (5)

Table 2. Ability grouping (IRCRA score, French/sport climbing scale and font scale) – females. The % of the overall females' sample and the number of subjects (in brackets).

Ability group (IRCRA score)	French/sport climbing scale	Font scale	% (n)
Lower grade (1–9)	≤ 5	≤ 2	8,5 % (13)
Intermediate (10–14)	5+ - 6b+	3 - 5	34,6 % (53)
Advanced (15–20)	6c - 7b+	5+ - 7A	39,2 % (60)
Elite (21–26)	7c - 8b+	7A+ - 8A	16,3 % (25)
Higher elite (26–32)	≥ 8c	≥ 8A+	1,3 % (2)

The study had ethical approval from the Univeristy of Primorska Faculty of Health Sciences (registration number: 0120-690/2017/8). Participants participated voluntarily and anonymously.

Research instrument and study design

An online survey was developed to determine the use of recovery strategies of Slovenian sport climbers. A convenience sampling method was employed by distributing an online survey to climbing clubs in Slovenia, which subsequently forwarded it to their respective members. The target population comprised individuals actively involved in climbing, with a minimum participation of at least 1x per week for at least 1 year. A total of 72 climbing clubs were invited; however, the specific response rate is not available. The inclusion criteria ensured participants met the specified climbing activity requirements. A survey was based on previous published surveys, which have already been validated and refer to the contents of recovery strategies (Altarriba-Bartes et al., 2021; Bender et al., 2018; Kellmann et al., 2002). The survey (Appendix

1) consisted of a combination of open and closed questions, including checkboxes and Likert scales.

In the first part, we obtained the basic data of the sample (i.e., sex, age, climbing experience, number of years of climbing, level of climbing). Subsequently, the questionnaire consisted of the following subsections: a) recovery strategies used by sport climbers, b) sleeping habits of sports climbers, c) beliefs about the effectiveness of individual strategies, d) self-assessment of the quality of recovery.

The study was pilot-tested on a sample of 15 climbers to refine the survey and was then active from February to May 2022 and promoted via climbing clubs and social media. The criteria for completing the survey were: age at least 16 years and active involvement in climbing (minimum 1x/week) for at least 1 year.

Statistical analysis

The obtained data were analyzed using the SPSS program (SPSS Statistics 22, IBM, New York, USA). We calculated descriptive statistics (frequency, mean, standard deviation) and analyzed differences between competitive sport climbers and recreational sport climbers. Based on the research question and the associated data, we statistically evaluated the obtained values with the help of statistical tests. If the data do not meet the criteria for using the Chi-square test and the t-test, we used the appropriate data transformation. If we were still unable to use the desired statistical test after data transformation, we chose a suitable alternative test. We used the Mann-Whitney U-test as a non-parametric alternative to the t-test, the effect size was interpreted using Eta-squared (η^2) with categories for small effect (η^2 = 0.01–0.06), medium effect (η^2 = 0.06–0.14), and large effect ($\eta^2 > 0.14$). The Wilcoxon Signed Ranks Test was used as a non-parametric alternative to the paired t-test, the size of the effect was interpreted using Cohen's d (small effect (r = 0.1–0.3), medium effect (r = 0.3–0.5), large effect ($r > 0.5$)). Fisher's exact test was used as an alternative to the Chi-square test, and the effect size was interpreted using Cramer's V (small effect (V = 0.1–0.3), medium effect (V = 0.3–0.5), large effect ($V > 0.5$)). We also used Spearman's correlation coefficient, where we interpreted significance (very weak (r = 0.01–0.19), weak (r = 0.2–0.39), moderate (r = 0.4–0.59), strong (r = 0.6–0.79) and very strong (r = 0.8–1.00).

RESULTS

Recovery strategies used by sport climbers

The most utilized recovery strategies among sport climbers are sleep/passive rest, stretching and the consumption of food and drink. Utilized recovery practices are shown in Table 3.

Table 3. Use of recovery strategies. The % of the overall sample who use recovery strategies and the number of subjects (in brackets) is given.

Most utilized recovery	% (n)
Sleep and pasive rest	84.4 % (286)
Stretching	77.3 % (262)
Consumption of food and drink	71.4 % (242)
Nutritional supplements	28.3 % (96)
Foam rolling	26.0 % (88)
Active recovery	24.2 % (82)
Massage	19.5 % (66)
Gel/cream application	19.5 % (66)
Cold bath/shower	10.6 % (36)

Time of the first use of recovery strategies

Most sport climbers reported the first use of recovery strategies immediately after training. There was no statistically significant difference (Fisher's exact test; $p = 1$; Phi = 0.051) in the time of first use of recovery strategies between competitive and recreational sport climbers.

Table 4. Time of the first use of recovery strategies. The % and the number (in brackets) of competitive and recreational sport climbers is given.

	Competitive sport climbers % (n)	Recreational sport climbers % (n)
Immediately after training	66.7 % (6)	63.0 % (208)
Within 2–12 hours	33.3 % (3)	28.2 % (93)
Within 12–24 hours	/	7.0 % (23)
After 24 hours	/	1.8 % (6)

Reason for choosing recovery strategies

Reasons of choice were divided into 4 parts: decision-making based on a) scientific evidence, b) personal opinion/decision, c) professional opinion or d) conviction of friends/teammates. There was no statistically significant difference (Fisher's exact test; p = 0.732; Phi = 0.03) between competitive and recreational sports climbers and the reason for choosing recovery strategies.

Table 5. Reason for choosing recovery strategies. The % and the number (in brackets) of competitive and recreational sport climbers is given.

	Competitive sport climbers % (n)	Recreational sport climbers % (n)
Based on personal opinion/decision	66.7 % (6)	70.6% (233)
Based on scientific evidence	11.1% (1)	7.6% (25)
Expert opinion	11.1 % (1)	13.9 % (46)
Based on the beliefs of teammates	11.1 % (1)	7.9 % (26)

Individualization of recovery strategies

There was a difference between competitive sport climbers and recreational sport climbers in the individualization of recovery strategies (Fisher's exact test; p = 0.012; Phi = 0.15). The vast majority of competitive sport climbers (8 out of 9) have individualized recovery strategies, compared to less than half (43%) of recreational sport climbers.

Amount of sleep

There was no statistically significant difference in the amount of sleep (Fisher's exact test; p = 0.071) between competitive sport climbers and recreational sport climbers. 87% (284) of recreational sport climbers and 6 of 9 competitive sport climbers sleep less than 8 hours.

Table 6. Quantity of sleep. The % and the number (in brackets) of competitive and recreational sport climbers is given.

	Competitive sport climbers % (n)	Recreational sport climbers % (n)
≤ 6 hours	11.1 % (1)	8.3 % (27)
6 – 7 hours	33.3 % (3)	36.9 % (120)
7 – 8 hours	22.2 % (2)	42.2 % (137)
8 – 9 hours	22.2 % (2)	12.0 % (39)
≥ 9 hours	11.1 % (1)	0.6 % (2)

Number of strategies used

There was a statistically significant difference in the mean value of the strategies used between competitive and recreational sport climbers (Mann-Whitney U-test; $U = 685$; $p = 0.005$), but the effect size was small ($\eta 2 = 0.023$). Competitive sport climbers use more strategies than recreational sport climbers. Recreational sport climbers used an average of 3.9 ± 1.9 strategies, while the number of strategies used by competitive sport climbers was 5.8 ± 2.3.

Opinions on the effectiveness of post-exercise recovery strategies

Sleep versus active recovery

Sport climbers have a statistically significantly better opinion of the effectiveness of sleep on recovery than active recovery on post-exercise recovery (Wilcoxon Signed Ranks Test; $Z = -11.255$; $p < 0.001$, $r = 0.64$). 209 (68%) sport climbers think that sleep is more effective, 24 (8%) sport climbers think that active recovery is more effective, while 76 (25%) sport climbers think that there is no difference.

Sleep versus cold bath/shower

Sports climbers have a statistically significantly better opinion of the effectiveness of sleep on recovery than of cold bath/shower on post-exercise recovery (Wilcoxon Signed Ranks Test; $Z = -12.326$; $p < 0.001$, $r = 0.724$). 216 (75%) sport climbers think that sleep is more effective, 21 (7%) sport climbers think that cold bath/shower is more effective, while 53 (18%) sport climbers think that there is no difference.

Nutrition versus active recovery

Sports climbers have a statistically significantly better opinion of the effectiveness of nutrition on recovery than active recovery on post-exercise recovery (Wilcoxon Signed Ranks Test; $Z = -8.629$; $p < 0.001$, $r = 0.491$). 164 (53%) sport climbers think that nutrition is more effective, 36 (12%) sport climbers think that active recovery is more effective, while 109 (35%) sport climbers think that there is no difference.

Nutrition versus cold bath/shower

Sports climbers have a statistically significantly better opinion of the effectiveness of nutrition on recovery than of cold bath/shower on post-exercise recovery (Wilcoxon Signed Ranks Test; $Z = -10.596$; $p < 0.001$, $r = 0.622$). 189 (65%) respondents think that nutrition is more effective, 29 (10%) respondents think that cold bath/shower is more effective, while 72 (25%) respondents think that there is no difference.

Table 7. Belief in effectiveness of recovery strategy on post exercise recovery. The % of overall sample for each recovery strategy is given.

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
Sleep	0.9 %	1.8 %	4.9 %	20.5 %	71.9 %
Nutrition	0.6 %	4.6 %	8.3 %	42.5 %	44.0 %
Compression garments	21.8 %	16.3 %	44.9 %	16.3 %	0.7 %
Active recovery	3.2 %	10.7 %	20.7 %	46.9 %	18.4 %
Contrast water therapy	6.8 %	9.2 %	32.4 %	39.9 %	11.6 %
Cold bath/shower	10.0 %	11.4 %	33.8 %	32.1 %	12.8 %

Self-assessment of the quality of recovery

The self-assessment of recovery was rated by sports climbers from 1 to 6. The self-assessment of recovery was divided into four subcategories and participants were asked to evaluate how they usually feel: perceived exertion (effort required to complete the workout: 1 = excessive effort; 6 = hardly any effort), perceived recovery (sensation of recovery prior to workouts.: 1 = still not recovered; 6 = energized and recharged), performance during rest/between recovery activities (effectiveness in rest and recovery activities.: 1 = Not successful; 6 = Successful) and physical recovery after a week of climbing (feeling of physical recovery after a week of climbing: 1 = Never; 6 = Always). Perceived exertion was rated with a median of 3 (IQR 1), perceived recovery was rated with a median of 4 (IQR 1), they rated performance during rest/between recovery activities with a median of 4 (IQR 1) and physical recovery after a week of climbing as 5 (IQR 1).

There was a statistically significant difference in the perceived exertion score between competitive and recreational sport climbers (Mann-Whitney U-test; $U = 653.5$; $p = 0.004$), but the effect size was small ($\eta2 = 0.025$). Recreational sport climbers rated the perceived exertion on average as 3.4; competitive sport climbers as 2.3.

There was no statistically significant difference between competitive and recreational sport climbers in the average score of perceived recovery (Mann-Whitney U-test; $U = 772.0$; $p = 0.017$), performance during rest/between recovery activities (Mann-Whitney U-test; U =

1160.0; p = 0.363) and physical recovery after a week of climbing (Mann-Whitney U-test; U = 1092.5; p = 0.249).

DISCUSSION

The aim of the study was to find out which strategies sport climbers use to optimize their recovery and what are the differences between competitive and recreational climbers. This study also aimed to find out how much attention sport climbers pay to sleep and what beliefs they have about the effectiveness of different recovery strategies. The results gave us insight into how recovery strategies are reflected in the recovery of sport climbers.

The most utilized recovery strategy among sports climbers is sleep/passive rest. Sleep is critical (Peake, 2019) and an essential component of recovery (Halson, 2008; Singh et al., 2022) and is the single best recovery strategy (Bird, 2013). Adequate duration and quality of sleep have an important role in athletic physiological and psychological recovery (Lastella et al., 2015; Malhotra, 2017). Although the function of sleep is still relatively unknown, lack of sleep is related to cognitive impairment and negatively affects metabolic, immunological and restorative physiological processes and is therefore essential in the recovery process (Samuels, 2008). Sleep in other sports is rarely the most commonly used strategy. Although Altarriba-Bartes et al. (2021) came to similar results to ours, other studies did not confirm our findings (Murray et al., 2018; Shell et al., 2020).

The second most utilized strategy is stretching. This finding is surprising because there is not much evidence to support stretching as an effective recovery strategy (Afonso et al., 2021). For instance, there were no positive effects of stretching on the recovery of elite youth soccer players (Pooley et al., 2017), elite youth basketball players (Pernigoni et al., 2023) or on the recovery of untrained individuals (Torres et al., 2013; Lund et al., 2007). Stretching does not have or has little effect on recovery (Apostolopoulos et al., 2018; Pooley et al., 2017) and had no positive effects on DOMS or fatigue (Dupuy et al., 2018; Pooley et al., 2017). Stretching is commonly utilized by climbers for enhancing flexibility and it may also serve as a form of recovery strategy due to traditional practices. This connection could be linked to a lower awareness among sports climbers about sports research, a notion supported by our study results. For most sports climbers, the reason for using a particular recovery strategy is based on a personal decision and not on scientific evidence.

The consumption of food and drinks is barely the third most prevalent recovery strategy. This could arise from maintaining a low body weight (Strand, 2022). Michael, Joubert, et al. (2019) found that 82% of adolescent sport climbers do not meet their target energy intake. On the contrary, existing evidence strongly supports nutritional strategies as efficacious in enhancing recovery (Markus et al., 2021; McCartney, 2017). Post-exercise dietary recommendations emphasize the importance of high carbohydrate availability to increase the rate of muscle glycogen resynthesis; especially when there is a limited recovery time between two exercise sessions (e. g. 4 hours) (McCartney, 2017; Podlogar & Wallis, 2022). Energy intake must be appropriate to the energy expenditure. The average rate of energy expenditure during climbing depends on the type and difficulty of the route and varies between 9 and 13 kcal/min (Michael, Witard, et al., 2019) and is thus comparable to marathon running (Loftin et al., 2007).

Consumption of proteins is important to optimize the physical and metabolic adaptations that occur at the level of skeletal muscle and other tissues in response to exercise (Witard et al., 2019). It is difficult to replace the fluid lost during exercise, which is why dehydration at the end of the exercise is common. Dehydration negatively affects endurance (Goulet, 2011), strength and cognitive function and skill-based performance (Hillyer et al., 2015; Savoie et al., 2015), which can have an impact on performance in subsequent training sessions. Adequate post-exercise rehydration is an effective strategy in preventing dehydration and is therefore an effective recovery strategy (Peden et al., 2023).

The ranking of nutrition strategies as the third employed strategy can be linked with the prevalent issue of eating disorders. The generally known problem of eating disorders in sport climbing is also supported by evidence (Joubert et al., 2020; Michael, Joubert, et al., 2019; Peoples et al., 2021). Similar to other sports, like gymnastics (Tan et al., 2016), where athletic performance is greatly influenced by body mass, the purpose of low energy intake is to maintain a low body mass and thus potentially improve sport performance (Joubert et al., 2020; Mermier, 2000). While low body mass and a high strength-to-mass ratio provide a competitive advantage, disordered eating is associated with health and psychological problems that can negatively affect athletic performance (Strand, 2022). In order to achieve optimal sport climbing performance and maintain a suitable body weight, methodological approach to nutritional strategies is essential (Michael, Witard, et al., 2019; Smith et al., 2017). This highlights the need for further research in this area.

There were no significant differences between competitive sport climbers and recreational sport climbers in the timing of recovery strategies. Interestingly only 63% of all sport climbers use the strategies immediately after training. It is worth noting that the literature lacks specific guidelines for the timing of post-exercise strategies such as stretching, massage and cryotherapy were found in the literature, so we assume that the timing of these strategies does not play a major role, while the timing of nutrient intake plays a large role (Bonilla et al., 2020; Kerksick et al., 2017; Kessinger, 2018; Smith et al., 2017). In case of a short recovery time, using strategies immediately after exercise seems to be the most appropriate.

A significant portion of sports climbers use recovery strategies based on their personal choice (6 out of 9 competitive sport climbers and 71% of recreational sport climbers). Interestingly, the percentage of competitive sport climbers isn't notably different from the percentage of recreational sport climbers. It would be expected that the choice of recovery strategies for athletes would be based more on scientific evidence and expert opinion than on personal choice. However, competitive sport climbers have more individualized recovery strategies than recreational sport climbers (8 out of 9 competitive sport climbers compared to 43% of recreational sport climbers), suggesting that competitive sport climbers pay more attention to recovery.

Choosing the strategies requires an understanding of the athlete's interactions between training, recovery and performance. Appropriate use and interpretation of available stress and recovery tools (e. g. Recovery-Cue (Kellmann et al., 2002)) allow individually and situationally appropriate choice of recovery strategies. In addition to other things, in our study competitive sport climbers used more recovery strategies (5.8 ± 2.3) than recreational sport climbers (3.9 ± 1.9), which also suggests that competitive sport climbers pay more attention to recovery than recreational sport climbers. Tavares et al. (2017) came to similar findings. In their study, competitive athletes used a significantly greater number of recovery strategies than recreational athletes (~8 vs. 3) and used them more frequently (~25 vs. ~6 times per week). This may be due to recreational athletes not having access to a variety of recovery strategies; recreational athletes may not understand the effects of a particular recovery strategy because they are not familiar with it and because recreational athletes are not exposed to the same amount of training load as competitive athletes and therefore do not need to use such recovery strategies (Tavares et al., 2017). At this point, it is also important to emphasize that recovery strategies are periodized similarly to the training process. In this way, we can achieve the positive benefits of stress, fatigue and pain after exercise, without which there are no long-term adaptations to exercise (Mujika et al., 2018). By monitoring the training process, the competition and the athlete's well-being, we can appropriately use recovery strategies.

Sleep attentiveness was measured by evaluating sleep time. Our findings revealed that only 13% of all respondents sleep more than 8 hours. Interestingly, only 3 out of 9 competitive sport climbers sleep for more than 8 hours, while only one competitive sport climber sleeps more than 9 hours. Lastella et al. (2015) found that elite athletes average 6.8 hours of sleep per night. Our results are similar, as they indicate that competitive sport climbers also sleep below the limit of the recommended amount of sleep (6 out of 9 sleep less than 8 hours). The rationale for this potential sleep deficit is the pace dictated by the training process (early morning training, frequent trips, parallel studies) (Malhotra, 2017). Lastella et al. (2015) came to the conclusion that athletes of individual sports sleep less and have a worse quality of sleep than athletes of team sports, which also support our findings. There was no significant difference in the amount of sleep between competitive and recreational sports climbers. Lack of sleep affects abilities such as decision-making, reaction time, fine motor skills, memorization and skill learning (Malhotra, 2017). Given that sleep has an impact on predictors of climbing performance, such as motor planning abilities and coordination (Winkler et al., 2023), further research is needed to determine the impact of sleep on performance in sport climbing.

Sport climbers believe that sleep has a greater effect on recovery than active recovery. However, when analyzing the relationship between sleep efficiency beliefs and sleep habits of sports climbers, a contradiction becomes evident. While 92% of sport climbers believe that sleep is an effective recovery strategy, only 13% of them sleep more than 8 hours. Murray et al. (2018) investigated the recovery practices in Division 1 collegiate athletes. They also found conflicting results between beliefs and practices of using sleep as a recovery strategy. 24% of participants believed and used sleep as a recovery strategy, while 63% of participants did not use sleep as a recovery strategy, although they believed it was an effective recovery strategy.

The results indicate that 65% of all sports climbers attribute a moderate or high effect to active recovery, yet only 24% of them utilize it. Given that the evidence for the effectiveness of active recovery is weak (Ortiz et al., 2019), it is interesting that the strategy is used by almost a quarter of all sports climbers. Draper et al. (2006) tested the effectiveness of active recovery on sports climbers and concluded that active recovery is an effective strategy. However, it's important to acknowledge that the positive effects of recovery during the trials were demonstrated through lactate concentration and effort assessment. Furthermore, the study involved recreational sport climbers, making it challenging to transfer it to competitive sports.

A substantial portion of sports climbers (45%) believe that using ice baths has a moderate (32%) or high (13%) effect on recovery. Hohenauer et al. (2015) in their meta-analysis concluded that the use of cold baths is more effective compared to passive rest after strenuous exercise. Cold baths do not have negative general or specific effects in athletes, so their use may depend on the preferences of the individual (Banfi et al., 2010).

Self-assessment of recovery was assessed using the Recovery-Cue tool (Kellmann et al., 2002). On a six-point scale, sport climbers evaluated their recovery with less than 4 (3.3) only in the "perceived exertion" category. An interesting fact is that the average rating in the same category among competitive sport climbers was only 2.3 compared to the higher rating (3.4) of recreational sport climbers. Which suggests that it would make sense to continuously assess recovery among competitive sport climbers.

The main limitation of this study is the small percentage of competitive sport climbers, which was to be expected and limiting the survey to Slovenian climbers. Furthermore, it should be noted that the sample was not representative. Further research should focus on the use of recovery strategies among competitive sport climbers and the impact of recovery strategies on perceived recovery and its reflection on performance in training and competition.

CONCLUSION

This study describes the recovery practices of Slovenian sport climbers. The most common recovery strategies among sport climbers are sleep/rest and stretching. Significant number of sport climbers sleep below the limit of the recommended amount of sleep. The poor eating and sleeping habits of sport climbers highlight the importance of further research in these areas. Personal opinions notably influence the choice of recovery strategies. Interestingly, our findings reveal discrepancies between individual beliefs regarding the effectiveness of specific strategies and their practical implementation. Competitive sport climbers have more individualized recovery strategies and use a greater number of recovery strategies.

Despite the fact that sport climbers' recovery strategies are often in conflict with the literature, based on the self-assessment of recovery, we can conclude that sport climbers recover solidly. This data may suggest that recovery does not play a major role in sport climbing.

Acknowledgements: This study was funded by Faculty of Health sciences, University of Primorska, Slovenia.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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