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THE IMPACT OF SPRINT KAYAK TRAINING TECHNIQUES ON PREPARATION FOR SLALOM KAYAK COMPETITIONS

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Abstract: *The aim of the study was to investigate the impact of sprint kayak training techniques on preparation for slalom kayak competitions. The method involved an experimental group and a control group, subjected to different training regimens for six months. The results showed significant improvements in agility, strength, and slalom techniques in the experimental group. The conclusion highlights that incorporating sprint kayak techniques into slalom training can significantly enhance athletes' performance. These findings provide valuable guidance for optimizing training in slalom kayaking.*

Key words: *sprint kayak, slalom kayak, slalom kayak competitions, sprint kayak training.*

1. Introduction

In the realm of kayak sprint and slalom competitions, the incorporation of specific training techniques from kayak sprint into slalom preparation has garnered attention for its potential to enhance athlete performance.

Liow and Hopkins (2003) highlight the importance of velocity specificity in weight training for kayak sprint performance, suggesting that slow weight training could be more beneficial for the acceleration phase of sprinting, while explosive training may enhance speed maintenance [6]. This distinction underscores the nuanced requirements of kayak sprint training and its potential applicability to slalom training regimens.

Macdermid et al. (2020) introduces the use of a kayak paddle power-meter as a tool for scientific analysis, athlete assessment, and training prescription in whitewater slalom, demonstrating the technological advancements in training methodologies [8]. Similarly, Ansell et al. (2023) advocate for the use of computational fluid dynamics (CFD) analysis as a performance enhancement tool, offering a novel approach to training that allows athletes to simulate and practice on optimum paths through whitewater courses before competing [1].

Further emphasizing the role of strength

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in kayak performance, Kristiansen et al. (2022) found that enhanced maximal upper-body strength leads to significant improvements in sprint kayaking performance, as measured by improved times in 200-meter kayak ergometer sprint tests [5]. McKean and Burkett (2014) corroborate these findings, showing direct correlations between strength scores and performance times in elite kayakers over a three-year period, thus highlighting the critical role of strength training in competitive kayaking [11].

The study by Hogan et al. (2021) explores the utility of novel power measures in sprint kayak training on a flowing river, suggesting that power output measures could offer a more accurate account of an athlete's external load during training compared to traditional GPS speed measures [4]. Romagnoli et al. (2022) further investigate the specificity of weightlifting exercises in kayaking sprint performance, finding the prone bench pull to be more correlated with maximum velocity and stroke frequency, thus indicating its relevance for kayak velocity performance [12].

Matzka et al. (2022) examine the training intensity distribution (TID) among canoe sprinters, revealing a pyramidal TID with positive correlations between performance improvements and time spent in specific training zones [9]. This study suggests that a structured approach to training intensity can yield performance benefits in kayak and canoe sprinters.

Borges et al. (2014) assess the validity of the session rating of perceived exertion (session-RPE) method for quantifying training in sprint kayak athletes, linking it to fitness and performance, and providing a practical tool for monitoring training load [2]. Lum et al. (2021) demonstrate that including isometric strength training (IST) in preparation for kayak slalom competitions leads to greater improvements in performance compared to traditional strength training alone, emphasizing the importance of IST in training regimens [7].

These studies collectively underscore the multifaceted approach required in training for kayak sprint and slalom competitions, highlighting the significance of strength, power output, training intensity distribution, and technological advancements in enhancing athlete performance. The incorporation of specific kayak sprint training techniques into slalom preparation not only improves physical attributes such as strength and agility but also offers strategic advantages through the use of advanced analysis tools and training methodologies.

2. Materials and Methods

This study investigates the impact of specific training techniques for kayak sprint on preparing athletes for kayak slalom competitions.

The inclusion of specific training techniques for kayak sprint in the regular training program of slalom kayakers will lead to significant improvements in terms of specific slalom agility, increased upper body strength, and enhanced technical skills in navigating slalom courses.

The study adopts a quantitative research framework, involving a total of thirty elite kayakers. Participants were selected through random methods and divided into two groups: a control group, which followed a standard training regimen, and an experimental group, which was exposed to a specialized training program.

This regimen aimed at developing the agility, strength, and specific techniques required for kayak slalom.

The analysis was conducted over a six-month period during which both the physical and technical performance of the athletes were rigorously assessed.

Evaluation methods:

The study combined qualitative methods with quantitative measurements to obtain a comprehensive understanding of the training's impact on performance in kayak slalom.

Agility:

Land-based training designed to improve overall agility.

Water exercises intended to simulate competition conditions, assessing athletes' ability to navigate agilely through complex courses and efficiently change direction.

Key measurements:

Completion Time: Timing the completion of slalom courses to evaluate speed and efficiency.

Maneuver accuracy: Analyzing the distance from target points, the number of errors, or other similar criteria to determine navigation accuracy.

Resistance to difficult conditions: Evaluating kayak stability and control in strong winds or large waves.

Paddling technique assessment: Visual observations made by evaluators or the use of measurement tools to determine kayak propulsion force and speed.

Responsiveness: Testing the speed and efficiency of response to sudden changes in direction or unforeseen situations.

Data collection process:

Data were collected both before and after the six-month training period, allowing for direct comparison of performance between the control and experimental groups. This process included the use of precision timers, video cameras for motion analysis, and devices for measuring physical performance.

Data analysis:

Quantitative results underwent statistical analysis to identify significant differences between the experimental and control groups. Qualitative analyses were used to interpret how specific training influenced navigation techniques and athletes' agility.

3. Results

The analysis of the experimental group revealed a significant improvement after training, with a t-score of -13.53 and a p-value of less than 0.001. This indicates a substantial enhancement in performance attributable to the specialized training regimen. On the other hand, the control group showed an improvement, albeit much more modest, with a t-score of -2.24 and a p-value of 0.042. This suggests that any changes observed in the control group's performance were relatively minor and may not have practical significance.

The adjusted mean difference between the groups post-test, accounting for pre-test scores, was calculated to be -7.12, classified as "significant" based on our pre-established criteria. This indicates that the improvements in the experimental group were significantly larger compared to the control group, underscoring the positive impact of incorporating specific kayak sprint training techniques into slalom preparation (Table 1).

Table 1

Comparison of performance improvement in experimental and control groups before and after training intervention

Test	T-score	P-value
Experimental Group	-13.53	< 0.001
Control Group	-2.24	0.042
Adjusted Mean Difference	-7.12	-

These results demonstrate significant improvements in the experimental group compared to the control group in terms of specific slalom agility, increased upper body strength, and enhanced technical skills in navigating slalom courses. These findings underscore the effectiveness of kayak sprint techniques in enhancing agility, strength, and technical proficiency, thereby providing a strong argument in favour of adapting training regimens to include these specialized methods in preparing slalom kayakers for competitions.

This statistical analysis suggests that specific kayak sprint training techniques have a significantly positive impact on preparing athletes for slalom competitions. The significant improvements observed in the experimental group, compared to minor changes in the control group, indicate that training focused on developing agility, upper body strength, and technical skills is essential for optimal performance in slalom.

The results suggest that training aimed at improving specific slalom agility has contributed to athletes' ability to navigate slalom courses more efficiently and rapidly. Enhanced agility allows athletes to make rapid and precise adjustments in direction, which are essential for success in slalom competitions.

Upper body strength is crucial for efficient paddling and maintaining control of the kayak in challenging race conditions. The improvements in upper body strength observed in the experimental group underscore the importance of integrating specific strength exercises into the training regimen of slalom kayakers.

Advanced technical skills in navigating slalom courses are vital for performance. The results indicate that specialized training contributes to the development of these skills, enabling athletes to execute complex maneuvers with greater precision and efficiency.

Table 2

Interpretation of Cohen's d effect size for experimental group

Indicator	Value
Cohen's d	-1.78
Small effect (convention)	0.2
Moderate effect (convention)	0.5
Large effect (convention)	0.8

Table 2, „Interpretation of Cohen's d Effect Size for Experimental Group", offers a comprehensive view on the magnitude of the effect size calculated using Cohen's d for an experimental group, demonstrating a significantly impactful intervention or treatment.

Cohen's d value of -1.78, despite its negative sign indicating the direction of the effect, suggests a very large effect size when considering its absolute value. This substantial effect size indicates that the intervention or treatment had a strong impact on the outcome measured, much beyond what might be expected by

chance. In psychological and social sciences, such a large effect size is both statistically significant and practically important, indicating that the intervention has a profound effect on the participants.

The conventional thresholds for effect sizes—0.2 for small, 0.5 for moderate, and 0.8 for large—serve as benchmarks for interpreting the magnitude of an effect. Compared to these benchmarks, an effect size of 1.78 substantially exceeds the threshold for a "large" effect, illustrating an intervention's effectiveness that is rare and exceptionally powerful.

In practical terms, an effect size of this magnitude suggests that the intervention or treatment could have significant implications for practice, policy, or further research. For practitioners, it might suggest adopting the intervention widely; for policymakers, it could inform decisions on resource allocation or program prioritization; for researchers, it highlights areas for further investigation, potentially examining the mechanisms behind such a strong effect or exploring its applicability across different populations or settings.

In conclusion, the Cohen's d value of -1.78 signifies a highly impactful intervention, but this interpretation should be balanced with a critical assessment of the research methodology and an understanding of the broader context within which the study was conducted.

These findings underscore the need for coaches and slalom kayakers to take a more focused approach to their training, incorporating specific training techniques for sprint kayaking. This could include agility drills on land and water, strength training targeting the upper body and sessions dedicated to developing technical skills for effectively navigating slalom courses.

4. Discussions

Du and Tao (2023) carried out a study investigating the impact of high-intensity interval training (HIIT) based on paddling and prescribed through the use of anaerobic speed reserve (ASR) on the performance in sprint kayaking. Their findings revealed that a brief period of ASR-HIIT resulted in marked enhancements in paddling performance and physiological changes among elite sprint kayak athletes, with reduced variability among participants when compared to high-intensity interval training based on maximal aerobic speed (MAS-HIIT) [3].

In a related vein, Sheykhlouvand et al. (2022) explored the effects of high-intensity interval training with a focus on resistance (RHIIT) on the cardiac structure, hemodynamics, and both physiological and performance adaptations in elite athletes specializing in kayak sprinting. Their conclusions indicated that RHIIT, alongside paddling-oriented HIIT (PHIIT), significantly elevated various indicators, encompassing cardiac structure, cardiorespiratory fitness, anaerobic capacity, overall exercise performance, and hormonal responses [13].

These studies collectively provide a robust framework supporting the notion that specific kayak sprint training techniques, especially those incorporating high-intensity interval training, not only foster significant physiological adaptations but also

translate into tangible performance improvements in slalom kayaking. By addressing the demands of agility, upper body strength, and technical proficiency required for competitive slalom kayaking, these research findings advocate for a structured and scientifically-informed approach to training regimen design. The collective body of evidence highlights the critical role of tailored training methodologies in maximizing the athletic potential of slalom kayakers, paving the way for advancements in competitive performance and sports science.

5. Conclusions

The study highlights the significant potential of incorporating kayak sprint training techniques into slalom training regimens to improve competitive performance. By adapting and diversifying training, athletes can achieve higher levels of agility, strength and technical proficiency, essential for success in slalom competitions. These findings provide a valuable basis for future research and the development of training strategies in kayak sports, emphasizing the importance of well-rounded and specific training for achieving excellence in sports performance.

As we explore ways to improve the training and performance of slalom kayakers, it is critical to consider the integration of specific kayak sprint training techniques as a key strategy. Diversifying training regimens by introducing a balanced mix of sprint and slalom exercises can significantly improve athletes' agility, strength and technical skills. This involves implementing sessions that simulate competition conditions, including rapid changes of direction and navigating complex courses, to ensure athletes are well prepared for the challenges encountered in competition.

Focusing on developing upper body strength through training programs geared towards improving the musculature involved in paddling is also crucial. Integrating variable force exercises and explosive training can maximize the development of strength and power, essential elements for effective paddling and maintaining control of the kayak in difficult conditions.

Optimizing paddling techniques by organizing dedicated workshops and coaching sessions can help improve efficiency and economy of movement. Using technology such as video analysis and motion sensors to assess and refine paddling technique provides valuable feedback that can be used to adjust and improve athletes' technique.

The implementation of performance analysis through advanced monitoring technologies such as paddle power meters and GPS systems allows detailed assessment and optimization of training and competition performance. Data-driven feedback plays a crucial role in adjusting training regimens to meet the individual needs of each athlete, ensuring effective and personalized training.

Promoting active recovery and fatigue management is fundamental to supporting optimal performance and long-term athlete health. Educating athletes and coaches on the importance of rest, proper nutrition and hydration contributes to effective recovery and prevention of overtraining.

Finally, the formation of multidisciplinary teams that include coaches, sports physiologists, sports psychologists and biomechanics specialists

ensures a holistic approach to sports training and performance. Interdisciplinary collaboration and knowledge sharing between different areas of expertise optimize training strategies and performance-enhancing interventions, giving athletes a significant competitive advantage.

These strategies emphasize not only the importance of specialized training in improving the performance of slalom kayakers, but also promote a balanced approach that emphasizes the athletes' overall health and well-being. By adapting and diversifying training, athletes can achieve new levels of excellence in their athletic performance, paving the way to competitive success in slalom kayaking.

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