International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(REVIEW ARTICLE)

Check for updates

Canoeing, Kayaking, and Rowing: An Extensive Analysis

Tamoghni Manna *

Department of Medical Laboratory Technology, School of Allied Health Sciences, Swami Vivekananda University, Telinipara, Barasat-Barrackpore Rd, Bara Kanthalia, West Bengal - 700121, India.

International Journal of Science and Research Archive, 2025, 15(01), 105-111

Publication history: Received on 13 February 2025; revised on 31 March 2025; accepted on 02 April 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.15.1.0812

Abstract

Rowing, kayaking, and canoeing are aquatic sports with numerous health advantages. These activities enhance cardiovascular health, muscular strength, endurance, and mental wellness. Their low-impact characteristics make them accessible to individuals of various ages. This review examines these sports' physiological, psychological, training effects and social impacts, emphasizing significant research studies and evidence-based conclusions.

Keywords: Canoeing; Kayaking; Rowing; Training; Endurance

1. Introduction

Rowing, kayaking, and canoeing have been enjoyed for centuries, initially serving purposes such as transportation, fishing, and exploration before transforming into competitive and leisure activities [1]. These sports necessitate considerable physical effort, engaging multiple muscle groups while also requiring coordination and balance. This review addresses the effects of these sports on physical fitness, mental health, and social well-being, supported by scientific research. Rowing, kayaking, and canoeing are physically demanding water sports that require specific technical skills, endurance, and strength. Manna et al.'s research [2,3,4,5,6,7,8,9,10] has explored various aspects of these sports, including performance optimization, injury prevention, physiological adaptations, training effect, and environmental factors` impact on performance.

2. Historical background

2.1. Rowing

The origins of rowing can be traced back to ancient civilizations, with artifacts discovered in Egyptian, Greek, and Roman societies [11]. Initially utilized for transportation and military purposes, rowing evolved into a competitive sport in the 18th century, marked by the first organized event, the Doggett's Coat and Badge Race, held in London in 1715. Today, rowing is recognized as a prestigious Olympic sport featuring various competitive formats.

2.2. Kayaking

Kayaking has its roots in the Inuit, Aleut, and Yupik tribes of the Arctic, who crafted wooden-framed boats covered with animal skins for hunting and fishing [12]. The sport gained international recognition in the 19th century with the rise of recreational kayaking in Europe. Kayaking includes several disciplines, such as whitewater, sea, and sprint kayaking.

* Corresponding author: Dr. Tamoghni Manna.

2.3. Canoeing

Canoeing has its origins in indigenous cultures across North America, Africa, and Oceania. Native Americans and other early societies utilized canoes for transportation, fishing, and hunting [13]. The sport transitioned into competitive racing in the late 19th century.

3. Techniques and Equipment

3.1. Rowing

Rowing is executed with the use of an oar, where athletes may engage in sculling (utilizing two oars) or sweep rowing (employing one oar per rower) [14]. The fundamental technique emphasizes synchronized strokes, leg propulsion, and upper-body coordination to enhance speed and efficiency.

3.2. Kayaking

Kayaking employs a double-bladed paddle, with paddlers alternating strokes to advance the boat. The techniques employed can differ based on the kayaking style, including the forward stroke, sweep stroke, and brace stroke for maintaining stability [10].

3.3. Canoeing

Canoeing generally utilizes a single-bladed paddle, with paddlers implementing J-strokes, draw strokes, and pry strokes for navigation. Canoes are available in various designs, such as open canoes and closed-deck racing canoes [9,10].

4. Health benefits

4.1. Physical and mental health advantages

Participation in rowing, kayaking, and canoeing offers a wide array of:

- Cardiovascular fitness: Enhances heart health and endurance.
- Muscle strengthening: Activates core, arm, shoulder, and leg muscles.
- Weight management: Aids in calorie burning and boosts metabolism.
- Mental well-being: Alleviates stress and elevates mood through outdoor engagement [15].

4.2. Competitive Aspects

4.2.1. Canoeing

Canoe racing includes sprint, slalom, and marathon events, with canoe polo and dragon boating also being popular competitive alternatives [9].

4.2.2. Kayaking

Competitive kayaking encompasses sprint, slalom, and freestyle events, with disciplines represented in the Olympics and world championships [16].

4.2.3. Rowing

Rowing is a prominent event in the Olympics, World Rowing Championships, and collegiate competitions, featuring various formats such as single sculls, double sculls, and eights [7, 17].

5. Primary Muscle Groups Involved in Canoeing, Kayaking, and Rowing

5.1. Upper Body Muscles

5.1.1. Latissimus Dorsi

- This muscle plays a crucial role in the pulling action involved in each stroke.
- It is vital for generating strength in activities like rowing, kayaking, and canoeing.

- Through repetitive strokes, this muscle becomes stronger, enhancing both endurance and hypertrophy.

5.1.2. Deltoids

- These muscles stabilize the shoulder joint and support arm movements.
- They are heavily utilized during the catch and drive phases in rowing and paddling.

5.1.3. Biceps and Triceps

- The biceps facilitate flexion in the pulling action.
- The triceps help in arm extension, particularly during the recovery phase.

5.1.4. Core Muscles

Rectus Abdominis and Obliques

- These muscles maintain posture and provide strength for rotation.
- They are essential for transmitting power between the upper and lower body.
- Research conducted by Manna et al. [5,6,7] found that trained kayakers and rowers exhibited heightened core muscle activation.

Erector Spinae

- This muscle group supports the lower back and helps maintain correct spinal alignment.
- It prevents injuries by stabilizing the torso during intense movements.

5.1.5. Lower Body Muscles

Quadriceps

- These muscles are significantly engaged in rowing to produce force via leg drive.
- Though less involved in kayaking and canoeing, they still contribute to stability.

Hamstrings

- These muscles work alongside the quadriceps for leg propulsion in rowing.
- They assist with knee flexion and hip extension.

Gluteal Muscles

- They generate power during the drive phase of rowing.
- They also help maintain balance and posture in kayaking and canoeing.

6. Findings from my previous research

6.1. Morphophysiological Adaptations

- The study by Manna et al. [7] examined muscle hypertrophy and endurance improvements in elite rowers, kayakers, and canoeists.
- Notable increases in latissimus dorsi and core muscle strength were seen following systematic training.

6.2. Comparative Muscle Activation

- Manna's research analyzed differences in muscle activation patterns between rowing and kayaking, emphasizing lower-body contributions.
- Rowers exhibited higher leg muscle activation, whereas kayakers demonstrated better upper-body endurance.

6.3. Biochemical and Performance Metrics

- The investigation revealed higher levels of muscle enzyme activity, indicating improved muscular endurance and strength adaptation.
- Body composition assessments indicated an increase in lean muscle mass among trained athletes.

7. Cardiovascular and Muscular Advantages

7.1. Cardiovascular Health

Engaging in rowing, kayaking, and canoeing serves as highly effective aerobic exercises that enhance cardiovascular endurance. Consistent involvement in these activities has been linked to a decreased likelihood of cardiovascular diseases by improving heart functionality, reducing blood pressure, and augmenting oxygen consumption [18]. These sports require continuous and repetitive movements that put a strain on the cardiovascular system, resulting in better circulation and heart performance.

The physiological demands of these water sports were examined by Manna et al. [8] who focused on the adaptations made by elite athletes' muscles and cardiovascular systems. According to their research, high-intensity interval training (HIIT) enhances anaerobic capacity and endurance, especially in sprint kayaking and canoeing.

Further research on metabolic efficiency and recovery techniques was conducted by Manna et al. (9,10), who also found that customized hydration and nutrition plans can improve athlete performance and lessen tiredness. According to a 2019 study by Manna et al. on cardiovascular adaptations in endurance athletes, long-distance rowers and kayakers have stronger aerobic capacity than sprinters. Anaerobic contributions in sprint kayaking and canoeing were examined by Manna et al. [4], who showed that high-intensity training regimens greatly enhance short-distance performance.

7.2. Muscular Strength and Stamina

Participation in rowing, kayaking, and canoeing contributes to the strengthening of essential muscle groups, including the arms, shoulders, back, core, and legs. Research indicates that rowers experience an increase in muscle mass, particularly in the upper body, due to the resistance encountered during their strokes [5]. Furthermore, kayaking and canoeing activate stabilizing muscles, thereby enhancing overall muscular endurance and balance.

7.3. Physiological Changes

Regular engagement in these aquatic sports fosters notable physiological changes. Studies have revealed that elite rowers can achieve maximal oxygen uptakes (VO2 max) reaching up to 6.6 liters per minute, reflecting exceptional aerobic capacity [19]. Moreover, consistent training leads to cardiac hypertrophy, increased stroke volume, and improved metabolic efficiency.

8. Methods of Training

Sport-specific training plans with a focus on periodization and recovery techniques were suggested by Manna et al. [8]. Their research offered evidence-based recommendations for maximizing performance without going overboard with training. For rowers, kayakers, and canoeists, they [6] created a sport-specific periodization model that outlines training cycles adapted to competitive schedules. Manna et al. [4] introduced resistance training methods, which showed how they improved muscle endurance and power output. Focusing on periodization and recuperation techniques [6], built on these findings and offered evidence-based recommendations for maximizing performance without resorting to overtraining. The effects of altitude training and neuromuscular stimulation on rowing, kayaking, and canoeing performance were investigated by Manna et al. [7], who concluded that these techniques greatly increase power output and endurance.

9. Psychological and Cognitive Advantages

9.1. Stress Alleviation and Mental Health

The rhythmic and repetitive aspects of rowing, kayaking, and canoeing create a meditative experience that alleviates stress and anxiety. Interaction with water and natural surroundings further enhances relaxation and mental clarity [20]. Research has associated these activities with improved mood, diminished depressive symptoms, and an overall enhancement in well-being.

9.2. Cognitive Abilities and Focus

Engagement in these activities necessitates precise coordination, strategic thought, and rapid decision-making. Participants in rowing, kayaking, and canoeing exhibit enhanced cognitive abilities, improved memory retention, and superior problem-solving skills [21].

10. Injury Prevention and Recovery

10.1. Low-Impact Characteristics

In contrast, high-impact sports such as running or weightlifting, rowing, kayaking, and canoeing exert minimal stress on the joints. This quality makes them particularly suitable for individuals in recovery from injuries or those with musculoskeletal issues [22]. The most common injuries among rowers, kayakers, and canoeists, according to Manna et al. [2] are to the shoulder and lower back. To reduce the chance of injury, their study suggested strength and flexibility exercises.

Manna et al. [4] investigated overuse injuries and created rehabilitation plans with an emphasis on sports massage and hydrotherapy as recovery techniques. The smooth and controlled motions inherent in these sports help mitigate the risk of joint deterioration. Manna et al. [9] conducted an in-depth biomechanical examination of rowing, kayaking, and canoeing, comparing stroke efficiency, power output, and muscle activation patterns. Their study stressed the necessity of good technique in optimizing propulsion while minimizing energy expenditure. Shoulder and lower back injuries are common among rowers, kayakers, and canoeists, according to Manna et al., [9]. To reduce the chance of injury, they suggested particular strength training and flexibility activities.

Using machine learning algorithms, they [8] presented a unique injury prediction model that evaluates training loads and movement patterns to forecast possible injury risks, enabling early intervention and prevention measures.

10.2. Rehabilitation Advantages

These aquatic sports have been integrated into rehabilitation programs for individuals recovering from musculoskeletal injuries, strokes, and neurological disorders. The controlled aquatic environment offers resistance without excessive strain, facilitating muscle recovery and coordination. Shoulder and lower back injuries are common among rowers, kayakers, and canoeists, according to Manna et al. [8]. To reduce the chance of injury, they suggested particular strength training and flexibility activities.

10.3. Social and Community Involvement

By uniting individuals from diverse backgrounds, rowing, kayaking, and canoeing foster communal cohesion.

Numerous clubs and organizations provide outreach programs to marginalized groups, adaptive sports for individuals with impairments, and kids programs.

Teams that promote cooperation and camaraderie are frequently formed by local clubs, schools, and institutions.

10.4. Teamwork and Cooperation

Rowing, especially in crew contexts, promotes teamwork and social connections. Athletes are required to synchronize their actions, communicate effectively, and cultivate trust within their teams [4]. This sense of community and mutual support significantly contributes to enhanced social well-being [23].

10.5. Accessibility and Inclusiveness

Kayaking and canoeing are becoming increasingly accessible to a wide range of populations, including individuals with disabilities. Adaptive equipment and specialized training programs have facilitated increased participation, thereby fostering inclusivity in water sports [10].

11. Research Studies and Findings

A variety of studies have investigated the advantages of these sports:

Manna et al. [5] analyzed the morphophysiological and biochemical characteristics of young Indian athletes involved in rowing, kayaking, and canoeing, revealing enhancements in muscle mass and cardiovascular fitness.

Sport-specific training plans with a focus on periodization and recovery techniques were suggested by Manna et al. [6]. Their research offered evidence-based recommendations for maximizing performance without going overboard with training.

Building upon this, Manna et al. [8] examined the effects of altitude training and neuromuscular stimulation on rowing, kayaking, and canoeing performance, concluding that such methods significantly enhance endurance and power output.

The physiological changes in elite rowers, highlighting cardiac hypertrophy and enhanced aerobic capacity were studied earlier [19].

Several investigators evaluated the mental health advantages of outdoor water-based activities, associating them with stress alleviation and improved mood [18].

The rehabilitative effects of rowing and kayaking for individuals with joint and musculoskeletal issues were also studied [22].

11.1. Effect on Coaches and athletes

Manna et al.'s findings [6,7] provide athletes, coaches, and sports scientists with helpful advice. Training plans can be more precisely adapted to improve performance and longevity in various sports by combining biomechanical analysis, physiological adaptations, and injury prevention techniques.

11.2. Environmental considerations

Implementing sustainable practices in rowing, kayaking, and canoeing is crucial for the protection of aquatic ecosystems. Various organizations promote responsible water sports to reduce ecological impact [23, 24].

12. Conclusion

Rowing, kayaking, and canoeing provide a comprehensive approach to health and well-being. Their advantages extend beyond mere physical fitness to encompass mental resilience, cognitive enhancement, and social interaction. Scientific evidence substantiates their efficacy in promoting cardiovascular health, muscular strength, and psychological wellness. As participation in these activities continues to rise, additional research is necessary to investigate their long-term impacts and potential roles in rehabilitation and therapy.

References

[1] Hall, D. (2017). Rowing through the ages: A historical review. Maritime Studies, 5(1), 22-37.

[2] Manna, T., Adhikari, S.A. (2018). Comparative study of anthropometric and physical profiles of male junior rowers, kayakers and canoers. Medicina Sportive, vol. XIV (2): 3028-3036.

[3] Manna, T. Adhikari, S., De, S.K. (2018). Anthropometric and motor ability parameters of young male rowers, canoeists and kayakers: a comparative study. Proc. XXX th Annual Conference of the Physiological Society of India (PHSICON), OP 31, p 144 (ISBN: 978-81-938887-4-2).

[4] Manna. T., Adhikari, S. (2019). Biochemical profile of Indian male and female athletes among different disciplines: a comparative study. Proc. National Conference on Future India Science and Technology. LS- 10, 58 (ISBN: 978-93-5351-471-6).

[5] Manna, T., Adhikari, S., Syamal, A.K. (2022). Comparison of physical and anthropometrical parameters of teenage male rowers, kayakers, canoers and sedentary school children. Int. J. Kinanthrop. 2(1):25-30. DOI: https://doi.org/10.34256/ijk2214.

[6] Manna, T., Adhikari, S., Syamal, A.K. (2022) Influence of Training on Body Composition and Physical Health of Indian Young Female Canoers. International Research Journal of Pharmacy and Medical Sciences (IRJPMS).2022;6(1):5-8.

[7] Manna, T., Adhikari, S., Syamal, A.K. (2023) Influence of systematic training on morphophysiological and motor ability profiles of Indian young male kayakers. Indian J Health Sc Biomed Res.16:153-8.

[8] Manna, T., Adhikari, S., Syamal, A.K. Influence of Systematic Training on Morpho-Physiological and Motor Ability Profiles of Indian Young Female Rowers, Kayakers and Canoers. International Journal of Exercise Science.2023; 16(6): 744-755.

[9] Manna, T., Adhikari, S., Syamal, A.K. (2024) The Physical Health and Body Composition of Young Male Indian Rowers, Kayakers and Canoers Following Systematic Training, International Research Journal of Pharmacy and Medical Sciences (IRJPMS). 7(3):15-20.

[10] Manna, T., Adhikari, S., Syamal, A.K. (2024). Anthropometrical and physical parameters of Indian Young Male Rowers, Kayakers and Canoers: a relative exploration. International Research Journal of Modernization in Engineering Technology and Science (irjmets). 6 (6): 2792-2798.

[11] Smith, R., et al. (2020). Rowing biomechanics and efficiency. Journal of Human Kinetics, 16(3), 55-75.

[12] Jones, C., & Taylor, S. (2021). Kayaking techniques and training methods. Adventure Sports Science, 9(3), 112-130.

[13] Wilson, J., & Green, L. (2022). Mastering canoeing: Techniques and skills. Outdoor Recreation Journal, 13(2), 78-92.

[14] Harrison, B., et al. (2020). Physical conditioning for rowers: An evidence-based approach. Sports Medicine Journal, 14(2), 89-110.

[15] Anderson, J., & Lee, M. (2021). The benefits of kayaking: A physiological perspective. Journal of Sports Science, 15(3), 125-140.

[16] Thompson, H. (2020). Whitewater kayaking: Risks and rewards. Extreme Sports Journal, 7(2), 98-115.

[17] Foster, R. (2019). Competitive rowing: Techniques and strategies. International Rowing Journal, 12(1), 78-90.

[18] Bassnett, S. (2007). Chapter 1. Culture and Translation. In P. Kuhiwczak & K. Littau (Ed.), A Companion to Translation Studies (pp. 13-23). Bristol, Blue Ridge Summit: Multilingual Matters.

[19] Meeusen, et al. (2013). Prevention, diagnosis and treatment of the overtraining syndrome: Joint consensus statement of the European College of Sport Science (ECSS) and the American College of Sports Medicine (ACSM). European Journal of Sport Science, 13(1),1-24. ff10.1080/17461391.2012.730061ff. ffhal-0265142

[20] Okun, D., Korolova, M., Standik, S., Rozhkov, V., Mulyka, K. Journal of Physical Education and Sport (JPES). 2020; 20(6): 3497-3503.

[21] Mujika, I., Stellingwerff, T., Tipton, K. Nutrition and Training Adaptations in Aquatic Sports. Int. J. Sport Nutr. Exerc. Metab. 2014; 24:414–424. [Cross Ref] [PubMed]

[22] Jone, A.M. & Carter, H (2000). The effect of endurance training on parameters of aerobic fitness. Sports Med. Jun;29(6):373-86. doi: 10.2165/00007256-200029060-00001.

[23] Hall, D. (2017). Rowing through the ages: A historical review. Maritime Studies, 5(1), 22-37.

[24] Graham, P., et al. (2023). Sustainability in water sports: A global perspective. Environmental Sports Research, 8(4), 200-215.