



Swimming in the rehabilitation and recreation of professional athletes

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Abstract. Swimming plays a significant role in professional athletes' recovery, contributing to physical and psycho-emotional rehabilitation following competitions and injuries. However, research on the use of swimming for rehabilitation and recreation among athletes remains insufficiently developed, highlighting the relevance of this study and its necessity in sports practice. This study aimed to assess the effectiveness of aquatic exercises in rehabilitation programmes for professional athletes with mild to moderate injuries, compared to traditional rehabilitation methods. Additionally, the study sought to determine the conditions under which swimming is most appropriate and effective for improving physical performance, reducing pain, and enhancing participants' motivation. The study involved 120 athletes from various sports, who completed an 8-week aquatic exercise programme. The programme included aerobic, stretching, and recovery exercises, conducted four times per week with gradually increasing intensity. Evaluation of the results was conducted through measurements of physical indicators (strength, endurance, flexibility), analysis of subjective well-being, and the use of a visual analogue scale to assess pain levels. The findings indicated that endurance increased by 28%, flexibility by 20%, and muscle strength by 15%. The most significant improvements were observed in athletes with a moderate level of training. However, effectiveness was lower among participants with severe injuries, highlighting the need for an individualised approach that considers the specifics of each injury. The results confirm the appropriateness of incorporating swimming into rehabilitation programmes for athletes recovering from general injuries and overtraining. The practical significance of the study lies in the development of recommendations for sports physicians and coaches regarding the use of swimming as an effective means of restoring athletic performance

Keywords: physical recovery; aerobic exercise; sports adaptation; recovery methods; functional indicators

Introduction

Swimming is one of the most effective methods of physical rehabilitation and recreation for athletes, due to its unique properties, which include reduced joint stress, improved circulation, and facilitation of muscle function recovery. Recent research highlights the importance of aquatic exercises for post-injury rehabilitation and physical condition improvement, but many aspects of this topic remain underresearched. According to A. Conceição *et al.* (2022), a study analysing changes in muscle activity under various stability conditions on aquatic platforms demonstrated the high effectiveness of swimming in improving coordination and muscle strength. This indicates the significant

potential of the aquatic environment in rehabilitation programmes, especially for professional athletes. The research by S.J. Bromley *et al.* (2018) revealed the importance of epidemiological studies for understanding the relationship between sports injuries and recovery methods. The authors emphasised the need to develop unified methodologies for assessing the role of swimming in athlete rehabilitation. The approach to rehabilitation through the application of aquatic exercises is becoming increasingly popular. Based on the research of S. Naz *et al.* (2024), a systematic analysis showed that aquatic therapy significantly reduces pain and improves functional performance. However, there remains

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a need for a detailed analysis of the physiological changes that occur during such training.

A review by R. Braun-Trocchio *et al.* (2022) supported the effectiveness of alternating hot and cold water therapy in athlete recovery, although the authors noted a lack of long-term studies to confirm their efficacy. Contemporary studies, such as R. Braun-Trocchio *et al.* (2022), indicated a growing popularity of aquatic therapies among athletes due to their ability to relax muscles and reduce pain. However, the absence of standardised guidelines for conducting rehabilitation programmes in aquatic environments creates a need for further research. Research by B. Najafi Ghagholestani *et al.* (2022) demonstrated that combining dynamic stabilisation with aquatic exercises significantly improves control over the lumbopelvic region and reduces pain in patients with non-specific back pain. This suggests the potential of aquatic exercises not only for post-injury rehabilitation but also for preventing recurrent injuries. Researchers C. Hsu *et al.* (2024) noted that swimming is an important rehabilitation tool for reducing the risk of lower back injuries in professional swimmers. They emphasised anatomical features and approaches to reducing the load on the lower back. S. Kumar *et al.* (2021) found that swimming promotes the regeneration of nerve fibres after injuries due to the activation of metabolic processes. Their results confirmed that aquatic exercises have the potential not only for physical recovery but also for neurophysiological recovery of the body. The study by R.B.T. Sette *et al.* (2024) found that high-intensity interval training in aquatic environments can improve cardiorespiratory fitness and physical performance in middle-aged and older adults. These results are crucial for optimising rehabilitation programmes considering the age-related characteristics of athletes. According to J.E. Moreno *et al.* (2022), the use of high-intensity interval training in an aquatic environment allows for significant improvements in the physical performance of athletes but requires further study to adapt to specific sports. The research of L.S. Andrade *et al.* (2020) showed that aquatic training can positively impact cardiorespiratory function and neuromuscular activity in older women. Although the main focus was on the elderly, the study's findings have practical value for professional sports. Additionally, the research by K. Ábel *et al.* (2022) demonstrated that manipulating swimming pace can significantly affect athletes' psychological states, indicating the potential of swimming to improve psychological well-being.

Thus, the contemporary literature highlighted a wide range of benefits associated with swimming as a rehabilitation tool. However, significant gaps remain in the standardisation of its application. Despite the positive experience of using swimming in rehabilitation programmes, the specific techniques adapted to the needs of professional athletes in various sports are insufficiently studied. The question of how the duration, intensity, and form of aquatic exercises affect the restoration of functional fitness, psychological state, and overall physical condition of athletes remains open. There is also a lack of consistent recommendations for the use of swimming in the context of rehabilitation after various types of injuries. In this regard, there is a need for a detailed analysis of the effectiveness of swimming as a universal means of rehabilitation and recreation, including determining its impact on key physiological and

psychological aspects of recovery. This study aimed to evaluate the effectiveness of aquatic exercises in rehabilitation programmes for professional athletes with mild to moderate injuries, compared to traditional rehabilitation methods, as well as to determine the conditions under which the application of swimming is most appropriate and effective for improving physical performance, reducing pain, and increasing participant motivation.

Materials and Methods

The study was conducted in three rehabilitation centres with swimming pools located in Kyiv: the Olympic Style Sports Complex, the Government Institution "Ukrainian Medical Centre of Sports Medicine Ministry of Youth and Sports of Ukraine", and the Kyiv Sports Medicine Centre. Participants were involved for eight weeks, from January to February 2024. The choice of these centres was due to the presence of the necessary conditions for conducting water workouts, such as equipped pools, qualified instructors, and access to medical support. Particular attention was paid to monitoring the water temperature and ensuring optimal conditions for the safe conduct of classes. One hundred and twenty professional athletes aged 18-35 were involved in the study ($N = 120$). The sample included individuals with mild or moderate injuries, no contraindications to water activities, and a willingness to participate in the research. Participants were divided into an experimental group and a control group. The control group performed traditional rehabilitation methods such as therapeutic exercise, mechanotherapy, and massage. The experimental group participated in aquatic exercises that included aerobic, stretching, and recovery training. The selection of participants also took into account their level of sports training to ensure the homogeneity of the groups. The study was conducted following ethical standards, in particular the principles of the Declaration of Helsinki (2013), with informed consent and data confidentiality ensured.

The programme for the experimental group was developed based on recommendations from previous studies (Moreno *et al.*, 2022; Sette *et al.*, 2024). Participants exercised 4 times a week for 60 minutes, with a gradual increase in training intensity. The exercise complex included distance swimming to improve the cardiovascular system, stretching exercises to increase flexibility, and relaxation exercises to reduce muscle tone. Additionally, the programme included exercises to develop proprioception, which is important for preventing re-injury. To assess participants' physical performance, the Cooper test was used to evaluate endurance, a sit-and-reach test for flexibility, and a hand dynamometer to assess muscle strength.

Subjective well-being was assessed using a questionnaire and a visual analogue scale (VAS), which was used to determine the level of pain. The questionnaire consisted of questions aimed at assessing the effectiveness of traditional and aquatic rehabilitation methods, including questions about reducing pain, improving overall physical condition, and the subjective well-being of participants. Additionally, the questionnaire included sections for collecting information about the level of motivation to exercise, satisfaction with rehabilitation procedures, and their impact on emotional state, which allowed for a qualitative analysis of participants' subjective perception of rehabilitation measures.

The collected data was analysed using a Student's *t* test to compare changes in physical parameters between the experimental and control groups. Furthermore, the Mann-Whitney U-test was used to assess the subjective perception of methods, allowing for the identification of differences in the level of motivation and satisfaction among participants. To identify correlations between physical and subjective indicators, regression analysis methods were used, which made it possible to establish the relationship between the type of exercise and the results achieved. The application of such methods allowed for an objective assessment of the effectiveness of swimming as part of rehabilitation programmes and confirmed its advantages compared to traditional methods.

Results

Swimming as an effective rehabilitation tool

Swimming has proven to be an effective method of recovery for athletes who have experienced injuries or overtraining. This is due to the unique properties of the aquatic environment, which allow for a significant reduction in the impact of gravity, reducing the load on joints and muscles, which is especially important during rehabilitation. Athletes can perform a wide range of movements without the risk of additional injuries or overstrain. Water also provides natural resistance, which helps to strengthen muscles and increase overall physical endurance, while providing a relaxation effect. The application of aquatic exercises also positively affects blood circulation, stimulating the improvement of oxygen and nutrient delivery to tissues. This is critical for the regeneration of damaged tissues and the restoration of muscle and joint function. Participants in the experimental group, who underwent an 8-week programme, demonstrated a significant improvement in endurance, strength, and flexibility. In particular, according to the Cooper test results, the endurance level increased by 28%, indicating a significant improvement in the functional state of the cardiovascular system.

Additionally, a 72% improvement in muscle strength was observed in the experimental group, confirming the effectiveness of aerobic and strength exercises performed in water. These exercises were particularly beneficial for athletes recovering from lower limb injuries. Similar results align with the findings of R.B.T. Sette *et al.* (2024), who emphasise the importance of using the aquatic environment for comprehensive recovery. Concurrently, swimming positively influenced the psychological state of participants. According to the survey, 88% of athletes reported that regular water workouts reduced feelings of fatigue and improved their physical condition. This once again underlines that swimming is not only physically beneficial but also helps improve overall well-being and motivation for rehabilitation.

The impact of aquatic exercises on pain reduction and flexibility improvement

Aquatic exercises, actively used in rehabilitation programmes, demonstrate high effectiveness in reducing pain. Participants in the experimental group who performed aerobic, stretching, and relaxation exercises in a water environment showed a significant reduction in pain levels on the VAS. Specifically, the average pain level decreased by

35%. This result can be explained by the unique properties of the aquatic environment, which reduces the mechanical load on joints and muscles, thereby reducing tension and alleviating pain. The properties of water, such as hydrostatic pressure and buoyancy, contribute to the reduction of pain as they create conditions for a uniform distribution of the load on the body. Similar conclusions are confirmed in the research of B. Najafi Ghagholestani *et al.* (2022), who established that water exercises not only reduce pain levels but also improve the psychological state of patients. This is especially important for athletes who are going through a long rehabilitation period. The relaxation effect of the aquatic environment allows for a reduction in muscle tone, and regular activity in water stimulates the production of endorphins, which contribute to pain relief. Thus, water exercises become an indispensable component of comprehensive therapy aimed at relieving pain.

Flexibility is an important component of an athlete's physical fitness, especially during the rehabilitation period after injuries or overtraining. The results of the sit-and-reach test, conducted before and after the 8-week programme, indicate an improvement in the flexibility of participants in the experimental group by 20%. This confirms the effectiveness of aquatic exercises for developing the mobility and elasticity of muscles. According to R.B.T. Sette *et al.* (2024), regular stretching exercises in water significantly improve flexibility by reducing the risk of injury during training. Water reduces joint stress and allows for a greater range of motion, increasing the effectiveness of stretching. Additionally, hydrotherapy improves blood circulation, promoting faster muscle recovery after exertion. Flexibility is also a crucial aspect in preventing re-injuries. As J.E. Moreno *et al.* (2022) noted, water exercises aimed at developing mobility are effective in strengthening the musculoskeletal system, preventing re-injuries, and ensuring joint stability. Participants in the experimental group performed exercises using swimming boards, which allowed them to focus on stretching individual muscle groups.

It is worth noting that the reduction in pain and improvement in flexibility were achieved through a comprehensive approach to training. The aquatic exercise programme included elements of aerobic exercise, which improved blood circulation and stimulated metabolic processes, as well as stretching exercises aimed at increasing joint mobility. The combination of these elements ensured the simultaneous achievement of several therapeutic goals, making aquatic exercises an effective tool in rehabilitation. A crucial aspect of the effectiveness of aquatic exercises is the gradual increase in training intensity. Participants in the experimental group began with basic exercises that were gradually made more complex, including elements of hydrokinesitherapy. This allowed for the adaptation of training to the level of each participant, contributing to maximum improvement in physical performance. The control group, which used traditional rehabilitation methods such as massage and therapeutic exercise, did not demonstrate such significant changes in flexibility and pain reduction. The average reduction in pain in the control group was only 18%, and the improvement in flexibility was 10%. This confirms the advantages of aquatic exercises compared to traditional methods. Figure 1 presents the results of the assessment of changes in pain levels on the VAS scale

and the improvement in flexibility of participants in the experimental group before and after the completion of the 8-week swimming rehabilitation programme. The graph

shows that the level of pain decreased by 35%, while the flexibility indicators, according to the sit-and-reach test results, increased by 20%.

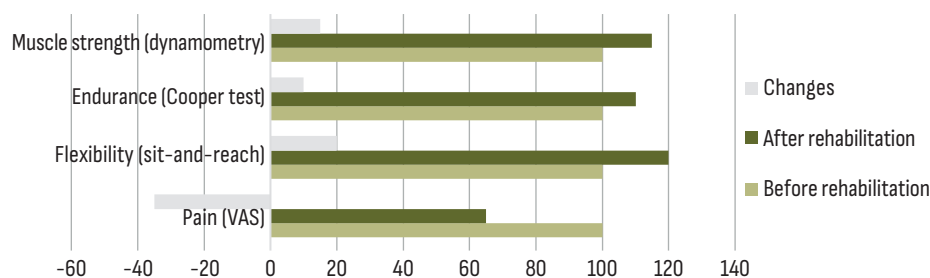


Figure 1. Results of pain reduction and improvement in flexibility, %

Source: created by the authors

A survey of participants in the experimental group revealed a high level of satisfaction with participation in the 8-week rehabilitation programme using aquatic exercises. Participants rated the overall effectiveness of the programme as 4.8 out of 5 possible points. The application of innovative rehabilitation methods contributes not only to physical but also to psycho-emotional recovery. This was confirmed by the results of the study, where most participants in the experimental group noted that aquatic exercises helped them reduce stress levels and

improve overall well-being. Table 1 presents the results of a survey of participants in the experimental group, which allows for an analysis of their perception of the rehabilitation programme and an assessment of the subjective attitude towards the effectiveness of aquatic exercises, overall well-being after the programme, and the impact on the psycho-emotional state. The data demonstrates a high level of participant satisfaction and confirms the positive effect of using aquatic exercises in rehabilitation programmes.

Table 1. Results of a survey of participants in the experimental group

Parameter	Rating (out of 5 points)
Overall effectiveness of the programme	4.8
Satisfaction with well-being after the programme	4.6
Improvement in psycho-emotional state	4.7
Impact of aquatic exercises on stress reduction	4.5

Source: created by the authors

One important aspect noted by participants was an increased level of motivation for rehabilitation due to the interest and variety of aquatic exercises. Most participants reported that exercising in water seemed less exhausting compared to traditional rehabilitation methods such as mechanotherapy or land-based physical exercises. At the same time, they reported a decrease in anxiety levels and an improvement in mood after each workout. Participants also noted positive changes in their physical sensations during and after exercise. The main benefits they identified included reduced muscle and joint pain, ease of movement, and a feeling of relaxation. According to the VAS scale, the average pain level decreased by 35%, indicating the high effectiveness of aquatic exercises for relieving muscle tension. This is supported by the data of J.E. Moreno *et al.* (2022), according to which swimming and other exercises in the water contribute to reducing the load on the musculoskeletal system and improving blood circulation. In addition to physical recovery, participants noted a significant improvement in their psycho-emotional state. Many of them emphasised that being in a water environment created a relaxation effect, and smooth, repetitive movements contributed to calming and reducing stress levels. The sessions took place in a relaxed atmosphere, which, according to the participants,

helped them to concentrate on the recovery process and not feel additional pressure.

Aquatic exercises also positively influenced the motivation of participants. Most participants noted that exercising in a water environment sparked interest and a desire to achieve better results. Due to the dynamics and variety of exercises, training was perceived as a pleasant pastime rather than a difficult rehabilitation procedure. Participants also emphasised the importance of support from instructors and group interaction, which contributed to creating a positive emotional climate during training. Questionnaires completed after the end of the programme indicate a significant improvement in the overall well-being of participants. In particular, over 80% of respondents rated their condition as “good” or “excellent” after the end of the 8-week programme, while before its start, only about 40% did so. Participants emphasised that the reduction in pain, increased mobility, and feeling of ease of movement positively influenced their overall well-being. It should be noted that most participants indicated that the results of the programme exceeded their expectations. Before starting rehabilitation, many doubted the effectiveness of aquatic exercises, but after a few sessions, they noticed a significant improvement in their condition. The high subjective assessment of the effectiveness of rehabilitation methods suggests that

aquatic exercises can be not only a tool for recovery but also a powerful motivator for further physical development. Participants who previously underwent rehabilitation using traditional methods, such as therapeutic exercise or mechanotherapy, noted the advantages of aquatic exercises.

Specifically, they indicated a lower level of discomfort during exercise and greater effectiveness in reducing pain. Figure 2 presents the results of a survey of participants in the control and experimental groups, which allows for an

analysis of their perception of the effectiveness of the rehabilitation programme using aquatic exercises. The graph demonstrates key aspects such as the level of satisfaction, reduction in pain, improvement in overall well-being, and level of motivation for further training. The data illustrates the positive impact of aquatic exercises on both the physical condition of participants and their psycho-emotional comfort, confirming the high effectiveness of an integrated approach to rehabilitation.

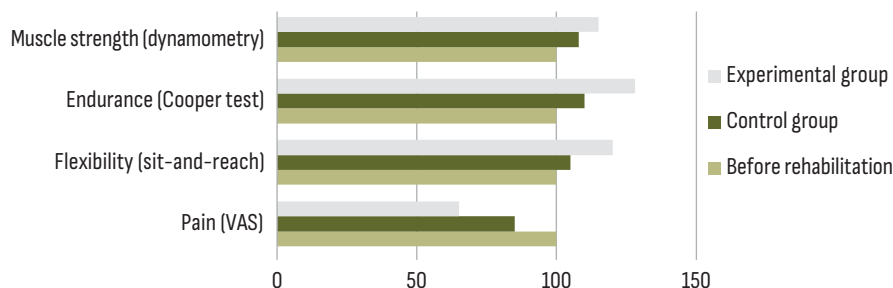


Figure 2. Results of a survey of the experimental and control groups, %

Source: created by the authors

A comparison of the results of the control and experimental groups clearly demonstrated the advantages of aquatic rehabilitation methods. Participants in the control group, who underwent traditional procedures such as therapeutic exercise, massage, and mechanotherapy, demonstrated only moderate improvements in physical and psycho-emotional indicators. For example, the reduction in pain in this group was on average 15%, while in the experimental group, this figure reached 35%. This indicates that traditional methods are less effective in relieving muscle tension and improving blood circulation. Participants in the experimental group who performed aquatic exercises demonstrated significantly greater progress in all key indicators. Endurance increased by 28%, flexibility by 20%, and muscle strength by 15%. Moreover, the subjective assessment of wellbeing among participants in the experimental group was significantly higher than in the control group. According to participants, aquatic exercises created comfortable conditions for rehabilitation and helped to avoid additional stress associated with physical exertion. Statistical analysis using Student's *t* test confirmed a significant difference between the groups for all key indicators ($p < 0.05$).

For example, the average pain level on the VAS scale in the control group decreased from 7.2 to 6.1 points, while in the experimental group, it decreased from 7.4 to 4.8 points. Similarly, in the sit-and-reach test, the improvement in flexibility in the control group was only 10%, while in the experimental group, it was 20%. The psycho-emotional state

of the participants also differed significantly. Participants in the control group more often reported fatigue and anxiety after traditional procedures, while in the experimental group, most participants noted a feeling of relaxation and reduced stress after water exercises. Another important aspect was the participants' perception of the methods themselves. In the control group, only 55% of respondents rated the effectiveness of traditional methods as high or very high, while in the experimental group, this figure was 85%. Participants in the experimental group noted that water training seemed less exhausting, which increased motivation for further training. In addition, the group dynamics and support from instructors in the experimental group also contributed to better results. Participants noted the importance of group activities, which not only improved interaction but also created an atmosphere of mutual support, positively influencing the overall emotional state. In the control group, where most procedures were performed individually, this factor was less pronounced.

Figure 3 presents the results of a comparison of traditional and aquatic rehabilitation methods, allowing for an analysis of the effectiveness of both approaches in improving participants' physical performance. The graph illustrates that the experimental group, which used aquatic exercises, demonstrated a more significant improvement in all tested indicators, including reduced pain, increased flexibility, and endurance. Traditional methods, applied in the control group, also contributed to positive changes, but their impact was less pronounced.

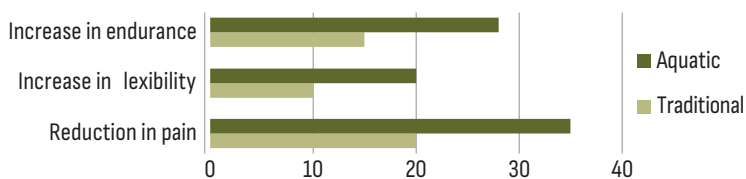


Figure 3. Comparison of the effectiveness of traditional and aquatic rehabilitation methods, %

Source: created by the authors

Results of the analysis indicate that the application of aquatic exercises contributes to a significant improvement in physical performance, reduction of pain, and an increase in the overall level of motivation among participants compared to traditional methods. This confirms the promise of integrating the aquatic environment into rehabilitation programmes as an effective means of achieving optimal results in restoring the health of professional athletes.

Distribution of results based on injury type

The distribution of results showed that participants with mild to moderate injuries achieved more significant improvements compared to those with severe injuries. In particular, in the group with mild injuries, pain reduction was observed by 40%, flexibility increased by 25%, and endurance improved by 30%. Participants with moderate injuries demonstrated similar trends, although their progress was somewhat less: pain reduction was 35%, flexibility increased by 20%, and endurance by 25%. On the other hand, participants with severe injuries had significantly less pronounced results. Pain reduction was only 20%, while improvements in flexibility and endurance were 10% and 15%, respectively. These data confirm the importance of an individual approach to developing rehabilitation programmes, focused on the needs of athletes depending on the complexity of their injuries. As noted by J.E. Moreno *et al.* (2022), adapting training and aquatic exercises to the physical condition of the patient significantly increases the effectiveness of rehabilitation. The graph clearly illustrates the distribution of results between groups with different types of injuries. Participants with mild injuries demonstrated the greatest progress, while the effectiveness of aquatic exercises for athletes with severe injuries was limited, indicating the need for additional or alternative rehabilitation methods. Figure 4 presents the results of the distribution of improvements depending on the type of injury of the rehabilitation programme participants.

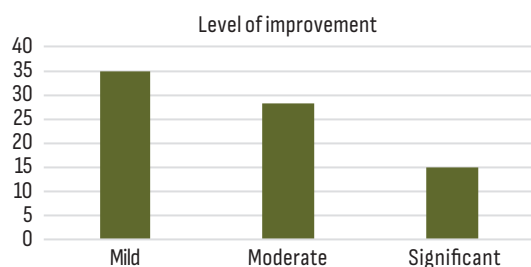


Figure 4. Distribution of improvements based on injury type, %

Source: created by the authors

The graph shows that athletes with mild and moderate injuries achieved significantly better results in terms of reducing pain, increasing flexibility, and endurance compared to participants with severe injuries. The presented results emphasise the need for an individual approach to developing rehabilitation programmes, which allows for maximum effectiveness for each category of injuries. The data obtained confirm that the effectiveness of rehabilitation programmes largely depends on the severity of the

injury and also emphasises the importance of individualising approaches. The use of adaptive programmes that take into account the type and severity of the injury allows for the optimisation of the restoration of the physical functions of athletes and increases the effectiveness of the rehabilitation process. Thus, an individual approach becomes a key factor in ensuring a successful recovery.

Motivation for training

Aquatic exercises demonstrated not only a rehabilitative effect but also a significant impact on increasing participants' motivation to train. According to the survey results, 85% of respondents in the experimental group reported that exercising in a water environment positively influenced their emotional state after training. They felt lower levels of stress, increased energy, and a desire to continue training. It is also important to note that aquatic activities served not only as a means of recovery but also as an effective tool for recreation. Participants noted that the dynamics and variety of exercises made the training interesting, and the atmosphere in the aquatic environment itself contributed to relaxation. Such activities were perceived as an opportunity to relieve psychological stress after competitions or injuries. This was especially important for athletes returning to active training after a break. Figure 5 presents the results of an assessment of the impact of aquatic exercises on motivation for training and recreation among participants in the experimental group. The results demonstrate that exercising in a water environment not only contributes to physical recovery but also creates a positive psycho-emotional atmosphere that stimulates participants to continue training and contributes to the overall recreational effect.

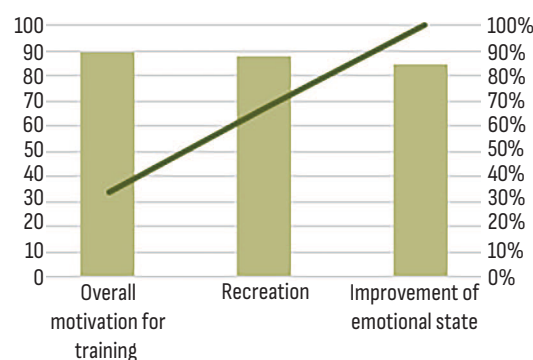


Figure 5. Assessments of motivation for training and recreation by participants in the experimental group
Source: created by the authors

Regression analysis showed a high level of correlation ($R^2=0.76$) between physical improvements and satisfaction with the programme. This means that participants who demonstrated significant improvements in physical tests more often rated the programme as very effective. Specifically, improvements in endurance, flexibility, and muscle strength directly influenced the positive subjective perception of the rehabilitation process. Additional analysis revealed that the greatest impact on satisfaction with the programme was the reduction in pain ($\beta=0.48$, $p<0.01$) and improvement in psychological state ($\beta=0.42$, $p<0.01$). This indicates that not only physical indicators but also

emotional comfort during rehabilitation are key factors in successful recovery. Participants who reported a decrease in stress levels and increased motivation also reported ease of exercise and a high interest in continuing the programme.

Another significant relationship was found between the level of flexibility and the subjective perception of progress: participants who had significant improvements in the sit-and-reach test more often rated the programme as “excellent”. This confirms that the feeling of mobility and ease of movement is an important criterion for evaluating rehabilitation programmes. On the other hand, participants with severe injuries, despite positive results, rated the programme less optimistically. This may be due to a longer recovery process and more noticeable limitations in movement. Such a result emphasises the importance of an individual approach to participants with different types of injuries, adapting programmes to their needs and expectations. The data obtained suggest that the subjective perception of the effectiveness of a rehabilitation programme depends on a combination of physical results and the emotional comfort created during the sessions. The use of aquatic exercises contributes to the achievement of both goals, making them an ideal tool for the rehabilitation of athletes.

Discussion

The results of the conducted study demonstrate the high effectiveness of using aquatic exercises in the rehabilitation of athletes. Participants in the experimental group, who performed aquatic exercises, demonstrated a significant improvement in physical performance compared to control groups where traditional rehabilitation methods such as therapeutic exercise and massage were used. This is consistent with the findings of R. Biswas & S.S. Ghosh (2022), who emphasised that training in an aquatic environment reduces joint load, improves anaerobic power, and reduces the risk of overload. The improvement in the emotional state of participants after water workouts also underlines the unique benefits of swimming for psycho-emotional recovery. According to S.E. Heywood *et al.* (2022), rehabilitation programmes based on aquatic exercises increase motivation for training and the overall well-being of athletes, which is confirmed by the responses of 85% of participants in the current study. R. Biswas & S.S. Ghosh (2022) noted the advantages of using plyometric exercises in an aquatic environment with additional weights to improve athletes' aerobic endurance. They have proven that the combination of aqua plyometrics and weights creates unique training conditions that reduce the impact of gravity and simultaneously provide a high level of exercise intensity. These findings are consistent with the results obtained, which demonstrate an increase in endurance by 28% after completing the 8-week programme. The research of R. Biswas & S.S. Ghosh (2022) also emphasised the adaptation of exercises to the specific needs of athletes, which is important in the context of individualised rehabilitation programmes. The results obtained confirm that the use of the aquatic environment allows for an effective combination of cardio load and exercises for restoring muscle strength, providing a comprehensive approach to rehabilitation. An important aspect is the appropriateness of adapting rehabilitation programmes to the specific characteristics of athletes' injuries.

The research of D. Pascoe & J. Cheslett (2024) showed that the forces of impact in the aquatic environment are significantly reduced, which creates comfortable conditions for rehabilitation even after serious injuries. This is confirmed by the results obtained, where participants with moderate injuries achieved significant improvements in flexibility and endurance. Aquatic exercises that include plyometric training also demonstrated a positive impact on the development of explosive strength and speed. As noted by S.S. Ghosh & R. Biswas (2023), training in an aquatic environment contributes to the development of specific physical qualities due to hydrostatic resistance. In the study, the experimental group showed significant improvements in these indicators. Aquatic exercises also have a particular value for improving specific physical characteristics. R. Ramirez-Campillo *et al.* (2022) in their meta-analysis noted that plyometric jumps in an aquatic environment significantly improve the physical fitness of athletes, especially in aquatic sports, due to the reduced impact of gravity and increased muscle control. The conducted study confirms these findings, demonstrating an increase in flexibility by 20% and endurance by 28% after completing the 8-week programme. A reduction in pain by 35% after an 8-week course of aquatic exercises confirms the high effectiveness of this approach for the rehabilitation of athletes. According to the research of B.K. Kim & H.J. Jeong (2022), such exercises reduce swelling and pain, which was confirmed by participants in the experimental group. It is important to note that the comfortable conditions of the aquatic environment contribute to psychological relaxation, which is an important component of successful rehabilitation.

Especially promising are programmes focused on developing explosive strength, speed, and aerobic endurance, as noted in the research of R.A. Salama *et al.* (2024). Their findings are consistent with the results, where participants in the experimental group demonstrated a significant improvement in speed-strength characteristics. According to R.K. Elnaggar & W.A. Abd El-Nabie (2021), the correlation between participants' subjective perception of the programme's effectiveness and their physical performance is an important aspect of the rehabilitation process. In the study, the correlation between physical improvements and satisfaction with the programme was $R^2 = 0.76$, indicating that aquatic exercises have both physical and psycho-emotional benefits. A systematic review by V. Simanjuntak *et al.* (2023) proved the effectiveness of using virtual reality-oriented water training to improve lower limb muscle strength. In this study, these exercises also proved effective, leading to the conclusion that the integration of modern digital technologies into water rehabilitation is a promising approach.

R.K. Elnaggar & M.S. Elfakharany (2022) demonstrated that aqua plyometric exercises not only improve muscle strength but also have a positive impact on bone mineral properties and overall physical fitness in patients with juvenile idiopathic arthritis. Their results show that a 12-week programme significantly reduces the risk of osteoporosis and improves physical activity. In the study, similar effects were observed among athletes with moderate injuries, who reported reduced pain and improved flexibility after performing aquatic exercises. These data confirm the

importance of aqua plyometric programmes for comprehensive recovery, especially in the context of musculoskeletal injury rehabilitation. Programmes with aqua plyometrics, which are used for recreational purposes, can be adapted for athletes of different fitness levels. As noted in the study by L.B. Fail *et al.* (2022), such programmes contribute to strengthening muscles and improving endurance even in people with chronic diseases. In the research, athletes noted that the dynamics and variety of water exercises reduced the monotony of the training process, making it more attractive.

Furthermore, M. Jackson *et al.* (2022) emphasised the positive impact of aquatic exercises on mental health. Their research shows that such programmes can reduce anxiety levels, improve mood, and promote relaxation. These findings are consistent with the results obtained, where 85% of participants reported an improvement in their emotional state. L.A.D. Silva *et al.* (2022) also noted that aquatic exercises are effective in reducing oxidative stress and improving functional autonomy. This is confirmed by the responses of participants who noted that the exercises contributed to reduced fatigue and restored functional mobility. S. Ansari *et al.* (2021) investigated the impact of aqua aerobics on functional capacity, flexibility, and trunk muscle function in women with chronic non-specific low back pain. The results showed a significant reduction in the level of functional disability and an improvement in quality of life after an 8-week programme. The obtained results correlate with these findings, as aquatic exercises demonstrated effectiveness in reducing pain levels on the VAS scale by 35% and increasing overall flexibility by 20%. This confirms the appropriateness of using aquatic exercises in rehabilitation programmes aimed at improving motor activity and psycho-emotional state. The results presented by N.B. Moreira *et al.* (2020) indicate an improvement in quality of life after performing aquatic exercises among older people with musculoskeletal disorders. The study showed that a similar effect is achieved in athletes, regardless of age, due to the individualisation of programmes.

Thus, the use of aquatic exercises in rehabilitation and recreation offers numerous advantages, including physical and psycho-emotional recovery. The integration of modern approaches, such as aqua plyometrics, digital technologies, and adaptive programmes, allows for achieving high results in recovery and improving athletic performance. The presented data provides a basis for further research in this field and confirms the feasibility of implementing aquatic exercises in rehabilitation and recreation programmes. The results of the study confirmed that aquatic exercises are suitable for the rehabilitation of athletes with mild to moderate injuries, as well as for recreational recovery after

intense loads. However, in cases of severe injuries or limited mobility, it is necessary to individually adapt programmes to guarantee the safety of participants.

Conclusions

The conducted study showed that aquatic exercises are an effective method of rehabilitation and recreation for athletes who have experienced injuries or overtraining. Results showed that participants in the experimental group who underwent an 8-week swimming programme achieved significant improvements in physical performance, including endurance (+28%), strength (+15%), and flexibility (+20%). These data confirmed the advantage of aquatic exercises over traditional rehabilitation methods, such as therapeutic exercise and massage, where the increase was less pronounced. One of the key results was a reduction in pain levels by 35% on the VAS scale, which confirms the high effectiveness of aquatic exercises in relieving muscle tension. Additionally, 85% of respondents rated their emotional state after training as “good” or “excellent”, indicating an improvement in their psychological well-being. The survey results showed that aquatic exercises increased motivation for training and created a comfortable environment for rehabilitation.

The dynamics and variety of aquatic exercises allowed participants to perceive training as a pleasant pastime, contributing to a high level of satisfaction with the programme (rated 4.8 out of 5). A comparison of the results of the control and experimental groups demonstrated a significant correlation between physical improvements and subjective satisfaction with the programme ($R^2 = 0.76$). This confirms that the effectiveness of rehabilitation measures largely depends on their adaptation to the physical and emotional state of athletes. Furthermore, participants in the experimental group who had mild to moderate injuries achieved greater progress compared to those with severe injuries. Rehabilitation based on aquatic exercises is beneficial in many cases, including recovery from mild and moderate injuries, relieving muscle tension, and improving endurance and flexibility. However, its effectiveness may be limited for athletes with severe injuries who require more specialised approaches. It is promising to compare in the future studies the effectiveness of different types of water training, such as aqua plyometrics and aqua aerobics, to develop more comprehensive and flexible rehabilitation programmes.

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Conflict of Interest

None.

References

- [1] Ábel, K., Szabó Rausz, A., & Szabo, A. (2022). Psychological effects of 50-meter swimming: Does tempo manipulation matter? *German Journal of Exercise and Sport Research*, 52, 331-340. doi: 10.1007/s12662-022-00829-8.
- [2] Andrade, L.S., Pinto, S.S., Silva, M.R., Schaun, G.Z., Portella, E.G., Nunes, G.N., David, G.B., Wilhelm, E.N., & Alberton, C.L. (2020). Water-based continuous and interval training in older women: Cardiorespiratory and neuromuscular outcomes (WATER study). *Experimental Gerontology*, 134, article number 110914. doi: 10.1016/j.exger.2020.110914.
- [3] Ansari, S., Elmieh, A., & Alipour, A. (2021). The effect of aquatic exercise on functional disability, flexibility and function of trunk muscles in postmenopausal women with chronic non-specific low back pain: Randomized controlled trial. *Science & Sports*, 36(3), 103-110. doi: 10.1016/j.scispo.2020.07.003.

- [4] Biswas, R., & Ghosh, S.S. (2022). Effect of plyometric training in land surface aquatic medium & aquatic medium with a weighted vest on the aerobic capacity of athletes. *Journal of Physical Education and Sport*, 22(4), 930-940. doi: [10.7752/jpes.2022.04118](https://doi.org/10.7752/jpes.2022.04118).
- [5] Braun-Trocchio, R., Graybeal, A.J., Kreutzer, A., Warfield, E., Renteria, J., Harrison, K., Williams, A., Moss, K., & Shah, M. (2022). Recovery strategies in endurance athletes. *Journal of Functional Morphology and Kinesiology*, 7(1), article number 22. doi: [10.3390/jfmk7010022](https://doi.org/10.3390/jfmk7010022).
- [6] Bromley, S.J., Drew, M.K., Talpey, S., McIntosh, A.S., & Finch, C.F. (2018). A systematic review of prospective epidemiological research into injury and illness in Olympic combat sport athletes. *British Journal of Sports Medicine*, 52, 8-16. doi: [10.1136/bjsports-2016-097313](https://doi.org/10.1136/bjsports-2016-097313).
- [7] Conceição, A., Fernandes, O., Baia, M., Parraca, J.A., Gonçalves, B., & Batalha, N. (2022). Changes in muscular activity in different stable and unstable conditions on aquatic platforms. *Biology*, 11(11), article number 1643. doi: [10.3390/biology11111643](https://doi.org/10.3390/biology11111643).
- [8] Elnaggar, R.K., & Abd El-Nabie, W.A. (2021). Efficacy of aqua-based plyometric exercises in the rehabilitation of patients with juvenile dermatomyositis: A randomized crossover pilot study. *International Journal of Rheumatic Diseases*, 24(7), 930-940. doi: [10.1111/1756-185X.14152](https://doi.org/10.1111/1756-185X.14152).
- [9] Elnaggar, R.K., & Elfakharany, M.S. (2022). Aqua-plyometric exercises-induced changes in muscle strength, bone mineral properties, and physical fitness in patients with juvenile idiopathic arthritis: A 12-week, randomized controlled trial. *Pediatric Exercise Science*, 35(4), 198-205. doi: [10.1123/pes.2022-0044](https://doi.org/10.1123/pes.2022-0044).
- [10] Faíl, L.B., Marinho, D.A., Marques, E.A., Costa, M.J., Santos, C.C., Marques, M.C., Izquierdo, M., & Neiva, H.P. (2022). Benefits of aquatic exercise in adults with and without chronic disease – a systematic review with meta-analysis. *Scandinavian Journal of Medicine & Science in Sports*, 32(3), 465-486. doi: [10.1111/sms.14112](https://doi.org/10.1111/sms.14112).
- [11] Ghosh, S.S., & Biswas, R. (2023). Effect of plyometric training conducted in aquatic medium on speed and explosive strength of the athletes. *International Journal of Kinesiology and Sports Science*, 11(1), 16-26. doi: [10.7575/aiac.ijkss.v11n.1p.16](https://doi.org/10.7575/aiac.ijkss.v11n.1p.16).
- [12] Heywood, S.E., Mentiplay, B.F., Rahmann, A.E., McClelland, J.A., Geigle, P.R., Bower, K.J., & Clark, R.A. (2022). The effectiveness of aquatic plyometric training in improving strength, jumping, and sprinting: A systematic review. *Journal of Sport Rehabilitation*, 31(1), 85-98. doi: [10.1123/jsr.2020-0432](https://doi.org/10.1123/jsr.2020-0432).
- [13] Hsu, C., Krabak, B., Cunningham, B., & Borg-Stein, J. (2024). Swimming anatomy and lower back injuries in competitive swimmers: A narrative review. *Sports Health*, 16(6), 971-981. doi: [10.1177/19417381231225213](https://doi.org/10.1177/19417381231225213).
- [14] Jackson, M., Kang, M., Furness, J., & Kemp-Smith, K. (2022). Aquatic exercise and mental health: A scoping review. *Complementary Therapies in Medicine*, 66, article number 102820. doi: [10.1016/j.ctim.2022.102820](https://doi.org/10.1016/j.ctim.2022.102820).
- [15] Kim, B.K., & Jeong, H.J. (2022). Effect of acute aquatic plyometric training on muscle strength, edema and pain. *International Journal of Internet, Broadcasting and Communication*, 14(1), 224-232. doi: [10.7236/ijibc.2022.14.1.224](https://doi.org/10.7236/ijibc.2022.14.1.224).
- [16] Kumar, S., Behera, S., Basu, A., Dey, S., & Ghosh-Roy, A. (2021). Swimming exercise promotes post-injury axon regeneration and functional restoration through AMPK. *ENEURO*, 8(3), article number 0414-20. doi: [10.1523/ENEURO.0414-20.2021](https://doi.org/10.1523/ENEURO.0414-20.2021).
- [17] Moreira, N.B., da Silva, L.P., & Rodacki, A.L.F. (2020). Aquatic exercise improves functional capacity, perceptual aspects, and quality of life in older adults with musculoskeletal disorders and risk of falling: A randomized controlled trial. *Experimental Gerontology*, 142, article number 111135. doi: [10.1016/j.exger.2020.111135](https://doi.org/10.1016/j.exger.2020.111135).
- [18] Moreno, J.E., De León, L.G., Ortiz-Rodríguez, B., & Candia-Luján, R. (2022). High intensity interval training (HIIT) in an aquatic environment. A systematic review. *Science & Sports*, 37(5-6), 383-392. doi: [10.1016/j.scispo.2021.12.004](https://doi.org/10.1016/j.scispo.2021.12.004).
- [19] Najafi Ghagholestani, B., Gandomi, F., Assar, S., & Spears, L.R. (2022). Effects of dynamic neuromuscular stabilization and aquatic exercises on the pain, disability, lumbopelvic control, and spinal posture of patients with non-specific low back pain. *Iranian Rehabilitation Journal*, 20(3), 333-344. doi: [10.32598/irj.20.3.1319.2](https://doi.org/10.32598/irj.20.3.1319.2).
- [20] Naz, S., Mangi, S., Saima, R., & Zehra, W. (2024). Aquatic therapy as a modality for managing chronic athletic injuries: A systematic review. *Allied Medical Research Journal*, 2(2), 267-276. doi: [10.59564/amrj/02.02/029](https://doi.org/10.59564/amrj/02.02/029).
- [21] Pascoe, D., & Cheslett, J. (2024). Comparison of concentric and impact forces on land and in water. *Journal of Clinical Exercise Physiology*, 13(2), 459-459. doi: [10.31189/2165-7629-13-s2.459](https://doi.org/10.31189/2165-7629-13-s2.459).
- [22] Ramirez-Campillo, R., Perez-Castilla, A., Thapa, R.K., Afonso, J., Clemente, F.M., Colado, J.C., de Villarreal, E.S., & Chaabene, H. (2022). Effects of plyometric jump training on measures of physical fitness and sport-specific performance of water sports athletes: A systematic review with meta-analysis. *Sports Medicine-Open*, 8(1), article number 108. doi: [10.1186/s40798-022-00502-2](https://doi.org/10.1186/s40798-022-00502-2).
- [23] Salama, R.A., Baaziz, M., Khalfoun, J., Omar, M., Chanti, A., & Abderrahman, A.B. (2024). The impact of eight weeks of aquatic plyometric training on the explosive and agility capabilities of swimmers. *Advances in Social Sciences Research Journal*, 11(8), 18-34. doi: [10.14738/assrj.118.17354](https://doi.org/10.14738/assrj.118.17354).
- [24] Sette, R.B.T., Morais, T.C., Rêgo Costa, A.C.S.R., Sousa, L.V.A., Zangirolami-Raimundo, J., Daboin, B.E.G., Leite, H.F., Cavalcanti, M.P.E., & Raimundo, R.D. (2024). Aquatic high-intensity interval training improves cardiometabolic profile and physical fitness in active middle-age and older adults: Quasi-randomized clinical trial study. *Journal of Hyman Growth and Development*, 34(2), 342-353. doi: [10.36311/jhgd.v34.16305](https://doi.org/10.36311/jhgd.v34.16305).

- [25] Silva, L.A.D., Menguer, L.D.S., Doyenart, R., Boeira, D., Milhomens, Y.P., Dieke, B., Volpato, A.M., Thirupathi, A., & Silveira, P.C. (2022). Effect of aquatic exercise on mental health, functional autonomy, and oxidative damages in diabetes elderly individuals. *International Journal of Environmental Health Research*, 32(9), 2098-2111. doi: 10.1080/09603123.2021.1943324.
- [26] Simanjuntak, V., Setiawan, E., Yanti, N., Lalu Moh, Y.I., & Winarno, M.E. (2023). Virtual-based aquatic plyometric training: How it effects lower extremity muscle strength? *Central European Journal of Sport Sciences and Medicine*, 44, 95-105. doi: 10.18276/cej.2023.4-08.
- [27] The Declaration of Helsinki. (2023). Retrieved from <https://www.wma.net/policies-post/wma-declaration-of-helsinki/>.

Плавання у процесі реабілітації та рекреації професійних спортсменів

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Анотація. Плавання відіграє важливу роль у відновленні професійних спортсменів, сприяючи фізичній та психоемоційній реабілітації після змагань і травм. Водночас дослідження застосування плавання для реабілітації та рекреації спортсменів є недостатньо розробленими, що обґрунтовує актуальність цього дослідження та його необхідність у спортивній практиці. Метою роботи було оцінити ефективність водних вправ у реабілітаційних програмах для професійних спортсменів із легкими та середньої тяжкості травмами, порівняно з традиційними методами реабілітації, а також визначити умови, у яких застосування плавання є найбільш доцільним і результативним для покращення фізичних показників, зниження больових відчуттів і підвищення мотивації учасників. У дослідженні брали участь 120 спортсменів із різних видів спорту, які проходили восьми тижневу програму водних вправ. Програма включала аеробні, розтягувальні та відновлювальні вправи, які проводилися 4 рази на тиждень із поступовим підвищенням інтенсивності. Оцінка результатів здійснювалася за допомогою вимірювання фізичних показників (сила, витривалість, гнучкість), аналізу суб'єктивного самопочуття та використання візуально аналогової шкали для оцінки больового синдрому. Результати показали, що витривалість зросла на 28 %, гнучкість – на 20 %, а сила м'язів – на 15 %. Найкращі результати спостерігалися у спортсменів із середнім рівнем підготовки. Водночас для учасників із тяжкими травмами ефективність була нижчою, що вказує на необхідність індивідуального підходу та врахування специфіки травм. Отримані результати підтверджують доцільність застосування плавання в реабілітаційних програмах для спортсменів із загальними травмами та перевагою. Практична значимість дослідження полягає у створенні рекомендацій для спортивних лікарів і тренерів щодо використання плавання як ефективного засобу відновлення спортивної форми.

Ключові слова: фізичне відновлення; аеробні вправи; спортивна адаптація; методи відновлення; функціональні показники