

Swimming as a Low-Impact Modality for Pre- and Post-Surgical Rehabilitation: A Cross-Sectional Community Study of Pain and Musculoskeletal Outcomes

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Swimming is a low-impact exercise, so it is well suited for people who cannot tolerate high-impact activity. However, there is currently limited evidence to support its use as a structured rehabilitation method. This cross-sectional community study aimed to investigate this gap by examining whether frequent swimming is associated with lower self-reported musculoskeletal pain. To do so, a survey that assessed age, swimming habits and history, presence of musculoskeletal conditions and corresponding pain levels, and surgical history was conducted to complement the existing literature on aquatic therapy (specifically swimming). Twenty-five people completed this survey through online swimming forums, social media groups, and personal networks. The participants' responses were first analyzed using visual trends from graphs, and then with statistical tests (exact tests and Kruskal-Wallis tests) to see if there were any statistically significant associations between swimming frequency, age, and self-reported musculoskeletal pain (on a scale from 1 to 10). Swimming frequency was not significantly associated with pain ($p = 0.931$). However, swimming frequency and age group were significantly associated ($p = 0.042$), but the groups were very small, so this result should be treated with caution. Descriptively, musculoskeletal conditions generally became more common with age (0 of 6 aged 1-19 had a condition, compared with 3 of 4 aged 50-59). With only twenty-five participants and twelve pain ratings, and a self-selected sample, these results can describe patterns in this group, but cannot show whether swimming affects pain. Future studies should have a larger group of participants with more comparison groups (like land-based therapy patients) and follow the same people over time (a longitudinal design) to evaluate whether swimming actually lowers pain, or whether people with less pain are simply more able to swim often.

Keywords: Swimming; Rehabilitation; Musculoskeletal pain; Surgical recovery; Low-impact exercise; Physical therapy

Introduction

Recovery after surgery is a long process that mainly relies on physical therapy and a medication schedule. These methods are effective, but their cost and limited accessibility highlight a need for alternatives. Aquatic therapy is one such option, but research on its role in modern rehabilitation is limited compared to land-based rehabilitation methods (like physical therapy). Rehabilitation usually has two goals: rebuilding muscle and joint strength by putting controlled stress on muscles and joints so they get stronger, and supporting mental and social well-being. Because swimming is whole-body and low impact, it may help with both goals, which is why I made swimming the focus of the study.

Currently, post-surgical recovery generally involves a regimen of physical therapy and medications: opioid analgesics remain a common component of post-surgical pain manage-

ment, and physiotherapy aims to assist patients in recovering after an injury or surgery, or manage symptoms from a health condition that affects movement^{1,2}. Traditional physiotherapy is a series of land-based exercises that are designed to help patients regain functional ability and movement. While recovery duration varies by injury type, post-surgical physical therapy outcomes are commonly assessed at twelve-week and longer intervals, showing the gradual nature of functional recovery³. While this routine is somewhat effective, it poses numerous disadvantages that make post-surgical recovery difficult. For example, some negatives are that therapy sessions are expensive, patients skip taking medication because of cost, and opioids carry risks of addiction and overdose, highlighting a need for safer and more accessible rehabilitation options.

Aquatic therapy offers a safer and potentially more cost-effective alternative to traditional methods. One benefit of aquatic therapy is buoyancy: due to buoyancy, patients experience less joint stress while still gaining improvements in

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balance, gait, quality of life, and reduced fear of falling⁴.

Swimming may help some patients manage various medical conditions well enough that they can even delay surgery. Some general benefits of swimming include that it improves cardiorespiratory function, benefits patients with chronic diseases, and aids in motor development⁵. Specifically, swimming may help patients with chronic diseases such as osteoporosis by increasing bone mineral density in postmenopausal women when practiced for three to six hours weekly⁶. Additionally, swimming can benefit musculoskeletal conditions by minimizing joint stress and promoting muscle relaxation⁷. These examples matter since symptom severity influences whether patients choose surgery. One study indicates that patients are more likely to opt for surgery for musculoskeletal disorders when they experience greater levels of symptoms or dysfunction⁸. In a randomized trial of patients with hip osteoarthritis, those who received exercise therapy with education compared to those who received education only had a 44% lower risk of needing hip replacement surgery over six years⁹. Similarly, a study of more than 55,000 people with hip or knee osteoarthritis found that those who became unwilling to have surgery after an exercise and education program were about 20% less likely to have joint replacement within five years than those who stayed willing¹⁰. Although these studies examined land-based exercise, swimming is a low-impact form of exercise, so it may offer a similar benefit for delaying surgery. However, this has not been studied directly.

Swimming is also beneficial after surgery due to its gentle, low-impact nature and its ability to engage multiple muscle groups. For example, swimming builds muscle strength, endurance, and joint mobility through water resistance¹¹. For breast cancer patients after mastectomy, an aquatic exercise program that included swimming improved upper limb function, with buoyancy and hydrostatic pressure identified as contributing mechanisms¹². An important thing to note is that the effectiveness of swimming in post-surgical recovery does vary depending on the body part affected. Swimming shows more promising results for certain musculoskeletal conditions compared to others. For example, in a small trial of 20 people, patients who did their rehab exercises in water after ACL reconstruction had less knee swelling and better self-reported function than those who exercised on land¹³. Adding on, in patients with knee osteoarthritis, aquatic therapy improved pain, physical function, knee extension strength, and walking ability¹⁴.

Swimming offers benefits to a wide range of ages and demographics. Swimming is particularly useful for patients with movement challenges, such as those who are overweight or older. A University of Michigan poll on healthy aging found that 70 percent of adults aged 50 to 80 reported joint pain¹⁵. In water, buoyancy reduces the weight joints have to carry, so people of different ages and body types can move more

easily^{16–19}. However, one study found that men may need a longer recovery period than women after shoulder and knee surgery²⁰.

This study uses the biopsychosocial model of rehabilitation, which says recovery involves the body, the mind, and a person's social life at the same time. Swimming fits this model because it supports physical rehabilitation, offers mental health benefits, and is often cheaper than other therapies.

Swimming is a broad exercise that has many different techniques and strokes, and some are more beneficial than others. Freestyle and backstroke were proposed for rehabilitation after hip and knee surgery²¹. By contrast, butterfly and breaststroke can be more harmful due to their higher musculoskeletal load and risk of injury²². Overuse injuries, such as lower back pain, may also arise if swimming techniques and biomechanics are not carefully managed²². Early aquatic therapy after orthopedic surgery improved function and did not increase wound complications, but starting after about 14 days may be safer^{23,24}. To avoid further complications, patients are advised to wait until wounds heal, and begin with shallow-water movements before progressing to full strokes.

The study explores the physical benefits of swimming for recovery, but it is also important to highlight the psychological and emotional benefits. Even a brief 50-meter swim can improve core affect in both freestyle and breaststroke, regardless of tempo²⁵. Swimming also reduces stress, increases endorphins, improves self-esteem, and promotes better sleep²⁶. Outdoor open-water swimmers report improved well-being, emotional regulation, and pain relief²⁷.

Although swimming has been examined in structured clinical trials for specific conditions, fewer studies have looked at how self-directed swimming frequency impacts musculoskeletal pain across different age groups in the general community. This study uses survey data to explore that gap. I wanted to find out whether people who swim more often report less musculoskeletal pain, and whether that relationship differs across age groups.

Methodology

I conducted an observational, cross-sectional survey using a Google Form to look at how swimming frequency related to musculoskeletal conditions and pain. The survey had eight questions, which are listed in Table 1 with their response options and purpose.

I first emailed local physical and aquatic therapy centers, but I got no responses. I then went to Reddit, where some subreddits blocked my survey, but r/swimming allowed it. This forum provided about twenty participants, ranging in age from 1-19 to 50-59. I also shared the survey in Discord and Facebook groups, where some communities blocked my posts once again, and through personal networks (friends and family). In

Table 1 Survey questions, response options, and purpose of each question.

#	Question	Response options	Purpose
1	What is your age?	1–19; 20–29; 30–39; 40–49; 50–59; 60–69; 70–79; 80–89; 90+	Musculoskeletal conditions become more common as people get older
2	How often do you swim?	Almost every day of the week; 1–3 times a week; One time per month; Less than once a month/rarely	To examine how swimming frequency relates to pain
3	Have you ever had proper training (e.g., by a coach) for swimming?	Yes; No	Proper technique lowers the risk of injury
4	Do you have any current musculoskeletal conditions or issues (e.g., arthritis)?	Yes; No	To see whether swimming helps or hurts these conditions
5	If so, how would you rate the pain on a scale of 1 to 10?	1 (least painful) to 10 (most painful)	Current level of musculoskeletal pain
6	Have you ever had to have surgery?	Yes, for a current musculoskeletal condition; Yes, for a past musculoskeletal condition; Yes, for a different condition; Never	Past surgeries can affect pain and recovery
7	How do you think swimming affects your pain, whether it be related/unrelated to a previous condition?	Less painful; No difference; More pain	Participants' own view of how swimming affects their pain
8	Anything else you would like me to know about?	Open response	Open space for additional information

Note. Question 5 was intended for participants who reported a current condition or issue; two participants who reported no condition also gave a rating. Not all participants answered Questions 7 and 8.

total, twenty-five responses were collected between April 5, 2025, and May 12, 2025. Four of these responses came in April, with the other twenty-one coming in May.

The Google Form started with a short passage that introduced me as a high school student researching swimming in recovery. I also included that the survey would take under five minutes, and that responses were anonymous. Participation in the survey was voluntary, and submitting the form was taken as consent. Additionally, I collected no names, emails, or other identifying information, and the survey involved no medical intervention.

Responses from the survey were exported from Google Forms to Google Sheets and summarized with bar graphs and box plots. Because only three participants selected “one time per month” or “less than once a month/rarely,” these two categories were combined into one group for analysis. Twelve out of the twenty-five participants gave pain ratings, including two who reported no current musculoskeletal condition; all were included in the pain analyses. Eleven out of the twenty-five participants reported a past surgery (ten for a different condition, one for their current condition), which was too few to compare pain by surgery history.

I also conducted statistical tests to check whether the patterns in the graphs could be due to chance. I used Fisher-Freeman-Halton exact tests for swimming frequency $\times$ age and musculoskeletal condition $\times$ age because all combinations had expected counts below five. I used Kruskal-Wallis tests for pain across age and frequency groups because pain ratings were ranked, not evenly spaced, and the groups were small. These tests were run in Python (SciPy) at a significance level of 0.05, and no correction for multiple comparisons was applied.

The survey received fewer responses than expected, especially from older adults. I had hoped for about fifty responses, including more from people sixty and over. Other recruitment methods –like going in person to parks, gyms, and therapy centers, or contacting facilities outside of the local area– would likely have allowed me to get more and more varied participants.

In the survey, I did not collect baseline health, athletic history, pool access, past treatment, condition severity and duration, or time since surgery. Without these variables, I could not control for confounders, so the results show associations, not cause and effect.

Results

Age vs Swimming Frequency

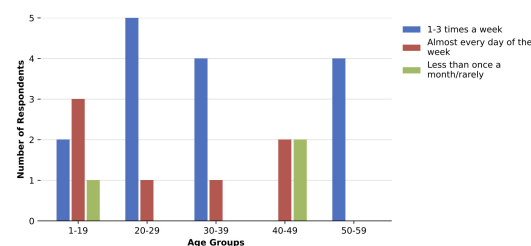


Figure. 1 Distribution of swimming frequency across age groups ($n = 25$). The most common reported frequency was one to three times per week, observed across the 20–29, 30–39, and 50–59 groups. The 1–19 group showed a varied distribution with responses spread across almost daily, one to three times per week, and rarely. The 40–49 group showed a balanced split between almost daily and rarely. An exact test of swimming frequency by age group did reach significance, $p = 0.042$.

Age vs Pain Level

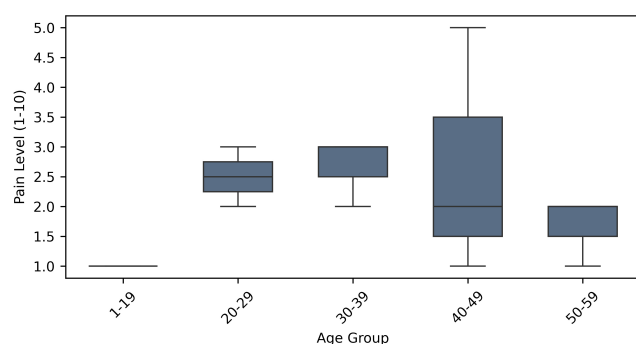


Figure. 2 Reported current pain level (from a scale of 1 to 10) by age group among participants who reported a pain value. The 1–19 group included one respondent who reported a pain level of 1. The 20–29 and 30–39 groups showed similar distributions with median pain levels of 2.5 and 3. The 40–49 group showed the broadest range, with values from 1 to 5 and a median of 2. The 50–59 group had the same median pain as the 40–49 age group (2), but a narrower range (1 to 2). A Kruskal-Wallis test of pain by age group did not reach significance, $H(4) = 4.18$, $p = 0.382$.

Age vs Musculoskeletal Conditions

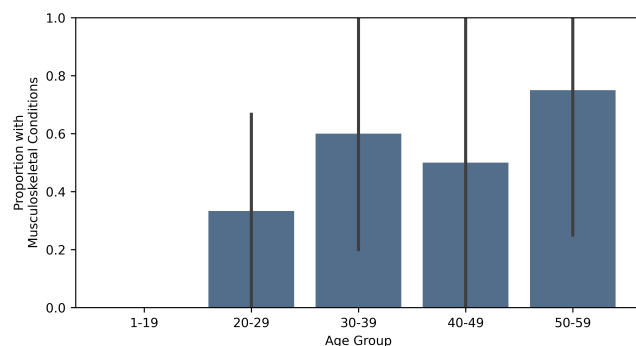


Figure. 3 Proportion of participants reporting a current musculoskeletal condition by age group ($n = 25$). The proportion generally increased from the 1–19 group, in which no conditions were reported, to the 50–59 group, in which approximately 75% of respondents reported a condition. An exact test of musculoskeletal conditions by age group did not reach significance, $p = 0.129$.

Discussion

This study examined swimming frequency, age, and self-reported musculoskeletal pain in 25 people, and 12 of them gave pain ratings. People who swam almost daily and 1–3 times a week had the same median pain value of 2, while those who swam less than once a month/rarely had a slightly higher

Swimming Frequency vs Pain Level

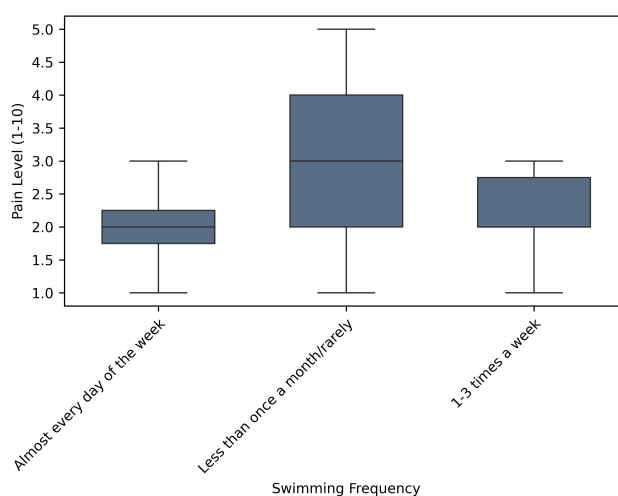


Figure. 4 Reported pain level by swimming frequency. Participants who swam almost daily reported a median pain level of 2. Those who swam one to three times per week also reported a median pain level of 2. Participants who swam less than once a month or rarely reported the highest median pain, of 3 ($n = 2$), with the widest range. A Kruskal-Wallis test of pain by swimming frequency did not reach significance, $H(2) = 0.14$, $p = 0.931$.

value of 3. However, it is worth noting that this group only included 2 people. Additionally, musculoskeletal conditions were generally more common in older groups, from 0 of 6 people in the 1–19 group to 3 of 4 people in the 50–59 group. This aligns with the University of Michigan poll, which found that 70% of adults aged 50 to 80 reported joint pain¹⁵. However, because of the small number of pain ratings, these pain results can neither support nor contradict the earlier findings that swimming may reduce joint pain.

Swimming frequency was not significantly associated with self-reported pain (Kruskal-Wallis, $H(2) = 0.14$, $p = 0.931$), and neither was age group (Kruskal-Wallis, $H(4) = 4.18$, $p = 0.382$). Having a musculoskeletal condition also did not differ significantly across age groups (Fisher-Freeman-Halton exact test, $p = 0.129$), although the proportion showed that 0 of 6 people aged 1–19 had a condition compared with 3 of 4 aged 50–59. The only significant result was an association between swimming frequency and age group (Fisher-Freeman-Halton exact test, $p = 0.042$). However, the 40–49 age group was split between almost daily (2) and rarely (2), while most other groups mostly swam 1–3 times a week. Because most age-group/frequency combinations had 0 to 2 people, one or two people answering differently could change the result. Only 12 of 25 participants gave pain ratings, because most participants were healthy swimmers, and the pain question only applied to

Table 2 Summary of statistical tests across age and swimming frequency groupings.

Test	Variables	Statistic	df	<i>p</i> value	<i>n</i>
Fisher-Freeman-Halton exact	Swimming frequency × age group	—	—	0.042	25
Fisher-Freeman-Halton exact	Musculoskeletal condition × age group	—	—	0.129	25
Kruskal-Wallis	Pain × age group	$H = 4.18$	4	0.382	12
Kruskal-Wallis	Pain × swimming frequency	$H = 0.14$	2	0.931	12

Note. Exact tests were used because expected cell counts were below 5. Only the association between swimming frequency and age group reached significance at the 0.05 level, before correction for multiple comparisons; it would not remain significant after a Bonferroni correction for four tests (threshold 0.0125) and should be interpreted with caution given the small group sizes. Kruskal-Wallis tests include the 12 participants who reported pain values.

people with a condition. With only 2 to 6 people per frequency group, there is no way to tell whether swimming frequency relates to pain. The link between age and swimming frequency ($p = 0.042$) depended mostly on the four people aged 40-49, so it needs to be checked in a larger sample of people.

If I repeated this study, I would recruit people who currently have a musculoskeletal condition or are recovering from surgery. To do this, I would reach them in person at physical therapy centers, because most participants were healthy swimmers from r/swimming, so only 10 of 25 had a condition, and emailing therapy centers got no responses. I would also include people with similar conditions who do not swim and people doing land-based physical therapy, since only three participants swam rarely. One question my survey could not answer is whether swimming definitively lowers pain or whether people with less pain are just more able to swim often. Following the same people over time would help illustrate which comes first: swimming more or lower pain.

Implications for Future Research

The following considerations are drawn from existing literature rather than the present data and are intended to inform hypotheses for future research.

The studies reviewed in the Introduction suggest that swimming and aquatic therapy may help with relieving pain, gaining strength, and also recovery after some surgeries, but this research has gaps that need to be looked into further. Specifically, most of these studies study general patient groups and do not look at how swimming affects people of different races and income levels. We also know little about how pool access and cultural attitudes toward swimming can affect the types of people that get this care, and how they recover. Currently, research has focused on musculoskeletal surgery, rather than cardiac or neurological surgery. Future trials should include more diverse participants and a wider range of surgeries.

Based on the studies reviewed in the Introduction, swimming and other water-based exercise may be a useful addition to recovery plans for older adults and people with joint problems^{4,14}. Freestyle and backstroke were proposed for rehabilitation after hip and knee surgery, while butterfly and breaststroke kicks put higher loads on the lower back^{21,22}. As noted earlier, infection from open wounds and overexertion can oc-

cur while swimming, so patients should wait until wounds heal and start with walking in water before swimming full strokes.

Conclusion

This study examined swimming frequency, age, and self-reported musculoskeletal pain in 25 community respondents. In the graphs, musculoskeletal conditions were generally more common in older groups; daily and weekly swimmers had the same median pain; and pain did not clearly differ by swimming frequency. The only significant result was between swimming frequency and age group ($p = 0.042$), and it came from very small groups. Overall, the findings from this study should be treated as descriptive patterns within a self-selected sample rather than evidence of swimming's clinical effectiveness as a rehabilitation method. This study is a first look at swimming habits and pain across age groups in a community sample, and the next study should test, in a larger group, whether swimming frequency is related to pain before and after surgery.

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