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Use of Nonsteroidal Anti-inflammatory Drugs (NSAIDs) in Amateur Sports – Efficacy and Safety: A Review of Current Literature

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I. Abstract

Objective: To evaluate current evidence on the efficacy and safety of nonsteroidal anti-inflammatory drugs (NSAIDs) in amateur athletes, with particular emphasis on pain relief, recovery, performance outcomes, and adverse health effects.

Methods: This review synthesised recent literature on NSAID use in physically active populations, with a focus on clinical efficacy, usage patterns, and exercise-related adverse effects.

Results: NSAID use in amateur sport is common, frequently self-directed, and often prophylactic. Although these agents may provide modest short-term analgesia, controlled studies do not show consistent benefits for performance, strength recovery, training adaptation, or return to play. Mechanistically, NSAIDs inhibit prostaglandin-mediated pathways involved not only in pain and inflammation, but also in renal perfusion, gastrointestinal mucosal protection, and exercise-related tissue adaptation.

During prolonged or high-intensity exercise, particularly in endurance settings characterised by dehydration and heat stress, NSAID exposure may impair renal autoregulation and increase the risk of acute kidney injury. It may also aggravate gastrointestinal mucosal injury and permeability. Cardiovascular risk remains less clearly defined in athletes, but remains clinically relevant, especially in older individuals or those with pre-existing risk factors.

Conclusions: NSAIDs should not be used routinely to prevent expected soreness or to support endurance participation. Their clearest role is brief, individualised use for selected acute injuries, in which analgesia must not be mistaken for accelerated healing.

For general practitioners, the key recommendation is cautious prescribing at the lowest effective dose for the shortest necessary duration, combined with explicit counselling on renal, gastrointestinal, and cardiovascular risks and consideration of safer alternatives, including topical NSAIDs, paracetamol, load modification, and rehabilitation.

Keywords: NSAIDs; amateur athletes; weekend warriors; sports medicine; recovery; renal injury; topical NSAIDs

II. Introduction

Problem Definition: Expanding Participation in Amateur Sports

Over the past two decades, participation in mass amateur sporting events, including marathons, triathlons, and high-intensity functional training formats such as CrossFit, has increased substantially worldwide. The growing popularity of recreational exercise has also stimulated interest in factors affecting exercise capacity, recovery, and health-related outcomes among physically active individuals across different age groups [1]. This development reflects not only broader public-health efforts to promote physical activity, but also sociocultural trends that valorise endurance challenges and recreational competition. Yet the physiological demands

imposed by such activities frequently exceed the level of adaptation achieved by many participants, commonly described as “weekend warriors.” These individuals often undertake intermittent bouts of high-intensity exercise without adequate conditioning, thereby increasing their susceptibility to musculoskeletal injury, delayed-onset muscle soreness (DOMS), and exercise-induced inflammation.

Relative to well-trained individuals, such participants typically exhibit lower baseline aerobic capacity, diminished neuromuscular efficiency, and limited heat acclimatisation. Accordingly, they appear more vulnerable to dehydration, exertional rhabdomyolysis, and renal or gastrointestinal complications during prolonged exertion. They also commonly combine high-intensity competition with inadequate recovery, thereby compounding the risk of systemic complications [2]. This physiological and behavioural constellation creates a setting in which pharmacological suppression of symptoms, most commonly through NSAID use, may obscure early warning signs of systemic strain.

Drug Availability and Normalisation of Routine NSAID Use

A major determinant of NSAID overuse in amateur sport is their broad over-the-counter availability. Agents such as ibuprofen, naproxen, and diclofenac are readily accessible without prescription and are often perceived as low-risk interventions. Within athletic communities, this perception is further reinforced by social normalisation, whereby NSAID use is frequently treated as a routine element of training or competition preparation rather than as a targeted medical intervention [3,4]. Similar patterns have been observed in the general population, where over-the-counter analgesics are frequently perceived as safe and are often used without adequate awareness of potential adverse effects. Such behavioural tendencies may contribute to the normalisation of NSAID use among amateur athletes and reinforce self-medication practices [5].

Importantly, such normalisation is not supported by consistent evidence of benefit. Although NSAIDs may attenuate certain aspects of exercise-induced inflammation and reduce perceived soreness, their effects on functional recovery and performance remain inconsistent. Some studies report modest analgesic benefit without measurable improvement in muscle function, whereas others demonstrate no significant difference compared with placebo [6]. Early inflammatory signalling is increasingly recognised as integral to muscle repair and adaptation, suggesting that indiscriminate suppression may prove counterproductive [7]. Routine incorporation of NSAIDs

into amateur sporting practice therefore appears to reflect cultural habit more than evidence-based necessity.

The normalisation of NSAID use also tends to obscure important safety concerns. NSAIDs impair renal prostaglandin synthesis, thereby reducing renal blood flow and increasing the risk of acute kidney injury during prolonged exercise, particularly under conditions of volume depletion [2]. They may likewise aggravate exercise-induced gastrointestinal injury, including increased intestinal permeability and mucosal damage [8]. Chronic or repeated exposure may further exacerbate cardiovascular risk factors, including elevated blood pressure and prothrombotic states, particularly in older adults or in those with pre-existing hypertension, chronic kidney disease, or cardiovascular disease [9,10].

The Role of General Practitioners in Guiding Safe NSAID Use

Given the rising prevalence of NSAID use among amateur athletes and the evident mismatch between perceived benefit and potential harm, improved clinical guidance is needed. General practitioners are especially well positioned to address this issue, as they often represent the primary point of contact for recreational athletes seeking advice regarding pain management, injury prevention, and return to activity.

Effective counselling requires a nuanced understanding of both the pharmacological properties of NSAIDs and the physiological context in which exercise occurs. While short-term NSAID use may be appropriate in selected cases of acute injury, routine prophylactic administration before endurance events is not supported by current evidence and may increase the risk of adverse outcomes without improving performance [11].

Evidence concerning training adaptation and tissue healing is more equivocal and often derives from resistance-training models, older adults, or non-amateur populations. Nevertheless, repeated or chronic NSAID exposure has, in some settings, been associated with attenuated muscle hypertrophy or altered tissue remodelling, particularly under high-dose regimens or in tendon-related conditions [12,13].

In addition to oral NSAID use, clinicians should consider alternative strategies within a broader evidence-based framework for pain management. These include topical NSAID formulations, which may provide localised analgesia with reduced systemic exposure, as well as non-

pharmacological measures such as activity modification, cryotherapy, and progressive loading protocols.

Accordingly, the objective of this review is to critically evaluate the available literature on NSAID use in amateur sport, with particular emphasis on the balance between efficacy, including pain relief, performance, and recovery, and safety, including renal, gastrointestinal, cardiovascular, and tissue-healing risk. Although some of the cited evidence derives from elite athletes, military cohorts, or older adults rather than amateur athletes specifically, these data remain informative for understanding mechanisms and risk contexts relevant to recreational sport. By synthesising the available evidence, this review aims to equip general practitioners with the knowledge required to provide individualised, evidence-based recommendations to amateur athletes and recreational exercisers, thereby promoting safer and more sustainable engagement in physical activity.

III. Mechanism of Action in the Context of Physical Exertion

Pharmacological Basics: Cyclooxygenase Inhibition

Nonsteroidal anti-inflammatory drugs exert their principal pharmacological effect through inhibition of cyclooxygenase enzymes, specifically COX-1 and COX-2, which catalyse the conversion of arachidonic acid into prostaglandins, prostacyclins, and thromboxanes. These lipid mediators are central to the regulation of inflammation, nociception, vascular tone, platelet aggregation, and gastrointestinal mucosal integrity [14].

COX-1 is constitutively expressed in most tissues and supports homeostatic processes, including gastric mucosal protection, renal perfusion, and platelet function. This protective role may be particularly relevant when superimposed upon exercise-induced splanchnic hypoperfusion during prolonged endurance events. By contrast, COX-2 is inducible and upregulated in response to inflammatory stimuli, mechanical stress, and tissue injury, all of which are intrinsic to exercise-induced muscle damage [7].

Traditional non-selective NSAIDs inhibit both isoforms, thereby producing analgesic and anti-inflammatory effects at the cost of increased gastrointestinal and renal risk. Selective COX-2 inhibitors were developed to mitigate gastrointestinal toxicity; however, they have been

associated with increased cardiovascular risk, likely through an imbalance between thromboxane A_2 and prostacyclin [9,10].

Within the setting of physical exertion, prostaglandins, particularly PGE_2 and $PGF_{2\alpha}$, extend far beyond the mediation of pain. They regulate local blood flow, modulate nociception, and exert an important influence on muscle protein synthesis and satellite-cell activation after exercise-induced microtrauma [7]. Inhibition of these pathways may therefore alter not only acute symptom perception, but also longer-term adaptation. During prolonged endurance exercise, attenuation of prostaglandin-mediated vasodilation and renal perfusion may likewise contribute to reduced kidney blood flow and impaired thermoregulatory responses, thereby providing a mechanistic link to exercise-associated kidney injury [2].

The Role of Inflammation in Sport: Adaptive Versus Maladaptive Processes

Exercise-induced inflammation is best understood as a tightly regulated and essential component of physiological adaptation rather than as a purely pathological response. Following unaccustomed or high-intensity exercise, particularly that involving eccentric loading, skeletal muscle fibres sustain microdamage that initiates a coordinated inflammatory cascade. This response includes infiltration of neutrophils and macrophages, release of cytokines, and activation of intracellular signalling pathways [7,15].

Such inflammation fulfils several adaptive functions. It facilitates clearance of damaged cellular components, promotes the activation and proliferation of satellite cells, and supports the anabolic signalling pathways required for muscle hypertrophy and structural remodelling [7,16]. Prostaglandin-mediated signalling is central to these processes, linking mechanical stress to cellular adaptation.

Although NSAIDs may reduce perceived soreness through suppression of inflammatory mediators, their effects on recovery and adaptation are more complex. Experimental data indicate that NSAID exposure can reduce post-exercise muscle protein synthesis, whereas findings on satellite-cell activity and muscle regeneration remain mixed and appear to depend on the injury model, dose, and timing of administration [7,16].

Evidence from human training studies supports caution in certain contexts. Chronic NSAID use during resistance training has been associated with attenuated muscle hypertrophy in younger

individuals, particularly under high-dose, long-duration regimens [13,17]. These effects, however, are not uniform and appear to depend on age, training status, and the dose and duration of NSAID administration. Lower-dose or short-term use has yielded more variable results, and some studies have reported no significant change in muscle mass or strength outcomes.

Within tendon and connective tissue, prostaglandin inhibition may impair collagen synthesis and extracellular-matrix remodelling, potentially delaying recovery from common overuse injuries such as patellar or Achilles tendinopathy, which are frequently encountered among amateur endurance and strength athletes [12,18].

Notably, studies in older adults suggest a different response profile, with some evidence indicating that NSAID use does not impair, and may in certain contexts even enhance, gains in muscle mass and strength, possibly through modulation of chronic low-grade inflammation [17]. These findings, however, derive largely from older non-athletic adults rather than amateur athletes per se. In amateur athletes, whose exercise stimuli are often intermittent and whose recovery practices may be inconsistent, indiscriminate NSAID use may alter adaptive signalling without clearly improving functional outcomes.

IV. Epidemiology of NSAID Use Among Amateurs

The Prophylactic Use Phenomenon

NSAID use in amateur sport extends well beyond post-exercise symptom control and frequently assumes a prophylactic form, defined as ingestion before exercise in anticipation of pain or discomfort. This pattern is particularly well documented in endurance sport, where surveys and event-based studies report substantial pre-race use among recreational runners and triathletes. Across marathon, ultramarathon, and broader amateur endurance cohorts, approximately 30% to 50% of participants report NSAID use before competition, suggesting that prophylactic use has become normalised within certain sporting subcultures [11,19,20].

This behaviour appears to be driven by anticipated pain, concern about maintaining performance, and peer norms that frame NSAIDs as a routine part of race preparation. Yet current sports-medicine guidance does not recommend prophylactic use for either performance enhancement or injury prevention. Although some athletes report subjective symptom relief, this perceived benefit has not translated reliably into measurable ergogenic or recovery effects [4].

From a safety perspective, pre-emptive ingestion is concerning because it ensures peak drug exposure during a period of marked physiological stress characterised by dehydration, reduced renal perfusion, and gastrointestinal ischaemia. Observational studies have linked pre-race NSAID use with higher rates of exercise-associated hyponatraemia, gastrointestinal complaints, and acute kidney injury, although the strength of these associations varies across cohorts and is influenced by ambient temperature, hydration strategy, exercise duration, and dose [2,21]. The epidemiological signal therefore supports caution even where causality cannot be inferred uniformly across studies.

Most Commonly Used Substances

Among amateur athletes, ibuprofen is consistently the most commonly reported NSAID, followed by diclofenac and naproxen. The predominance of ibuprofen likely reflects its broad over-the-counter availability, relatively short half-life, and reputation as a comparatively safe option for intermittent pain relief. Survey data from recreational and endurance athletes repeatedly identify ibuprofen as the leading agent in this setting [20,22].

Diclofenac also features prominently in race-related studies and, in at least one large marathon cohort, was the single most commonly used analgesic before competition. Its continued popularity likely reflects perceived potency and familiarity, despite a less favourable cardiovascular safety profile than some alternatives. Naproxen is used less frequently than ibuprofen but remains relevant because its longer half-life may appeal to athletes seeking prolonged analgesia during extended events, albeit at the cost of longer systemic exposure [10]. By contrast, topical NSAID formulations provide localised analgesia with substantially reduced systemic exposure and may therefore align more closely with safety concerns in endurance settings, although they are reported less frequently in amateur-sport surveys [9,21].

Usage patterns are not uniform across amateur athletes. Available studies suggest variation by sport, event duration, sex, and possibly age, with particularly high prevalence in endurance disciplines such as marathon running and triathlon. Some cohorts indicate sex-related differences in timing of use, with women reporting higher post-race consumption in certain recreational samples, although sex-stratified data remain limited and findings are not fully consistent across studies [20]. This remains an underexplored area of the literature.

The decision to use NSAIDs is rarely guided by formal medical advice in amateur populations. Rather, it is often shaped by prior personal experience, informal recommendations, and ease of purchase. This self-directed pattern is clinically important because surveys also describe poor awareness of adverse effects, frequent use before or during events, and dosing behaviours that do not accord with best-practice recommendations, including repeated intake across training, competition, and recovery periods [3,4,20]. Overall, the epidemiological literature reveals frequent, often unsupervised NSAID use among amateur athletes and underscores the need for targeted education and clinician-led counselling.

V. Efficacy in Injury Management and Recovery

Acute Injuries: Symptom Relief Versus Return to Play

The clearest benefit of NSAIDs in amateur sport lies in short-term symptom control for selected acute injuries. In sprains, contusions, and other uncomplicated soft-tissue injuries, NSAIDs may reduce pain and swelling sufficiently to improve early function. That symptomatic benefit, however, should not be conflated with accelerated biological healing. Across systematic reviews, evidence for faster return to play or superior long-term outcomes remains inconsistent, and any early functional advantage appears to be driven primarily by analgesia rather than by demonstrable enhancement of tissue repair [23-25]. Contemporary sports medicine increasingly emphasises structured rehabilitation, injury-prevention strategies, and athlete education as key determinants of successful return to sport, often exceeding the contribution of pharmacological symptom control alone [26].

This distinction is clinically important because post-injury inflammation is not purely harmful. Rather, it constitutes part of the reparative cascade that supports tissue clearance, regeneration, and remodelling. Suppression of this response may improve short-term comfort, but current evidence does not show that routine NSAID use reliably hastens safe recovery. In this setting, NSAIDs should therefore be regarded as symptom-modifying rather than recovery-accelerating agents [24,25].

Recovery and Performance Outcomes

NSAIDs are also widely used for exercise-related soreness and perceived enhancement of recovery, yet the evidence in this domain remains limited and inconsistent. Meta-analytic data

indicate that NSAIDs do not consistently improve sport-performance indices in healthy individuals, and available trials do not demonstrate reliable gains in strength recovery, endurance, or training adaptation [25,27]. In endurance competition, studies such as Nieman et al [6]. likewise failed to show a meaningful performance advantage despite ongoing use.

Their effects on muscle adaptation are more complex. Mechanistic studies raise concern that NSAIDs may blunt certain anabolic signalling pathways, although evidence regarding satellite-cell activity and regeneration remains mixed and may depend on the injury model and the timing of administration [7,16]. In younger adults exposed to high-dose regimens, chronic NSAID use may compromise hypertrophic adaptation [13]. By contrast, some data from older adults do not demonstrate impaired adaptation and, in certain contexts, even suggest preserved or enhanced gains [17]. Even so, the totality of the evidence does not support NSAIDs as recovery-enhancing drugs for routine use in amateur athletes.

Overuse Pain and the Danger of Masking Pathology

NSAID efficacy is particularly limited in overuse conditions. In tendinopathy and other load-related disorders, these agents may provide transient analgesia, but they do not reliably address the underlying structural pathology and may encourage continued loading of incompletely recovered tissue. This creates the clinical risk that short-term suppression of pain will facilitate progression of the underlying disorder, particularly when athletes continue to train or compete through symptoms [12,18,23].

This concern is especially pertinent in tendon-to-bone and bone stress injuries. Evidence from the bone-healing and stress-fracture literature suggests that NSAIDs may impair remodelling or adaptation in these tissues, rendering pain masking potentially more hazardous than beneficial [28-30]. For amateur athletes, the practical implication is straightforward: NSAIDs may reduce the perceived severity of injury without reducing the injury itself.

VI. Safety and Adverse Effects

Gastrointestinal Injury During Exercise

The safety profile of NSAIDs in sport must be interpreted in light of the physiological stresses imposed by exercise itself. In amateur athletes, particularly those participating in endurance

events, adverse effects are not attributable to the drug in isolation, but rather to the interaction between NSAID exposure and exercise-induced disturbances in gastrointestinal perfusion, renal haemodynamics, thermoregulation, and tissue remodelling. Consequently, the risk profile of NSAIDs in sport differs in meaningful ways from that observed in sedentary clinical populations.

The gastrointestinal hazard of NSAID use in sport is best conceptualised as the product of exercise-induced splanchnic hypoperfusion and drug-induced mucosal vulnerability. In trained athletes, ibuprofen has been shown to increase resting and exercise-related markers of intestinal injury, worsen the lactulose/rhamnose permeability ratio, and increase upper gastrointestinal symptoms, indicating that NSAID exposure can exacerbate the enteropathy already provoked by strenuous exercise [8].

This interpretation is supported by broader sports-medicine reviews that identify gastrointestinal toxicity as one of the most common adverse effects of NSAIDs and emphasise that endurance exercise, heat stress, and reduced gut perfusion further narrow the margin of safety [31]. At the same time, the literature is not entirely uniform. Pannone and Abbott [32] concluded that evidence linking NSAIDs to adverse health outcomes in marathon and ultra-endurance running remains limited and heterogeneous. The most appropriate interpretation, therefore, is that NSAIDs do not fully account for all race-day gastrointestinal complaints, but may plausibly amplify exercise-induced intestinal injury in susceptible athletes.

Renal Risk During Prolonged Exertion

Mechanistic Basis

During prolonged endurance exercise, renal perfusion is already challenged by hypovolaemia, sympathetic vasoconstriction, thermal stress, gastrointestinal fluid loss, and, in some cases, rhabdomyolysis. NSAIDs further compromise this physiological context by inhibiting prostaglandin-mediated renal vasodilation, thereby impairing a compensatory mechanism on which the kidney becomes increasingly dependent under exercise stress. For amateur athletes, the key issue is that NSAID toxicity is magnified not in isolation, but in combination with dehydration, heat, illness, and prolonged exertion.

Clinical Evidence

In the systematic review by Hodgson et al [33]., severe acute kidney injury after endurance events was commonly associated with multiple concurrent risk factors, particularly NSAID exposure in combination with intercurrent illness or gastrointestinal upset. More direct evidence is provided by the randomised trial conducted by Lipman et al [2]., in which acute kidney injury occurred more frequently in ultramarathon runners assigned to ibuprofen than placebo. Subsequent literature has largely reinforced this interaction-based model [34-36].

Cardiovascular Considerations in Amateur Athletes

Cardiovascular risk has been less well studied in athletes specifically, and much of the available evidence derives from general-population rather than athlete-specific studies. Evidence from the general population indicates that NSAIDs, particularly agents with stronger COX-2 effects, are associated with increased risks of major coronary events, stroke, heart failure, and atrial arrhythmias [31,37]. Proposed mechanisms include reduced endothelial prostaglandin production, a relative shift towards thrombosis, sodium and water retention, and increased vascular tone [31].

Within the sporting context, direct evidence linking NSAID use to acute cardiovascular events during competition remains sparse, and extrapolation must therefore remain cautious. Prospective athlete-specific studies with adjudicated cardiovascular outcomes are lacking and should be regarded as a research priority. Nevertheless, hypovolaemia, sympathetic activation, and thermal strain may increase the relevance of these adverse effects, particularly in older amateur athletes and in those with occult cardiovascular risk.

Effects on Muscle Adaptation and Recovery

With respect to muscle tissue, the evidence is more heterogeneous than for kidney or bone. Mechanistically, COX inhibition may interfere with post-exercise adaptation because prostaglandins contribute to the regulation of skeletal-muscle protein turnover, satellite-cell activity, and anabolic signalling. Human outcome data, however, do not consistently demonstrate a deleterious effect at clinically relevant doses.

Trappe et al [17]. reported that over-the-counter ibuprofen or paracetamol administered during 12 weeks of resistance training in older adults did not inhibit adaptation and appeared to enhance hypertrophy and strength gains, whereas Dalle et al [38]. found that moderate ibuprofen exposure

did not impair skeletal-muscle regeneration in an experimental model. These findings suggest that the effects of NSAIDs on muscle biology depend on dose, tissue state, timing, age, and whether one is examining acute molecular signalling or longer-term functional outcomes. Even so, the available evidence does not justify their use to enhance recovery outcomes in amateur sport.

Bone Healing and Tendon-to-Bone Remodelling

The picture is more cautionary with respect to bone and tendon-to-bone healing. Experimental evidence indicates that prostaglandin inhibition can interfere with endochondral ossification and skeletal remodelling, and Pountos et al [39]. identified downregulation of TGF-β3 as one plausible mechanism through which NSAIDs may impair fracture healing. In clinical synthesis, Al Farii et al [30]. found that post-fracture NSAID exposure was associated with an increased risk of non-union, particularly with longer durations of use.

Concern also extends to bone stress adaptation. Hughes et al [29]. reported an approximately threefold increased risk of diagnosed stress fracture among soldiers prescribed NSAIDs. By contrast, evidence on tendon-to-bone healing remains more heterogeneous, although concern persists, particularly for selective COX-2 inhibition [28]. Overall, the signal that NSAIDs may impair bone healing and stress adaptation is more consistent than the signal for impaired muscle regeneration.

These considerations are summarised in Table 1.

Table 1. NSAID Risk Stratification in Amateur Athletes

Risk Domain	Lower-Risk Contexts	Higher-Risk Contexts
Gastrointestinal	Short-duration use; well-hydrated athlete; no ulcer history; localised pain where topical therapy may suffice.	Pre-race or during-race oral use; prolonged endurance events; heat stress; dehydration; prior peptic ulcer disease; concurrent alcohol, corticosteroids, or anticoagulants.
Renal	Brief use in a euhydrated athlete without kidney disease or intercurrent illness.	Endurance exercise; hypohydration; vomiting or diarrhoea; heat exposure; rhabdomyolysis risk; chronic kidney disease; concurrent nephrotoxic medication.
Cardiovascular	Young athlete without known cardiovascular risk factors; shortest effective course.	Older amateur athlete; hypertension; heart failure; established cardiovascular disease; prolonged or high-dose use; agents with less favourable cardiovascular

		profiles.
Bone / Tendon-to-Bone Healing	Situations in which anti-inflammatory treatment is not required and simple analgesia or topical therapy is adequate.	Suspected stress fracture; post-fracture healing; tendon-to-bone healing; repeated pain-masking use that enables premature return to loading.

VII. Recommendations for Clinical Practice

Taken together, the preceding evidence suggests that NSAIDs should occupy only a limited and carefully contextualised role in the management of pain among amateur athletes.

When Short-Term Oral NSAID Use Is Justified

From a clinical standpoint, NSAIDs should be presented to amateur athletes as selective adjuncts rather than default recovery tools. Their clearest indication is short-term use for acute nociceptive pain associated with a clearly inflammatory injury, particularly when pain is substantial enough to impair sleep, early function, or progression through rehabilitation. Even in that context, the goal is symptom control rather than acceleration of tissue healing. NSAIDs should therefore be used briefly, individualised to the clinical situation, and integrated with load modification and rehabilitation rather than prescribed as stand-alone recovery interventions [23-25].

Key Message for Patient Counselling

Analgesia Is Not Healing

NSAIDs may reduce pain, but they do not reliably accelerate tissue recovery and should not be used to continue loading a symptomatic injury, to prevent anticipated soreness, or to render continued participation safer than the underlying pathology warrants [2,30,31].

This message is particularly important in amateur sport, where unsupervised use is common. Rudgard et al [20]. found that only a minority of amateur endurance athletes used NSAIDs on the advice of a doctor or pharmacist, while Rosenbloom et al [22]. reported that half of recreational runners used NSAIDs without advice and that most desired more information regarding harms and benefits. Additional caution is warranted in the presence of dehydration, intercurrent illness, gastrointestinal upset, or known renal, gastrointestinal, or cardiovascular vulnerability, because these are precisely the contexts in which the literature identifies the clearest risk.

Topical NSAIDs for Localised Soft-Tissue Pain

Topical NSAIDs merit greater emphasis than they typically receive in primary care. A Cochrane review found that topical NSAIDs provide good levels of pain relief in acute musculoskeletal conditions such as sprains, strains, and overuse injuries, probably similar to oral NSAIDs, with minimal systemic adverse effects [40]. In a randomised, placebo-controlled trial, diclofenac 4% spray gel improved swelling, pain on active movement, tenderness, and mobility in patients with acute uncomplicated ankle sprain and was well tolerated [41]. Accordingly, when pharmacological treatment is required for localised soft-tissue pain, a topical formulation may be preferable to an oral NSAID, particularly in athletes with gastrointestinal, renal, or cardiovascular risk factors.

Paracetamol for Simple Pain Management

When the clinical objective is simple analgesia rather than suppression of inflammation, paracetamol may represent the more appropriate first-line oral option. This is particularly relevant in uncomplicated pain states in which swelling and inflammatory control are not the principal therapeutic targets.

Relative to NSAIDs, paracetamol is not associated with the same exercise-specific concerns related to gastrointestinal mucosal injury, renal hypoperfusion during endurance exercise, cardiovascular risk amplification, or possible interference with bone healing. Sports-medicine and IOC-oriented pain guidance therefore support paracetamol as a legitimate non-opioid analgesic option rather than as an inferior alternative when straightforward analgesia is required and no clear anti-inflammatory indication exists [23,42].

That said, paracetamol should be presented as safer, not risk-free. Its advantage in athletes is relative: it avoids several exercise-specific adverse pathways that render NSAIDs problematic, but it does not directly treat inflammation and becomes hazardous when recommended dosing is exceeded. This point is particularly important in sport because unsupervised analgesic use and concomitant medication use are common. Accordingly, patient education should address maximum daily dose, avoidance of combining multiple paracetamol-containing products, and caution in athletes with heavy alcohol use or pre-existing liver disease [43].

A Practical Prescribing Hierarchy for Primary Care

For general practitioners, the most practical prescribing hierarchy is as follows:

- Prioritise non-pharmacological management wherever feasible, including load modification, rehabilitation, sleep optimisation, and gradual return to activity.
- Use topical NSAIDs first for localised soft-tissue pain when pharmacological treatment is required.
- Reserve oral NSAIDs for selected short-term indications, particularly acute inflammatory pain, and avoid prophylactic or during-event administration.
- Prefer paracetamol for straightforward analgesia when anti-inflammatory action is not the principal therapeutic objective.

VIII. Limitations and Conclusions

Limitations

This review has several limitations. First, it is narrative rather than systematic and is therefore inherently more susceptible to selection bias than a formal systematic review or meta-analysis. Second, the literature synthesised herein encompasses heterogeneous populations, including endurance and resistance athletes, trained and untrained participants, and, in some mechanistic or safety studies, professional as well as amateur cohorts.

Third, the cited evidence varies substantially with respect to NSAID agent, dose, route, timing, and duration, thereby limiting direct comparability across studies. Finally, much of the exercise-physiology literature remains based on predominantly male samples, reducing certainty when extrapolating findings across sex and age groups and underscoring the need for more robust sex-stratified analyses.

Conclusions

NSAIDs in amateur sport should be regarded as context-dependent interventions rather than routine recovery aids. They may provide useful short-term analgesia in selected acute injuries, particularly when pain interferes with sleep, early function, or rehabilitation, but these indications are relatively narrow. In routine amateur practice, NSAID use frequently extends beyond them

and takes the form of self-directed or prophylactic intake before training or competition, circumstances under which the overall risk-benefit profile becomes substantially less favourable.

The central clinical message is that pain reduction should not be mistaken for tissue recovery. Current evidence does not support NSAIDs as reliable enhancers of performance, return to play, or long-term adaptation. By contrast, evidence of harm, particularly gastrointestinal injury, acute kidney injury under endurance stress, and masking of clinically important pain signals, is more persuasive. Cardiovascular concerns are less well defined in athletes, but they remain clinically relevant, especially in older amateurs and in those with occult comorbidity.

For general practitioners, the most appropriate strategy is cautious, individualised prescribing for the shortest duration necessary, together with explicit avoidance of prophylactic use in the absence of a defined indication. Patient education should emphasise the distinction between analgesia and healing, the lack of evidence supporting routine preventive use, and the value of alternatives such as load modification, rehabilitation, topical NSAIDs, and paracetamol when simple pain relief is required.

Disclosure

The authors declare that this manuscript is original, has not been published previously, is not under consideration elsewhere, and has been approved by all listed authors.

Supplementary Materials

Not applicable.

Author Contributions

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References

1. Wiatrak A, Mosiejczuk H, Szylińska A, Rył A, Turoń-Skrzypińska A, Maziarz A, Rotter I. The effect of smoking and physical activity level on exercise capacity in older adults. Journal of Education, Health and Sport. 2018;8(11):240-252. https://doi.org/10.5281/zenodo.1482851.

2. Lipman GS, Shea K, Christensen M, Phillips C, Burns P, Higbee R, Koskenoja V, Eifling K, Krabak BJ. Ibuprofen versus placebo effect on acute kidney injury in ultramarathons: A randomised controlled trial. Emerg Med J. 2017;34(10):637-642. https://doi.org/10.1136/emermed-2016-206353.

3. Alaranta A, Alaranta H, Heliövaara M, Airaksinen M, Helenius I. Use of prescription drugs in athletes. Sports Med. 2008;38(6):449-463. https://doi.org/10.2165/00007256-200838060-00002.

4. Warden SJ. Prophylactic use of NSAIDs by athletes: A risk/benefit assessment. Phys Sportsmed. 2010;38(1):132-138. https://doi.org/10.3810/psm.2010.04.1770.

5. Kozłowski P, Cuch B, Kozłowska M, Kozłowska K, Jędrzejewska B. Analysis of habits and behaviours related to the use of over-the-counter painkillers. Journal of Education, Health and Sport. 2015;5(3):174-182. https://doi.org/10.5281/zenodo.16307.

6. Nieman DC, Henson DA, Dumke CL, Oley K, McAnulty SR, Davis JM, Murphy EA, Utter AC, Lind RH, McAnulty LS, Morrow JD. Ibuprofen use, endotoxemia, inflammation, and plasma cytokines during ultramarathon competition. Brain Behav Immun. 2006;20(6):578-584. https://doi.org/10.1016/j.bbi.2006.02.001.

7. Mackey AL, Rasmussen LK, Kadi F, Schjerling P, Helmark IC, Ponsot E, Aagaard P, Durigan JLQ, Kjaer M. Activation of satellite cells and the regeneration of human skeletal muscle are expedited by ingestion of nonsteroidal anti-inflammatory medication. FASEB J. 2016;30(6):2266-2281. https://doi.org/10.1096/fj.201500198R.

8. van Wijck K, Lenaerts K, van Loon LJC, Peters WHM, Buurman WA, Dejong CHC. Aggravation of exercise-induced intestinal injury by ibuprofen in athletes. Med Sci Sports Exerc. 2012;44(12):2257-2262. https://doi.org/10.1249/MSS.0b013e318265dd3d.

9. Bhala N, Emberson J, Merhi A, Abramson S, Arber N, Baron JA, Bombardier C, Cannon C, Farkouh ME, FitzGerald GA, Goss P, Halls H, Hawk E, Hawkey C, Hennekens C, Hochberg M, Holland LE, Kearney PM, Laine L, Lanas A, Lance P, Laupacis A, Oates J, Patrono C, Schnitzer TJ, Solomon S, Tugwell P, Wilson K, Wittes J, Baigent C. Vascular and upper gastrointestinal effects of non-steroidal anti-inflammatory drugs: Meta-analyses of individual participant data from randomised trials. Lancet. 2013;382(9894):769-779. https://doi.org/10.1016/S0140-6736(13)60900-9.

10. Bally M, Dendukuri N, Rich B, Nadeau L, Brophy JM. Risk of acute myocardial infarction with NSAIDs in real world use: Bayesian meta-analysis of individual patient data. BMJ. 2017;357:j1909. https://doi.org/10.1136/bmj.j1909.

11. Tscholl PM, Vaso M, Weber A, Dvořák J. High prevalence of medication use in professional football tournaments including the World Cups between 2002 and 2014: A narrative review with a focus on NSAIDs. Br J Sports Med. 2015;49(9):580-582. https://doi.org/10.1136/bjsports-2015-094784.

12. Almekinders LC. Anti-inflammatory treatment of muscular injuries in sport: An update of recent studies. Sports Med. 1999;28(6):383-388. https://doi.org/10.2165/00007256-199928060-00001.

13. Lilja M, Mandić M, Apró W, Melin M, Olsson K, Rosenborg S, Gustafsson T, Lundberg TR. High doses of anti-inflammatory drugs compromise muscle strength and hypertrophic adaptations to resistance training in young adults. Acta Physiol (Oxf). 2018;222(2):e12948. https://doi.org/10.1111/apha.12948.

14. Vane JR, Botting RM. Mechanism of action of anti-inflammatory drugs. Am J Med. 1998;104(3A):2S-8S. https://doi.org/10.1016/S0002-9343(97)00203-9.

15. Peake JM, Neubauer O, Della Gatta PA, Nosaka K. Muscle damage and inflammation during recovery from exercise. J Appl Physiol (1985). 2017;122(3):559-570. https://doi.org/10.1152/japplphysiol.00971.2016.

16. Trappe TA, White F, Lambert CP, Cesar D, Hellerstein M, Evans WJ. Effect of ibuprofen and acetaminophen on postexercise muscle protein synthesis. Am J Physiol Endocrinol Metab. 2002;282(3):E551-E556. https://doi.org/10.1152/ajpendo.00352.2001.

17. Trappe TA, Carroll CC, Dickinson JM, LeMoine JK, Haus JM, Sullivan BE, Lee JD, Jemiolo B, Weinheimer EM, Hollon CJ. Influence of acetaminophen and ibuprofen on skeletal muscle adaptations to resistance exercise in older adults. Am J Physiol Regul Integr Comp Physiol. 2011;300(3):R655-R662. https://doi.org/10.1152/ajpregu.00611.2010.

18. Kaux JF, Forthomme B, Le Goff C, Crielaard JM, Croisier JL. Current opinions on tendinopathy. J Sports Sci Med. 2011;10(2):238-253. https://pmc.ncbi.nlm.nih.gov/articles/PMC3761855/ (Access: 20.04.2026).

19. Gorski T, Cadore EL, Pinto SS, da Silva EM, Correa CS, Beltrami FG, Kruel LFM. Use of NSAIDs in triathletes: Prevalence, level of awareness and reasons for use. Br J Sports Med. 2011;45(2):85-90. https://doi.org/10.1136/bjsm.2009.062166.

20. Rudgard WE, Hirsch CA, Cox AR. Amateur endurance athletes' use of non-steroidal anti-inflammatory drugs: A cross-sectional survey. Int J Pharm Pract. 2019;27(1):105-107. https://doi.org/10.1111/ijpp.12469.

21. Küster M, Renner B, Oppel P, Niederweis U, Brune K. Consumption of analgesics before a marathon and the incidence of cardiovascular, gastrointestinal and renal problems: A cohort study. BMJ Open. 2013;3(4):e002090. https://doi.org/10.1136/bmjopen-2012-002090.

22. Rosenbloom CJ, Morley FL, Ahmed I, Cox AR. Oral non-steroidal anti-inflammatory drug use in recreational runners participating in Parkrun UK: Prevalence of use and awareness of risk. Int J Pharm Pract. 2020;28(6):561-568. https://doi.org/10.1111/ijpp.12646.

23. Harle CA, Danielson EC, Derman W, Stuart M, Dvořák J, Smith L, Hainline B. Analgesic management of pain in elite athletes: A systematic review. Clin J Sport Med. 2018;28(5):417-426. https://doi.org/10.1097/JSM.0000000000000604.

24. Dubois B, Esculier JF. Soft-tissue injuries simply need PEACE and LOVE. Br J Sports Med. 2020;54(2):72-73. https://doi.org/10.1136/bjsports-2019-101253.

25. Pham H, Spaniol F. The efficacy of non-steroidal anti-inflammatory drugs in athletes for injury management, training response, and athletic performance: A systematic review. Sports (Basel). 2024;12(11):302. https://doi.org/10.3390/sports12110302.

26. Mojsiewicz K, Kempińska-Podhorodecka A. The most common injuries, rehabilitation and recovery among soccer practitioners. Journal of Education, Health and Sport. 2021;11(5):65-77. https://doi.org/10.12775/JEHS.2021.11.05.007.

27. Cornu C, Grange C, Regalin A, Munier J, Ounissi S, Reynaud N, Kassai-Koupai B, Sallet P, Nony P. Effect of non-steroidal anti-inflammatory drugs on sport performance indices in healthy people: A meta-analysis of randomized controlled trials. Sports Med Open. 2020;6(1):20. https://doi.org/10.1186/s40798-020-00247-w.

28. Duchman KR, Lemmex DB, Patel SH, Ledbetter L, Garrigues GE, Riboh JC. The effect of non-steroidal anti-inflammatory drugs on tendon-to-bone healing: A systematic review with subgroup meta-analysis. Iowa Orthop J. 2019;39(1):107-119. https://doi.org/10.17061/ijor.v39i1.836.

29. Hughes JM, McKinnon CJ, Taylor KM, Kardouni JR, Bulathsinhala L, Guerriere KI, Popp KL, Bouxsein ML, Proctor SP, Matheny RW. Nonsteroidal anti-inflammatory drug prescriptions are associated with increased stress fracture diagnosis in the U.S. Army population. J Bone Miner Res. 2019;34(3):429-436. https://doi.org/10.1002/jbmr.3616.

30. Al Farii H, Farahdel L, Frazer A, Salimi A, Bernstein M. The effect of NSAIDs on postfracture bone healing: A meta-analysis of randomized controlled trials. OTA Int. 2021;4(2):e092. https://doi.org/10.1097/OI9.0000000000000092.

31. Fitzpatrick D, Leckie T, Heine G, Hodgson L. The use of pain killers (NSAIDs) in athletes: How large is the risk. J Sci Med Sport. 2025;28(3):198-205. https://doi.org/10.1016/j.jsams.2024.11.010.

32. Pannone E, Abbott R. What is known about the health effects of non-steroidal anti-inflammatory drug (NSAID) use in marathon and ultraendurance running: A scoping review. BMJ Open Sport Exerc Med. 2024;10(1):e001846. https://doi.org/10.1136/bmjsem-2023-001846.

33. Hodgson LE, Walter E, Venn RM, Galloway R, Pitsiladis Y, Sardat F, Forni LG. Acute kidney injury associated with endurance events—is it a cause for concern? A systematic review. BMJ Open Sport Exerc Med. 2017;3(1):e000093. https://doi.org/10.1136/bmjsem-2015-000093.

34. Tidmas V, Brazier J, Bottoms L, Muniz D, Desai T, Hawkins J, Sridharan S, Farrington K. Ultra-endurance participation and acute kidney injury: A narrative review. Int J Environ Res Public Health. 2022;19(24):16887. https://doi.org/10.3390/ijerph192416887.

35. Vauthier JC, Touzé C, Mauvieux B, Hingrand C, Poussel M, Chenuel B. Increased risk of acute kidney injury in the first part of an ultra-trail: Implications for abandonment. Physiol Rep. 2024;12(9):e15935. https://doi.org/10.14814/phy2.15935.

36. Linder BA, Jeong S, Stute NL, El-Kurd OB, Vondrasek JD, Pasternak A, Bagley JR, Watso JC, Schlader ZJ, Babcock MC, Grosicki GJ, Robinson AT. Hypohydration augments the acute increase in urinary biomarkers of kidney injury following the 100-mile Western States Endurance Run. J Appl Physiol (1985). 2025;139(5):1379-1391. https://doi.org/10.1152/japplphysiol.00289.2025.

37. Trelle S, Reichenbach S, Wandel S, Hildebrand P, Tschannen B, Villiger PM, Egger M, Jüni P. Cardiovascular safety of non-steroidal anti-inflammatory drugs: Network meta-analysis. BMJ. 2011;342:c7086. https://doi.org/10.1136/bmj.c7086.

38. Dalle S, Poffe C, Hiroux C, Ramaekers M, Deldicque L, Koppo K. Ibuprofen does not impair skeletal muscle regeneration upon cardiotoxin-induced injury. Physiol Res. 2020;69(5):847-859. https://doi.org/10.33549/physiolres.934482.

39. Pountos I, Panteli M, Walters G, Giannoudis PV. NSAIDs inhibit bone healing through the downregulation of TGF-β3 expression during endochondral ossification. Injury. 2021;52(6):1420-1426. https://doi.org/10.1016/j.injury.2021.01.007.

40. Derry S, Moore RA, Gaskell H, McIntyre M, Wiffen PJ. Topical NSAIDs for acute musculoskeletal pain in adults. Cochrane Database Syst Rev. 2015;2015(6):CD007402. https://doi.org/10.1002/14651858.CD007402.pub3.

41. Predel HG, Giannetti B, Seigfried B, Novellini R, Menke G. A randomised, double-blind, placebo-controlled multicentre study to evaluate the efficacy and safety of diclofenac 4% spray gel in the treatment of acute uncomplicated ankle sprain. J Int Med Res. 2013;41(4):1187-1202. https://doi.org/10.1177/0300060513487639.

42. Hainline B, Derman W, Vernec A, Budgett R, Deie M, Dvořák J, Harle C, Herring SA, McNamee M, Meeuwisse W, Moseley GL, Omololu B, Orchard J, Pipe A, Pluim BM, Ræder J, Siebert C, Stewart M, Stuart M, Turner JA, Ware M, Zideman D, Engebretsen L. International Olympic Committee consensus statement on pain management in elite athletes. Br J Sports Med. 2017;51(17):1245-1258. https://doi.org/10.1136/bjsports-2017-097884.

43. Yargiç MP, Torgutalp ŞŞ, Erdağı K. Nonsteroidal anti-inflammatory drugs and paracetamol use in elite-level Olympic-style weightlifters: A survey study. J Sports Med Phys Fitness. 2021;61(7):991-996. https://doi.org/10.23736/S0022-4707.21.11604-4.