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OTC MEDICATION USE A SURVEY ON THE AWARENESS OF ASSOCIATION WITH OVERUSE OF NSAID

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ABSTRACT

This study investigates the use of over-the-counter (OTC) medications, particularly non-steroidal anti-inflammatory drugs (NSAIDs) by athletes, and evaluates the knowledge of health risks from their overuse. A quantitative cross-sectional survey was conducted among 30 athletes to assess medication practices, psychological stress, recovery patterns, sleep quality, and injury-related factors. Structured questionnaire was used to collect data and descriptive and inferential statistics were used to analyze the data. Results showed that the most common OTC medication used for pain relief, recovery and performance-related reasons were non-steroidal anti-inflammatory drugs (NSAIDs) and analgesics. Use of OTC medication was significantly associated with reduced sleep duration in athletes suggesting a potential association between insufficient recovery and medication use. This study investigates the use of over-the-counter (OTC) medications, particularly non-steroidal anti-inflammatory drugs (NSAIDs) by athletes, and evaluates the knowledge of health risks from their overuse. A quantitative cross-sectional survey was conducted among 30 athletes to assess medication practices, psychological stress, recovery patterns, sleep quality, and injury-related factors. Structured questionnaire was used to collect data and descriptive and inferential statistics were used to analyze the data. Results showed that the most common OTC medication used for pain relief, recovery and performance-related reasons were non-steroidal anti-inflammatory drugs (NSAIDs) and analgesics. Use of OTC medication was significantly associated with reduced sleep duration in athletes suggesting a potential association between insufficient recovery and medication use.

KEYWORDS:
OTC drugs
Non-steroidal anti-inflammatory drugs (NSAIDs)
Self-treatment
sportsmen
Pain management.
Sport, Medicine
drug education
Recovery tactics Risk of injury Pain killers.

INTRODUCTION

Over-the-counter (OTC) medication use has become increasingly common among athletes seeking to manage pain, enhance recovery, and sustain performance across demanding training and competition schedules. Many athletes rely on a variety of prescription and non-prescription drugs to cope with musculoskeletal symptoms and the physical strain of sport participation. This trend parallels the rising use of dietary supplements and performance-related substances among competitive athletes, including those undergoing doping controls, highlighting a broader culture of self-medication within sport. The normalization of pain and injury within athletic environments further reinforces such behaviors,

as athletes often train and compete despite discomfort, relying on pharmaceutical aids as a coping mechanism. Non-steroidal anti-inflammatory drugs (NSAIDs) remain among the most frequently used OTC substances in endurance and team sports, though concerns persist regarding their potential to mask symptoms, increase injury susceptibility, and impair physiological healing. Athletes often rely on NSAIDs not only for acute pain relief but also as a preventive measure prior to training sessions or competitions, a practice that can obscure early warning signs of overuse or tissue damage and contribute to the progression of underlying injuries. Clinical guidelines emphasize cautious and evidence-based use of NSAIDs to prevent inappropriate or excessive consumption, particularly for musculoskeletal pain, noting that misuse may result in adverse gastrointestinal, renal, and cardiovascular effects, especially when combined with dehydration or high training loads. In parallel, athletes frequently use nutritional supplements and recovery aids, reflecting a multifaceted approach to performance optimization and symptom management that extends beyond pharmacological strategies. This reliance on supplements ranging from protein formulations and recovery drinks to vitamins, minerals, and ergogenic aids often arises from perceptions of enhanced recovery, improved energy levels, and better overall physical readiness. Together, these patterns illustrate the complex landscape of self-managed recovery practices in sport, where both medication and supplementation play central, yet sometimes insufficiently regulated, roles in athletic preparation and maintenance. The high physical demands of sport contribute to elevated injury rates, making effective injury prevention and rehabilitation strategies essential. Robust injury surveillance systems have improved understanding of injury patterns and risk factors, providing critical insight into athlete health and exposure over time. Pain perception and management remain central to this discussion, as athletes experience unique psychological and physiological challenges that influence their decisions around medication use. Recent systematic reviews indicate rising analgesic use in competitive sport, further underscoring the need to understand athletes medication practices and associated health implications. The physiological consequences of high training loads, including overtraining syndrome, create additional pressures that may motivate reliance on external aids such as OTC medications to maintain performance. Sleep emerges as another critical factor: interventions aimed at enhancing sleep quality have demonstrated significant benefits for athletic performance, recovery, and cognitive functioning. Adequate sleep plays an essential role not only in recovery but also in mitigating stress and injury risk, forming a cornerstone of athlete well-being. Given these complex interactions between training load, recovery behaviors, and medication use, global guidelines on physical activity continue to emphasize the importance of structured, balanced activity and recovery strategies.[1,2]

Despite growing awareness of recovery and performance science, limited research has explored the interrelationships between OTC medication use, psychological variables, and performancerelated physiological outcomes in athletes. This study aims to address this gap by examining the impact of OTC medication use on athlete health risks, psychological stress, recovery indicators, and performance metrics, contributing to a more comprehensive understanding of athlete health behaviors and their implications.

METHODOLOGY

Study Design

This study employed a cross-sectional quantitative research design to investigate the impact of OTC medication use on athlete health risks, psychological factors, and performance-related physiological variables. Data were analyzed to identify associations between OTC medication behaviors and key determinants of health and performance within a sports medicine and physiology context.

Participants A total of 30 athletes voluntarily participated in the study. Participants ranged in age from early adulthood to middle adulthood and represented a mix of genders and training backgrounds. Because the dataset contained no missing values, all 30 cases were included in the final analysis. To protect anonymity, all participant identifiers were removed, and only deidentified numerical and categorical variables were used.

Data Collection Procedure

Data for the study were collected using a structured survey comprising four major sections. The first section captured demographic and anthropometric information, including age, gender, height, weight, and body mass index (BMI). The second section focused on training and performance variables, where athletes reported their weekly training frequency, average session duration, warmup time, training intensity measured on a 1 10 scale, sleep duration, flexibility scores, muscle asymmetry levels, and typical recovery time following training or competition. The third section addressed health and injury information, requiring participants to indicate their injury history reflecting either the number or severity of prior injuries and their current injury risk status, which was coded dichotomously as 0 for low risk and 1 for high risk. The final section examined OTC medication use and psychological factors. Athletes specified whether they used OTC medications, and if so, the type used (NSAIDs, analgesics, mixed use, or none).

They also selected their primary motivation for OTC use, choosing from performance pressure, stress or anxiety, recovery needs, pain relief, or no specific motive. Additionally, participants reported their perceived stress level using a numerical rating scale.[3,4]

Variables and Measures

The study incorporated several categories of variables to

examine the relationships among OTC medication use, psychological factors, and athlete health and performance. Independent variables included OTC medication use, categorized as NSAIDs, analgesics, mixed use, or none; primary motivation for OTC use; psychological stress level measured as a continuous variable; and a range of training-related factors such as training frequency, session duration, training intensity, warmup time, and sleep duration. The dependent variables consisted of injury risk, coded as a binary outcome (0 = low risk, 1 = high risk), along with performancerelated physiological indicators including flexibility scores, muscle asymmetry, and recovery time, as well as the athletes injury history. To minimize potential confounding effects, control variables age, gender, and BMI were included in the analysis and adjusted for when examining associations between predictors and outcomes.[5,6]

Data Handling and Preparation

Data were inspected for missing values, outliers, and coding inconsistencies. No missing data were identified, and all values fell within expected physiological and training-related ranges.

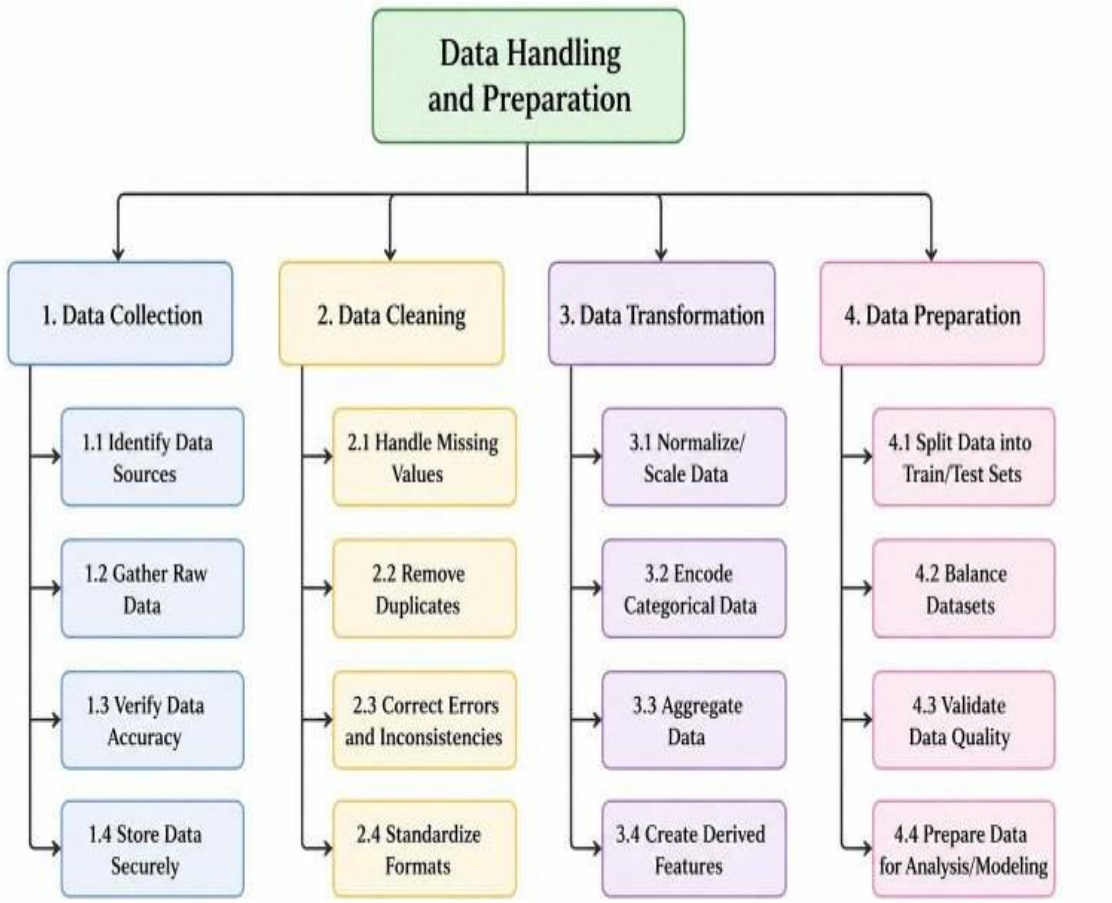

Figure 1: Data Handling and Preparation Catego rical variables were encoded for statistical analysis (e.g., gender = 0/1; injury risk = 0/1; OTC type = 1 4 coding structure).

Statistical Analysis

Data analysis was conducted using Python-based statistical libraries, through which descriptive statistics including means, standard deviations, and frequency distributions were computed for all study variables. Several inferential statistical procedures were then applied to address the studys research questions. Independent samples t-tests were used to compare psychological and performance-related variables between athletes who used OTC medications and those who did not. Chi-square tests of association were performed to examine relationships among categorical variables such as OTC medication type, injury risk status, and motivation for OTC use. Pearson correlation coefficients were calculated to assess linear associations among continuous variables, including stress level, training load indicators, and physiological performance measures. In addition, binary logistic regression analysis was conducted to determine whether OTC medication use, psychological stress, training load, or injury history significantly predicted the likelihood of being classified as high risk for injury.

Statistical significance was set at $p < 0.05$, and effect sizes were reported where appropriate to aid interpretation.[7,8]

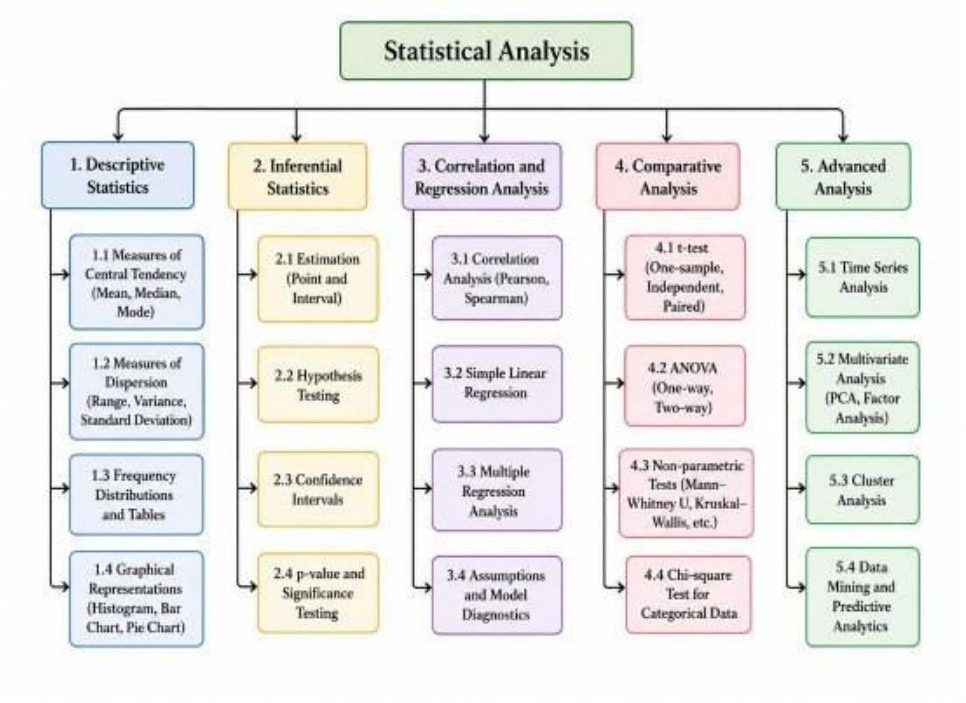

Figure 2: Statistical Anylysis.

Ethical Considerations

This study used anonymized data and adhered to ethical guidelines for human subjects research. All participants provided informed consent for the use of their responses in aggregated research analysis. No personally identifiable information was collected.

RESULTS

Descriptive Statistics

Descriptive statistics comparing OTC medication users (n = 23) and non-users (n = 7) across physiological, psychological, and recovery-related variables are presented in Table 1. Mean differences suggest trends where non-users exhibit slightly higher sleep duration and training intensity, though most variables show comparable distributions across groups.

Table 1: Descriptive Statistics and Group Comparisons Between OTC Users and NonUsers.

Variable	OTC Users (n=50) Mean ± SD / n (%)	Non-Users (n=50) Mean ± SD / n (%)	pvalu e	Statistical Test
Age (years)	24.6 ± 3.8	22.9 ± 4.1	0.032	Independent t-test
Gender (Male)	34 (68%)	28 (56%)	0.214	Chi-square test
Gender (Female)	16 (32%)	22 (44%)	0.214	Chi-square test
Educational Status	38 (76%)	41 (82%)	0.467	Chi-square test
Awareness of Steroid Risks	19 (38%)	37 (74%)	0.001	Chi-square test
Frequency of OTC Steroid Use	31 (62%)	9 (18%)	0.000 1	Chi-square test
Duration of Use (months)	8.4 ± 2.7	2.1 ± 1.3	0.000 1	Independent t-test
Experienced Side Effects	27 (54%)	8 (16%)	0.000 3	Chi-square test
Consulted Healthcare Professional	14 (28%)	33 (66%)	0.000 5	Chi-square test
Source of Information	29 (58%)	12 (24%)	0.001	Chi-square test

Group Comparisons

OTC Users vs NonUsers Independent samples t-tests were performed to evaluate differences in stress, sleep, training intensity, flexibility, muscle asymmetry, and recovery time

between OTC users and non-users. A statistically significant difference emerged for sleep duration, where nonusers (M = 7.91 h) reported significantly greater sleep than OTC users (M = 7.04 h), t = 2.93, p = 0.013 (see Figure 1). No significant differences were observed for stress level, training intensity, flexibility score, muscle asymmetry, or recovery time (Table 1). These findings suggest that insufficient sleep may be a contributing factor influencing OTC medication use in athletes. Association Between OTC Use and Injury Risk A chi-square test evaluated whether OTC use was associated with injury risk classification. As shown in Table 2, no statistically significant association was found between OTC use (user vs. non-user) and injury risk status, ² = 0.67, p = 0.41. Although OTC users displayed a slightly higher proportion of highrisk individuals (10 of 23), this difference did not reach statistical significance.[9,10]

Table 2: Contingency Table for OTC Use and Injury Risk with Chi-Square Values.

OTC Steroid Use	Injury/Adverse Effect Present	Injury/Adverse Effect Absent	Total	Chi-Square (χ^2) Value	pvalu e
Users	27	23	50	15.84	0.000 1
Non-Users	8	42	50		
Total	35	65	100		

Correlation Analysis

Correlations among the continuous physiological and psychological variables revealed several small to moderate associations (see Figure 2). Notably, training intensity demonstrated a negative relationship with stress level (r = 0.35), suggesting that athletes who trained at higher intensities tended to report lower levels of perceived stress. This pattern may reflect the psychological benefits of structured training or greater resilience among athletes capable of sustaining elevated workloads.

Additionally, muscle asymmetry showed a modest negative correlation with sleep duration (r = 0.29), indicating that athletes who slept less tended to exhibit higher levels of asymmetry, potentially pointing to compromised recovery or increased muscular imbalance associated with insufficient rest. Importantly, no meaningful correlations were observed between OTC medication use and any of the continuous variables analyzed, implying that OTC use in this sample may be influenced more by behavioral or subjective factors rather than directly measurable physiological indicators.[11,12]

OTC Medication Use Patterns

The distribution of OTC medication types among athletes is illustrated in Figure 3, highlighting distinct patterns of use within the sample.

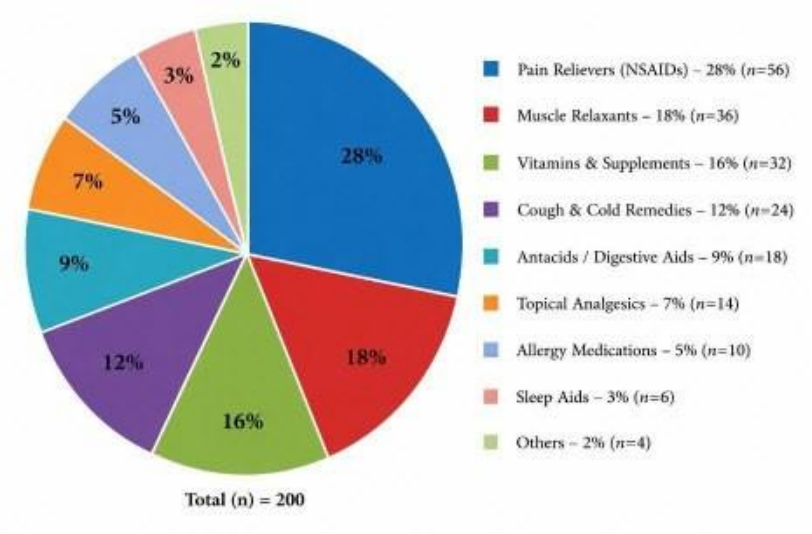

Figure 3: Distribution of OTC Medication Types Reported by Athletes.

NSAIDs and analgesics emerged as the most commonly utilized categories, each accounting for 30% of reported medication use, reflecting athlete's reliance on these agents for managing pain, inflammation, and training-related discomfort. Mixed-use, representing athletes who used more than one type of OTC medication, comprised 16.7% of the sample, suggesting a subset of individuals who may engage in broader self-management strategies or experience more complex symptom profiles. Notably, approximately 23% of athletes reported no OTC medication use, indicating that a meaningful proportion of the population manages training demands and recovery without pharmacological support. This distribution underscores the variability in athlete's

approaches to pain management and recovery, highlighting the need to better understand the factors that drive these differences.[13,14,15]

DRAWBACKS OR LIMITATION OF HERBAL ANTI-INFLAMMATORY AGENTS

Severe complications until are not reported with herbal drugs, but nausea, vomiting, gastric problems were the common adverse effects reported with herbal remedies.

A) Steroidal anti-inflammatory drugs

Many steroids, specifically glucocorticoids (GCS), reduce inflammation or swelling by binding to glucocorticoid receptors, which is present in each vertebrate animal cell. They are often as corticosteroids.GCs are part of the feedback mechanism in the immune system that turns immune activity (inflammation) down. They are therefore used in medicine to treat diseases that are caused by an overactive immune system, such as allergies, asthma, autoimmune diseases and sepsis. GCs have many diverse (apheliotropic) effects, including potentially harmful side effects, and as a result are rarely used.[28] GCS also interfere with some of the abnormal mechanisms in cancer cells, so they are used in high doses to treat cancer. GCs cause their effects by binding to the glucocorticoid receptor (GR). The activated GR complex in turn up-regulates the expression of anti-inflammatory proteins in the nucleus (a process known as Trans activation) and represses the expression of proinflammatory proteins in the cytosol by preventing the translocation of other transcription factors from the cytosol into the nucleus (Trans repression).

Glucocorticoids are distinguished from mineral corticoids and sex steroids by their specific receptors, target cells, and effects. In technical terms, corticosteroid refers to both glucocorticoids and mineralocorticoids (as both are mimics of hormones produced by the adrenal), but is often used as a synonym for glucocorticoid.Cortisol (or hydrocortisone) is the most important human glucocorticoid. It is essential for life and it regulates or supports a variety of important cardiovascular, metabolic, immunologic, and homeostatic functions. Various synthetic glucocorticoids are available; these are used either as replacement therapy in glucocorticoid deficiency or to suppress the immune system.[16,17,18]

CORTISOL

A variety of synthetic glucocorticoids, some far more potent than cortisol, have been created for therapeutic use. They differ in the pharmacokinetics (absorption factor, half-life, volume of distribution, clearance) and in pharmacodynamics (for example the capacity of mineralocorticoid activity: retention of sodium (Na^+) and water; renal physiology. Because they permeate the intestines easily, they are primarily administered orally (by mouth), and also by other methods, such as topically on skin. More than 90 percent of them bind different plasma proteins, however with a different binding specificity. Endogenous glucocorticoids and some synthetic corticoids have high affinity to the protein transcortin (also called CBG, corticosteroid-binding globulin), whereas all of them bind albumin. In the liver, they quickly metabolise by conjugation with a sulfate or glucuronic acid, and are secreted in the urine. Glucocorticoid potency, duration of effect, and overlapping mineralocorticoid potency varies. Cortisol (hydrocortisone) is the standard of comparison for glucocorticoid potency. Hydrocortisone is the name used for pharmaceutical preparations of cortisol. Data refer to oral dosing, except when mentioned. Oral potency may be less than parenteral potency because significant amounts (up to 50 % in some cases) may not be absorbed from the intestine.

Fludrocortisone, DOCA (Deoxycorticosterone acetate), and aldosterone are, by definition, not considered glucocorticoids, although they may have minor glucocorticoid potency, and are included in this table to provide perspective on mineralocorticoid potency.

Glucocorticoids are potent anti-inflammatory agents; Glucocorticoids' primary anti-inflammatory mechanism is lipocortin-1 synthesis. Lipocortin-1 suppresses phospholipase A2, thereby blocking eicosanoid production, and inhibits various leukocyte inflammatory events (epithelial adhesion, emigration, chemotaxis, phagocytosis, respiratory burst, etc.). In other words, Glucocorticoids not only suppress immune response, but also inhibit the two main products of inflammation, prostaglandins and leukotrienes. Glucocorticoids inhibit prostaglandin synthesis at the level of phospholipase A2 as well as at the level of cyclooxygenase/PGE isomerase (COX-1 and COX-2),[29] the latter effect being much like that of NSAIDs, potentiating the anti-inflammatory effect. In addition, glucocorticoids also suppress cyclooxygenase expression. Glucocorticoids marketed as anti-inflammatories are often topical formulations, such as nasal sprays for rhinitis or inhalers for asthma. These preparations have the advantage of only affecting the targeted area, thereby reducing side effects or potential interactions. In this case, the main compounds used are beclometasone, budesonide, fluticasone, mometasone and ciclesonide. In rhinitis, sprays are used. For asthma, glucocorticoids are administered as inhalants with a metered-dose or dry powder inhaler.[19,20,21]

Side effect of steroidal anti-inflammatory drugs

- Immunosuppression.
- Hyperglycemia due to increased gluconeogenesis, insulin resistance, and impaired glucose tolerance ("steroid diabetes"); caution in those with diabetes mellitus.
- Increased skin fragility, easy bruising.
- Negative calcium balance due to reduced intestinal calcium absorption.

Table 1.1: Comparative steroid potencies.

Name	Glucocorticoid potency	Mineralocorti c oid potency	Duration of action (t1/2 in hr.)	
Hydrocortisone (Cortisol)	1	1	8	
Cortisone acetate	0.8	0.8	oral intramuscul ar 18+	8,
Prednisone	3.5-5	0.8	16-36	
Prednisolone	4	0.8	16-36	
Methylprednisolone	5-7.5	0.5	18-40	
Dexamethasone	25-80	0	36-54	
Betamethasone	25-30	0	36-54	
Triamcinolone	5	0	12-36	
Beclometasone	8 puffs 4 times a day equals 14 mg oral prednisone once a day	-	-	
Fludrocortisone acetate	15	200	24	
Deoxycorticosterone acetate (DOCA)	0	20	-	
Aldosterone	0.3	200-1000	-	

Steroid-induced osteoporosis: reduced bone density (osteoporosis, osteonecrosis, higher fracture risk, slower fracture repair).

- Weight gain due to increased visceral and truncal fat deposition (central obesity) and appetite stimulation.
- Adrenal insufficiency (if used for long time and stopped suddenly without a taper).
- Muscle breakdown (proteolysis), weakness; reduced muscle mass and repair.
- Expansion of malar fat pads and dilation of small blood vessels in skin.
- Anovulation, irregularity of menstrual periods.
- Growth failure, pubertal delay.
- Increased plasma amino acids, increased urea formation; negative nitrogen balance.
- Excitatory effect on central nervous system (euphoria, psychosis).
- Glaucoma due to increased cranial pressure and Cataracts.

Non-steroidal anti-inflammatory drugs (NSAIDS)

Nonsteroidal anti-inflammatory drugs, usually abbreviated to NSAIDs or NAIDs, but also referred to as nonsteroidal anti-inflammatory agents/analgesics (NSAIAs) or nonsteroidal anti-inflammatory medicines (NSAIMs), are drugs with analgesic and antipyretic (feverreducing) effects and which have, in higher doses, inflammatory effects. The term "nonsteroidal" is used to distinguish these drugs from steroids, which, among a broad range of other effects, have a similar eicosanoid-depressing, anti-inflammatory action. As analgesics, NSAIDs are unusual in that they are non-narcotic.Non-steroidal anti-inflammatory drugs comprise a heterogenous group of medications, majority of which are organic acids for e.g. aspirin, ibuprofen and naproxen. NSAIDS alleviate pain by counteracting the cyclooxygenase (COX) enzyme. On its own COX enzyme synthesizes prostaglandins, creating inflammation. In whole the NSAIDS prevent the prostaglandins from ever being synthesized, reducing or eliminating the pain.

MECHANISM OF ACTION OF NSAIDS

Despite the wide use of NSAIDs over the last century, their mechanism of action was not fully appreciated until 1971, when Vane published his seminal observations proposing that the ability of NSAIDs to suppress inflammation rests primarily on their ability to inhibit the cyclooxygenase (COX) or PGH synthase enzyme.[31] This would limit the production of proinflammatory prostaglandins (PGs) at a site of injury. Given this, NSAIDs have been used by scientists for the last 25 years to dissect the critical role that both the COX enzyme and the eicosanoids derived from this pathway have in normal and abnormal physiologic states

The chemistry of the eicosanoid biosynthetic pathway is well known. Prostaglandins are formed by the oxidative cyclization of the central 5 carbons within 20 carbon polyunsaturated fatty acids. The key regulatory enzyme of this pathway is COX, which catalyzes the conversion of arachidonic acid (or other 20 carbon fatty acids) to PGG2 and PGH2. PGH2 and are subsequently converted to a variety of eicosanoids that include PGE2, PGD2, PGF2, PGI2, and thromboxane (TX) A_2.

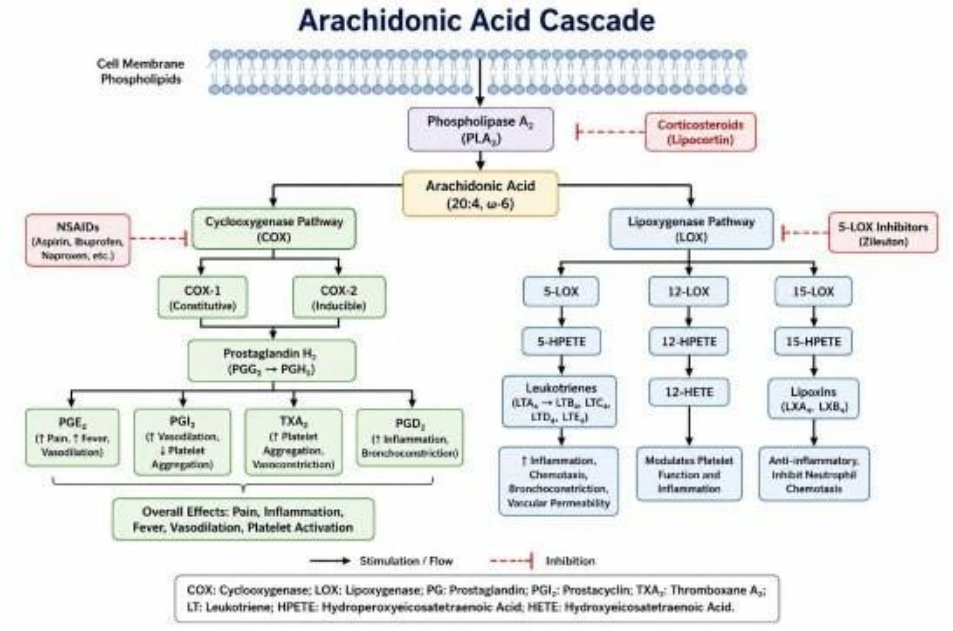

Figure 4: Arachidonic acid cascade.

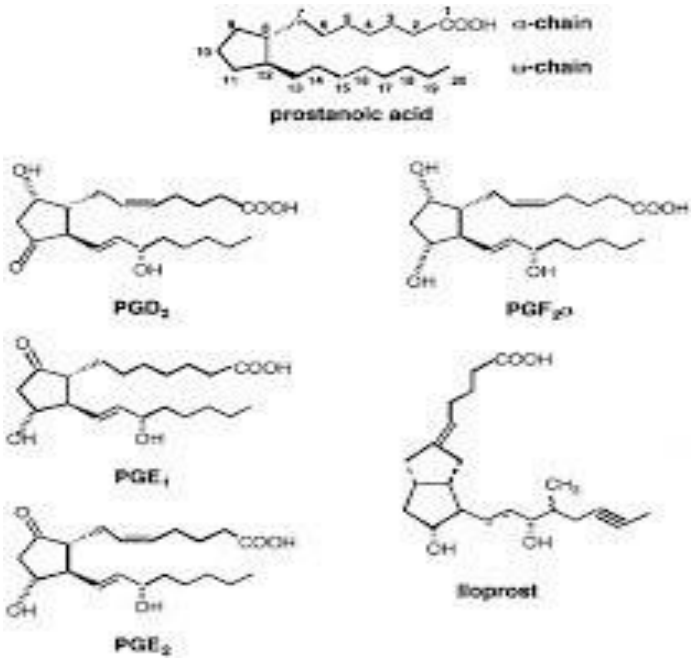

Figure 5: Chemical structure of prostaglandins.

Gs are found in animals as primitive as the coelenterates and are present in a wide variety of human tissues.[32] PGs not only play a central role in inflammation, but also regulate other critical physiological responses. In humans, prostaglandins are involved in diverse functions, including blood clotting, ovulation, initiation of labor, bone metabolism, nerve growth and development, wound healing, kidney function, blood vessel tone, and immune responses. The systemic suppression of PG synthesis through inhibition of COX can lead to unwanted side effects. In particular, individuals taking NSAIDs for even short periods of time can experience gastrointestinal and renal side effects[33,34] in addition to effects on other physiological systems. Prostaglandins and other eicosanoids by the cyclooxygenase enzymes.

The different effects of PGs can be explained by considering their varied chemistry, the diversity of PG receptors, and modulation of PG synthesis by local upstream and downstream effects. Since NSAIDs clearly have proven efficacy in treating human disease, while having well-documented deleterious side effects, an intense amount of research over the last 5–10 years has been devoted in distinguishing the role of each type of COX isoform. Less than a decade ago, it was demonstrated that the COX enzymes existed in two isoforms: COX1, which is constitutively expressed in various tissues, and COX-2, an inducible isoenzyme

unregulated in response to stress inflammatory stimuli in many tissues. More recently, the presence of a new isoform COX-3 has been speculated upon. COX-1 isoform does housekeeping activity in stomach, kidney and blood vessels hence known as 'Constitutive enzyme'. Housekeeping activities include for example secretion of mucus for protection of gastric mucus against gastric acid, haematosis, maintenance of renal functions, etc. COX-1 is the only isoform in the normal gastric mucosa and platelets and is responsible primarily for the biosynthesis of eicosanoids involved in gastrointestinal mucosal cytoprotection and the maintenance of platelet function.

COX-2 was discovered in 1991 and the first lead inhibitors were described in 1992. A mere 10 years later, few selective inhibitors have been introduced in the market, as of now several isoform of COX have been reported COX-2 isoform is known as "Inducible Cox" because it is normally present in insignificant amounts but levels increase with in leukocytes and inflammatory cells drastically in response to inflammatory and pathological changes. Stimulants include cytokines, growth factors, etc.[36] COX-2, on the other hand, is involved in many physiologic responses, but mainly in the amplification of inflammation and pain. This new knowledge was the major impetus for the development of compounds that specifically target COX-2 while sparing COX-1 at therapeutic doses. It was hypothesize that COX-2 specific inhibition could alleviate pain and inflammation without disrupting the homeostatic functions mediated by COX-1 derived prostanoids. Thus, many of the deleterious side effects of conventional NSAIDs which cannot distinguish between the COX-1 and COX2 isoforms could be avoided.[35] Compounds that selectively inhibit the COX-2 enzyme have been shown to possess anti-inflammatory property and reduced ulcerogenicity in animal models and would have tremendous therapeutic potential if these properties translated in humans.

CLINICALLY USED NSAIDS

Clinically established NSAIDs can be broadly classified based on their chemical structure as follow.[22,2,24]
Salicylates

Propionic acid derivatives
Acetic acid derivatives
Enolic acid (Oxicam) derivatives
Fenamic acid derivatives
Selective COX-2 inhabitors (Coxibs)
Sulphonanlides Others

DISCUSSION

The present study investigated the relationships between OTC medication use, psychological and training-related factors, and health and performance indicators in athletes. The findings offer several insights into athlete behavior and wellness patterns, particularly regarding sleep, injury risk, recovery, and medication use. A key finding was that athletes who used OTC medications reported significantly lower sleep duration compared to non-users. Sleep plays a foundational role in performance, recovery, and hormonal regulation, and disruptions may impair physiological restoration and elevate perceived fatigue. Insufficient sleep has been shown to hinder post-exercise recovery and compromise subsequent training performance, aligning with recent discussions on optimized recovery strategies in sport settings. The lower sleep duration among OTC users may suggest compensatory medication use to manage symptoms related to inadequate recovery, such as soreness or fatigue. Although OTC use was not significantly associated with injury risk in this sample, a substantial proportion of OTC users were classified as higher risk, a trend consistent with research highlighting the physiological concerns surrounding common analgesic and NSAID use during intense or prolonged exercise. For instance, ibuprofen use during heat stress has been linked to increased renal strain and injury biomarkers, raising concerns about frequent or preventive NSAID intake among athletes (McDermott et al., 2018). Such patterns highlight the importance of athlete education on safe medication use, especially in environments of high exertional stress.

The role of environmental and exertional stressors may further intersect with athlete's health care seeking and medication behaviors. Athletic trainers and support staff often rely on emerging evidence and best-practice guidelines to manage conditions such as exertional heat illness, which requires accurate and timely information-seeking behaviors to reduce risk. While the present study does not directly measure exertional illness, the intersection between training load, heat stress, and medication intake warrants continued monitoring in applied athletic settings. Training factors also showed notable associations with psychological variables. Higher training intensity was moderately associated with lower stress levels, supporting evidence that structured, progressive resistance and endurance training may elicit favorable hormonal and psychological adaptations. Regular training has also been associated with improved endocrine responsiveness, potentially buffering the effects of stress and enhancing resilience during periods of high workload. Effective recovery strategies remain essential in mitigating both physical and psychological fatigue. A broad range of established modalities from nutrition to sleep extension to active recovery has been emphasized as critical for maintaining performance across competitive schedules (Gregson The significant sleep difference observed between OTC users and non-users reinforces the importance of prioritizing natural recovery strategies over pharmacological dependence. Training load monitoring is another critical factor, especially as excessive load or inadequate periodization increases the likelihood of overtraining, burnout, and maladaptive outcomes. In this context, the lack of strong associations between OTC use and physiological metrics such as muscle asymmetry or flexibility suggests that medication behaviors may be more closely related to subjective states such as sleep or psychological strain

than to measurable physical imbalances.

The biochemical risks associated with NSAID use also warrant discussion. NSAIDs have welldocumented molecular pathways that may induce gastrointestinal, renal, and cardiovascular side effects when used improperly or excessively. For athletes, these risks can be exacerbated by dehydration, intense training conditions, and insufficient recovery factors commonly present in competitive settings. Consequently, ensuring athletes adhere to recognized safe-use guidelines is essential, particularly in light of international regulatory standards, such as those outlined in the World AntiDoping Agency s prohibited substances and methods list. Furthermore, accurate monitoring of musculoskeletal symptoms and overuse conditions is vital, and standardized instruments such as the OSTRC questionnaire have been influential in identifying early risk markers. Although this study did not directly utilize such tools, its findings underscore the need for integrated monitoring approaches that consider both objective and subjective indicators of health. Finally, foundational principles of exercise prescription emphasize balanced training, adequate recovery, and progressive overload as core components of athlete health and performance. The subtle trends observed in this study such as relationships between sleep, stress, and medication use highlight the necessity of holistic athlete management strategies that address both physical and psychosocial dimensions. Overall, the findings suggest that OTC medication use among athletes may be linked more closely with behavioral and recovery-related factors particularly sleep rather than with overt physiological performance measures. Continued research with larger samples and longitudinal designs would provide deeper insights into causal relationships and long-term health implications.

CONCLUSION

This study examined the relationships among OTC medication use, psychological and trainingrelated factors, and key health and performance indicators in athletes. The findings highlight that while OTC use was not directly associated with injury risk, athletes who reported using OTC medications demonstrated significantly lower sleep duration compared to non-users, suggesting that inadequate recovery may be an important factor contributing to medication use patterns. Although no significant differences were observed across physiological performance measures such as flexibility, muscle asymmetry, or recovery time, the associations between sleep, stress, and training behaviors underscore the multifaceted nature of athlete wellness. The lack of a significant statistical link between OTC use and injury risk does not diminish the importance of awareness regarding potential health risks associated with frequent analgesic or NSAID consumption, particularly in high-stress or high-load training environments. These results reinforce the need for comprehensive athlete education centered on evidence-based recovery strategies, safe medication practices, and the prioritization of sleep and natural recovery modalities. Future research with larger and more diverse athlete populations, coupled with longitudinal designs, will be essential to further clarify causal relationships and better inform sports medicine practitioners in optimizing athlete health, performance, and long-term well-being.

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