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Acute Mountain Sickness in Physically Active Individuals: The Role of Fitness, Acclimatization and Symptom Monitoring in Preparation for Mountain Exercise - A Narrative Review

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Abstract (Structured)

Background. Mountain exercise, trekking, skiing and altitude training expose physically active individuals to hypobaric hypoxia and acute altitude illness. AMS usually occurs after rapid ascent above approximately 2500 m and may impair safety and performance.

Aim. This narrative review summarizes evidence on AMS in physically active individuals, focusing on fitness, ascent profile, acclimatization, load management, hydration, nutrition, symptom monitoring and anti-doping issues.

Material and methods. A PubMed-based narrative search was performed in May 2026 using terms related to AMS, altitude illness, athletes, exercise, mountaineering, acclimatization, prevention, Lake Louise Score, oxygen saturation, hydration and nutrition. English-language studies, reviews, consensus statements and guidelines were prioritized. WADA documents were consulted for doping issues.

Results. Rapid ascent, inadequate acclimatization, previous altitude illness, high early exercise intensity, individual oxygenation responses and poor symptom awareness are clinically important determinants of AMS risk. Fluid and energy imbalance may worsen exercise tolerance and complicate symptom interpretation, but they are not substitutes for acclimatization. The 2018 Lake Louise AMS Score is a practical field tool, whereas SpO2 and heart rate are supportive parameters only.

Conclusions. High physical fitness does not eliminate AMS risk. Preparation should combine gradual ascent, low training load during the first 24-48 h, individualized risk assessment, adequate nutrition and hydration, and daily symptom monitoring. New headache with gastrointestinal symptoms, dizziness, unusual fatigue, ataxia, confusion or dyspnea at rest should prompt rest, cessation of ascent and, when indicated, descent or treatment.

Key words: acute mountain sickness, altitude illness, athletes, mountain exercise, acclimatization, Lake Louise Score, hydration, high-altitude training.

1. Introduction

Mountain sport has become increasingly accessible to recreationally active people as well as competitive athletes. Trekking above 2500 m, high-altitude trail running, ski touring, mountaineering expeditions and structured altitude camps are no longer limited to elite alpinists. Improved transport infrastructure allows rapid access to mountain resorts, cable-car stations and high passes, shortening the time available for physiological acclimatization. This creates a specific problem for sports medicine: physically fit individuals often reach altitude with high confidence and strong motivation to train, yet they are exposed to the same hypobaric hypoxia as less trained travelers (Khodaee et al., 2016; Luks et al., 2017).

AMS is associated with recent altitude gain, headache and additional symptoms such as gastrointestinal discomfort, fatigue or weakness, dizziness or light-headedness. The 2018 revision of the Lake Louise AMS Score removed sleep disturbance from the core scoring system because disturbed sleep at altitude may occur independently of AMS severity. This change is important for field studies and for practical monitoring, because sleep complaints alone should not be interpreted as diagnostic of AMS without the characteristic symptom cluster (Roach et al., 2018; Meier et al., 2017).

Altitude reduces the partial pressure of inspired oxygen and triggers ventilatory, cardiovascular, renal and neurovascular responses. During early exposure, endurance capacity declines, heart rate at a given submaximal workload may rise, perceived exertion increases and recovery can be impaired. For athletes, these changes may be misinterpreted as loss of fitness or insufficient training effort, encouraging an inappropriate increase in intensity precisely when the risk of AMS is greatest (Khodaee et al., 2016; Bonato et al., 2023).

The relationship between physical fitness and altitude illness is clinically counterintuitive. Good aerobic capacity improves sea-level performance and may facilitate mountain mobility, but it does not guarantee protection against AMS. In a study of rapid passive ascent to 3450 m, endurance-trained men had a higher incidence of early AMS than less trained controls. This finding should be interpreted as evidence that training status is not protective during early, incompletely acclimatized exposure, not as proof that endurance training is universally harmful (Sareban et al., 2020).

AMS and high-altitude cerebral edema (HACE) are often considered part of a neurological continuum of acute altitude illness, whereas high-altitude pulmonary edema (HAPE) is a distinct pulmonary syndrome that may occur independently. For practical safety planning in mountain sport, all three conditions should be considered within the broader group of acute altitude illnesses because each can impair performance and decision-making and may require urgent descent or medical treatment (Luks et al., 2017; Luks et al., 2024).

Research Objective. Given the growing popularity of mountain exercise and altitude-based training among recreationally active individuals and athletes, the objective of this narrative review is to summarize PubMed-indexed evidence on AMS risk in physically active populations and translate this evidence into practical preparation and monitoring recommendations for mountain activity.

Research Problems. The review addresses the following questions: Does high physical fitness protect athletes from AMS? Which altitude-related, behavioral and physiological factors are most relevant for physically active individuals? How should acclimatization, early exercise-load reduction, hydration, nutrition and symptom monitoring be organized before and during mountain exercise? Which warning signs should prompt cessation of ascent, rest, medical treatment or descent?

Research Hypotheses. As a narrative review, this paper does not test statistical hypotheses using original data. The working hypotheses guiding the synthesis were: H1, high physical fitness does not eliminate AMS risk; H2, rapid ascent and vigorous early exercise increase symptom probability in susceptible individuals; H3, gradual acclimatization and structured symptom monitoring can reduce clinical consequences of AMS during mountain sport; H4, oxygen saturation and heart rate may support field assessment but should not replace symptom-based clinical evaluation.

2. Research materials and methods

2.1. Participants.

This manuscript is a narrative review and did not include recruitment of human participants, intervention, randomization or collection of original biological data. The population of interest was defined as healthy or apparently healthy physically active individuals, recreational mountain tourists, trekkers, mountaineers, endurance athletes and athletes exposed to high altitude for training or competition.

Studies involving mixed groups of travelers, military personnel or mountaineers were considered when their findings were transferable to exercise, ascent profile, symptom monitoring or prevention strategies. The review focused on acute altitude exposure and short-term preparation for mountain exercise rather than chronic high-altitude residence. Pediatric populations, pregnancy and individuals with major cardiopulmonary disease were not the primary focus because these groups require separate medical recommendations.

2.2. Procedure / Search protocol / Source selection.

A narrative literature search was performed in PubMed in May 2026. The search combined keywords and Medical Subject Heading-like concepts related to altitude illness and sports exposure. Principal search concepts included: "acute mountain sickness", "acute altitude illness", "high altitude illness", "athletes", "endurance athletes", "exercise", "physical activity", "trekking", "mountaineering", "altitude training", "acclimatization", "risk factors", "prevention", "Lake Louise Score", "oxygen saturation", "hydration" and "nutrition". Additional relevant publications were identified from reference lists of key PubMed Central full-text articles and clinical guidelines.

Eligible sources included PubMed-indexed original studies, systematic reviews, meta-analyses, narrative reviews, clinical guidelines and consensus statements written in English. Priority was given to publications from 2016-2026, but older highly cited or methodologically important papers were included when they provided essential evidence on exercise, fluid balance, ascent rate, prediction or return-to-activity principles. Official WADA documents were additionally consulted because pharmacological prevention and treatment in competitive athletes must be interpreted together with anti-doping regulations.

Publications were excluded if they focused exclusively on chronic mountain sickness, long-term high-altitude residents, animal experiments, non-sport occupational cohorts without transferable implications, case reports with limited generalizability or non-English full texts. The selection was intentionally pragmatic because the aim was to support a narrative synthesis suitable for a sports medicine journal rather than to perform a formal systematic review or meta-analysis.

Table 1. Literature search strategy and eligibility criteria.

Element	Applied criterion	Rationale for the review
Database	PubMed was used as the main biomedical database; PubMed Central full texts were used when available.	PubMed provides broad coverage of biomedical and sports-medicine literature relevant to acute altitude illness.
Time frame	Main emphasis on 2016-2026; older seminal studies included when essential.	Recent guidance was prioritized while retaining landmark evidence on exercise, ascent rate and hydration.
Population	Physically active adults, trekkers, mountaineers, recreational athletes and endurance athletes.	The aim was to keep the paper sport-oriented and relevant to Quality in Sport.
Included study types	Original studies, systematic reviews, narrative reviews, consensus statements and clinical guidelines.	This enables practical synthesis of physiology, field evidence and recommendations.
Excluded sources	Non-English publications, non-human studies, purely chronic high-altitude residence studies and papers without relevance to exercise or AMS prevention.	These exclusions improved clinical applicability for mountain exercise preparation.
Synthesis method	Narrative synthesis with thematic grouping by fitness, ascent profile, exercise load, monitoring, hydration, nutrition, medication and return to activity.	A quantitative meta-analysis was not performed because the review question was practical and heterogeneous.

Source: Authors' own elaboration based on PubMed-indexed literature and official WADA documents.

Because this manuscript is a narrative review rather than a systematic review, a formal PRISMA-style flow diagram was not prepared. A simplified source-selection summary is presented in Table 2.

Table 2. Simplified source identification, inclusion and exclusion summary.

Record category	Number / description	Main reason for exclusion
Records identified	PubMed search and reference-list screening; exact count not formally recorded.	Not applicable.
Records included	24 PubMed-indexed scientific publications and 2 official WADA documents were included in the final narrative synthesis and reference list.	Not applicable.
Main reasons for exclusion	Records were excluded pragmatically during abstract and full-text screening.	Non-English or unavailable full texts; chronic/resident-only altitude studies; animal/laboratory-only studies; non-sport cohorts; case reports; low relevance to AMS prevention or monitoring.

Source: Authors' own elaboration based on the narrative PubMed search and source selection criteria.

2.3. Data collection and analysis / Statistical analysis.

Data were extracted narratively from selected publications. Extracted information included study population, altitude exposure, ascent profile, exercise context, diagnostic or symptom-monitoring method, major risk factors, prevention strategies, pharmacological considerations and practical implications for sports medicine. Findings were organized into thematic categories rather than numerical outcomes.

2.3.1. Statistical Software.

No statistical software was used because the study did not include original quantitative data, pooled effect-size calculation or meta-analysis. Tables were developed to synthesize selected findings and translate them into practical recommendations for athletes, coaches and physically active mountain tourists.

2.3.2. AI.

AI-assisted language tools were used only to support manuscript organization, academic English refinement and consistency of wording. Literature selection, interpretation of findings, assessment of clinical relevance and final conclusions were performed and verified by the authors. No AI tool was used to generate original data, perform statistical calculations or replace critical evaluation of the cited PubMed-indexed sources.

2.3.3. Statistical Methods.

No formal statistical hypothesis testing was performed. The manuscript uses narrative comparison of published findings, clinical guidelines and field studies. Where studies reported numerical outcomes, such as incidence, symptom scores, oxygen saturation or altitude exposure, these were interpreted qualitatively and placed in the context of the overall literature. Because included studies differed in population, altitude, ascent rate, diagnostic criteria and exercise exposure, pooling of results would not have been methodologically appropriate within the scope of this article.

3. Research results

3.1. Acute mountain sickness as a sports medicine problem

AMS is usually a self-limited but potentially disabling condition that develops in non-acclimatized individuals after ascent to altitude. It is clinically relevant to sport because symptoms overlap with fatigue, dehydration, insufficient sleep, gastrointestinal upset and overreaching. In athletes, this overlap may delay recognition: headache after travel, nausea after a long climb, unusual tiredness during training or dizziness during ascent may be interpreted as normal exertional stress rather than early AMS (Meier et al., 2017; Luks et al., 2024).

The 2018 Lake Louise AMS Score provides a practical field method for symptom-based monitoring. The core symptom domains include headache, gastrointestinal symptoms, fatigue or weakness and dizziness or light-headedness. A total score of three or more in the setting of recent altitude gain, with headache present, is commonly used to define AMS in research. This tool is simple enough for daily use during trekking, altitude camps or mountain competitions, although it should not replace clinical judgment (Roach et al., 2018).

For physically active individuals, the early period after arrival is especially important. A person may arrive at a resort or base camp in the afternoon and start running, cycling or ski touring the next morning. Symptoms can develop within hours, while physiological acclimatization requires longer. The first 24-48 h at a new sleeping altitude should therefore be treated as a low-load adaptation phase rather than as a normal training block (Khodaee et al., 2016; Luks et al., 2024).

3.2. Fitness, endurance training and AMS susceptibility

A common misconception in mountain tourism is that high fitness protects against AMS. Fitness improves locomotor efficiency, strength reserve and endurance at sea level, but AMS is not simply a disease of poor conditioning. The primary environmental stressor is hypobaric hypoxia, and susceptibility depends on ascent rate, sleeping altitude, previous altitude illness, ventilatory response, individual oxygenation, fluid balance and behavioral choices (Khodaee et al., 2016; Burtscher et al., 2021).

The study by Sareban et al. directly challenges the assumption that endurance training is protective. In that investigation, endurance-trained men exposed to rapid passive ascent to 3450 m had a higher incidence of early AMS than less trained controls. The result should be translated cautiously: high aerobic capacity should not be used as clearance for rapid ascent, but the study does not prove that endurance training itself is harmful in all altitude contexts (Sareban et al., 2020).

Athletes may also be at increased behavioral risk. They often ascend for a purpose: competition, training camp, summit attempt or adventure event. This context creates pressure to maintain training volume, follow a preplanned itinerary and ignore early symptoms. At altitude, familiar paces and power outputs may produce higher physiological strain, so early training should be guided by symptoms, perceived exertion and recovery rather than by sea-level targets alone (Khodaee et al., 2016; Bonato et al., 2023).

3.3. Ascent rate, sleeping altitude and early exercise load

Ascent profile is among the most modifiable determinants of AMS. Risk is closely related to the magnitude and speed of altitude gain, particularly sleeping altitude. Daytime visits to high altitude may be better tolerated than sleeping there, because nocturnal hypoxia and longer exposure increase symptom risk. In practical mountain planning, the key variable is not only the highest altitude reached but also how quickly the body is required to sleep and recover at a new altitude (Luks, 2012; Luks et al., 2024).

Field studies in trekking populations show that ascent patterns influence both AMS and summit success. In a six-day ascent of Mount Kilimanjaro, itinerary-related factors were relevant to illness and performance outcomes. For recreational athletes, a slower itinerary may improve the probability of completing the goal more safely than an aggressive schedule that maximizes daily altitude gain (Lawrence & Reid, 2016).

Vigorous exercise during the first hours after rapid ascent may aggravate hypoxemia and symptom burden in susceptible individuals. This does not mean that all light activity is contraindicated. Rather, evidence supports conservative pacing and avoidance of maximal efforts, intervals or long summit pushes during the first 24-48 h at a new sleeping altitude (Roach et al., 2000; Khodaee et al., 2016).

Table 2. Major risk factors and modifying factors for acute mountain sickness in physically active individuals.

Risk or modifying factor	Why it matters	Practical implication	Selected sources
Rapid ascent / large sleeping-altitude gain	Acclimatization lags behind hypoxic exposure, especially during the first days.	Plan gradual ascent; avoid increasing sleeping altitude when symptomatic.	Luks, 2012; Luks et al., 2024; Hsu et al., 2015
Previous AMS or poor altitude tolerance	Past illness indicates individual susceptibility and recurrence risk.	Classify as higher risk; consider slower ascent and medical prophylaxis after clinical consultation.	Luks et al., 2024; Jia et al., 2026

High early exercise intensity	Vigorous effort may worsen hypoxemia and symptoms before acclimatization.	Reduce load for 24-48 h; avoid intervals and maximal efforts after arrival.	Roach et al., 2000; Khodaee et al., 2016
Endurance-athlete profile after rapid ascent	High fitness does not guarantee protection during early exposure.	Do not use fitness as clearance for rapid ascent; monitor symptoms daily.	Sareban et al., 2020
Low oxygen saturation / large desaturation	May indicate vulnerability to hypoxic stress, but SpO2 alone is not diagnostic.	Use pulse oximetry as supportive information, not as the sole decision tool.	Shen et al., 2020; Cobb et al., 2021
Fluid or energy imbalance	May worsen exercise tolerance and complicate symptom interpretation.	Drink according to thirst and losses; avoid forced overhydration; maintain energy intake.	Nerin et al., 2006; Gatterer et al., 2013; Viscor et al., 2023
Insufficient symptom knowledge	Symptoms may be normalized as exertion, travel fatigue or poor sleep.	Teach Lake Louise symptoms and warning signs before ascent.	Roach et al., 2018; Meier et al., 2017

Source: Authors' own elaboration based on cited PubMed-indexed sources.

3.4. Symptom monitoring and the role of oxygen saturation

The most useful field approach to AMS remains symptom-based monitoring. During the first days at altitude, athletes should be encouraged to report new headache, gastrointestinal symptoms, dizziness and unusual fatigue rather than hide them to preserve a training opportunity. A simple morning and evening Lake Louise-based check can support shared decisions in trekking groups, training camps and mountain competitions (Roach et al., 2018; Meier et al., 2017).

Pulse oximetry is widely available and may help identify marked desaturation, but oxygen saturation varies with altitude, temperature, peripheral perfusion, device quality and individual physiology. A low value should increase caution, particularly when accompanied by symptoms, but a normal value does not exclude AMS. Resting heart rate may reflect hypoxia, dehydration, poor recovery, illness or anxiety; neither variable should override symptoms (Cobb et al., 2021; Shen et al., 2024).

Research on prediction is promising but not yet sufficient for routine screening. Shen et al. reported that oxygen desaturation patterns after exercise at low altitude were associated with subsequent AMS risk in a sex-dependent manner. However, such testing is not yet a routine clearance method for recreational athletes and requires further validation before being used as a standalone decision tool (Shen et al., 2020).

3.5. Hydration, nutrition and supplementation considerations

Hydration recommendations should avoid two extremes. Dehydration may worsen headache, fatigue, orthostatic symptoms and exercise tolerance, making AMS harder to assess. At the same time, forced overhydration is not an evidence-based preventive strategy and may be harmful. Fluid intake should be individualized according to thirst, urine output, sweat losses, gastrointestinal tolerance and environmental conditions (Nerin et al., 2006; Gatterer et al., 2013; Viscor et al., 2023).

Nutrition at altitude is affected by appetite suppression, gastrointestinal symptoms, cold exposure, exercise duration, food availability and the burden of carrying supplies. Carbohydrate-rich foods are often practical during hypoxic exercise because they support energy availability and are usually easier to consume during exertion. However, real mountain settings require flexible strategies: frequent small meals, adequate total energy, sufficient protein for recovery and attention to gastrointestinal tolerance (Viscor et al., 2023; Karpęcka-Gałka & Frączek, 2024).

Dietary supplements proposed for altitude exposure have inconsistent evidence or limited field applicability. For a sports medicine review, the safest recommendation is to prioritize evidence-based ascent strategy, symptom monitoring, adequate energy intake and individualized medical prophylaxis where appropriate rather than reliance on unproven supplements (Luks et al., 2024; Karpęcka-Gałka & Frączek, 2024).

3.6. Pharmacological prevention, treatment and anti-doping considerations

Acetazolamide is an evidence-based pharmacological agent for AMS prevention in selected individuals and itineraries, but it is not a nutritional supplement and should not be presented as a substitute for acclimatization. Dexamethasone has selected preventive or treatment roles, particularly when rapid ascent is unavoidable or when symptoms require medical management, but it should not be treated as a routine performance tool. Worsening AMS, HACE or HAPE requires descent and medical care rather than continued ascent under medication alone (Luks et al., 2024).

In competitive athletes, medication decisions require anti-doping consideration. Acetazolamide is listed by WADA among diuretics and masking agents prohibited at all times. Systemic glucocorticoids, including dexamethasone, are prohibited in competition when administered by oral, injectable or rectal routes. Therefore, athletes subject to anti-doping regulations require appropriate medical documentation and, when applicable, a Therapeutic Use Exemption (World Anti-Doping Agency, 2026a; World Anti-Doping Agency, 2026b).

Oxygen should be understood as an emergency or therapeutic measure rather than a performance strategy in this context. When severe neurological signs, severe dyspnea at rest, inability to walk, confusion or ataxia occur, oxygen, portable hyperbaric treatment and medication may be useful, but descent remains the most important definitive intervention when feasible (Luks et al., 2017; Luks et al., 2024).

Table 3. Medical and anti-doping considerations for selected AMS-related interventions in competitive athletes.

Intervention	Clinical role	Important consideration for athletes
Acetazolamide	Prevention of AMS in selected individuals and high-risk itineraries; may support acclimatization but does not replace gradual ascent.	Listed by WADA as a diuretic/masking agent prohibited at all times; medical documentation and TUE procedures may be required.
Dexamethasone	Selected prevention or treatment contexts, particularly when rapid ascent is unavoidable or symptoms require medical treatment.	Systemic glucocorticoids are prohibited in competition by oral, injectable or rectal routes; timing and TUE requirements must be checked.
Supplemental oxygen	Treatment support for severe altitude illness and emergencies; may be used while descent is organized.	Should be treated as a medical intervention; it does not justify continued ascent in a deteriorating athlete.
Descent	Definitive intervention for worsening AMS, HACE or HAPE when feasible.	Should not be delayed because of competition pressure, summit goals or training plans.

Source: Authors' own elaboration based on Luks et al. (2024) and WADA documents.

3.7. Practical preparation before mountain exercise

Preparation should begin before travel. Athletes and physically active tourists should review previous altitude response, planned itinerary, sleeping altitudes, transport mode, expected daily effort and access to descent or medical care. Previous AMS, rapid travel to sleeping altitude above 3000 m, inability to modify the schedule or relevant cardiopulmonary disease should prompt more cautious planning and, when appropriate, pretravel medical consultation (Luks et al., 2024; Khodaee et al., 2016).

Sea-level training should develop aerobic capacity, muscular endurance, downhill tolerance, load carriage, technical skill and injury prevention. However, it cannot fully reproduce hypobaric hypoxia. A well-prepared runner or cyclist may arrive with excellent musculoskeletal and cardiovascular capacity but still lack acclimatization. Therefore, the training plan should include an altitude transition plan: lower intensity after arrival, flexible goals and symptom-based decisions (Bonato et al., 2023; Deng et al., 2025).

Pre-acclimatization through previous altitude exposure or hypoxic conditioning may be useful in selected contexts, but its protective effect depends on protocol, timing and individual response. For most recreational athletes, the most realistic preventive strategy is itinerary design: avoid sleeping high on the first night when possible, add rest days, increase sleeping altitude gradually and allow the schedule to change if symptoms develop (Luks, 2012; Luks et al., 2024).

3.8. Practical monitoring during the first days at altitude

The first day at altitude should be conservative even for fit individuals. Training should be reduced in duration and intensity, and technical or risky terrain should be avoided if symptoms are present. Easy walking, light mobility work or short low-intensity sessions may be acceptable for asymptomatic individuals, but high-intensity intervals, time trials, long summit pushes and heavy strength sessions are poorly suited to the early exposure phase (Roach et al., 2000; Khodaee et al., 2016).

Daily monitoring can be organized around five questions: Is there a new headache? Are nausea, appetite loss or vomiting present? Is dizziness or light-headedness present? Is fatigue disproportionate to the effort? Is coordination, walking stability or mental clarity impaired? The first four questions reflect AMS symptom domains, while the fifth screens for severe neurological involvement. If symptoms appear, training intensity should be reduced and sleeping altitude should not be increased until symptoms are stable or improving (Roach et al., 2018; Luks et al., 2024).

The team should identify decision points in advance. Mild AMS generally requires stopping ascent, rest, symptomatic treatment and observation. Moderate or worsening symptoms require more caution. Severe headache, repeated vomiting, ataxia, confusion, breathlessness at rest or inability to continue should prompt descent and medical treatment. In sport, return to activity should be gradual after symptom resolution because premature continuation may impair performance and increase risk (Luks et al., 2024; DeWeber & Scorza, 2010).

Figure 1. Practical pathway for preparation and monitoring of physically active individuals during early altitude exposure.

Step 1	Step 2	Step 3	Step 4	Step 5
Pre-ascent risk assessment	Gradual ascent and sleep-altitude plan	First 24-48 h: low exercise intensity	Daily symptom + SpO_2 monitoring	Rest, stop ascent, treat or descend if warning signs occur

Source: Authors' own elaboration based on Wilderness Medical Society recommendations and PubMed-indexed sports altitude literature.

Table 4. Evidence-informed preparation and monitoring plan for recreational athletes and mountain-sport participants.

Phase	Main objective	Recommended actions	Warning signs / decision threshold
2-6 weeks before travel	Build readiness and identify risk.	Train aerobic base, muscular endurance and technical skills; review previous	Prior AMS, rapid travel to sleeping altitude >3000 m or cardiopulmonary

		altitude response; plan itinerary.	disease should prompt medical consultation.
Travel and arrival day	Minimize early hypoxic and exertional stress.	Avoid maximal exertion; hydrate according to thirst; avoid alcohol; eat palatable carbohydrate-rich foods.	New headache, nausea, dizziness or unusual fatigue should lead to rest and no further ascent.
First 24-48 h	Allow early acclimatization and detect symptoms.	Use low intensity only; monitor Lake Louise symptoms; use SpO2 as supportive information.	Headache plus gastrointestinal symptoms, dizziness or unusual fatigue suggests AMS risk.
Ongoing ascent/training	Increase load only when stable.	Increase sleeping altitude gradually; schedule hard sessions after adaptation; adjust plan to symptoms.	Do not sleep higher if AMS symptoms are present.
Symptomatic phase	Prevent progression.	Stop ascent, rest, treat symptoms; consider medication according to medical guidance, severity and anti-doping rules.	Worsening symptoms, ataxia, confusion, severe dyspnea or inability to continue require descent and urgent care.
Return to activity	Resume safely after recovery.	Restart with low intensity after symptom resolution; monitor recurrence; avoid immediate hard sessions.	Recurring symptoms after activity indicate need for further rest or descent.

Source: Authors' own elaboration based on Luks et al. (2024), Roach et al. (2018), Khodaee et al. (2016), DeWeber and Scorza (2010), and WADA documents.

3.9. Return to activity after AMS symptoms

Return to activity at altitude should be symptom-guided. The key principle is that activity should resume only after symptoms have clearly improved or resolved and the individual is not continuing to ascend while symptomatic. If symptoms recur with exercise, the load should be reduced and the plan reassessed (DeWeber & Scorza, 2010; Luks et al., 2024).

Because validated return-to-altitude sport protocols after mild AMS are limited, a staged approach should be treated as a practical framework rather than a formally validated algorithm. A reasonable sequence is rest at the same altitude, light activity without further ascent when symptoms improve, gradual return to planned training after symptom resolution, and cautious continuation of ascent only if the individual remains asymptomatic.

Coaches should also consider performance consequences. AMS is associated with headache, appetite loss, poor sleep and increased perceived exertion, all of which reduce training quality. Conservative management is therefore not only safer but also more rational for preserving the value of a training camp or expedition (Khodaee et al., 2016; Bonato et al., 2023).

3.10. Special considerations for coaches, teams and recreational groups

Group dynamics can either reduce or increase altitude risk. Clear leadership, symptom education and flexible itineraries improve safety, whereas summit pressure, financial cost and fear of disappointing the group may encourage symptom concealment. A written safety plan should specify who monitors symptoms, who decides about ascent, where descent routes are located and what medical resources are available (Luks et al., 2024; Khodaee et al., 2016).

Monitoring should not become punitive. If reporting symptoms leads to blame or exclusion, athletes may hide warning signs. Leaders should normalize AMS as a physiological response that can occur even in fit individuals. This framing is consistent with evidence that high fitness does not guarantee protection and that endurance athletes may remain vulnerable after rapid ascent (Sareban et al., 2020).

Differential diagnosis remains important. Headache and fatigue at altitude may reflect AMS, dehydration, viral illness, migraine, hypoglycemia, sleep deprivation or overexertion. Fever, focal neurological deficits, chest pain, persistent vomiting, ataxia, confusion or dyspnea at rest should prompt consideration of alternative or more severe diagnoses and urgent medical evaluation (Meier et al., 2017; Luks et al., 2017; Luks et al., 2024).

3.11. Limitations of the available evidence

The literature on AMS in athletes is less extensive than broader altitude-illness literature in trekkers, military personnel and travelers. Studies differ in altitude, ascent rate, exercise exposure, population characteristics and diagnostic criteria, making direct comparison difficult. Athlete-specific evidence strongly supports the principle that fitness is not protective by itself, but it is weaker for precise prediction of which athlete will develop AMS under a given itinerary (Khodaee et al., 2016; Sareban et al., 2020).

Older studies often used previous AMS scoring systems that included sleep disturbance, whereas the 2018 Lake Louise AMS Score removed sleep disturbance from the core score. This limits direct comparison of AMS incidence between older and newer studies. Field research is also difficult to standardize because temperature, sleep, food intake, hydration, psychological stress, training intensity and medication use may vary (Roach et al., 2018; Meier et al., 2017).

Prediction models and personalized risk assessment are promising, but most approaches are not yet simple enough for routine recreational use. Nutrition and supplementation studies often address expedition performance rather than AMS prevention specifically, so dietary advice should be framed as supportive rather than as a proven standalone preventive intervention (Wang et al., 2024; Jia et al., 2026; Viscor et al., 2023; Karpęcka-Gałka & Frączek, 2024).

4. Discussion

This narrative review supports a practical conclusion: high physical fitness is not a reliable protective factor against AMS. Fitness improves the ability to perform work, but AMS susceptibility is governed mainly by hypoxic exposure, acclimatization, individual physiology and behavior. In sports settings, rapid travel, fixed competition schedules and early vigorous exercise may create additional risk even in well-trained individuals (Khodaee et al., 2016; Sareban et al., 2020).

Prevention should be framed around ascent planning, load management and symptom monitoring. Ascent planning reduces the hypoxic dose, load management avoids unnecessary physiological strain during incomplete acclimatization, and monitoring enables early action. These elements are interdependent: symptom monitoring has limited value without a flexible itinerary, while good fitness without altitude-specific planning may create false security.

The first 24-48 h at altitude deserve emphasis. Reduced intensity during this period should not be interpreted as detraining or weakness. Rather, it is a protective strategy that may preserve later training quality and expedition success. Light activity may be acceptable for asymptomatic participants, but high-intensity intervals, long summit pushes and maximal efforts are poorly suited to early exposure.

Hydration and nutrition should support exercise tolerance and recovery but should not be presented as substitutes for acclimatization. Practical advice should emphasize drinking according to thirst and losses, avoiding forced overhydration, maintaining energy intake, limiting alcohol during early ascent and using palatable carbohydrate-rich foods when appetite is reduced (Viscor et al., 2023; Karpęcka-Gałka & Frączek, 2024).

Pharmacological prophylaxis should remain individualized and medically supervised. Acetazolamide has an established preventive role in selected individuals and itineraries, but it does not license rapid ascent or hard training immediately after arrival. Dexamethasone has selected preventive or treatment roles but should not be treated as a routine performance tool. In competitive athletes, medication decisions must also consider anti-doping regulations, including WADA status and possible TUE requirements (Luks et al., 2024; World Anti-Doping Agency, 2026a; World Anti-Doping Agency, 2026b).

For the target journal, the value of this review lies in translating altitude medicine into sports practice. Coaches, physicians, medical students and recreational athletes need a simple framework: assess risk before travel, ascend gradually, reduce load early, monitor symptoms, avoid sleeping higher when symptomatic, and descend or seek medical treatment when severe neurological or respiratory signs appear.

Future research should better define athlete-specific risk profiles. Important questions include whether particular endurance phenotypes are more susceptible to early AMS, how sex modifies exercise-related desaturation and symptom development, how wearable devices can support symptom-based monitoring, and how altitude training protocols can balance performance goals with safety. Such research should use standardized AMS criteria, clearly described ascent profiles and real training-load data.

5. Conclusions

1. Acute mountain sickness is a relevant sports medicine problem because physically active individuals increasingly participate in mountain exercise, trekking, altitude training and high-altitude competitions.

2. High aerobic fitness does not eliminate AMS risk; endurance athletes may still develop symptoms, especially after rapid passive ascent and vigorous early activity.

3. The most important modifiable preventive strategies are gradual ascent, conservative exercise intensity during the first 24-48 h, flexible itinerary planning and avoidance of further ascent when symptoms are present.

4. The 2018 Lake Louise AMS Score is practical for daily field monitoring. Oxygen saturation and heart rate may support assessment but should not replace symptom-based clinical decisions.

5. Hydration and nutrition support exercise tolerance and recovery, but they are not substitutes for acclimatization. Forced overhydration and reliance on unproven supplements should be avoided.

6. Acetazolamide and dexamethasone require medical supervision; in competitive athletes, anti-doping status and potential TUE requirements must be checked before use.

7. New headache with gastrointestinal symptoms, dizziness, unusual fatigue, ataxia, confusion or dyspnea at rest should prompt rest, cessation of ascent and, when indicated, descent or medical treatment.

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