NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ

Quality in Sport. 2026;51:68417. eISSN 2450-3118.

https://doi.org/10.12775/QS.2026.51.68417

Quality in Sport. eISSN 2450-3118

Journal Home Page https://apcz.umk.pl/QS/index

LOHIN, Mariia-Khrystyna, KAROL, Michał, KOSESKA, Kamila, BOROWICZ, Jan, GÓRECKI, Bartosz, KLOCH, Kinga, ROMANIUK, Patryk, STRAWIŃSKA, Aleksandra and BEDNARCZYK, Małgorzata. Heavy menstrual bleeding and iron-deficiency anemia in physically active women: dietary strategies, screening, and referral red flags – a narrative review. Quality in Sport. 2026;51:68417. eISSN 2450-3118. https://doi.org/10.12775/QS.2026.51.68417

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 19.01.2026. Revised: 01.02.2026. Accepted: 01.02.2026. Published: 10.02.2026.

Heavy menstrual bleeding and iron-deficiency anemia in physically active women: dietary strategies, screening, and referral red flags – a narrative review

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Abstract
Purpose: Heavy menstrual bleeding (HMB) is common in reproductive-age women and may be underreported in sport, where fatigue is often attributed to training load, stress, or low energy availability. This narrative review summarizes evidence on HMB coexisting with iron deficiency (ID) and iron-deficiency anemia (IDA) in physically active women and translates it into practical screening, nutrition, and referral guidance. Materials and Methods: FIGO AUB (PALM–COEIN) and NICE guidance were integrated with sports-medicine evidence on exercise-related iron stress and post-exercise hepcidin regulation. Results: HMB can deplete iron stores before anemia is detected on routine blood counts. In athletes, increased iron demand and losses and transient hepcidin elevations may further reduce absorption and functional iron availability; serial ferritin assessment is often more informative than a single test. Conclusions: An integrated pathway - routine screening questions, appropriate laboratory testing, individualized nutrition, monitored supplementation when indicated, and timely gynecology/hematology referral when red features are present - may improve health protection and training continuity.

Key words: heavy menstrual bleeding; iron-deficiency anemia; female athletes; screening; nutrition;

1. INTRODUCTION

In sport, fatigue can become a kind of everyday currency. Sometimes it is exactly what it seems - a straightforward response to training stimulus that improves with rest. Often, however, the story is more complicated, and then it becomes easy to treat an early warning sign as the “normal cost” of preparation. In physically active women, persistent sleepiness, reduced tolerance for high-intensity work, impaired concentration, or slower recovery are frequently attributed to training load, inadequate energy intake, or stress. This explanation is sometimes correct, but it also carries a risk: it can delay recognition of gynecologic and hematologic problems that directly shape oxygen transport, energy metabolism, and the capacity to adapt to training. Heavy menstrual bleeding (HMB) and the associated depletion of iron stores - whether or not anemia is already present belong to this group. [3,12,13]
This distinction is not merely semantic. In active women, declining iron stores can affect well-being and the ability to tolerate training loads before frank anemia develops and before a standard complete blood count raises concern. In athlete settings, this matters because early symptoms are usually nonspecific: training stops “clicking,” sustaining intensity becomes harder, and recovery stretches from one day to the next, often without an obvious explanation in the training plan. [9–13,18,28] Practically, this can look like a gradual loss of “top-end” pace, an unusual rise in perceived exertion, or a pattern where the athlete can start a session well but cannot maintain intensity across intervals. [9,18,28] When coaches and athletes are used to attributing these changes to training volume or life stress, the underlying cause may remain invisible for months. [5,6]
Modern clinical approaches to HMB increasingly emphasize functional impact - how bleeding affects daily life - rather than attempting to quantify blood loss using a single numerical threshold. [3] From a sports-medicine perspective, this shift is crucial: bleeding that is not described as “extreme” can still steadily drain iron stores across months, especially during periods when erythropoietic demand rises and training volume increases. In many sports, menstrual losses also accumulate alongside exercise-related factors, making iron balance difficult to restore through diet alone, particularly if heavy bleeding persists across multiple cycles. [10,17,19] Beyond training, HMB and abnormal uterine bleeding (AUB) can carry a measurable quality-of-life burden and economic impact, which also translates into missed training days, reduced competition readiness, and the practical stress of managing bleeding in sport environments. [24]
At the same time, HMB is a symptom, not an etiologic diagnosis. It therefore requires differential thinking within the framework of AUB and attention to structural and nonstructural causes described by FIGO in the PALM–COEIN system. [1,2] This point is especially relevant in sport: “iron” is often the first conversation, but without evaluating why bleeding is heavy, management can drift into a cycle of short-term improvement followed by relapse. [1–3] In other words, iron repletion may temporarily improve symptoms while the driver of blood loss remains unchanged, leading to recurrent deficiency and repeated interruptions to training. [3,12,23]
Evidence in active populations suggests that HMB is common and often underdiagnosed. Bruinvels and colleagues reported a high frequency of self-reported heavy bleeding in exercising women, alongside a low rate of seeking

medical help despite frequent iron supplementation. [5] This pattern self-treatment, variable adherence, and delayed work-up has practical consequences: athletes may normalize symptoms, quietly adjust training, or rotate iron supplements without a clear plan for monitoring response. [5,17] Broader sport-focused reviews also emphasize that menstrual cycle related symptoms and bleeding patterns can influence perceived readiness and training continuity, but are still inconsistently addressed in routine sport-health monitoring. [6] In many teams, menstrual health is still discussed only when a problem becomes severe, rather than being integrated into standard screening in the way injuries or sleep are. [6]

The physiology of iron regulation makes the issue even more complex in athletes. Iron is required not only for hemoglobin and oxygen transport but also for mitochondrial enzymes and energy metabolism, so deficiency can affect endurance performance and perceived fatigue even before anemia is diagnosed. [12–15,18] In the classic model, exercise-related "iron stress" reflects increased requirements, increased losses, and periodic reductions in absorption driven in part by hepcidin. [14–17,19] Hepcidin rises in response to inflammatory and exercise stimuli and reduces absorption and iron mobilization; mechanistically it acts by binding to ferroportin and inducing its internalization, limiting iron export from enterocytes and macrophages. [16,30] After prolonged or intense exercise, hepcidin can be elevated for several hours and dietary iron absorption may be reduced during this window, which matters for athletes who habitually take iron with post-training meals or supplements. [10,29] In practice, the athlete with HMB can be trying to "catch up" on iron at precisely the time when absorption is least favorable, particularly during heavy training blocks. [10,17,29]

In parallel, athlete care often involves differential thinking about low energy availability and RED-S, especially when menstrual issues are present. Although HMB is different from functional hypothalamic amenorrhea, the realities can overlap in practice: athletes may restrict intake, struggle with adequate fueling during high training loads, or experience broader symptoms that blur the clinical picture. [20] Reviews discussing eating disorders, the Female Athlete Triad, and RED-S underline that menstrual and iron-related complaints should be assessed in context rather than treated as isolated "nutrition problems." [8,20] This is not about labeling every athlete with fatigue as RED-S; rather, it is a reminder that a structured history and basic laboratory evaluation can prevent both under- and over-attribution. [12,14,20]

Finally, it is important to recognize that in some patients HMB can be the first sign of an underlying bleeding disorder, particularly when heavy bleeding has been present since menarche or when there is a personal/family history of abnormal bleeding. [21–23] Clinical guidance for adolescents emphasizes screening and appropriate management pathways, and hematology-focused reviews highlight that targeted work-up can change management choices and reduce the risk of recurrent iron deficiency. [21–23] For athletes, this matters because the default "take iron and monitor" approach may be insufficient or even misleading if the true driver is gynecologic or hemostatic. [1–3,21–23]

The aim of this narrative review is therefore to present an integrated approach: how to recognize HMB in physically active women, how to interpret iron-related laboratory results in the context of training and potential inflammation, which dietary and supplementation strategies are most defensible, and which alarm features should shift management from "nutrition and monitoring" to timely specialist evaluation. [1–3,9–11,21–23] We focus on a pragmatic pathway that can be implemented in sport settings: routine screening questions, appropriately timed laboratory testing, hepcidin-aware nutrition and supplementation strategies, and referral decisions grounded in AUB frameworks rather than performance metrics alone. [1–3,10,17,29]

2. METHODS AND NARRATIVE REVIEW

A narrative review format was chosen because the topic sits at the intersection of gynecology, hematology, and sport science, and the available literature includes clinical guidelines, observational studies, and mechanistic or applied reviews on iron physiology in athletes. This approach was considered appropriate because the evidence base is heterogeneous: it spans symptom definitions and diagnostic pathways used in gynecology, iron-related laboratory interpretation and treatment strategies used in internal medicine/hematology, and training-related physiology that modifies iron availability in athletes. [1–3,12–17] Rather than attempting a formal quantitative synthesis (which would require comparable outcomes and consistent study designs), the goal of this review was to integrate key clinical and sports-medicine concepts into a practical, athlete-relevant framework. [1–3,17,19]

The review focused on three linked questions that frequently arise in applied sport settings: (1) how HMB should be defined and approached clinically within abnormal uterine bleeding (AUB) frameworks; (2) how iron deficiency and iron-deficiency anemia should be screened, interpreted, and treated when exercise-related factors may alter biomarkers and absorption; and (3) when symptoms or history should trigger referral for gynecologic or hematologic evaluation rather than continued self-management with diet or supplements. [1–3,12,13,21–23] To structure the gynecologic component, the FIGO terminology and the PALM–COEIN classification system were used to emphasize that HMB is a symptom with multiple potential etiologies and therefore requires etiologic thinking. [1,2] Guidance on the clinical assessment and management of HMB was aligned with major evidence-based recommendations, including NICE NG88, which prioritizes functional impact, individualized evaluation, and etiology-directed management. [3]

For the sports-medicine component, priority was given to sources describing exercise-related "iron stress" and the physiology of hepcidin as a regulator of iron absorption and mobilization. [14–17,19] Mechanistic work on hepcidin and ferroportin regulation was used to support key explanatory statements about why oral iron strategies may be less effective when timing and inflammatory stimuli are not considered. [16,30] Applied studies and athlete-oriented syntheses were included where they linked training load to inflammation, hemolysis, or hepcidin expression, or where they evaluated post-exercise changes in absorption that have direct implications for the timing of iron intake. [10,29] In addition, evidence on iron deficiency without anemia and its effects on adaptation or work capacity was included to justify the practical emphasis on early detection, not only the prevention of overt anemia. [18,28]

Because heavy bleeding can sometimes be the first clinical manifestation of an underlying bleeding disorder, papers addressing screening and work-up for bleeding disorders in adolescents and women with menorrhagia were incorporated as a separate evidence stream. [21–23] This was done to ensure that the proposed practical pathway includes decision points that identify athletes who need specialist assessment rather than repeated cycles of supplementation alone. [21–23] Finally, where relevant to athlete care and differential diagnosis, sport consensus guidance on relative energy deficiency in sport (RED-S) and related reviews were considered to acknowledge that menstrual and fatigue presentations in athletes may overlap with broader energy-availability concerns, even when HMB is the primary symptom. [8,20]

Overall, the selected literature was used to build an integrated narrative that moves from definitions and classification (AUB/HMB) through athlete-specific modifiers of iron balance (training-related losses and hepcidin-mediated changes in absorption) to practical screening, interpretation of laboratory results, and referral thresholds. [1–3,10,14–17,19,21–23,29,30] The intention was to translate these concepts into a realistic approach that can be applied in active populations, where symptom reporting may be delayed and where performance-related explanations can unintentionally overshadow gynecologic and hematologic causes. [5,6,12,17]

3. HMB IN PHYSICALLY ACTIVE WOMEN: DEFINITIONS, CLASSIFICATION, AND WHY THE PROBLEM OFTEN REMAINS HIDDEN

In clinical practice, heavy menstrual bleeding (HMB) is considered present when menstrual blood loss becomes heavy enough to interfere with normal functioning and quality of life. This definition intentionally shifts attention away from "numbers" and toward lived impact: bleeding that forces very frequent changes of menstrual products, causes leakage despite appropriate protection, disrupts sleep, interferes with work or school responsibilities, limits training participation, or is accompanied by symptoms compatible with iron depletion and anemia. [3,24] This functional approach is particularly useful in physically active populations, because athletes may normalize symptoms for months and still describe them as "manageable," even while training quality, recovery, and day-to-day well-being gradually decline. [3,5,6]

In routine care, objective measurement of menstrual blood loss is uncommon. Clinicians therefore rely primarily on what the patient notices and reports-pattern, duration, the practical burden of product use, and associated symptoms. [3] In the sports setting, these same questions can be adapted into brief screening prompts that are easier to answer than "How many milliliters do you lose?" and more likely to capture clinically meaningful bleeding. Importantly, HMB is not only a clinical nuisance: abnormal uterine bleeding (AUB), including HMB, is associated with substantial reductions in health-related quality of life and measurable economic burden, reinforcing that the problem is not trivial even when hemoglobin remains "normal." [24]

Where a more structured estimate is needed, validated tools such as the pictorial blood loss assessment chart (PBAC) can support communication and follow-up over time. [4] PBAC is often most useful as a practical monitoring tool: it allows athletes and clinicians to track whether symptoms are stable, improving, or worsening across cycles, and it can make consultations more concrete-especially when the athlete struggles to describe what "heavy" means in words. [4] In applied settings, the key advantage is not perfection of measurement but consistency: repeated PBAC-based tracking can help identify a progressive trend that might otherwise be missed in busy training periods. [4]

Crucially, HMB must be situated within the broader concept of AUB, because heavy bleeding is a symptom rather than an etiologic diagnosis. The FIGO PALM–COEIN system provides a clinically useful structure by classifying AUB causes into structural and nonstructural categories (PALM: Polyp, Adenomyosis, Leiomyoma, Malignancy/hyperplasia; COEIN: Coagulopathy, Ovulatory dysfunction, Endometrial, Iatrogenic, Not otherwise classified). [1,2] This classification matters in sport for a very practical reason: if the diagnostic step is skipped, management can easily collapse into a one-dimensional "iron problem," where supplementation temporarily improves laboratory markers but the underlying driver of blood loss persists and relapse becomes likely. [1–3] In other words, treating low ferritin without asking why bleeding is heavy can create a cycle of short-term stabilization followed by repeated depletion. [1–3]

The "hidden" nature of HMB in athletes is multifactorial. Cultural norms and embarrassment remain powerful barriers, and many individuals have grown up believing that heavy bleeding is simply something to endure. [3,5,6] Sport adds extra pressures: the expectation of uninterrupted training availability, fear of being perceived as "less resilient," and the practical inconvenience of discussing intimate symptoms with coaching or medical staff-especially in environments where menstrual health is not normalized as part of routine monitoring. [5,6] Survey data in exercising women show that self-reported heavy bleeding can be common, yet medical help-seeking remains low; at the same time, iron supplementation is frequently used, suggesting that many athletes attempt self-management without a full diagnostic evaluation. [5] This pattern can delay recognition of AUB etiologies and can also postpone identification of important differential diagnoses such as bleeding disorders, where HMB may be an early presenting feature and changes the appropriate work-up and management plan. [21–23]

In practice, the consequence is that iron deficiency may be "treated" repeatedly while HMB remains unaddressed. [5] From a clinical perspective, this is a missed opportunity: earlier identification of HMB within an AUB framework allows both symptom relief and prevention of recurrent iron depletion, which is often more effective than repeatedly rebuilding iron stores after each cycle. [1–3] For athlete health services, this supports a simple takeaway: asking routine, normalized questions about bleeding impact is not an optional add-on-it is a prevention strategy that can reduce long-term burden and protect training continuity. [3,5,6,24]

4. IRON DEFICIENCY AND ANEMIA IN SPORT: WHY PHYSICAL ACTIVITY RAISES THE STAKES

Iron is required not only for hemoglobin and oxygen transport but also for a wide range of enzymes involved in mitochondrial function and energy metabolism. [12–16] In sport, that matters in concrete terms: iron status influences aerobic capacity, the ability to sustain high-intensity work, and-often earlier and less dramatically-day-to-day fatigue, concentration, and recovery between sessions. [12–15] The clinical point is simple but important: performance-relevant symptoms may appear before anemia is obvious on a routine complete blood count. [12–14] This is one reason why athlete health services increasingly treat iron status as a functional parameter rather than a "binary" normal/abnormal hemoglobin problem. [17,19]

Sports-medicine and hematology literature consistently distinguish between iron deficiency with anemia and iron deficiency without anemia. [9–11,12,13] Iron-deficiency anemia (IDA) can reduce oxygen-carrying capacity and therefore clearly impair endurance performance, but iron deficiency without anemia can still reduce training quality and adaptation by limiting iron-dependent metabolic processes. [9–11,18,28] Experimental evidence in previously untrained women shows that tissue iron deficiency without anemia can impair improvements in endurance capacity after aerobic training, supporting the idea that "low iron but normal hemoglobin" is not automatically benign in active populations. [18] Broader physiological syntheses also link iron deficiency to reduced work capacity and increased perception of effort, which aligns with the athlete's real-world experience of sessions feeling disproportionately hard. [28] In athlete-focused reviews, this is reflected in the observation that iron deficiency may be associated with reduced exercise economy and poorer training adaptation even when anemia is not present. [9–11,18,21]

In the classic model, exercise-related "iron stress" reflects three interacting mechanisms: increased requirements, increased losses, and periodic reductions in absorption. [9,14–17] Requirements can rise because training stimulates erythropoiesis and tissue remodeling; losses may occur through mechanisms such as hemolysis, sweating, gastrointestinal microbleeding, and-depending on the athlete-dietary restriction or low iron intake. [14–17,19] The practical consequence is that athletes often operate close to the threshold where intake only barely matches needs, and any additional loss can push stores down over weeks or months. [17,19] When heavy menstrual bleeding (HMB) is present, the athlete begins from a higher-loss baseline, and training can make restoration of iron balance harder even when dietary intake appears reasonable on paper. [3,9–11,17]

A key biological regulator in this context is hepcidin, the central hormone controlling systemic iron homeostasis. [14–17] Hepcidin rises in response to inflammation and to exercise-related stimuli and transiently reduces intestinal iron absorption while also limiting iron mobilization from stores. [14–17] Mechanistically, hepcidin reduces iron availability by binding to ferroportin (the iron exporter on enterocytes and macrophages) and inducing its internalization, which decreases iron export into the circulation. [30] This mechanism helps explain why an athlete may "do everything right" in terms of eating iron-rich foods or taking supplements and still see slow improvement: if intake repeatedly coincides with periods of elevated hepcidin, absorption efficiency can be lower than expected. [10,14–17]

Experimental and applied evidence indicates that after prolonged exercise, hepcidin can rise and dietary iron absorption from a meal may be reduced for several hours. [10,29] In one applied study, a prolonged bout of running increased hepcidin and decreased dietary iron absorption in trained runners, supporting the practical idea that timing matters-not only the dose of iron. [10] Earlier mechanistic work also connects training surface and intensity with inflammation, hemolysis, and hepcidin expression, reinforcing that the hepcidin response is not an abstract laboratory phenomenon but a real-world feature of training stress. [29] For many athletes, this matters most during heavy microcycles or competition periods, when training is frequent and the "recovery window" becomes the default time for meals and supplements. If oral iron is routinely taken immediately post-exercise, it may repeatedly fall into a lower-absorption window. [10,17,29]

Sport-oriented syntheses focused on female endurance athletes therefore highlight the value of "hepcidin-aware" strategies, including timing oral iron away from the immediate post-exercise period, aligning monitoring with training phases, and interpreting iron biomarkers with attention to recent training load and inflammatory states. [7,17] This approach does not suggest that athletes should chase perfect timing at the expense of adherence; rather, it acknowledges that small practical adjustments (e.g., taking iron at a time less likely to coincide with post-exercise hepcidin elevation) may improve the odds of repletion when deficiency is present. [7,10,17]

Finally, iron-related problems in athletes rarely occur in isolation from the broader context of energy availability. Menstrual disturbances can be embedded in low energy availability and RED-S, and this overlap is clinically relevant even when HMB is the primary presenting complaint. [8,20] If an athlete is restricting intake, struggling to meet carbohydrate needs, or maintaining a chronically low energy budget, the diet may not support iron intake and absorption sufficiently, and fatigue may be incorrectly attributed to either "just training" or "just iron." [8,20] In practice, a balanced approach is needed: evaluate bleeding and iron status systematically, but also consider fueling patterns and broader RED-S risk when symptoms and history suggest it. [20]

5. SCREENING AND DIAGNOSIS: HOW TO ASK, WHAT TO TEST, AND HOW TO INTERPRET RESULTS IN AN ATHLETE

In sport, the largest barrier to HMB screening is often not laboratory access but the conditions for disclosure. Menstrual health should be treated as a routine athlete-health parameter, alongside sleep quality, injury history, illness episodes, and tolerance of training load. [3,6] In many settings, athletes only disclose menstrual problems when symptoms become disruptive or embarrassing, so the goal of screening is to create a "normal" space for short, factual questions rather than waiting for a crisis. [5,6] A useful practical rule is to ask in the same neutral tone as questions about injuries or gastrointestinal issues-because the way the question is asked often determines whether the answer is honest. [6]

In clinical terms, screening should focus on functional impact and recognizable "red flag" features of heavy bleeding rather than on attempts to quantify blood loss precisely. [3] In practical terms, it is useful to ask about indicators suggestive of HMB such as the need to change menstrual products more often than every two hours, "flooding" or sudden heavy flow, overnight leakage, passing large clots, using two methods of protection at once, or limiting training/competition because of bleeding. [3,4] If an athlete struggles to describe heaviness, a structured tracking tool such as the PBAC can support communication and follow-up, especially when monitoring whether interventions are helping across cycles. [4] Because HMB is part of the broader abnormal uterine bleeding (AUB) framework, history-taking should also include cycle regularity, pain, intermenstrual bleeding, postcoital bleeding, bleeding after a period of stability, and contraception or medication use that may influence bleeding patterns. [1–3]

Equally important is remembering that HMB is not a diagnosis by itself. The FIGO PALM–COEIN system exists precisely to encourage etiologic thinking and to separate structural from nonstructural causes of AUB. [1,2] In athlete care, this matters because "treat the iron" is often the first response, but persistent HMB requires evaluation of why bleeding is heavy in the first place. [1–3] A focused history can also identify clues suggesting a bleeding disorder-especially heavy bleeding since menarche, easy bruising, frequent epistaxis, prolonged bleeding after dental work or minor procedures, or a family history of abnormal bleeding-which should shift the plan toward appropriate specialist work-up. [21–23] These features are particularly important to ask about directly, because athletes may not volunteer them unless prompted. [21–23]

Laboratory evaluation should include, at minimum, a complete blood count (CBC) and, when iron deficiency is suspected, assessment of iron stores and related markers interpreted in clinical context. [12,13] A CBC is essential because anemia changes both urgency and management priorities, but a normal hemoglobin does not exclude clinically relevant iron deficiency in athletes. [12–14,18] For that reason, iron assessment should not rely on hemoglobin alone; iron deficiency can exist without anemia and still be associated with reduced training adaptation and increased fatigue. [18,28] In practice, serial monitoring is often more informative than a single measurement, because athletes' iron balance can shift across training blocks and seasons. [12,17,19]

Interpretation of ferritin deserves special attention. Ferritin is commonly used as a marker of iron stores, but it is also an acute-phase reactant; inflammation, infection, injury, and heavy training can raise ferritin transiently and mask depleted stores. [14–17] In athletes, this is particularly relevant because competition, recent illness, musculoskeletal injury, or an unusually intense microcycle can shift inflammatory signaling and therefore alter iron markers. [14–17,29] Mechanistically, inflammatory pathways and hepcidin regulation can change iron distribution and availability, meaning that "normal-looking" ferritin in the wrong context can be misleading. [14–17] For this reason, trends over time-ideally with consistent sampling conditions-may be more informative than a single result taken after a hard event or during illness. [12,17]

From a practical standpoint, it is helpful to standardize the timing and conditions of testing whenever possible. If a sample is taken immediately after a demanding training block or shortly after competition, results may reflect transient physiological responses rather than a stable baseline. [14–17,29] Aligning blood draws with relatively stable training periods, documenting recent illness/injury, and repeating measurements when results are inconsistent with symptoms can reduce misinterpretation. [12,17,29] This approach fits athlete care well because decisions about supplementation, dietary changes, or referral often depend not on one number but on a pattern: symptoms, bleeding history, and how biomarkers behave across time. [3,12,17]

Finally, screening should be linked to action. If history suggests HMB within an AUB framework, evaluation should not stop at iron replacement; persistent heavy bleeding, intermenstrual or postcoital bleeding, marked pain, or sudden changes in bleeding pattern warrant etiologic evaluation according to clinical guidance. [1–3] Similarly, if bleeding-disorder features are present, referral and appropriate hematologic assessment should be considered early, because this can change both gynecologic management and the strategy for preventing recurrent iron deficiency. [21–23] In athlete settings, making these pathways explicit helps avoid the common scenario in which the athlete repeatedly self-supplements iron while the underlying driver remains untreated. [5,21–23]

6. DIETARY STRATEGIES: IMPROVING THE ODDS OF IRON REPLETION WITHOUT OVERLOADING THE DIET

Nutrition advice around iron can easily collapse into the simplistic message of "eat more iron-rich foods." In physically active women, effectiveness depends not only on the total amount of iron consumed but also on bioavailability, the presence of absorption inhibitors, and physiologic "windows" shaped by inflammation and hepcidin regulation. [9–11,14–17] In practice, athletes often follow diets that look "clean" and nutrient-aware on paper, yet still struggle with iron repletion-especially when training volume is high or menstrual blood losses continue across multiple cycles. [9–11,17,19] For that reason, nutrition in this setting is less about a single "perfect" food list and more about building repeatable habits that increase the probability of absorption over weeks rather than days. [17,19]

A first goal is to increase dietary iron density within a realistic energy budget. This point matters because athletes do not always have unlimited room for extra calories, particularly in endurance sports or in disciplines where body mass is closely monitored. [19,20] In addition, iron supports hemoglobin synthesis and oxygen transport, but it is also required for iron-dependent enzymes involved in cellular energy metabolism, which helps explain why symptoms such as fatigue or reduced training tolerance can appear even before anemia is clearly diagnosed. [13–15,18] In practical terms, improving iron density may involve prioritizing iron-containing foods at one or two consistent meals per day, rather than trying to "fix everything" at once and ending up with a plan that is too complicated to follow during heavy training weeks. [17,19]

Heme iron sources are generally more bioavailable than nonheme plant iron, and women are a recognized risk group for iron depletion, which makes this difference clinically relevant. [13–15] For athletes who eat little meat or follow plant-forward patterns, nonheme iron strategies can still work, but they depend more strongly on meal composition and absorption conditions. [14,15] Pairing nonheme iron sources with vitamin C–rich foods can improve absorption, while common inhibitors-coffee, tea, and high-dose calcium-are often best handled through spacing rather than elimination. [15] This "spacing" approach tends to be more realistic in athlete life: it allows someone to keep their normal habits (e.g., morning coffee) while simply moving iron-rich meals or supplements away from the highest-inhibition window. [15,19]

Training adds the hepcidin layer. Hepcidin is a central regulator of iron homeostasis and can increase after exercise, transiently reducing intestinal absorption and limiting iron mobilization from stores. [14–17] Mechanistically, hepcidin acts by binding to ferroportin and promoting its internalization, which reduces iron export from enterocytes and macrophages into the circulation. [30] This mechanism provides a practical explanation for a common athlete experience: "I'm taking iron and eating well, but the numbers barely move." [14–17] If an iron-rich meal or an oral iron supplement is taken immediately after a hard session, intake may coincide with a period of reduced absorption. [10,14–17] Applied evidence shows that prolonged running can increase hepcidin and decrease dietary iron absorption for several hours, supporting the practical rationale for avoiding the immediate post-exercise window when feasible. [10] Earlier work also links training intensity and surface with inflammatory and hemolytic responses and changes in hepcidin expression, reinforcing that this is not a purely theoretical concern during demanding training phases. [29]

For many athletes, timing therefore becomes as important as iron content itself-not in the sense that every dose must be "perfect," but in the sense that small, sustainable adjustments can meaningfully improve absorption over time. [7,10,17,29] Sport-oriented syntheses focused on female endurance athletes emphasize the value of hepcidin-aware planning, which can be combined with routine monitoring to adapt strategy during heavy training blocks, illness periods, or competition phases. [7,17] Importantly, dietary strategies can support repletion and reduce recurrence risk, but they do not replace diagnostic evaluation when ongoing blood loss (e.g., HMB) persists or when symptoms and history suggest additional risk factors that require medical management. [1–3,21–23]

7. SUPPLEMENTATION AND ITS LIMITATIONS: WHEN IT HELPS, WHEN IT BACKFIRES, AND WHEN IT IS NOT ENOUGH

In clear iron deficiency and especially iron-deficiency anemia, diet alone is often insufficient, particularly when heavy menstrual bleeding (HMB) persists and the cause of bleeding is not treated. [1–3,12,13,17] Clinical guidance on iron-deficiency anemia emphasizes that iron replacement should be guided by diagnosis and followed with an assessment of response, rather than treated as an open-ended, self-directed practice. [12,13] In sport settings, however, supplementation is often initiated early and informally-sometimes because fatigue is interpreted as "normal training tiredness," and sometimes because athletes prefer a quick fix that does not require discussing menstrual bleeding. [5,6,17] This creates a predictable pattern: short-term improvement, inconsistent adherence, and then recurrence when losses continue or the regimen is not tolerable. [12,17]

At the same time, supplementation is an area where "shortcuts" are common: high doses taken without diagnostics, no monitoring of response, gastrointestinal side effects, and poor adherence. [12,13,17] In practice, athletes often report nausea, constipation, abdominal discomfort, or a feeling that iron "does not sit well," which can quickly reduce adherence-especially during travel or competition periods when routine and food choices are already disrupted. [12,17] Another common problem is treating numbers rather than the clinical picture: supplementing aggressively when ferritin is borderline but symptoms and context suggest transient inflammatory effects, or-conversely-stopping too early once hemoglobin normalizes even though stores remain low. [12–15,17] Because ferritin can be influenced by inflammation and training stress, interpretation and follow-up should be contextual rather than automatic. [14–17,29]

Evidence also indicates that "more" is not necessarily "better." In iron-depleted women, alternate-day dosing of oral iron given as a single dose may improve absorption compared with consecutive-day dosing and twice-daily split dosing, and it can also be easier to tolerate. [11] The practical implication is important for athlete care: if side effects are limiting adherence, changing the regimen may be more effective than increasing the dose. [11,17] This supports a "minimum effective" mindset-use a regimen that the athlete can realistically sustain, then verify response and adjust as needed. [11,12,17]

In athlete practice, a pragmatic approach is therefore to pair supplementation decisions with monitoring, align dosing with training schedules, and avoid repeatedly "resetting" therapy without reassessing ongoing losses. [11,12,17] This is particularly relevant because exercise-induced hepcidin responses can transiently reduce absorption; if iron is always taken in the immediate post-exercise window, the effective absorbed dose may be lower than expected. [10,14–17] Applied evidence showing reduced dietary iron absorption after prolonged running provides a practical rationale for avoiding the immediate post-exercise period for oral iron when feasible. [10] In real life, this does not require perfection: even shifting iron intake to a time of day less likely to coincide with elevated post-exercise hepcidin can be a workable compromise. [10,17] Athlete-focused reviews highlight the value of hepcidin-aware planning and follow-up during different training phases. [7,17]

Regardless of regimen, the key clinical principle remains: supplementation treats a consequence, not the etiology of HMB. [1–3] Guidelines on abnormal uterine bleeding stress that HMB should be approached within an etiologic framework (PALM–COEIN), because persistent heavy bleeding requires evaluation and, when indicated, etiology-directed management rather than indefinite iron replacement alone. [1–3] This is also where bleeding disorders must remain on the radar: HMB can be a presenting feature of an underlying hemostatic disorder, and identifying this changes management priorities and referral decisions. [21–23] In other words, supplementation is often necessary and helpful, but it works best when it is used as part of a broader plan: confirm deficiency, support adherence with tolerable dosing, monitor response, and address the source of ongoing losses. [1–3,12,13,17]

8. ALARM FEATURES AND URGENT REFERRAL CRITERIA: WHEN TO STOP OPTIMIZING DIET

In sport, it is easy to focus on performance-linked metrics such as ferritin and hemoglobin, because they are measurable and easy to compare across training blocks. However, heavy menstrual bleeding (HMB) is not merely a "training inconvenience" and should not be reduced to iron markers alone. It is a symptom within the abnormal uterine bleeding (AUB) framework and can signal an underlying condition that requires causal evaluation and, in many cases, etiology-directed treatment. [1–3] Alarm features are not meant to alarm for their own sake; they provide a practical threshold for when the "optimize diet + monitor labs" approach is no longer sufficient and when timely referral is necessary to protect health and prevent repeated cycles of depletion. [1–3,12,13]

A useful way to think about red flags in athlete care is to group them into three domains: (1) physiological instability or likely severe anemia, (2) gynecologic features that raise suspicion of structural or other AUB etiologies, and (3) features suggesting an underlying hemostatic disorder. [1–3,12,13,21–23] This structure helps clinicians and support staff act consistently, especially in sport settings where symptoms may be normalized and disclosure delayed. [3,5,6]

1. Symptoms suggestive of severe anemia or significant physiologic consequences of bleeding

Particularly concerning are symptoms consistent with severe anemia or meaningful physiological compromise, such as progressively worsening weakness, presyncope or syncope, palpitations, chest discomfort, or dyspnea disproportionate to effort. [12,13] In athletes, a key issue is that reduced performance may appear "explainable" by training load, but instability symptoms are not an acceptable cost of sport and should prompt urgent clinical assessment. [12,13] Clinical guidance on iron-deficiency anemia emphasizes that severity and symptom burden should guide urgency; if an athlete describes escalating shortness of breath on previously tolerable sessions or recurrent near-fainting, the priority shifts from training adjustments to medical evaluation. [12,13] Even when hemoglobin is not yet critically low, the combination of heavy ongoing loss and symptomatic intolerance can progress quickly, particularly if bleeding continues across cycles. [3,12,13]

2. Bleeding-pattern changes or pelvic symptoms requiring gynecologic evaluation regardless of iron status

A second group includes bleeding symptoms that warrant gynecologic evaluation even if iron markers are only mildly abnormal. Sudden changes in bleeding pattern, new intermenstrual bleeding, postcoital bleeding, or bleeding that becomes progressively heavier over a short time period should trigger etiologic evaluation within PALM–COEIN. [1,2] Significant pelvic pain, pressure symptoms, or a sensation of pelvic "fullness" also increases suspicion of structural causes, and the PALM–COEIN framework is specifically designed to prevent clinicians from treating HMB as a standalone diagnosis. [1,2] NICE guidance similarly emphasizes that assessment should be guided by symptoms and suspected etiology, not only by laboratory outcomes or the patient's ability to cope. [3] In sport, this is important because athletes may tolerate and normalize symptoms until they become disruptive; screening and referral thresholds therefore need to be explicit rather than left to subjective interpretation. [3,6]

3. Features suggesting an underlying bleeding disorder (hematology-oriented red flags)

A third area concerns suspected hemostatic disorders. HMB since menarche, a family history of bleeding diathesis, easy bruising, frequent epistaxis, or prolonged bleeding after minor procedures or dental work should raise concern. [21–23] This is clinically important because HMB can be the first obvious sign of a bleeding disorder and identifying this changes both diagnostic priorities and management options. [21–23] In practice, athletes often present first with fatigue or "low ferritin," but the history may reveal long-standing bleeding symptoms that were never framed as abnormal. [21–23] Recognizing this pattern helps avoid repeated cycles of iron repletion followed by relapse when the underlying bleeding tendency is not addressed. [21–23]

Why referral decisions matter in athlete settings

In many teams and clinics, the default response to suspected HMB is to recommend iron supplementation and dietary changes. While these are often necessary, they should not delay appropriate specialist input when red flags are present. [1–3,12,13,17] The cost of delay is not only medical-recurrent depletion can erode training continuity, increase perceived fatigue, and create repeated disruptions that athletes often experience as frustrating and demoralizing. [3,5,6] Clear referral criteria help prevent a cycle where the athlete becomes responsible for "managing" symptoms alone. [3,5]

Brief note on medical management options (after confirmation of HMB/AUB)

When HMB is confirmed, medical management options-selected according to etiology, symptoms, and patient preferences-may include levonorgestrel-releasing intrauterine systems, NSAIDs, or antifibrinolytics. [25–27] The evidence base for these approaches has been summarized in systematic reviews, and the key practical point for athlete care is that reducing bleeding can be as important for long-term iron balance as replacing iron itself. [25–27] In other words, if heavy bleeding continues, even a well-designed supplementation plan may function as a temporary patch rather than a durable solution. [1–3]

9. A PROPOSED MANAGEMENT PATHWAY IN PHYSICALLY ACTIVE SETTINGS

A workable approach in physically active settings is less about a one-time intervention and more about building a repeatable routine that links education, screening, treatment, and follow-up across the season. When menstrual health is not embedded into routine monitoring, it often disappears between microcycles and competitions, and problems are addressed only after performance declines or symptoms become difficult to ignore. [6] Surveys suggest that even when heavy bleeding is present, many athletes do not seek medical help and instead self-manage with intermittent supplementation, which increases the likelihood of recurrent depletion and delayed etiologic assessment. [3,5,6]

In practical terms, the pathway begins with normalization. Brief, neutral questions about cycle regularity and bleeding impact can be asked alongside standard athlete-health items such as sleep, injury history, and illness episodes. [3,6] NICE guidance emphasizes functional impact and symptom-led assessment, which fits athlete care well: athletes usually describe the burden of leakage, frequent product changes, or activity limitation more clearly than they can quantify blood loss. [3] When tracking is useful for follow-up, PBAC can support more consistent communication and help capture whether bleeding is stable, improving, or worsening across cycles. [4]

When HMB is suspected, the history should be anchored in the AUB framework rather than treated as "an iron problem." FIGO PALM–COEIN is useful here because it reinforces that HMB is a symptom with multiple potential etiologies, including structural and nonstructural causes. [1,2] A focused history should also flag features that warrant early referral-intermenstrual or postcoital bleeding, significant pelvic pain or pressure, and abrupt changes in bleeding pattern. [1–3] At the same time, a small set of questions about bleeding tendency is important, because HMB may be the first presenting feature of a hemostatic disorder; heavy bleeding since menarche, easy bruising, prolonged bleeding after minor procedures, or a family history of bleeding are the kinds of clues that should trigger appropriate hematologic evaluation. [21–23]

Laboratory assessment should then be used to integrate symptoms and history with objective data. A complete blood count is necessary, but a normal hemoglobin does not exclude clinically relevant iron deficiency in athletes. [12–14,18] Because ferritin is an acute-phase reactant and training load, illness, or injury can transiently affect biomarkers, interpretation should be contextual and trends over time are often more informative than a single snapshot. [14–17,29] For athlete services, it is helpful to document recent competition, acute illness, or unusually heavy training before sampling so results are not overinterpreted in the wrong context. [12,17,29]

Nutrition strategies can support iron repletion by increasing iron density and improving bioavailability in a way that the athlete can sustain during training and travel. [17,19] If low energy availability or restrictive eating is suspected, nutritional support should consider the broader context because under-fueling can undermine recovery and make iron repletion harder. [8,20] When deficiency is clear or response to diet is inadequate, oral supplementation is often needed, but the regimen should be tolerable and paired with monitoring rather than repeatedly restarted without reassessing ongoing losses. [11–13,17] Evidence in iron-depleted women suggests that alternate-day dosing as a single dose can improve absorption compared with consecutive-day or split dosing, which has practical implications for adherence. [11] In athletes, timing also matters: post-exercise hepcidin elevations can reduce absorption for several hours, and applied evidence shows reduced dietary iron absorption after prolonged running, supporting the rationale for avoiding the immediate post-exercise window when feasible. [10,14–17,29]

Importantly, long-term stability usually requires reducing losses when bleeding remains heavy. Etiology-directed management of HMB within the AUB framework should proceed in parallel with iron replacement, especially when red flags are present or when repeated cycles of depletion occur. [1–3] Evidence-based options to reduce bleeding include levonorgestrel-releasing intrauterine systems, NSAIDs, and antifibrinolytics, chosen according to etiology and patient preferences. [25–27] Over a season, the most meaningful marker of success is not a single ferritin number but a stable pattern: fewer relapses, more predictable training tolerance, and earlier recognition when bleeding patterns change or symptoms worsen. [1–3,6,17]

10. CONCLUSIONS

Heavy menstrual bleeding (HMB) is common among physically active women and is often underestimated in sport settings, contributing to delayed recognition of iron deficiency (ID) and iron-deficiency anemia (IDA). [3,5,6] In many athlete environments, symptoms such as fatigue, reduced training tolerance, or slower recovery are first explained by training load, stress, or low energy availability, which can be true-but this “default interpretation” may also postpone a necessary gynecologic and hematologic work-up. [3,6] The practical consequence is that athletes may continue to train through progressive depletion, sometimes adapting their training expectations downward long before the problem is formally identified. [5,6]

The clinical relevance of HMB is not limited to declines in hemoglobin. Functional consequences of low iron for energy metabolism, exercise economy, and the ability to tolerate repeated training stimuli may appear earlier, sometimes when standard blood counts still look acceptable. [9–15,18,28] This distinction matters in athlete care, because the earliest warning signs are usually nonspecific-training feels “harder than it should,” maintaining intensity becomes difficult, and recovery becomes less predictable. [9–11,18,28] Evidence from exercise and clinical literature supports that iron deficiency without anemia can still impair adaptation in endurance capacity and reduce work capacity, reinforcing the need to take early symptoms seriously rather than waiting for overt anemia. [18,28]

In athletes, iron balance is particularly sensitive because training can increase requirements and losses, while post-exercise hepcidin responses may transiently reduce absorption and functional iron availability. [10,14–17,29,30] This makes timing and planning relevant: even with good dietary intent, iron intake may be less effective if it repeatedly coincides with periods of reduced absorption. [10,14–17] Athlete-focused syntheses highlight the practical value of hepcidin-aware strategies and of monitoring iron status across training phases rather than relying on single “snapshot” tests. [7,17] At the same time, nutrition strategies and supplementation-while often necessary-cannot substitute for etiologic evaluation when bleeding remains heavy. [1–3,17]

For these reasons, screening should begin with normalized, routine questions about bleeding features and functional impact, followed by laboratory assessment interpreted in the context of training load and possible inflammation. [3,12–17,29] Using a structured AUB framework such as FIGO PALM–COEIN helps ensure that HMB is approached as a symptom with potential structural and nonstructural causes, rather than as a problem reduced to iron markers alone. [1,2] Crucially, persistent or abruptly changed bleeding patterns, suspected bleeding-disorder features, severe anemia, or instability symptoms should prompt timely referral to gynecology and/or hematology. [1–3,12,13,21–23] In practice, the most protective approach is an integrated pathway: education that supports disclosure, consistent screening, appropriate testing, individualized nutrition, monitored supplementation when indicated, and early referral when red flags are present. [1–3,5–7,11–17,21–23]

DISCLOSURE

The authors declare that they have no relevant financial or non-financial interests to disclose.

AUTHOR CONTRIBUTIONS

Conceptualization: M.K.L.
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Visualization: A.S.
Supervision: M.K.L.
Project administration: M.K.L.
Funding acquisition: none.

All authors have read and agreed with the published version of the manuscript.

FUNDING STATEMENT

This research received no external funding.

INSTITUTIONAL REVIEW BOARD STATEMENT

Not applicable. This study is a narrative review and did not involve human participants or animals.

INFORMED CONSENT STATEMENT

Not applicable. No human participants were involved in this study.

DATA AVAILABILITY STATEMENT

No new data were created or analyzed in this research. Data sharing is therefore not applicable.

ACKNOWLEDGMENTS

Not applicable.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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