femington

Int. J. Clin. Res. Med. Sci. (2026) 1(4):1–13
Article ID: IJCRMS-2026-1033

Optimising Lean Mass and Performance: A Sports Nutrition Framework for Protein Intake in Track and Field Athletes During Energy Balance and Restriction

Yagnesh Ahir
yagnesh_ahir@hotmail.com
Independent Researcher

Abstract

Track and field athletes across sprinting, jumping, throwing, endurance, and race walking disciplines require strategic protein nutrition to support training adaptation, manipulate body composition, and optimise power-to-weight or strength-to-weight ratios. This review synthesises current evidence to establish practical protein recommendations that exceed general population guidelines (0.8–1.0 $g \cdot kg^{-1} \cdot day^{-1}$) while addressing the unique demands of weight-stable and energy-restricted athletic phases. For athletes maintaining body weight or aiming for lean mass gain, daily protein intakes of approximately 1.6 $g \cdot kg^{-1} \cdot day^{-1}$, distributed as 0.3–0.4 $g \cdot kg^{-1}$ per meal across 3–4 feedings, optimally stimulate muscle protein synthesis; when using whole foods rather than isolated proteins, slightly higher per-meal doses (0.4–0.5 $g \cdot kg^{-1}$) are recommended. During voluntary energy restriction for high-quality weight loss defined as fat mass reduction with preservation or gain of lean mass daily protein requirements increase to 1.6–2.4 $g \cdot kg^{-1} \cdot day^{-1}$, with per-meal targets of 0.4–0.5 $g \cdot kg^{-1}$. This elevated intake counteracts the energy-conservation-induced suppression of muscle protein synthesis, particularly when combined with resistance exercise. Mechanistic evidence shows that higher protein availability during energy deficit restores postprandial anabolic responses and mitigates lean mass loss without adverse renal or bone effects in healthy individuals with normal renal function. Leucine-rich, rapidly digested protein sources provide superior stimulation of muscle protein synthesis compared to slower proteins. The paper provides event-specific example meal plans for an 80 kg sprinter/jumper and a 55 kg distance runner, illustrating practical translation. Importantly, protein increases should primarily replace dietary fat rather than carbohydrate to preserve training quality, and a gradual weight loss rate ($\sim$ 0.5 kg/week) is recommended. The sports nutrition framework presented here integrates daily and per-meal protein targets, macronutrient trade-offs, and resistance training as a synergistic stimulus, offering evidence-based guidance for track and field athletes seeking to optimise body composition and performance in both energy balance and energy restriction.

Keywords

• Protein intake • Track and field • Muscle protein synthesis • Energy restriction • Body composition • Sports nutrition • High-quality weight loss • Training adaptation

1. Introduction

Track and field encompasses events with markedly different physiological demands, from short-duration sprinting and throwing to distance running and technically demanding jumps. Athletes in these disciplines therefore require nutrition plans that reflect their event, training load, and performance objectives. Protein

© 2026 Femington Academic Publishing. All rights reserved.

is especially relevant because it supplies amino acids for muscle repair and remodelling after training and supports the adaptations elicited by repeated exercise exposure [1, 2].

Sports training generally raises protein needs above the allowance intended for sedentary adults. The population recommendation of 0.8–1.0 $g \cdot kg^{-1} \cdot day^{-1}$ is designed to maintain nitrogen balance under relatively low activity demands. It does not necessarily provide sufficient substrate for athletes undertaking substantial training volumes, in whom protein supports synthesis, helps limit exercise-related breakdown, and contributes to tissue adaptation [3]. The contrast is evident across track and field: endurance athletes may cover more than 100–150 km in a week, while sprinters and power athletes can complete multiple demanding sessions in a single day.

Daily protein totals alone do not describe the full nutritional strategy. The size, quality, and spacing of individual servings also influence the muscle's response to feeding. Evidence comparing different daily eating patterns suggests that distributing protein across relatively regular meals can support 24-hour muscle protein synthesis more effectively than concentrating much of it in one meal [4]. Accordingly, recommendations commonly specify approximately 0.3–0.4 $g \cdot kg^{-1}$ at each meal to provide a sufficient anabolic stimulus.

Many track and field athletes seek to change body composition while retaining the physical qualities required for their event. In particular, reducing fat mass without sacrificing lean tissue can improve power-to-weight or strength-to-weight ratios. This objective becomes difficult during an energy deficit, when dietary planning must provide enough protein to support muscle retention while preserving carbohydrate availability for demanding training [5, 6]. Such an approach is referred to here as high-quality weight loss.

An energy deficit initiates physiological adjustments that reduce energy expenditure. Some energetically costly processes, including muscle protein synthesis, may be downregulated during this period. If this response is not adequately managed, athletes can lose lean tissue, with possible consequences for strength, power, and event performance [7]. Adequate protein intake, particularly when paired with resistance exercise, can help counter this response and support the retention of muscle tissue.

Muscle mass reflects the cumulative balance between two ongoing processes: muscle protein synthesis and muscle protein breakdown. Tissue is gained when synthesis exceeds breakdown over time; the reverse balance results in loss. Synthesis is particularly responsive to feeding and exercise, making dietary protein an important means of influencing net muscle protein balance. After a protein-containing meal, circulating amino acids rise and stimulate synthesis, while amino acid- and insulin-related pathways can also reduce breakdown [8].

Recommendations for practical use must account for event demands, the structure of the training year, and differences between athletes. A shot-putter or javelin thrower faces different loading patterns from a 10,000 m runner or marathon athlete. Training volume, session intensity, and the performance value of muscle mass relative to leanness therefore affect how general protein guidance should be applied [9].

This review examines protein nutrition for track and field athletes during both weight-stable and energy-restricted periods. It presents daily and per-meal intake targets, explains the muscle-protein processes relevant to training and body-composition change, and uses meal-planning examples to show how the recommendations can be incorporated into athletes' diets.

1.1 Review Methodology

This article is a **narrative review** rather than a systematic review. It was undertaken to synthesise existing evidence and translate current protein recommendations into practical guidance for track and field athletes. The methodology was as follows.

Databases consulted. Literature was identified through searches of PubMed/MEDLINE, Scopus, and SPORTDiscus. Reference lists of included articles and relevant review papers were also screened manually to identify additional sources.

Search keywords. Search terms included combinations of: "protein intake," "protein requirement," "muscle protein synthesis," "energy restriction," "caloric restriction," "weight loss," "body composition," "lean mass," "athlete," "track and field," "sprint," "jump," "throw," "endurance," "race walking," "leucine," "resistance training," and "sports nutrition."

Selection criteria. Studies were considered relevant if they: (i) examined protein intake, protein timing, or protein distribution in athletic or physically active populations; (ii) reported outcomes related to muscle protein synthesis, lean mass, strength, power, or performance; (iii) addressed energy restriction or weight loss in lean or athletic populations; or (iv) provided consensus or position-stand statements on sports nutrition. Priority was given to randomised controlled trials, systematic reviews, meta-analyses, and position stands from recognised professional bodies. Narrative reviews and mechanistic studies were included where they informed physiological rationale. Studies were excluded if they were not available in English, involved clinical populations unrelated to athletic performance, or did not report relevant outcomes.

Limitations of the approach. As a narrative review, the search was not exhaustive, no formal risk-of-bias assessment was undertaken, and study selection was not performed independently by multiple reviewers. The recommendations therefore reflect a synthesis of the available evidence rather than a systematic appraisal of every relevant study. This limitation is acknowledged in the Conclusion.

2. Related Work

Several strands of research underpin current protein guidance for athletes. Witard, Garthe, and Phillips reviewed protein requirements in the context of track and field training and body-composition goals. Their work identified approximately 1.6 $g \cdot kg^{-1} \cdot day^{-1}$ as a useful target for athletes maintaining body weight and discussed the rationale for higher intakes during energy restriction [1]. The present review draws on this event-focused analysis when formulating its recommendations.

Helms and colleagues assessed protein intake during caloric restriction in lean athletes with resistance-training experience. Their review supported higher protein provision as a means of limiting the loss of lean body mass and discussed a range of 1.8–2.7 $g \cdot kg^{-1} \cdot day^{-1}$ for this setting [5]. These findings have informed later guidance for athletes undertaking planned weight reduction.

The distribution of protein across meals has also been investigated. In a study of healthy adults, Mamerow and colleagues reported that a more even allocation over three meals, at approximately 30 g per meal, produced 25% higher 24-hour muscle protein synthesis than a pattern in which intake was concentrated toward the evening [4]. The result supports attention to meal-level intake rather than reliance on the daily total alone.

Hector and Phillips considered protein strategies for elite athletes seeking weight loss, with particular attention to body composition and sporting performance [6]. They identified the combination of increased protein intake and resistance training as a useful approach to retaining lean tissue during an energy deficit.

In a randomised trial, Longland and colleagues compared protein intakes of 2.4 and 1.2 $g \cdot kg^{-1} \cdot day^{-1}$ during an energy deficit accompanied by intense exercise. The higher-protein group achieved greater lean mass gain and fat mass reduction [7]. This intervention offers experimental support for increasing protein availability during weight loss in exercising individuals.

Phillips and colleagues have examined how dietary protein contributes to muscle adaptation, including

the influence of amino acid composition on the response to a meal [8]. Leucine is of particular interest because of its role in anabolic signalling. The leucine-threshold account proposes that a meal supplying roughly 2.5–3.0 g of leucine can provide a near-maximal stimulus for muscle protein synthesis, although this threshold may vary with protein source, meal composition, and individual factors.

For jumps, throws, and combined events, Sygo and colleagues set out nutrition guidance that reflects the demands of these disciplines [9]. Their event-oriented perspective helps place general protein targets within the practical requirements of specific track and field groups.

Morton and colleagues used systematic review and meta-analytic methods to assess protein supplementation alongside resistance training. Their analysis found that, in weight-stable adults, additional benefits for muscle mass and strength were not clearly evident above an intake of 1.6 $g \cdot kg^{-1} \cdot day^{-1}$ [10]. This result provides a basis for the target adopted for weight-stable athletes in the present review.

Phillips and colleagues have also discussed athlete protein requirements in relation to daily totals and individual meal doses. Their review supports tailoring recommendations to training status, objectives, and food preferences rather than applying a single prescription to every athlete [11].

3. Foundations of Muscle Protein Turnover and Adaptive Demands

Skeletal muscle is continually renewed through the concurrent processes of protein synthesis and protein breakdown. Training alters this turnover and can lead to remodelling that reflects the exercise stimulus [8]. The difference between the two rates determines whether muscle is maintained, accumulated, or lost. Because synthesis responds strongly to nutritional intake and exercise, providing adequate protein is a central dietary means of influencing this balance in athletes [1].

Following protein ingestion, amino acids enter the circulation and activate intracellular pathways involved in muscle protein synthesis. One important pathway involves mammalian target of rapamycin complex 1 (mTORC1), whose downstream signalling regulates the initiation and progression of protein translation. Leucine, one of the branched-chain amino acids, is a particularly effective signal within this pathway [11]. This helps explain why leucine-rich sources, including whey, can produce a stronger anabolic response than proteins containing less leucine.

The muscle protein synthetic response rises with protein dose until it approaches a point of saturation. Beyond that level, adding more protein to the same feeding does not produce a proportionate increase in synthesis. In young, healthy adults at rest, approximately 0.3–0.4 $g \cdot kg^{-1}$ of isolated protein per meal is commonly cited as an effective dose [4]. Mixed whole-food meals may require approximately 0.4–0.5 $g \cdot kg^{-1}$ because the food matrix and accompanying nutrients can alter gastric emptying and the rate at which amino acids become available.

Training-related muscle adaptation depends on the type of exercise performed. Resistance exercise promotes the synthesis of myofibrillar proteins that form the contractile machinery; over time, this can increase muscle-fibre cross-sectional area and support gains in strength and power. Endurance exercise places greater emphasis on mitochondrial and sarcoplasmic adaptations associated with oxidative metabolism and fatigue resistance, generally with less hypertrophy [9]. These distinct responses affect the amount and type of protein remodelling required.

Protein distribution must also take account of the temporary reduction in muscle responsiveness after a meal. Following protein ingestion, synthesis may return toward baseline after roughly 2–3 hours even when amino acids remain available. This response is often described as the muscle-full effect. It helps explain why very large servings are not necessarily more effective: once the response has approached saturation, additional amino acids may be oxidised rather than incorporated into muscle protein [10].

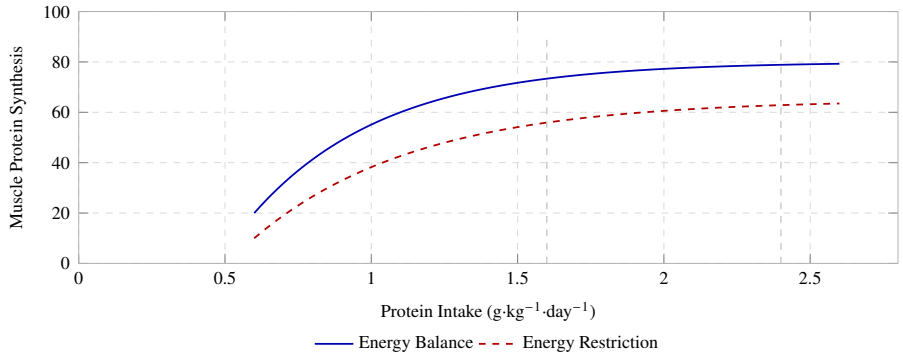


Figure 1: **Author-generated conceptual illustration.** Dose-response relationship between daily protein intake and muscle protein synthesis during energy balance and energy restriction. The curves are not plotted from a single primary dataset; they are schematic representations synthesised from the findings of Morton et al. [10], Longland et al. [7], and Helms et al. [5]. The y-axis is expressed in arbitrary units to convey relative, not absolute, differences in synthetic rate. The rightward shift during restriction represents the higher intake required to achieve a comparable synthetic response under negative energy balance. The dashed vertical lines mark the recommended daily targets of 1.6 and 2.4 g·kg^{-1}·day^{-1}.

The timing of protein intake in relation to exercise can influence the response to feeding. Muscle becomes more responsive to amino acids after training, so a protein-containing meal or snack in the post-exercise period can stimulate synthesis. This heightened sensitivity may persist for 24–48 hours after resistance exercise, although its magnitude and duration vary with the session and the individual; it should not be treated as a fixed-duration window [3, 11]. Placing suitable protein servings around training sessions can therefore help use this period of increased responsiveness [11].

Protein needs and responses differ among athletes. Age, training history, and muscle mass can affect baseline turnover and the response to a protein-containing meal. Athletes with greater muscle mass have higher absolute turnover and may require larger absolute amounts, whereas long-term training adaptation can modify the magnitude of the synthetic response. These differences support individual assessment when setting intake targets [6].

Protein is one part of recovery nutrition. Carbohydrate is needed to restore glycogen, while fluid intake helps re-establish hydration. Protein supports muscle protein synthesis and tissue remodelling; the relative contribution of each component depends on the training phase and the time available before the next session or competition. Protein planning should therefore be coordinated with the athlete's wider training and recovery schedule [3].

4. Quantitative Protein Prescriptions for Energy Balance

For athletes who are maintaining body weight or seeking to increase lean mass, research supports protein intakes above the general-population allowance. Evidence from intervention studies and meta-analyses identifies approximately 1.6 g·kg^{-1}·day^{-1} as a practical daily target for supporting resistance-training-related gains in muscle mass and strength under energy balance [10]. This level is close to the point at which the dose-response curve begins to flatten; higher intakes generally produce little additional benefit in weight-stable trained populations.

A daily target is most useful when translated into a feasible eating pattern. If most protein is consumed in one or two large servings, the athlete may miss opportunities to stimulate synthesis at other times of day. Distributing intake over 3–4 reasonably spaced meals or snacks allows repeated stimulation, with

Table 1: Summary of Protein Recommendations for Track and Field Athletes

Context	**Daily Intake** ($\mathbf{g \cdot kg^{-1} \cdot day^{-1}}$)	**Per-Meal Dose** ($\mathbf{g \cdot kg^{-1}}$)
Weight Maintenance	1.6	0.3–0.4
Weight Gain	1.6–1.8	0.3–0.4
High-Quality Weight Loss	1.6–2.4	0.4–0.5
High-Volume Training	1.8–2.0	0.4

approximately 0.3–0.4 $g \cdot kg^{-1}$ at each meal. An additional serving can be placed after exercise when it fits the training schedule [4].

For an 80 kg male sprinter or long jumper, a meal providing about 30 g of protein across four eating occasions gives a daily amount close to 128 g, consistent with the target of 1.6 $g \cdot kg^{-1} \cdot day^{-1}$. Ordinary foods can supply this quantity. Lean meat, poultry, fish, eggs, dairy products, and suitable plant-based foods also contribute micronutrients and dietary variety, so supplementation is not essential when food intake is adequate [1].

The meal examples in this review are intended as adaptable planning models rather than fixed prescriptions. Athletes can modify food choices, portion sizes, and meal timing to suit their preferences, cultural practices, and training schedules. For most, protein targets can be met by including protein-containing foods at meals and snacks, with particular attention to recovery after exercise; supplements are not a prerequisite [11].

Protein quality depends on amino acid composition as well as digestion and absorption. Complete proteins supply all essential amino acids in amounts that support human requirements. Sources with relatively high leucine content and rapid digestion, including whey, egg, and milk proteins, can produce a strong anabolic response. Slower-digesting or lower-leucine sources, such as casein, soy, and wheat, may produce a different response under some conditions [2]. These differences should be interpreted with caution: the leucine "threshold" is not a fixed value, and the anabolic superiority of rapidly digested proteins is most consistently observed when they are consumed in isolation and in relatively small doses. In mixed meals containing whole foods, differences between protein sources are attenuated, and total protein dose and overall diet quality become more important determinants of the response.

The response to a protein-containing meal is also shaped by its total energy content and the other macronutrients present. Adding carbohydrate may increase insulin availability, which can suppress protein breakdown and influence amino acid uptake; however, this contribution is generally smaller than the direct stimulation of synthesis by amino acids. Dietary fat can slow gastric emptying and alter the timing of amino acid appearance in the blood, although the practical importance of this effect in mixed meals remains uncertain [3].

Protein prescriptions may need to change as the training year progresses. Higher volume or more frequent sessions can increase tissue-remodelling demands and may justify a temporary rise in intake. During tapering or competition periods, lower training loads may allow athletes to remain toward the lower end of the recommended range. Aligning nutrition with the training phase provides a way to match dietary support to changing workloads [5].

Protein targets for maintaining muscle and gaining additional mass are related but not identical. An intake near 1.6 $g \cdot kg^{-1} \cdot day^{-1}$ can support maintenance and modest gains in trained individuals. During a planned mass-gaining phase, 1.6–1.8 $g \cdot kg^{-1} \cdot day^{-1}$ may be appropriate, as indicated in Table 1. Athletes

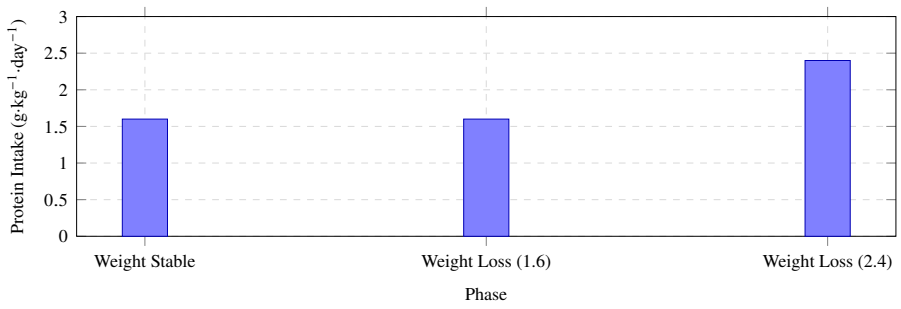


Figure 2: **Author-generated conceptual illustration.** Comparison of recommended daily protein intakes across different training phases for track and field athletes. The values plotted are the recommended targets presented in Table 1 of this manuscript and are derived from the ranges reported by Morton et al. [10], Helms et al. [5], and Longland et al. [7]. The figure is illustrative and is not a plot of primary experimental data. The weight-loss phase may require intakes up to 2.4 g·kg^{-1}·day^{-1} to preserve lean mass.

undertaking high-volume training, particularly when it includes progressive resistance work, may use 1.8–2.0 g·kg^{-1}·day^{-1} to provide additional amino acid availability [10].

5. Protein Strategies During Energy Restriction for High-Quality Weight Loss

A calorie deficit can make lean-mass retention more difficult. The physiological response to reduced energy availability may include lower muscle protein synthesis, increasing the likelihood of losing muscle tissue during weight reduction. For athletes, such losses may affect strength, power, and performance. Raising protein intake is therefore one dietary strategy for limiting this risk and retaining metabolically active tissue [6]. During energy restriction, the recommended daily protein range rises to approximately 1.6–2.4 g·kg^{-1}·day^{-1}.

The appropriate point within this range depends on the size of the energy deficit and the athlete's characteristics [5]. Greater protein availability can help offset the reduction in post-meal muscle protein synthesis associated with negative energy balance. A more substantial deficit may require a higher intake than a modest one.

One proposed mechanism for the benefit of higher protein intake during energy restriction is the maintenance of the post-meal synthetic response. Early in an energy deficit, muscle protein synthesis may fall by approximately 25%. Fasting synthesis can also decline, but sufficient protein at each meal may preserve or restore the response after eating, provided the dose is large enough to stimulate synthesis effectively [7]. This response is relevant to the preservation of lean tissue during weight loss.

A per-meal dose of 0.4–0.5 g·kg^{-1} is recommended during energy restriction. For an 80 kg sprinter, this equals approximately 32–40 g at each feeding. Four such servings provide about 128–160 g per day, within the lower-to-middle part of the recommended range. Reaching 2.4 g·kg^{-1}·day^{-1}, or about 192 g for this athlete, would require five servings of roughly 38–40 g or a comparable adjustment in feeding frequency. The upper target may be more relevant to athletes with greater muscle mass, those undertaking larger energy deficits, or those already accustomed to higher protein intakes [3].

Resistance exercise should be retained, where appropriate, when an athlete reduces energy intake. Additional dietary protein supplies amino acids for synthesis, while resistance training provides a mechanical stimulus that encourages the muscle to be retained. The two interventions act together; resistance training is particularly important because increasing protein intake alone does not provide

the same muscle-specific stimulus. Athletes who continue resistance work during weight loss generally preserve more lean mass than those who substantially reduce or stop it [5].

When protein intake is increased without changing the intended energy deficit, the source of the replacement calories matters. The evidence discussed here favours reducing dietary fat before reducing carbohydrate, because carbohydrate availability supports glycogen restoration and the quality of high-intensity training. Restricting carbohydrate may impair training capacity and add to the stress of an energy deficit [7]. Fat intake must nevertheless remain sufficient to meet essential fatty acid needs. An intake of approximately 0.5–1.0 $g \cdot kg^{-1} \cdot day^{-1}$ has been cited in this context, including for elite track and field athletes, in relation to endocrine function. Protein should displace fat only while these minimum needs are respected; if further energy reduction is required, other dietary adjustments or a less severe deficit may be preferable [5, 6]. The recommendation to prioritise carbohydrate preservation during energy restriction is based largely on evidence that low carbohydrate availability can impair high-intensity training performance and glycogen restoration; however, direct comparisons of fat versus carbohydrate restriction during matched energy deficits in track and field athletes are limited, and individual tolerance and training demands should guide the macronutrient distribution.

The speed of weight reduction is relevant to lean-mass retention. A gradual loss of approximately 0.5 kg per week (0.7% of body weight) has been associated with better preservation of lean tissue than a faster reduction of 1.0 kg per week (1.4%), even when protein intake is comparable. A smaller energy deficit imposes less catabolic pressure and may allow athletes to adapt without the same degree of energy-conservation response [6].

Potential health effects should be considered when prescribing high-protein diets. Concerns have historically focused on kidney function and bone health. However, evidence in healthy people with normal renal function has not demonstrated adverse renal outcomes at intakes up to 3.0 $g \cdot kg^{-1} \cdot day^{-1}$ [3, 8]. It should be emphasised that these findings apply to individuals with normal renal function; athletes with pre-existing kidney conditions should seek medical advice before adopting high-protein diets. Findings on bone health are also inconsistent with the older acid-ash hypothesis: protein may support bone when calcium and vitamin D intake are adequate [3, 11]. However, the evidence for bone health remains less consistent than that for renal function, and long-term data in athletes consuming very high intakes are limited.

A weight-loss nutrition plan should be tailored to the athlete rather than selected from the recommended range without context. Relevant considerations include habitual protein consumption, the intended size and duration of the energy deficit, training volume and type, and the target rate of weight reduction. Athletes who already consume substantial protein may need a smaller increase, whereas those training heavily or pursuing more rapid weight loss may need to work toward the upper part of the range to protect lean mass [1].

6. Practical Translation and Integration into Training Regimens

Protein guidance must be interpreted in light of the different demands of track and field events. Sprinters and jumpers depend on explosive force and adequate muscle mass; endurance athletes place greater emphasis on sustained work, leanness, and oxidative capacity. Combined events require qualities drawn from both groups. The same general intake range may therefore be applied differently according to the athlete's event and training programme [9].

The suggested targets of 1.6 $g \cdot kg^{-1} \cdot day^{-1}$ during energy balance, 1.6–2.4 $g \cdot kg^{-1} \cdot day^{-1}$ during energy restriction, and 0.3–0.5 $g \cdot kg^{-1}$ per meal are drawn largely from resistance-training and mixed-athlete

Table 2: Practical Meal Plan for an 80 kg Track and Field Athlete (Sprint/Jump/Throw), with Estimated Protein Content per Meal and Daily Total

Time	**Meal**	**Protein Sources**	**Estimated Protein (g)**
08:00	Breakfast	250 g oatmeal porridge + 200 ml low-fat milk	∼14
11:00	Post-training snack	200 g Greek yogurt + granola	∼20
13:30	Lunch	Omelet (2 eggs + cheese) + toast	∼22
16:30	Dinner	120 g chicken breast + rice + vegetables	∼36
19:30	Post-training snack	150 g cottage cheese + apple + berries	∼18
22:00	Evening snack	100 g tuna + small pasta salad	∼18
		Daily total	∼128

research. Their application across every track and field event should therefore be considered in relation to the available evidence. Sprint, jump, and throwing events involve high-force neuromuscular work. For these athletes, maintaining myofibrillar tissue and fast-twitch fibre size is directly relevant to performance, particularly when resistance training accompanies attempts to improve power-to-weight ratios [1, 9]. Endurance running and race walking involve greater volumes of oxidative work, with adaptations that include mitochondrial and sarcoplasmic protein synthesis and comparatively little hypertrophy. In these disciplines, carbohydrate intake must also remain sufficient for glycogen replacement and training tolerance [9]. The higher meal target of 0.4–0.5 $g \cdot kg^{-1}$ and daily intake approaching 2.4 $g \cdot kg^{-1} \cdot day^{-1}$ are most readily justified for power athletes combining resistance training with an energy deficit. Endurance athletes may be able to retain lean mass with intakes nearer 1.6–1.8 $g \cdot kg^{-1} \cdot day^{-1}$ when total energy and carbohydrate remain adequate [5, 6]. Throwers and combined-event athletes may fall between these broad patterns because their programmes include substantial muscle loading alongside technical and event-specific work. Direct dose-response evidence for these groups remains limited, so current prescriptions rely partly on findings from related athletic populations [9]. Event-specific targets should consequently reflect the athlete's training composition and body-composition objective rather than assume that one value suits all disciplines.

For an 80 kg male sprinter, long jumper, or javelin thrower, an intake of 1.6 $g \cdot kg^{-1} \cdot day^{-1}$ corresponds to approximately 128 g of protein daily. This can be divided among four eating occasions, each supplying around 30–35 g, although the athlete may spread intake over additional snacks as practical. The example pattern uses familiar foods: oatmeal porridge with milk and Greek yogurt at breakfast, an omelet with toast at lunch, chicken breast with rice and vegetables at dinner, and cottage cheese with fruit after training, with additional snacks to meet energy needs (Table 2). The athlete may also substitute salmon for chicken at dinner if preferred, provided the total protein and energy content remain comparable. Such a distribution provides repeated protein servings throughout the day [1].

For a 55 kg female distance runner or race walker, the same relative target equates to approximately 88 g of protein per day at 1.6 $g \cdot kg^{-1} \cdot day^{-1}$. This can be divided into four main feedings of roughly 20–25 g, with additional snacks to meet energy needs. The lower absolute quantities reflect body mass,

Table 3: Practical Meal Plan for a 55 kg Distance Runner or Race Walker, with Estimated Protein Content per Meal and Daily Total

Time	**Meal**	**Protein Sources**	**Estimated Protein (g)**
08:00	Breakfast	200 g Greek yogurt + granola	~22
11:00	Post-training snack	400 ml smoothie (yogurt + berries)	~10
13:30	Lunch	2 fried eggs + toast + salad	~16
16:30	Dinner	100 g salmon + potatoes + vegetables	~22
19:30	Post-training snack	150 g low-fat cottage cheese + 1 banana	~18
22:00	Evening snack	Small ham + cheese sandwich + 150 ml milk	~12
		Daily total	~88

while the relative meal dose remains around 0.3–0.4 g·kg^{-1}. Foods such as Greek yogurt, eggs, salmon, and other dairy products can meet this target without requiring large meal volumes that might displace carbohydrate needed for glycogen restoration [11].

Protein intake around exercise should be planned in relation to the timing of sessions. A meal or snack within approximately 1–2 hours after training can provide amino acids when muscle is responsive to feeding. Athletes completing two sessions in a day may need to schedule a protein-containing option after each workout. For endurance athletes, that recovery serving should also provide enough carbohydrate to support glycogen replacement [2].

Protein-containing snacks can help maintain a regular intake when the interval between main meals is long, particularly during demanding training periods. A snack supplying 15–20 g between breakfast and lunch or between lunch and dinner adds another opportunity to stimulate muscle protein synthesis. This approach may be useful for athletes whose daily target exceeds 1.8 g $\cdot$ kg^{-1} $\cdot$ day^{-1}, since achieving the total may require more frequent eating [4].

Protein supplements are convenient in some circumstances, but they are not inherently better than ordinary foods for meeting most athletes' needs. A supplement can be useful when a post-exercise meal is needed quickly or whole-food options are unavailable. Whole foods, however, contribute a wider range of nutrients and may offer greater meal satisfaction. Supplements can serve as an additional option for athletes whose appetite, training schedule, or dietary restrictions make food-based targets difficult to reach [3].

Nutrition education helps athletes apply protein guidance without depending on continuous supervision. Useful topics include the protein content of everyday foods, the value of dietary variety, and ways to distribute intake across meals and snacks. Understanding these practical details allows athletes to make food choices that fit their training and performance objectives [6].

Protein prescriptions should be reviewed as training and body composition change. Dietary records can help establish actual intake, while validated body-composition assessments and performance tests can show whether the broader strategy is producing the intended outcomes. Reviewing these measures at intervals allows practitioners to adjust the plan in response to changes in workload, physical status, or

performance [5].

7. Research Gaps and Applied Considerations

Important uncertainties remain in the evidence base for track and field athletes. In particular, the relationship between per-meal protein dose and muscle protein synthesis during energy restriction has not been fully established. Much of the available work has examined athletes or participants under weight-stable conditions. Studies conducted during controlled weight loss could clarify the meal-level doses that best balance anabolic response with dietary practicality [6].

The response to whole-food protein during an energy deficit also warrants closer study. Laboratory investigations have often used isolated sources such as whey, whereas meals contain mixed nutrients and food structures that affect digestion and amino acid availability. These differences may alter the muscle protein response under energy restriction. Direct comparisons would help determine how well findings from supplement studies translate to food-based diets [1].

Few studies have assessed how protein source and meal timing jointly influence body composition during weight loss in athletic populations. Existing work often relies on isolated supplements and tightly controlled feeding schedules. Athletes, by contrast, consume varied diets and follow schedules shaped by training and competition. Research that reflects these conditions is needed to test whether laboratory findings remain applicable in everyday practice [8].

Athletes do not respond uniformly to energy restriction or changes in protein intake. Differences in lean-mass retention may reflect variation in protein utilisation, the muscle's response to feeding, and the degree of metabolic adaptation to a calorie deficit. Genetic and epigenetic influences may contribute to these differences. Identifying factors associated with individual responses could support more precise dietary prescriptions [5].

Protein needs across track and field disciplines have not been studied equally. More evidence is needed for shot put, discus, hammer, and combined events, where muscle recruitment, force production, and training structure may differ from the demands of sprinting, jumping, or distance running. Detailed case studies and small-group investigations involving elite athletes in these less-represented events could help address this limitation [9].

The longer-term effects of maintaining high protein intake during weight reduction remain insufficiently characterised. Many existing interventions last only 2–4 weeks. Although short-term studies indicate that high-protein diets can be effective and well tolerated, longer follow-up is needed to assess metabolic health, renal function, and bone outcomes in athletes consuming elevated amounts over months or years [3].

The shift from weight loss to weight maintenance or planned weight gain is another area requiring study. Energy restriction can produce metabolic changes, including altered amino acid handling and protein-use efficiency. These changes may affect the amount of protein required once energy intake increases again. Better evidence on this transition would help practitioners plan nutrition across successive phases of the annual training cycle [7].

Protein intake could also be aligned more closely with periodised training. For example, requirements may differ between high-volume training blocks and taper or competition phases. Increasing protein when training stimulus and remodelling demands are greatest, then adjusting intake as workload falls, may improve the fit between diet and training. Studies that examine protein periodisation alongside training periodisation are needed to test this approach [10].

8. Conclusion

This review set out to synthesise current evidence on protein intake for track and field athletes during energy balance and energy restriction, and to translate that evidence into practical recommendations. Several conclusions can be drawn.

Protein intake during energy balance. For athletes maintaining body weight or seeking to increase lean mass, a daily protein intake of approximately 1.6 $g \cdot kg^{-1} \cdot day^{-1}$, distributed across 3–4 feedings of 0.3–0.4 $g \cdot kg^{-1}$ per meal, is supported by meta-analytic evidence as a practical target for supporting resistance-training-related gains in muscle mass and strength. When whole-food sources are used, per-meal doses of 0.4–0.5 $g \cdot kg^{-1}$ may be appropriate because the food matrix can slow amino acid availability.

Protein requirements during energy restriction. During voluntary energy restriction for high-quality weight loss, daily protein requirements increase to approximately 1.6–2.4 $g \cdot kg^{-1} \cdot day^{-1}$, with per-meal targets of 0.4–0.5 $g \cdot kg^{-1}$. This elevated intake helps counteract the energy-conservation-induced suppression of muscle protein synthesis and mitigates the loss of lean mass. The appropriate point within this range depends on the size of the energy deficit, the athlete's muscle mass, and habitual protein intake.

Importance of resistance training. Resistance training is a critical synergistic stimulus for lean-mass retention during energy restriction. Increasing protein intake alone does not provide the same muscle-specific stimulus as the combination of adequate protein and resistance exercise. Athletes who continue resistance training during weight loss generally preserve more lean mass than those who discontinue it.

Practical implications for track and field disciplines. Sprint, jump, and throwing athletes, whose performance depends on high-force neuromuscular work and maintenance of myofibrillar tissue, are likely to benefit most from the upper end of the recommended protein ranges, particularly when combining resistance training with an energy deficit. Endurance runners and race walkers may retain lean mass with intakes nearer 1.6–1.8 $g \cdot kg^{-1} \cdot day^{-1}$ when total energy and carbohydrate intake are adequate. Throwers and combined-event athletes may fall between these patterns. In all disciplines, protein increases should primarily replace dietary fat rather than carbohydrate to preserve training quality, and a gradual weight-loss rate of approximately 0.5 kg per week is recommended.

Limitations of the available evidence. The recommendations in this review are drawn largely from resistance-training and mixed-athlete research, and direct dose-response evidence for track and field athletes across all disciplines remains limited. Many existing studies are short-term (2–4 weeks), and the longer-term effects of high protein intake on metabolic health, renal function, and bone outcomes in athletes are not well characterised. The leucine threshold and the anabolic superiority of rapidly digested proteins are most consistently observed in isolated-protein studies; in mixed meals, total protein dose and overall diet quality become more important. As a narrative review, this paper did not employ systematic search or risk-of-bias assessment methods, and its conclusions should be interpreted with that limitation in mind. Future research should address these gaps, particularly in under-represented disciplines and during controlled weight loss in athletic populations.

References

[1] O. C. Witard, I. Garthe, and S. M. Phillips. Dietary protein for training adaptation and body composition manipulation in track and field athletes. *Int. J. Sport Nutr. Exerc. Metab.*, 29(2): 165–174, March 2019.

[2] R. Jäger et al. International society of sports nutrition position stand: protein and exercise. *J. Int. Soc. Sports Nutr.*, 14:20, June 2017.

[3] C. M. Kerksick et al. International society of sports nutrition position stand: nutrient timing. *J. Int. Soc. Sports Nutr.*, 14:33, 2018.

[4] M. M. Mamerow et al. Dietary protein distribution positively influences 24-h muscle protein synthesis in healthy adults. *J. Nutr.*, 144(6):876–880, June 2014.

[5] E. R. Helms, C. Zinn, D. S. Rowlands, and S. R. Brown. A systematic review of dietary protein during caloric restriction in resistance trained lean athletes: a case for higher intakes. *Int. J. Sport Nutr. Exerc. Metab.*, 24(2):127–138, April 2014.

[6] A. J. Hector and S. M. Phillips. Protein recommendations for weight loss in elite athletes: a focus on body composition and performance. *Int. J. Sport Nutr. Exerc. Metab.*, 28(2):170–177, March 2018.

[7] T. M. Longland, S. Y. Oikawa, C. J. Mitchell, M. C. Devries, and S. M. Phillips. Higher compared with lower dietary protein during an energy deficit combined with intense exercise promotes greater lean mass gain and fat mass loss: a randomized trial. *Am. J. Clin. Nutr.*, 103(3):738–746, March 2016.

[8] S. M. Phillips. The science of muscle hypertrophy: making dietary protein count. *Nutr. Rev.*, 69(6): 349–359, June 2017.

[9] J. Sygo, A. Kendig Glass, S. C. Killer, and T. Stellingwerff. Fueling for the field: nutrition for jumps, throws, and combined events. *Int. J. Sport Nutr. Exerc. Metab.*, 29(2):95–105, March 2019.

[10] R. W. Morton et al. A systematic review, meta-analysis and meta-regression of the effect of protein supplementation on resistance training-induced gains in muscle mass and strength in healthy adults. *Br. J. Sports Med.*, 52(6):376–384, March 2018.

[11] S. M. Phillips. A brief review of critical processes in exercise-induced muscular hypertrophy. *Sports Med.*, 44(1):71–77, January 2016.