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Review Article

Protein Requirements During Very-Low-Calorie Ketogenic Diet for Obesity-Limitations of Ideal Body Weight: An Updated Mini- Review

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Summary

Very-low-energy ketogenic therapy (VLEKT) is widely used in obesity management and commonly prescribes protein intake according to ideal body weight (IBW). Although this approach is practical and widely adopted in current guidelines, IBW does not directly reflect fat-free mass, skeletal muscle reserves, or the marked heterogeneity in body composition observed among individuals with obesity. This narrative mini-review examines the physiological basis of protein prescription during VLEKT and discusses the limitations of IBW-based approaches, with emphasis on sarcopenic obesity, anabolic resistance, preservation of lean mass during rapid weight loss, and body composition assessment. Available evidence indicates that reductions in lean tissue may still occur despite conventional protein prescriptions based on IBW. While no validated model for body-composition-guided protein prescription currently exists, the physiological rationale supporting fat-free-mass-based approaches deserves further investigation.

Keywords: Very-low-energy ketogenic therapy, VLEKT, Very-low-calorie ketogenic diet, VLCKD, Protein requirements, Ideal body weight, Fat-free mass, Body composition, Sarcopenic obesity, Obesity

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Introduction

Very-low-calorie ketogenic diets (VLCKDs) are being used with increasing frequency in obesity management and metabolic medicine.[1,2] More recently, the terminology has been updated, and the term very-low-energy ketogenic therapy (VLEKT) has been proposed to better describe these interventions.[3] These interventions combine marked caloric restriction, typically below 800 kcal per day, with severe carbohydrate restriction, usually below 50 g per day, to induce nutritional ketosis and a controlled protein intake, generally within medically supervised programs.[1,2] Current European recommendations, together with the consensus document from the Italian Society of Endocrinology, usually calculate protein prescription according to ideal body weight rather than actual body weight.[1,2]

In clinical practice, ideal body weight is often used mainly for practical reasons. In severe obesity, calculations based directly on actual body weight often generate protein prescriptions that appear disproportionate to the metabolic contribution of adipose tissue. Ideal body weight has therefore become a convenient clinical reference.

Ideal body weight is an anthropometric estimate rather than a direct measure of metabolically active tissue. It does not quantify skeletal muscle mass, organ tissue, extracellular water, or fat-free mass. Protein turnover and resting energy expenditure are more closely linked to lean tissue compartments than to body weight itself.[4-6] During severe caloric restriction, preserving lean mass becomes clinically relevant, particularly when weight loss occurs rapidly.

The issue becomes even more evident in patients with marked heterogeneity in body composition. Older adults and individuals with sarcopenic obesity may differ substantially in skeletal muscle reserves, inflammatory burden, anabolic responsiveness, and resting energy expenditure despite similar anthropometric characteristics. A single anthropometric parameter, such as ideal body weight, cannot adequately reflect the wide variability in body composition and skeletal muscle mass observed among individuals with obesity.

This article discusses the physiological rationale underlying protein prescription during VLEKT, with particular attention to the limitations of ideal-body-weight-based approaches and the potential relevance of body composition assessment.

Methods

This narrative mini-review was conducted to examine the physiological rationale underlying protein prescription during VLEKT, with particular focus on the limitations of ideal-body-weight-based approaches and the potential relevance of body composition assessment.

A literature search was performed using PubMed/MEDLINE. The primary search focused on articles published from January 2000 through May 2026. Seminal earlier publications relevant to protein metabolism, nutritional ketosis, body composition, and obesity were also considered when appropriate.

Search terms included combinations of “very-low-

calorie ketogenic diet", "VLCKD", "very-low-energy ketogenic therapy", "VLEKT", "protein intake", "protein requirements", "ideal body weight", "fat-free mass", "lean mass", "skeletal muscle", "body composition", "sarcopenia", "sarcopenic obesity", "anabolic resistance", "obesity", "weight loss", "lean mass preservation", and "GLP-1 receptor agonists".

Priority was given to clinical trials, systematic reviews, meta-analyses, international guidelines, consensus statements, and position papers addressing obesity management, ketogenic therapies, protein metabolism, body composition, sarcopenic obesity, and preservation of lean mass during weight loss. Additional references were identified through manual review of the reference lists of selected publications.

Protein requirements, lean tissue, and metabolic heterogeneity

Protein requirements depend not only on the amount of fat-free mass, but also on its metabolic activity. Skeletal muscle, visceral organs, and other lean tissues contribute substantially to protein turnover and resting energy expenditure.[4] Individuals with similar body weight or body mass index may still differ substantially in the relative amounts of skeletal muscle and fat mass, resulting in markedly different body-composition phenotypes.[5,6]

Geisler, Prado, and Müller questioned the adequacy of body-weight-based recommendations for estimating individual protein requirements.[4] Their analysis emphasized the relationship between fat-free mass, resting energy expenditure, and protein metabolism, arguing that body weight alone provides only an approximate estimate of physiological protein needs and does not adequately account for the marked heterogeneity in body composition among individuals with obesity.[5,6]

Severe caloric restriction generally leads to reductions in both fat mass and fat-free mass. The relative proportion varies among individuals and depends on several factors, including age, baseline adiposity, physical activity, protein intake, and metabolic stress.[7,8] Loss of skeletal muscle during rapid weight reduction may have clinically relevant consequences. Muscle tissue contributes to glucose utilization, physical performance, and resting energy expenditure, all of which may be negatively affected when muscle loss becomes substantial.[9]

During VLEKT, adequate protein intake is primarily intended to limit excessive loss of lean tissue during severe caloric restriction. Nutritional ketosis has long been associated with metabolic adaptations that may reduce protein catabolism, partly related to lower glucose requirements and altered substrate utilization.[10,11] This does not eliminate the need for adequate dietary protein intake. Age, baseline muscle reserves, inflammatory burden, exercise habits, and duration of energy restriction all influence the degree of lean mass loss observed during treatment.

Current VLEKT protocols generally prescribe protein intake according to ideal body weight, typically ranging between 0.8 and 1.5 g/kg IBW/day, with slight variations across studies, position papers, and expert consensus documents. This strategy is primarily intended to preserve lean mass during severe caloric restriction while maintaining nutritional ketosis. However, ideal-body-weight-based approaches may not adequately capture the marked heterogeneity in body composition and metabolically active lean tissue observed across individuals with obesity.

Limitations of ideal-body-weight-based protein prescription

Ideal body weight equations were not developed to estimate body composition. They do not distinguish adipose tissue from skeletal muscle or fat-free mass. Individuals with similar anthropometric characteristics may therefore exhibit substantially different metabolic profiles.

Most VLEKT protocols still rely on relatively uniform protein prescriptions despite considerable variability in body composition. One patient may retain substantial skeletal muscle mass despite excess adiposity, whereas another may already present with sarcopenic obesity, chronic low-grade inflammation, and impaired muscle quality. Under these conditions, similar protein prescriptions may not correspond to equivalent physiological requirements.

BMI and body weight provide no information regarding skeletal muscle reserves or lean tissue distribution. Population studies and clinical observations have identified phenotypes characterized by preserved muscle mass despite excess adiposity, as well as phenotypes associated with reduced muscle mass and altered metabolic function. [5,6,12]

If protein requirements are more closely related to fat-free mass than to ideal body weight, relying exclusively on anthropometric estimates risks oversimplifying the metabolic heterogeneity observed in obesity.

Aging and sarcopenic obesity

Sarcopenic obesity is now considered clinically relevant in obesity medicine, although diagnostic criteria continue to evolve.[13] In routine clinical practice, some patients already present with reduced skeletal muscle mass before weight-loss treatment even begins.

In older adults, defining adequate protein intake becomes more challenging because skeletal muscle progressively becomes less responsive to dietary protein intake and anabolic stimuli, a phenomenon commonly referred to as anabolic resistance.[14-17] Under these conditions, protein requirements may differ substantially from those observed in younger individuals.

Older adults and patients with sarcopenic obesity appear especially vulnerable to lean tissue loss during VLEKT. In these groups, ideal-body-weight-based prescriptions may remain clinically practical while still being physiologically incomplete.

Loss of skeletal muscle during aggressive weight reduction may have clinically relevant consequences. Muscle tissue contributes to glucose utilization, mobility, physical

function, and resting energy expenditure.[9] Preservation of muscle mass, therefore, remains clinically relevant not only from a body composition perspective, but also for maintaining functional capacity during obesity treatment.

Protein prescription during ketogenic therapy

Evidence from conventional hypocaloric diets consistently indicates that higher protein intake contributes to the preservation of fat-free mass during weight loss. Pasiakos and colleagues reported that protein intake above the recommended dietary allowance attenuated reductions in fat-free mass during short-term caloric restriction.[18] Resistance-training studies likewise support the interaction between dietary protein and maintenance of lean tissue.[19,20]

Whether these findings can be directly extrapolated to VLEKT remains uncertain. Severe carbohydrate restriction, nutritional ketosis, and rapid weight loss introduce additional metabolic variables that are not fully represented in conventional hypocaloric diets.

Most studies on VLEKT report clinically meaningful reductions in body weight, fat mass, and metabolic risk markers.[21-25] Preservation of lean mass, however, is not universal. Several VLEKT studies described reductions in fat-free mass despite conventional protein targets based on ideal body weight. Gómez-Arbeláez and colleagues reported measurable decreases in lean mass during the active ketogenic phase, although part of the variation appeared related to changes in hydration status and was partially recovered during follow-up.[22] Other studies and reviews similarly described reductions in lean tissue during rapid ketogenic weight loss despite conventional protein prescriptions based on ideal body weight.[7,8]

Exercise likely plays an important role in this setting. A pilot study in sarcopenic obesity evaluated VLEKT combined with interval training and specifically examined preservation of lean mass during treatment.[24] Although preliminary, the study reinforced the broader concept that maintenance of lean tissue during aggressive weight reduction likely depends on multiple interacting interventions rather than protein prescription alone.

It remains unclear whether body-composition-guided prescriptions improve preservation of lean tissue during VLEKT.

Body composition assessment in clinical practice

Assessment of lean and adipose compartments may provide clinically useful information during nutritional treatment. DXA, bioelectrical impedance analysis (BIA), computed tomography, and magnetic resonance imaging all allow some degree of body composition evaluation, although each method carries important limitations.

DXA is widely used in research settings and provides regional estimates of fat mass and lean soft tissue. Recommendations from the International Society for Clinical Densitometry established indications and reporting standards for DXA body composition analysis.[26,27] Broader clinical implementation, however, remains limited by cost, accessibility, weight restrictions, and interpretative variability.

BIA is easier to implement in outpatient practice, although it is strongly influenced by hydration status, edema, recent food intake, and device-specific equations. These limitations become especially relevant during ketogenic interventions, since glycogen depletion and rapid fluid redistribution substantially affect impedance-derived estimates.

Imaging-based assessment of skeletal muscle is more precise, although its routine use in nutritional practice remains limited.

Despite these limitations, body composition assessment appears physiologically more coherent than approaches based exclusively on ideal body weight, since it provides a more direct estimate of metabolically active compartments involved in protein metabolism. Nevertheless, cost, accessibility, methodological limitations, and interpretative variability still restrict its routine use across all clinical settings.

Current evidence and future directions

Protein intake during VLEKT still largely relies on empirical approaches, particularly when body composition is considered.

One major limitation is the lack of validated algorithms specifically developed for ketogenic therapy. Existing evidence supports the physiological relevance of fat-free mass. However, no standardized model currently defines how protein intake should be adjusted according to skeletal muscle mass, age, inflammatory burden, or physical activity during VLEKT.

Available evidence is still fragmented and largely indirect. Much of the current rationale derives from aging research, sarcopenia literature, sports nutrition, and conventional hypocaloric diets rather than from trials specifically designed for ketogenic interventions.

Recent literature has increasingly focused on preservation of skeletal muscle during obesity treatment. Caturano and colleagues discussed the clinical implications of weight-loss-induced muscle loss, emphasizing the role of adequate protein intake, exercise, and body composition monitoring. Similar conclusions emerge from recent reviews dedicated to preservation of muscle mass during caloric restriction, including discussions on exercise strategies and amino acid supplementation during weight loss.[28-30]

The growing use of GLP-1 receptor agonists has renewed attention toward preservation of lean mass during obesity treatment, particularly in older adults and in patients with sarcopenic obesity. Available studies have reported substantial interindividual variability in lean tissue changes during GLP-1-based therapy.[31-33]

From a clinical perspective, preservation of lean mass during VLEKT may become particularly relevant in older adults, sarcopenic obesity, and in patients undergoing rapid pharmacologically induced weight loss. Potential clinical applications include more individualized protein strategies based on body composition, particularly in patients at increased risk of skeletal muscle loss. In these settings,

preservation of lean mass may influence physical function, metabolic adaptation, and long-term weight maintenance. Prospective studies specifically addressing body-composition-guided protein prescription during VLEKT are still lacking. It remains uncertain whether individualized strategies based on fat-free mass improve clinical outcomes compared with conventional prescriptions based primarily on ideal body weight.

Towards a body composition-guided protein prescription

The conceptual framework supporting this approach is illustrated in Figure 1, whereas the proposed protein intake ranges are summarized in Table 1. This approach shifts from ideal body weight to grams of protein per kilogram of fat-free mass (g/kg FFM), which is more closely aligned with metabolically active tissue and protein turnover.

The proposed framework is based on the hypothesis that protein requirements during severe caloric restriction

Table 1. Conceptual framework for individualized protein prescription during VLEKT

% Fat Mass (FM)	Protein Intake (g/kg FFM) — Resistance exercise / physically active	Protein Intake (g/kg FFM) — Sedentary	Clinical Considerations
Lower relative fat mass <30%	~2.0–2.3	1.6–1.9	Generally associated with relatively preserved skeletal muscle mass despite obesity. Higher protein targets may support maintenance of lean tissue during aggressive weight loss.
Intermediate fat mass 30–40%	1.8–2.1	1.4–1.7	Most common body composition range observed in obesity. Protein requirements may vary according to age, physical activity, and baseline muscle reserves.
Higher fat mass >40%	1.6–1.9	1.3–1.6	Greater adiposity is frequently associated with lower relative lean mass and increased risk of sarcopenic obesity. Interpretation should consider body composition heterogeneity.
Sarcopenic obesity (low ASMM + high FM%)	1.8–2.2	1.7 – 2.0	Priority should be preservation of skeletal muscle mass and physical function. Resistance exercise and monitoring of body composition are strongly recommended.

Abbreviations: FM = fat mass; FFM = fat-free mass; ASMM = appendicular skeletal muscle mass.
For patients with sarcopenic obesity, a relatively higher protein intake may theoretically be considered (1.7–2.2 g/kg FFM) irrespective of activity level, due to the presence of anabolic resistance and increased risk of lean mass loss. In these individuals, resistance exercise should be encouraged whenever feasible to maximize the anabolic effect of dietary protein.

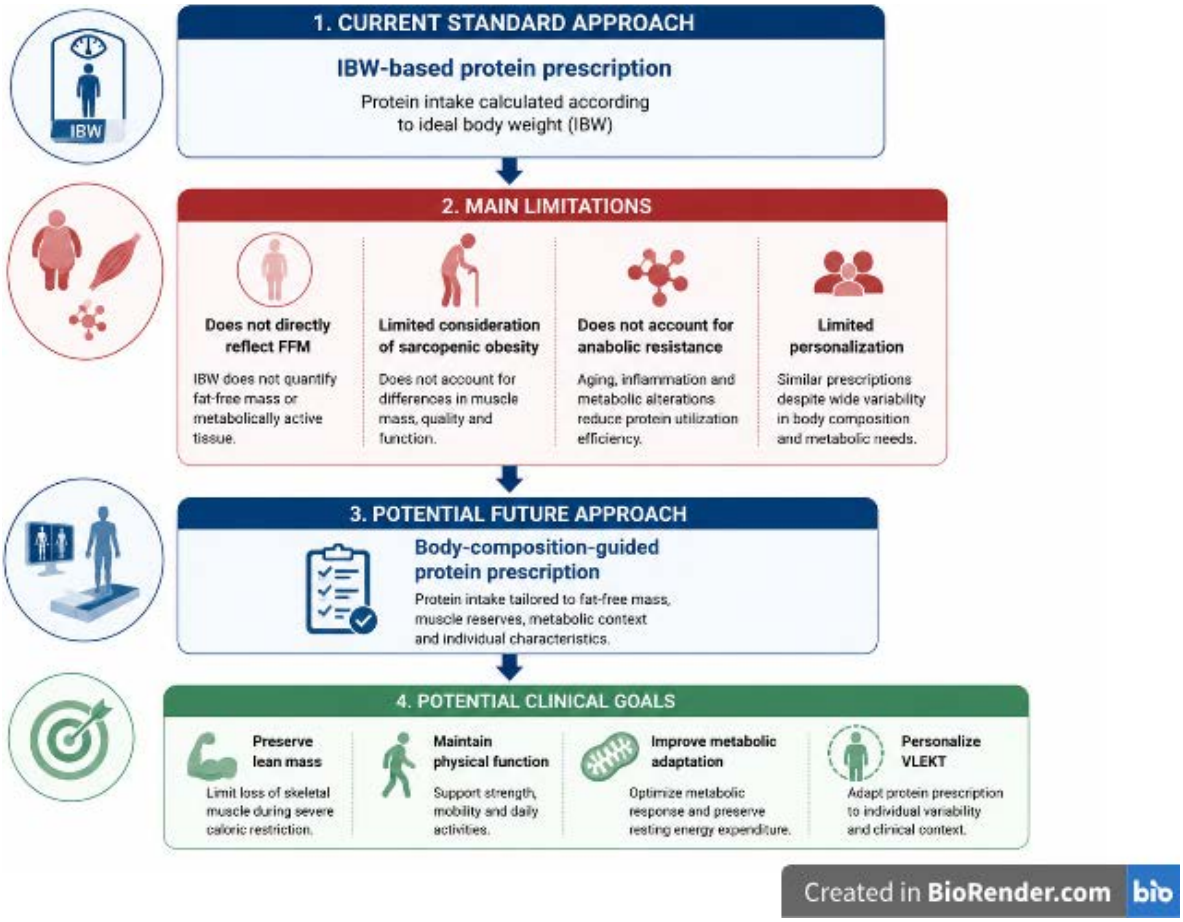

Figure 1. Conceptual framework for body-composition-guided protein prescription during very-low-energy ketogenic therapy (VLEKT).
IBW, ideal body weight; FFM, fat-free mass; VLEKT, very-low-energy ketogenic therapy

are influenced not only by adiposity, but also by skeletal muscle reserves, anabolic resistance, and physical activity level. Individuals with lower relative adiposity and greater lean tissue reserves may require higher protein intake to support maintenance of fat-free mass during rapid weight loss, particularly when resistance exercise is performed. Conversely, severe adiposity is often associated with lower relative lean mass and increased metabolic heterogeneity.

Patients with sarcopenic obesity may represent a particularly vulnerable subgroup because of reduced muscle reserves and anabolic resistance. In these individuals, relatively higher protein intake together with resistance exercise may theoretically contribute to preservation of skeletal muscle and physical function during VLEKT.

The ranges proposed in Table 1 are hypothetical and derived from physiological considerations together with indirect evidence from obesity, aging, and exercise literature. They should therefore be interpreted as a conceptual framework rather than as validated clinical recommendations.

Conclusion

Ideal body weight remains a practical reference for protein prescription during VLEKT, particularly when direct assessment of body composition is unavailable. At the same time, ideal body weight is not a direct estimate of metabolically active tissue.

Protein requirements during severe caloric restriction appear to be influenced by fat-free mass, skeletal muscle reserves, aging, anabolic resistance, and physical activity. These considerations become even more relevant in older adults and in sarcopenic obesity.

At present, no validated model for body-composition-guided protein prescription during VLEKT is available. Existing studies nevertheless indicate that reductions in lean mass may still occur despite conventional protein prescriptions based on ideal body weight. Whether fat-free-mass-based prescriptions improve clinical outcomes still needs to be clarified. Taken together, these observations suggest that more individualized approaches, beyond IBW alone, may ultimately improve the physiological relevance of protein prescription during VLEKT.

Authors' Contribution

Conceptualization: Marco Medeot.
Supervision: Marco Medeot.
Writing–original draft: Marco Medeot.
Writing–review & editing: Marco Medeot.

Competing Interests

The author declares no competing interests related to this manuscript.

Ethical Approval

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