School of Medicine
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Increased Dietary Protein as a Dietary Strategy to Prevent and/or Treat Obesity

by Heather J. Leidy, PhD

These data illustrate that a diet rich in protein appears to be an optimal strategy to prevent and/or treat obesity.

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Abstract

Obesity in America continues to be a major public health concern. Emerging scientific evidence suggests that a diet rich in high-quality protein is a beneficial dietary strategy to prevent and/or treat obesity. This paper provides a brief synopsis of the latest research regarding the effects of higher protein diets to improve body weight management and energy intake regulation. Specific focus on the effects of increased dietary protein on appetite control, satiety, and food cravings are also explored.

Overview

High protein diets have gained both support and criticism over the past decade when recommended as a dietary strategy to prevent and/or treat obesity. Although numerous studies have shown improvements in energy intake regulation and body weight management, others postulate reduced diet quality and harmful effects on bone and kidney function. This paper provides clinical evidence supporting the role of higher protein meals and/or diets in promoting overall health. The effects of increased dietary protein on appetite control, satiety, and food cravings are also explored.

Dietary Protein Requirements

Dietary protein is essential for human health, promoting growth and development and providing energy throughout the lifecycle. The recommended dietary allowance (RDA) for protein is set at 0.80g protein·kg^{-1}·d^{-1} for healthy adults to prevent deficiencies. This quantity equates to approximately 48g of protein/d for women, 56g of protein/d for men, and is roughly 10% of daily intake.[1] Although current NHANES data show that most Americans are meeting this quantity,[5] additional benefits might exist with increased dietary protein above the RDA. As discussed below, recent studies have examined the effects of protein intake that is higher than the RDA. Such higher protein intake remains well within the acceptable macronutrient distribution range (AMDR) which has been set by the Food and Nutrition Board of the Institute of Medicine, National Academy of Sciences as 10-35% of daily intake as protein.

Body Weight Management

In a recent meta-analysis involving 24 randomized, controlled trials of 1,063 overweight and obese individuals, changes in body weight and body composition were examined following 12.1 ± 9.3 weeks of controlled, energy-restricted diets containing either higher protein or standard protein intakes. Specifically,

the higher protein diets included 1.07-1.60g protein·kg^{1}·d^{-1} (27-35% of caloric intake as protein), whereas the standard protein diets contained 0.55-0.88g protein·kg^{-1}·d^{-1} (16-21% of intake as protein).[25] The meta-analysis showed that, compared to the standard protein diet, the higher protein version led to greater reductions in body weight (mean difference: -0.79 kg; CI: -1.50, -0.08; $p<0.03$) and fat mass (mean difference: -0.87 kg; CI: -1.26, -0.48; $p<0.001$) with increased preservation of lean mass (mean difference: +0.43 kg; CI: 0.09, 0.78; $p<0.01$).[25] Another meta-analysis was also recently performed but included randomized controlled trials that contained prescribed isocaloric diets with and without energy restriction.[20] The diets contained either higher protein (16-45% of daily intake as protein) or standard protein (5-23% of daily intake as protein).[20] This meta-analysis showed that, compared to the standard protein diet, the higher protein version led to greater reductions in body weight (mean difference: -0.36 kg; CI: -0.56, -0.17; $p<0.001$), body mass index (BMI; mean difference: -0.37 kg/m^2; CI: -0.56, -0.19; $p<0.001$) and waist circumference (mean difference: -0.43 cm; CI: -0.69, -0.16; $p<0.001$).

A large number of studies to date have examined the effects of higher protein intake in the context of controlled-feeding trials. However, two studies exist which provide useful data within a free-living, ad libitum feeding approach. As shown in Skov et al.,[21] overweight and obese adults completed a six-month dietary intervention consisting of either a higher protein (25% of daily intake as protein) or standard protein (12% of daily intake as protein) diet. Although protein consumption was tightly controlled, the participants were permitted to eat ad libitum. Over the six-month period, the higher protein diet led to greater weight loss compared to the standard protein diet (-8.9 kg vs. -5.1 kg, respectively; $p<0.05$) and greater fat mass loss compared to the standard protein diet group (-7.6 kg vs. -4.3 kg, respectively; $p<0.05$). Similar findings were also shown in another free-living, ad libitum feeding study by Weigle et al.[23] This trial was a single arm, control trial. The volunteers completed two weeks of a weight maintenance standard protein (15% of intake as protein) diet followed by two weeks of a weight maintenance higher protein (30% of intake as protein) diet. For the remainder of the 12 weeks, the volunteers were permitted to eat ad libitum as long as protein intake remained at 30% of daily calories. The consumption of the higher protein diet containing 30% of intake as protein led to an average weight loss of 5 kg over a 12-week period, 76% of which was fat mass[23].

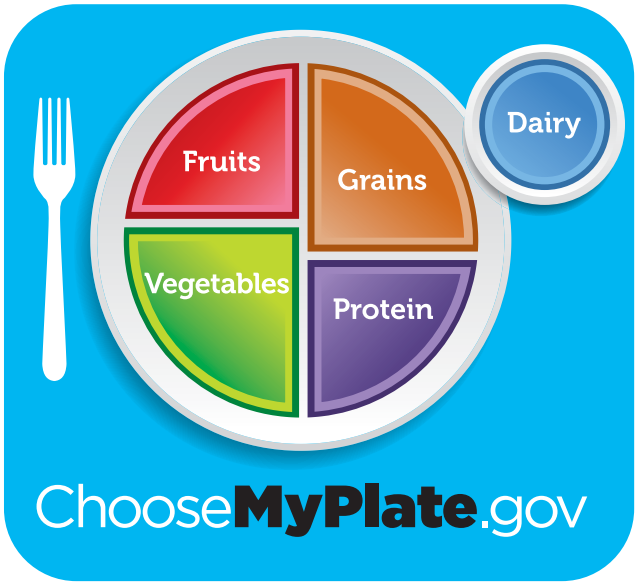
Another critical research question in this area of body weight management is whether increased dietary protein might be a key strategy to prevent and/or reduce weight re-gain following weight loss. As shown in Westerterp-Plantenga et al.,[24] the addition of dietary protein following an energy restriction diet leading to approximately 10% weight loss led to a smaller amount of weight re-gain (17% weight re-gain) over a three-month period compared to no additional protein (37% weight re-gain, $p<0.05$).[24] In fact, most of the weight that was re-gained with the addition of protein was fat free mass, whereas the weight re-gained when no protein was added was mostly fat mass.[24] Similar findings were also evident in a follow-up study extended to six months of weight maintenance.[19] Other studies which have extended out to even longer periods (i.e., 8-13 months) also report sustained weight and fat mass loss with higher protein diets compared to standard protein versions.[3, 12] Collectively, these data support the role of increased dietary protein to lead to greater loss of weight and fat mass loss and to support maintenance of that weight loss over the longer-term.

Protein Sources
The key is to mix different protein sources into your daily routine to satisfy your hunger, including animal and plant proteins.

Regulation of Food Intake

The previous data illustrating greater weight loss during free-living, ad libitum feeding with increased dietary protein suggests an energy imbalance state potentially through spontaneous (i.e., voluntary) reductions in intake. Although the majority of previous studies incorporated controlled-feeding, Skov et al. and Weigle et al. allowed total intake to vary as long as protein intake was maintained.[21, 23] In both of these studies, increased dietary protein led to voluntary

MyPlate Icon
The new MyPlate Icon was introduced along with updating of USDA food patterns for the 2010 Dietary Guidelines for Americans with a different shape to help grab consumers' attention with a new visual cue. MyPlate illustrates the five food groups using a familiar mealtime visual, a place setting. The Icon serves as a reminder for healthy eating, and is not intended to provide specific messages.



reductions in total calorie intake of approximately 400 kcal/d.[21, 23] In most, but not all, acute controlled-feeding studies, the consumption of higher protein meals led to greater reductions in energy intake by as much as 600 kcal, at the subsequent meal, compared to normal protein meals.[2, 6] The substantial, spontaneous reduction in intake with increased dietary protein raises the question of the mechanism(s)-of-action supporting the improvement in energy intake regulation. Potential mechanisms include the improvements in appetite control and satiety frequently observed with increased protein consumption.

Appetite Control and Satiety

Physiological eating is a term used to describe eating in response to acute and/or chronic fluctuations in energy states such as fasting, meal omission, and weight loss. Physiological eating is typically assessed through markers of appetite control and satiety. These include perceived sensations of hunger and fullness (satiety) along with the key peripheral hormonal signals which initiate hunger (i.e., ghrelin) or satiety (i.e., CCK, PYY, GLP-1).

One of the first studies to identify the satiating effect of dietary protein included the consumption of 38 different foods, varying in macronutrient content.[8] Retrospective analyses identified a satiety hierarchy with the consumption of protein-rich foods leading to the greatest feeling of satiety followed by carbohydrate-rich foods and foods high in fat.[8] Since then, numerous acute, meal-related studies have been completed to compare higher versus standard protein meals on markers of appetite control and satiety.

Most, but not all, acute fixed-meal studies have illustrated significant postprandial reductions in perceived hunger and increased perceived fullness following the consumption of higher versus standard protein single meals.[6, 13] These responses have also been accompanied by hormonal responses including reductions in ghrelin and increases in plasma PYY and GLP-1.[13, 22] Other studies have also shown that increased dietary protein, provided at breakfast, lunch, and dinner, leads to immediate and sustained increases in perceived fullness and increased concentrations of plasma PYY, which occur throughout the day and into the evening hours.[14, 18]

Fewer studies have examined the effects of increased dietary protein during weight loss and/or weight maintenance (following weight loss) on markers of appetite control and satiety. During weight loss, higher protein, energy restriction diets led to greater perceived fullness (satiety) compared to standard protein versions.[10, 9, 15] Similar findings were also reported during weight maintenance following weight loss, such that increased dietary protein during weight maintenance led to greater perceived fullness compared to a standard protein diet.[24, 19] These data provide clear evidence supporting the role of increased dietary protein for improved appetite control and satiety.

Food Cravings

Physiological signals play a critical role in regulating energy intake during acute and/or chronic energy imbalance states. However, most Americans are driven to eat through hedonic, reward-driven signals triggered by the current obesogenic environment, which consists of free and easy access to highly palatable, energy-dense foods. Data from our lab has recently shown that higher protein meals can significantly impact reward-driven eating behavior. In these studies, overweight and obese individuals consumed either higher or standard protein meals. Using functional magnetic resonance imaging (fMRI), we identified the neural activation patterns in response to food stimuli prior to subsequent eating occasions. Compared to standard protein meals, the higher protein versions led to reduced activation in select cortico-limbic brain regions, including the insula, hippocampus, parahippocampus, and/or middle pre-frontal cortex.[16, 17] These regions are typically associated with food cravings, food reward, memories, thoughts and executive function. We also found that higher protein meals reduced unhealthy evening snacking on high fat and/or high sugar foods compared to standard protein

meals.[16,17] Although the data are limited, there is some indication that increased dietary protein positively impacts reward-driven eating behavior.

Increased Protein Quantity

Studies suggest that the amount of daily protein intake necessary to promote improvements in energy intake regulation and body weight management lies between 1.2-1.6g protein·kg^{-1}·d^{-1}, which is approximately 25-30% of intake as protein.[11,15] As previously stated, this is well within the acceptable macronutrient distribution range for protein and allows for the ability to meet the recommendations for other requirements. These include obtaining <30% of daily intake as fat and meeting the guidelines for fruits, vegetables, dairy, fiber. However, one point to consider is the fact that the majority of mechanistic data, particularly with appetite control, satiety, and protein synthesis (data not discussed), focuses on meal-specific quantities and not total daily intake. In these studies, approximately 30g of protein/eating occasion is required to elicit the biological changes associated with increased protein intake. Further research is needed to provide sufficient evidence to generate meal-specific recommendations.

Potential Harmful Effects of High Protein Diets

Although increasing evidence exists documenting the benefits of higher protein diets, there is concern for harmful effects of these diets primarily on bone and kidney health. Previously, high protein diets were suggested to increase bone resorption, increase urinary calcium, and increase the risk of fractures and osteoporosis.[7] However, as shown in Heaney, et al.[7] as well as the recent meta-analysis by Santesso, et al.[20] there is no effect of increased dietary protein on calcium metabolism and/or markers of bone health (i.e., bone mineral density in total body, lumbar, and spine; osteocalcium; and risk of fracture) in diets containing 1.0-1.96g protein·kg^{-1}·d^{-1} (16-45% of daily intake as protein). With respect to kidney function, high protein diets have been associated with kidney hypertrophy and increased glomerular hyperfiltration, which, over time, might lead to the development of chronic kidney disease. According to the meta-analysis by Santesso et al.,[20] two studies found slight increases in urinary creatinine (a marker of kidney health) with higher protein diets compared to standard protein versions and four studies showed no effect. Further, in a 24-month study, which is the longest protein-related study to date, Friedman, et al.[4] documented no harmful effects on indices of kidney function, including glomerular filtration rate, with the consumption of higher versus standard protein intakes. Although current research suggests that increased dietary protein within the recommended range appears to be a safe dietary strategy, additional long-term studies are warranted.

Summary

The consumption of higher protein diets, containing between 25-30% of calorie intake as protein, leads to significant improvements in body weight management, through voluntary reductions in energy intake, weight loss, and beneficial changes in body composition. One mechanism-of-action is due, in part, to improvements in appetite control, satiety, and reward-driven eating behavior. To date, the minimum amount of protein required to elicit these mechanistic responses is 30g of protein/eating occasion, which is approximately 1½ servings of high quality protein-rich foods. Further, no data exist suggesting that this quantity of protein consumption elicits any harmful effects on kidney and/or bone health. In summary, these data illustrate that a diet rich in protein appears to be an optimal strategy to prevent and/or treat obesity.

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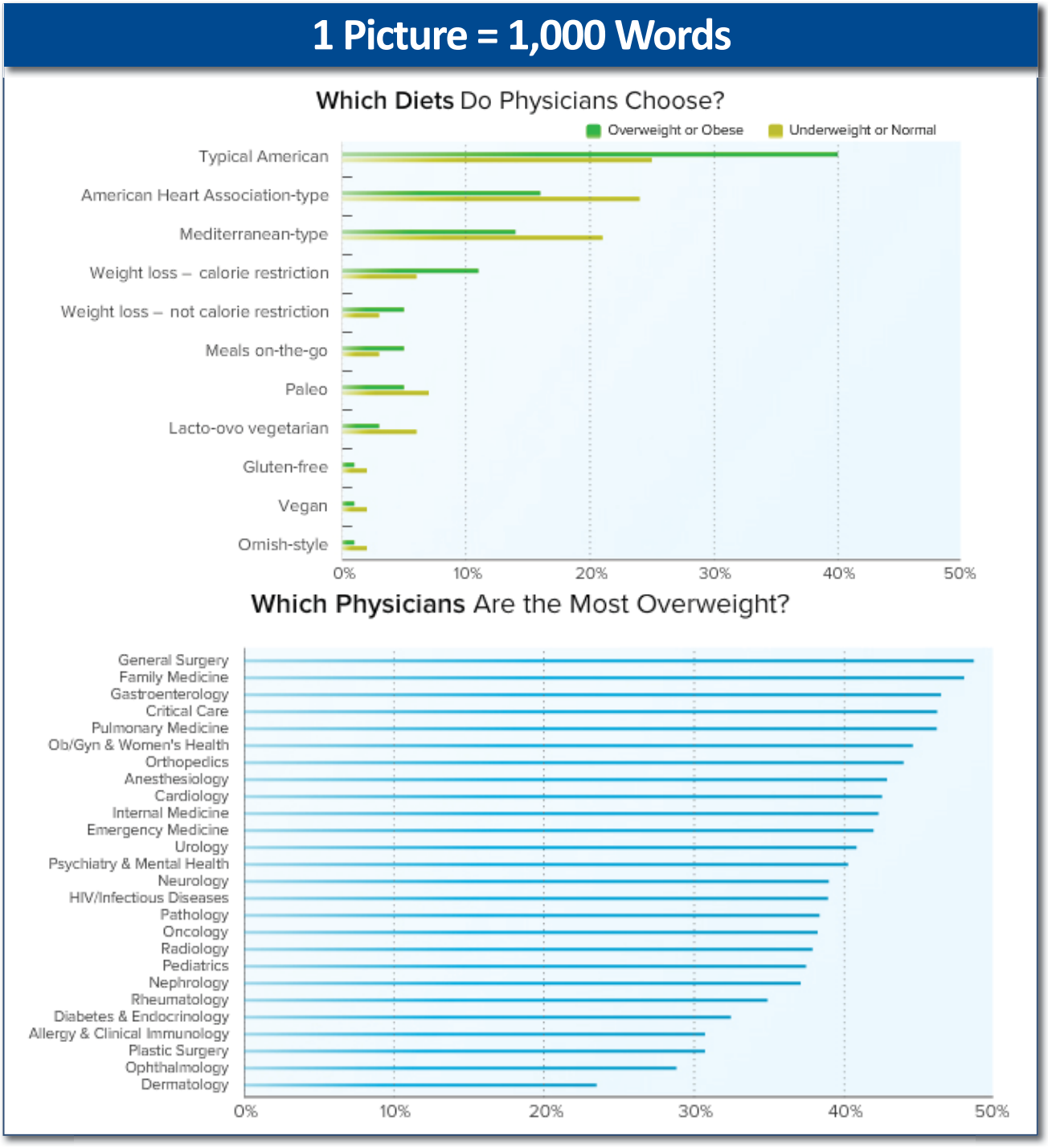
1 Picture = 1,000 Words



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Disclosure

None reported.

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