



PROTEIN-RICH FOODS IN THE MANAGEMENT OF OBESITY**SREEPRIYA S, M. THIRUMAL* AND KAMARAJ R**

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ABSTRACT

Obesity poses a grave risk to global health because of the high morbidity and mortality it causes. Dietary interventions are essential to its control, and dietary protein's contribution to the decline in obesity has received a lot of attention. In conclusion, increasing dietary protein consumption is essential for reducing obesity. By increasing energy expenditure, controlling appetite, and preserving lean body mass, high-protein diets can aid in weight loss. Protein should be included in an obesity treatment strategy, but personal dietary choices, medical issues, and general dietary patterns should also be taken into consideration. Overall, the relevance of dietary protein as a component of all-encompassing weight management techniques is highlighted by the function it plays in reducing obesity. An overview of the state of knowledge regarding the connection between the consumption of protein from food and the prevention and management of obesity is presented in this review.

Keywords: Dietary protein, obesity, prevalence, lifestyle interventions, management and prevention

INTRODUCTION:

Obesity is a serious health issue leading to many health complications [1-4], which can be chronic such as hypertension, cardiac diseases, hyperlipidaemia, and even cancer. It is a well-established forecaster of premature mortality [5, 6]. Dietary changes

and lifestyle variations have been linked to an increase in overweight and obesity. The ready availability of processed foods, lack of movement, and physical activity all add to the cause [7].

Disruption of balance in the energy uptake or intake as well as the energy expenditure causes excess piling of fats in various organs and adipose tissues leading to a rather convoluted metabolic disorder known as obesity. The advancement of obesity is linked with the interferences in lipid metabolism and hyperinsulinemia. Insulin resistance is the principal cause of obesity

usually determined by environment, diet, physical activity, and genetic changes, [8, 9]. These abnormalities are to be curbed by various therapeutic and preventive programs [10]. This review focuses on dietary modifications for the reduction of overweight and obesity; specifically dietary proteins in managing obesity.

Obesity; Causes and factors:

Table 1: Causes of obesity

Causes	Descriptors
Genes	A small percentage of obesity cases rise from genetic factors progressing towards some clinical complications. Mutations and changes in the leptin gene [11, 12] and its receptors are some monogenic causes of obesity. In every case, obesity occurs mostly due to overeating rather than disruption in the energy metabolism. Studies on heritability show that a third of the variation in Body Mass Index (BMI) could be due to genetic factors [13].
Metabolism	Obesity research for years has been aimed for a metabolic defect in obese and overweight people [14]. In the research, it was found that they have reduced their ability to use energy storage and increased the potential for fat storage due to their habit of eating less compared to lean people. Also, researchers have debunked the myth that obese people have lower metabolism which is quite the opposite. Overweight people also misreport their energy intake and show it less than it is. Ultimately allowing us to focus our attention on hunger and eating behaviour [15].
Behaviour	The balance of energy is often affected by important behaviour physical activity and good habits. Research on lean subjects has shown that there is a positive correlation between the amount of fat in the diet and energy intake. Energy-dense foods can be defined as fat, sugar-rich, and sparse in vegetable and fruit diets which can be unknowingly overconsumed. Another example of overconsumption of calories would be sugar-rich soft drinks [16, 17]. Studies have shown that the food items eaten outdoors offer bigger portions and these tend to increase the energy consumption in a single sitting, but they fail to provide people with the feeling of satiation which is directly associated with an increase in weight. Studies have also reported that the obese population has admitted to emotional eating that is they do not eat when hungry instead they will be eating as a result of stress, anxiety, or boredom [18].
Physical activity	Voluntary physical activity is proving to be necessary as daily activities now demand limited effort. Despite the person's body weight, physical activity could bring health benefits and could decrease the risks of diabetes and other metabolic disorders. Studies have also discovered that physical activity makes it easier to bring about a balance between energy intake and expenditure which in turn enhances the appetite-controlling system [15, 19, 20]
Environment	Development in the economy is associated with obesity which shows our dormant susceptibility to obesity. Studies of many communities having a traditional lifestyle around the world show that exposure to Western culture leads to rapid weight gain and obesity. Changing society leads to dependence on convenience food rather than home-cooked meals [21, 22].

Prevalence of obesity in India:

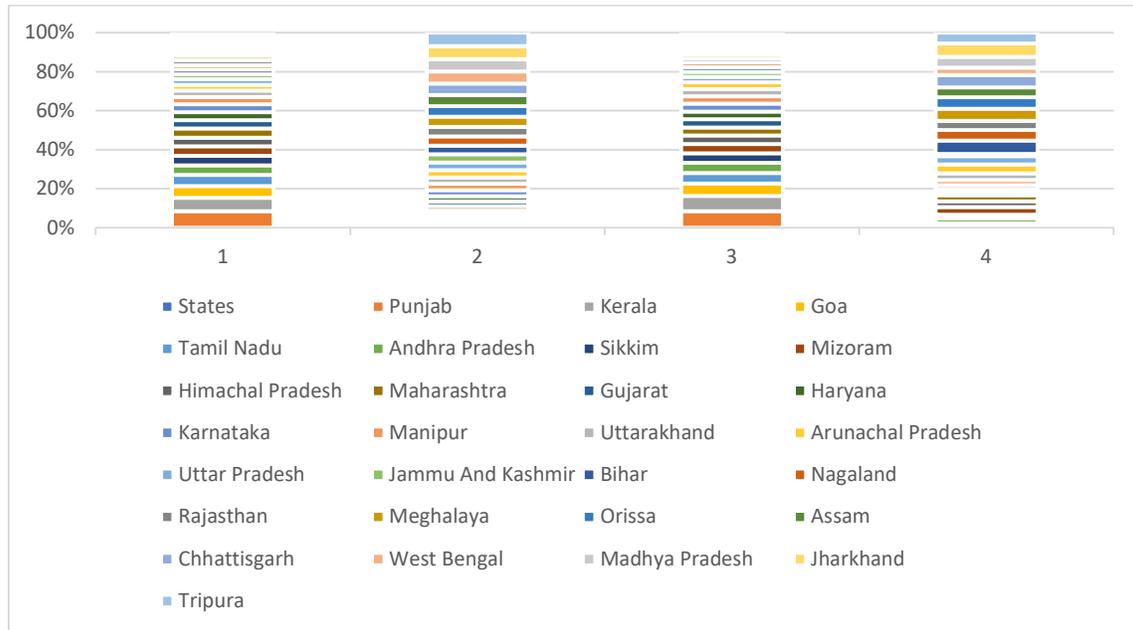


Figure 1: Based on data from the National Family Survey 2007 [23]

Y axis: Indicates the percentage of obesity in various states; X axis:1 -Percentage of obesity in males in different states of India; 2 - obesity in males in various ranks; 3- Percentage of obesity in females in various states of India; 4- obesity in females in various states according to ranks

India is one of the most populous countries in the world where malnutrition has been a big problem to deal with which has changed until recently when the focus shifted towards obesity. A surge in obesity in children and

adults has been discovered in recent studies [24]. Studies also revealed a surge in the population of overweight adults over the last two decades [25-31].

Table 2: Prevalence of obesity according to various factors

Prevalence of obesity	Description
By Age [32]	The National Family Health Survey (NHFS) 2005-2006 was conducted among 15-39-year-old age groups. Following are the surge in combined prevalence in a woman: 15 to 19-2.4% 20 to 29-8.2% 30 to39-17.4%
By Sex	NHFS-3 data of women and men aged between 15-49 showed a combined prevalence of 12.6% and 9.3% respectively [33]. NNMB(National Nutrition Monitoring Bureau) 2005-2006 data of women and men aged between 18-60 years respectively in rural India showed a combined prevalence of 10.9% and 7.8% [34]
By Urban-rural Residence	Combined prevalence was at a higher number of 30.9% in studies conducted across 10 industries in urban areas(28). Studies of the rural Indian population showed a lower obesity prevalence [35, 36].
By Socio-economic Status	NFHS studies showed a rise in prevalence of above 20% for those with higher education and 5-7% approx. among illiterate women. A positive correlation was shown between obesity and socioeconomic status [37-39].
By Region	Prevalence of obesity was seen more in the states of Punjab, Kerala, some of the northeastern states, and Delhi. Thinner or underweight women were found in Bihar, Chhattisgarh, and men in Madhya Pradesh, Tripura, and Rajasthan [33].

Predisposing factors associated with high protein diet:

A high protein diet is a boon for the overweight and obese population and could lead to weight loss but there have been studies that show that it could pose a risk to bones and kidneys. Some of the harmful results advocated are increasing the resorption of bones, increasing the chance of fracture of bone, osteoporosis, and accelerating urinary calcium excretion [40, 41] A meta-analysis of 74 Randomized Controlled Trials (RCTs) revealed regardless of the low protein or the high protein diet, there was no difference in the bone mineral density of the lumbar spine and hips of both the groups. Moreover, low protein diets are often associated with nutritional deficiencies as found in some studies that a diet low in protein could lead to bone loss furthering the risks of osteoporosis [42, 43]. Many have pointed out that high-protein diets may accelerate the glomerular filtration rate leading to renal hypertrophy. However, studies performed on 307 obese adults or 1624 females specifically subjected to a high protein diet and with normal renal function found no change whatsoever in the glomerular filtration rate bone mineral density, or urolithiasis [44, 45]. Thus, in conclusion, a high protein diet does not cause low bone mineral density or osteoporosis, however, it can unfavourably affect renal function in

people already suffering from kidney infection.

Lifestyle changes for obesity reduction:

Lifestyle interventions for obesity reduction include diet, behavioural therapy, and physical activity

Diet

Various kinds of diets could be seen when the topic of obesity reduction comes up such as low-calorie diets, high-protein diets, very low-calorie diets etc. The main goal of dietary changes is to achieve a negative energy balance state, which is to lose 1 to 2 lb/week, obese patients have to be in a calorie deficit of 500 to 1000 kcal/day. A low-calorie diet if maintained for 3 to 12 months could produce a weight loss at least 8% of the early body weight as reviewed by an expert panel. The panel also discovered that a targeted calorie deficit could yield a better result [46]. A recent study compared the results of four distinct diets, each of which had different protein, fat, or carbohydrate contents. The amount of weight lost after two years was found to be identical to low-calorie diets (an average of 4kg among trial participants) independent of the macronutrients they prioritized [47]. The Mediterranean and low carbohydrate diets were found to have more metabolic benefits than low-fat diets according to a study [48], and specifically Mediterranean diet was found to lower the risk for coronary artery disease [49].

Physical activity

The main goal of physical activity is to let subjects perform at least 30 min of it for 3-5 days per week which will result in a reduction of weight and a rise in cardiorespiratory fitness, further guarding against the lean body mass loss. Research revealed a negative correlation between weight regulation and the incidence of complicated comorbid conditions whereas a positive correlation was observed between weight regulation and education level of subjects [50]. Physical activity and a low-calorie diet combined could give a greater weight reduction in fat in the abdomen region selectively [46].

Behavioural therapy:

Goals to be achieved during reduction of the weight are already set out by behavioural therapy. Behavioural therapy includes stress handling, pace reduction of eating, exercise, support from society, monitoring of oneself (maintaining records of food and physical activity), and training for the prevention of recurrence of disease [51-53]. Behavioural therapy is found to be efficient when added to food, pharmacotherapy, or meal replacements [53].

Influence of protein-rich foods in the human body:

Obesity is a widespread disease and because of this rise in popularity of low carbohydrate, high protein diets has occurred [52]. These diets have asserted the

ability of protein-rich diets to induce weight loss, further improving cardiovascular health [54]. Dietary protein-rich food will have a positive effect on the body by increasing satiation, fat-free mass, and energy expenditure.

Energy expenditure

During the intake of protein diet energy expenditure is increased due to the raised resting metabolism and diet-induced thermogenesis. Diet-induced thermogenesis is defined as the energy necessary for absorption metabolism and storage of nutrients. With the amount of protein and calories in the diet, the diet-induced thermogenesis increased [55, 56].

While consuming a high-protein diet, the demand for oxygen increases to metabolize the in-taken protein which will increase satiety [57]. Similarly, people residing in higher altitudinal regions with low oxygen pressure have reduced dietary intake and are lighter [58].

Thus, due to an increase in dietary-induced thermogenesis compared to carbohydrates dietary protein will raise expenditure of energy restricting the loss of lean muscle mass preserving and decreasing weight [59].

Satiety hormones

The main hormones involved in the satiation induced during an intake of high protein diet are anorexigenic hormones secreted by enteroendocrine cells such as peptide tyrosine -tyrosine (PYY), glucagon-like-

peptide-1 (GLP-1) and Cholecystokinin (CCK) hormone [60-62]. A high protein diet (HPD) will stimulate the vagus nerve as well as the release of these hormones, hence lessening the intake of food [63]. Enteroendocrine cells detect nutrients in the GIT (gastrointestinal tract) and release these anorexigenic hormones in turn lessening food intake and raising satiation [64, 65]. Many clinical studies have found that diets rich in protein potentially heighten the feeling of fullness with an increase in plasma levels of these anorexigenic hormones [66, 67].

On the other hand, ghrelin an orexigenic hormone has the opposite effect on the body compared to anorexigenic hormones as ghrelin will heighten the feeling of hunger thus increasing the food intake. A diet rich in protein is found to reduce the plasma levels of ghrelin hormone and suppress the appetite [68-70].

Aminostatic hypothesis

The aminostatic hypothesis presented in 1956 suggested that a heightened level of plasma amino acid could lead to an increase in satiation and a decrease in hunger [71]. Many studies have shown that plasma amino acid concentration [72] and satiation [73, 74] of subjects having a high protein diet had a notable rise compared to those having a fat-rich or carbohydrate-rich diet. This

hypothesis has been unsupported recently as there is no link between the feeling of hunger and plasma amino acid levels and a surge of plasma amino acid after protein consumption is not often linked with appetite [75].

Gluconeogenesis

A diet rich in high protein also increases gluconeogenesis which will induce weight loss. Gluconeogenesis is an alternative pathway in which the leftover amino acids are involved during the consumption of a high-protein diet [76]. A high protein diet heightens the expression of phosphoenol pyruvate carboxykinase and glucose-6-phosphatase both of which are involved in gluconeogenesis. Gluconeogenesis thus raises energy expenditure in turn leading to loss of weight [77] and elevates glucose levels leading to a complete sense of satiation in the brain [77, 78].

Ketogenesis

A diet rich in protein and low in carbohydrates raise the levels of fasting blood β -hydroxybutyrate leading to satiation when compared to a standard diet [79, 80]. Even if all together energy consumption was lower during a day in a high protein diet, individuals tend to consume less at each consecutive meal thus preventing excess weight gain [81, 82].

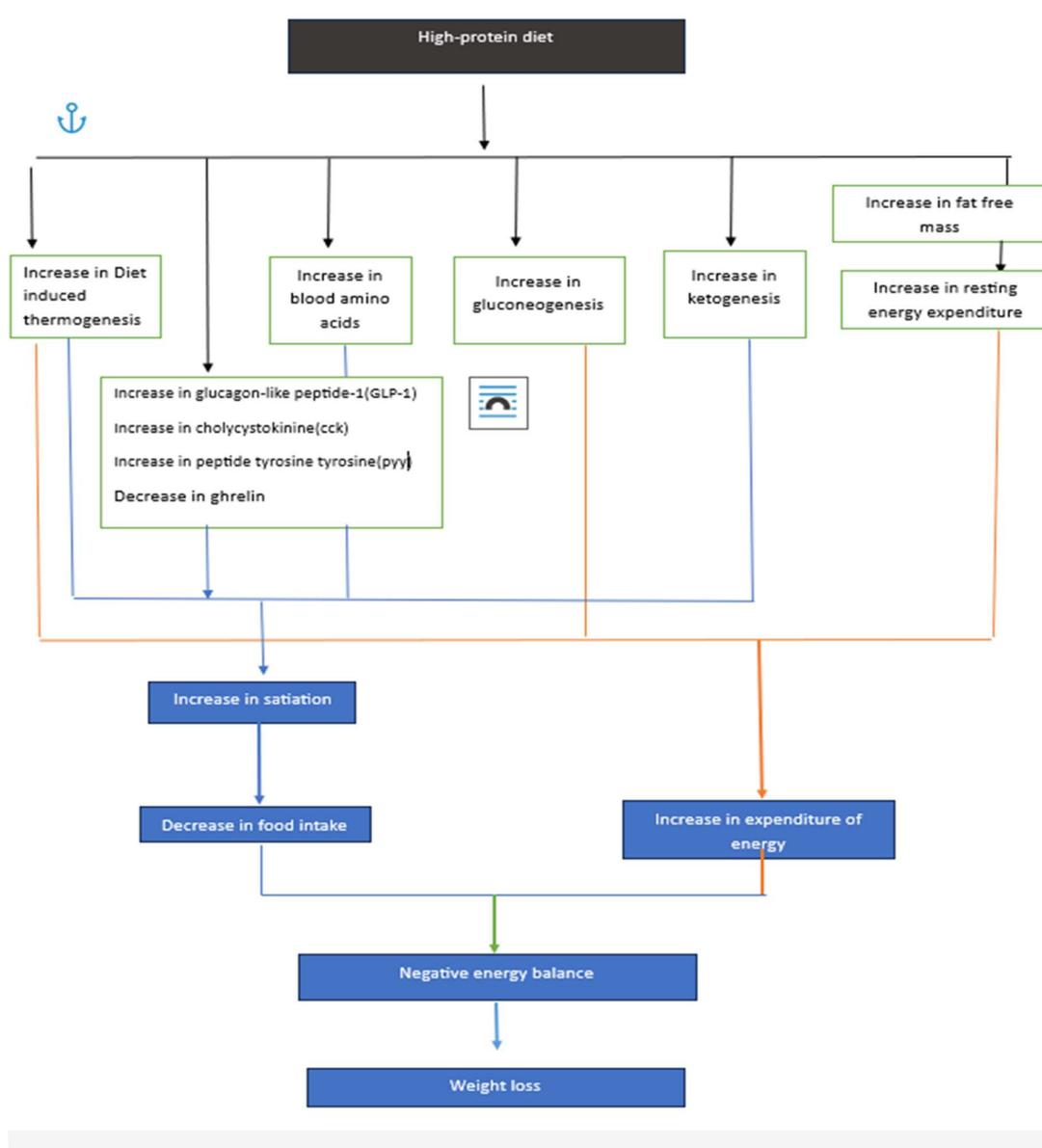


Figure 2: Mechanism involved in the weight loss induced by a high protein diet [83]

Clinical outcomes:

Protein is an essential macronutrient required for the human body for its growth and development. The dietary allowance suggested for the intake of protein to curb protein insufficiency in adults is 0.80g/kg

body weight (BW)/ day, which is 48-56g/day. Several clinical studies have worked to date to control body weight by ingesting a higher amount than the recommended dietary limits of protein intake [83].

Table 3: Outcome of Studies of High Protein Diet on Subjects

Serial number	Study design	Number of subjects	Number of subjects in each diet		Observations	References
			High protein diet	Control diet		
1	Meta-analysis	1,063	27-35	16-21	The study was conducted for less than a month. It was observed that there was a reduction of body weight (in kg), fat mass (in kg), systolic blood pressure(mmHg), and triglycerides levels (mg/dl) in the subjects consuming a high protein diet.	(84)
2	Meta-analysis	1,577	16-45	5-23		(85)
3	Randomized parallel	65	25	12		(86)
4	Single-arm trial	19	30	-		(87)
5	Randomized parallel	148	18	15		(88)
6	Randomized parallel	113	18	15		(89)
7	Randomized parallel	79	34	17		(90)
8	Randomized parallel	130	30	15		(91)

CONCLUSION:

Obesity is a serious condition which often affects many people around the world. The major causes of obesity are genes, metabolism, behaviour, physical activity and environment which could cause a significant increase in obesity around the world. According to the National Family Health Survey, the most obese states are Punjab, Kerala, Tamil Nadu and Haryana. Females above the age of 30 years were found to be more obese than their male counterparts in the Indian scenario. High-protein diet when ingested to treat obesity could pose a risk to the population already suffering from kidney infection. Ingestion of a high protein diet *alone* would not facilitate weight loss as lifestyle intervention should be performed along with the diet to produce effective weight loss. Those lifestyle interventions will include physical activity, behavioural therapy etc. A high protein diet

could have a positive effect on the human body such as an increase in energy expenditure, satiation, gluconeogenesis as well as ketogenesis in the body which will directly lead to a reduction in body weight.

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Conflicts of interest

The authors declare that they have no potential conflict of interest to declare.

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