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Strategy and supplements for improving body composition for gym users in India

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Abstract
According to NFHS-5, approximately 23.45% of the Indian adult population (age 15-49 years) were overweight or obese as their BMI was ≥25.0 kg/m2. The main cause of overweight and obesity is eating more calories (energy intake) than calories burned (energy expenditure). Most people while losing weight only focus on overall weight going down on the scale without thinking about particularly fat loss and body composition. Loss of lean body mass typically occurs along with weight loss. This loss of lean body mass has a number of negative consequences. As a result, weight loss methods that preserve lean body mass are beneficial. Regardless of macronutrient distribution, it is difficult to maintain lean body mass while being in a big calorie deficit. As a result, the impact of different dietary supplements on body weight and body composition has emerged as an active research study area. Many dietary supplements like protein powders and creatine have been found to improve body composition by preserving lean body mass. This paper describes a strategy and supplements for improving body composition for gym users in India.

Keywords: Fat loss, muscle retention, calorie deficit, whey protein, creatine, resistance training

1. Introduction
In 2016, 13% of the adult population worldwide (11% of men and 15% of women) were obese, while 39% of adults aged 18 and older (39% of men and 40% of women) were overweight [1]. Overall, about 23.45% of the Indian adult population (age 15-49 years) were overweight or obese as their BMI ≥25.0 kg/m2. Almost around 31.5% of adults in urban areas were overweight or obese [2].
The first law of thermodynamics, which states that energy can only be transferred from one form to another and cannot be generated or destroyed, is the foundation for the idea of energy balance. This concept of thermodynamics can be used to illustrate how body weight will change over time in response to changes in calorie intake and expenditure. When the body is in energy balance, body weight is stable. A positive energy balance, in which energy intake exceeds energy expenditure causes weight gain. A negative energy balance, in which energy expenditure exceeds energy intake causes weight loss [3].
The main cause of overweight and obesity is eating more calories (energy intake) than calories burned (energy expenditure) [3]. Worldwide, there has been an increase in the consumption of calorie-dense foods high in fat and simple sugars, as well as a decline in physical activity due to the increasingly sedentary nature of many types of jobs, changing modes of transportation, and increasing urbanization [4]. Obesity is a pandemic condition that can lead to health-related consequences by increasing the risk of developing lifestyle-related diseases such as type 2 diabetes mellitus, cardiovascular diseases, respiratory disorders, and several types of cancer [5].
The two most important factors responsible for improving body composition are Training and nutrition. Resistance training is the stimulus for muscle growth this is what triggers the anabolic processes which ultimately results in hypertrophy adaptations. Without training, there is no stimulus for muscle growth to occur so regardless of nutritional status the body won't grow any muscle mass. Nutrition, on the other hand, is more important for the regulation of body fat, a calorie deficit is required for fat loss to occur. Furthermore, nutrition also plays a supportive role in the retention and growth of muscle mass.

2. Body Composition
There are four molecular-level components in the human body namely water, fat, proteins, and minerals. [6] Lean body mass plus fat mass equals body weight LBM + FM = BW. One of the biggest limitations of BMI is that though it indicates overweight relative to height, it does not

differentiate between fat mass(FM) and lean body mass(LBM). [7] The body composition of people with the same BMI varies greatly. This is crucial because lean body mass and fat mass may have differing effects on mortality and other health outcomes. More skeletal muscle, which makes up the majority of lean body mass, has many health benefits[8] in contrast to excess fat mass, which has been demonstrated to be harmful to health [9, 10].

Many weight loss methods in the market claim that they will help in losing weight quickly and easily also known as crash dieting. Most people while losing weight only focus on overall weight going down on the scale without thinking about particularly fat loss and body composition. However, it is vital to note that a major portion of this weight loss while crash dieting is lean body mass loss [11, 12]. There are numerous benefits of maintaining a healthy percentage of muscle mass, such as regulating healthy blood sugar levels, maintaining healthy fat levels in the blood, controlling inflammation, and healthy aging [13-14]. Thus, losing muscle mass is detrimental to health, as muscle mass is a crucial component of your overall health. The detrimental effects of loss of lean body mass on health are lowered metabolism, fatigue, increased risk of injury, and several effects on mental health [15- 16]. Additionally, the metabolic decline that follows a loss of lean body mass causes body fat to regain [17-18]. Therefore, it is crucial to stop or minimize the loss of LBM in order to improve the sustainability of any weight loss method and to counteract any potential detrimental health effects.

Most people use fad diets in order to lose weight quickly which will make them lose weight fast but they will end up being unhealthy. Due to metabolic decline, there is a high chance that they will gain weight again. Thus, most people will end up being fat to skinny fat with too little muscle mass. One of the top dieting mistakes people make is actually eating too few calories and aggressively losing weight. Because when it comes to how to maintain muscle and even build muscle while losing fat, the body needs enough supply of calories and nutrients. Thus, people who eat in a smaller calorie deficit and lose weight slowly tend to retain or build muscle mass while people in a bigger deficit who lose weight quickly will lose muscle mass [19, 20].

People who should aim for body recomposition and those who will benefit the most include-

1. Overweight and obese individuals with BMI ≥25.0 kg/m2 [21].
2. Individuals who have never done any type of resistance training or who have never taken resistance training seriously.
3. Detrained individuals: Detraining is the temporary or permanent loss of training-induced adaptations as a result of insufficient training stimulus. The characteristics of detraining may differ based on the duration of training stoppage or insufficient training [22].

Following is a strategy to maximize fat mass loss and preserve or build muscle mass or at least minimize muscle loss.

3. How to improve body composition

3.1 Nutrition

First and most important requirement for weight loss is a calorie deficit (eating fewer calories than you expend) [23]. Being in a calorie deficit does not determine which tissues are lost it only determines that total body weight is lost.

However, the aim should be that the weight loss should occur from fat mass and not from lean body mass i.e. muscle mass. Thus, calorie deficit will ensure weight loss and thus fat loss but the body needs something to preserve or build muscle mass. Thus, a calorie deficit is mandatory for fat loss to occur.

3.1.1 Rate of weight loss – slow v/s fast

A slower rate of weight loss tends to result in better body composition outcomes. This happens due to two reasons. Firstly in a smaller calorie deficit, the body shows better muscle mass retention [24]. The other reason for opting small calorie deficit is more sustainability. A bigger calorie deficit comes with a lot of problems like increased hunger, more irritability, less energy, and overall lesser adherence to the diet. All these factors decrease the chances of sustaining the diet for a long period of time. However, several recent studies have found that fast weight loss might be just as good and safe as slow weight loss.

According to weight loss experts, losing 1–2 pounds per week is a healthy and safe rate, while losing more

than this is considered too fast. A slow weight loss approach will help to build healthy eating behaviors to keep the weight off, and is safer to do than fast weight loss, especially if there is no support of doctors and dietitians [27, 28]. The most practical recommendation would be to eat in a calorie deficit that anyone can sustainably handle with their lifestyle and preferences.

3.1.2 Protein

The most important macronutrient that will help in the retention or building of muscle is protein [29]. Proper resistance training is also required to stimulate muscle retention or muscle growth but the protein will provide amino acids for building muscle. Higher total daily protein intake results in greater muscle growth along with resistance training. However, past the point of 1.5 g/kg of body weight per day the effect on muscle growth is very less [30]. Higher protein intake while being in a calorie deficit helps with muscle retention or increases the chances of muscle growth in a calorie deficit. But it should be noted that protein intake alone is not sufficient for muscle retention, resistance training is a must to stimulate it. Protein intake should be at least 1.5 g/kg of bodyweight protein per day or it can also go higher to 2.2 g/kg of bodyweight to get maximum benefits. The higher the protein intake along with resistance training the better chances for the body to build muscle or retain muscle mass and lose more fat mass [31].

3.2 Training

The most important factor for muscle mass retention or muscle growth is resistance training along with higher protein intake. More specifically the goal of resistance training should be to stimulate muscle hypertrophy. Resistance training is important because without this stimulus there is no reason for the body to hold on the muscle mass [32]. Thus if someone is just in a calorie deficit it will help them lose body weight but it will also cause muscle mass loss along with body fat. On the other hand if someone is in a calorie deficit along with higher protein intake and resistance training then they will retain or increase muscle mass and will also lose more fat mass [33].

3.3 Sleep

Inadequate sleep has been linked with negative physiological outcomes for body composition and performance. Sleep appears to impact weight loss, it seems that longer sleep durations are associated with better weight loss and weight management over time [34-35]. In a controlled calorie deficit sleep, duration may not influence weight loss, however longer sleep duration may potentially promote greater retention in muscle mass and subsequently a greater loss of fat mass [36-37]. Overall promoting good sleep quality and quantity seems to be favorable for fat loss and muscle retention outcomes.

4. Dietary Supplements for improving body composition

4.1 Creatine

Creatine is one of the most researched supplements and it is very safe and effective too. [38] It can help with exercise performance by donating phosphate to ADP molecules to remake ATP during intense exercise. Creatine may have some cognitive benefits as well, although further research is needed [39].

Creatine is a nitrogen-containing compound made up of amino acids namely arginine, glycine, and methionine [40]. Food sources of creatine are foods like meat and fish. So, those who consume meat on regular bases can get around 1-2 grams of creatine per day [41]. However, those who are vegetarians and vegans will get negligible amounts of creatine from food sources. But creatine is produced in the body primarily made in the liver and to a lesser extent in the kidneys and pancreas [42-43]. Our body has around 100 grams of creatine which is mostly stored in the skeletal muscles [44].

Adenosine triphosphate (ATP) is a molecule that transports energy across cells. When cells use ATP to generate energy, the ATP molecule is broken down into adenosine diphosphate (ADP) and adenosine monophosphate (AMP) (AMP). ATP is only stored in limited amounts in your muscle tissue. Thus our body makes new ATP molecules and there are three ways our body does it. The energy systems in our body are the creatine phosphate energy system, anaerobic glycolysis, and oxidative phosphorylation. The creatine phosphate energy system is used by the body when we engage in high-intensity exercise. Whenever an individual engages in high-intensity exercise skeletal muscles start burning ATP for energy and it is converted to ADP and AMP. Creatine exists in cells as creatine phosphate, which contributes a high-energy phosphate group to an ADP molecule, converting it back into ATP [45].

Creatine supplementation boosts the cellular phosphocreatine pool, which speeds up the conversion of ADP into ATP, resulting in more energy available for high-intensity activity. This enhanced energy availability during exercise can lead to gains in strength and power output [46].

4.1.1 Creatine-benefits

Creatine supplementation increases the amount of creatine stored in our muscles. As a result, skeletal muscles can sustain powerful activity for longer which means the ability to push out more repetitions in the gym and improve performance in high-intensity exercise. Over time, this increased exercise capacity can lead to improvements in muscle mass and strength [47].

Some studies suggest that people who choose a vegetarian diet may have more to gain from creatine supplementation as the main source of dietary creatine is meat products. A recent study found that while vegetarians do benefit from creatine, they don't appear to have a consistent additional benefit in performance compared to non-vegetarians who also take creatine [48].

4.1.2 Creatine-side effects

Creatine has been around as a supplement since the early 1990s so there are almost 30 years of anecdotal use to go by. It should be kept in mind that creatine is a dietary supplement, not a medication or hormone. When used within the recommended dose of 3 to 5 grams per day, research shows no serious harm with up to 4 years of creatine use in adults [49, 50, 51]. There is no consistent evidence that creatine causes hair loss, kidney damage, or liver damage [52]. Some people may experience gut-related side effects like bloating or nausea after taking creatine. Others may experience a 1 to 2-kilogram increase in body weight as creatine can increase the fluid content of muscle cells.

Although there are many various types of creatine available, creatine monohydrate is the most affordable and efficient one [53]. Micronized creatine monohydrate has the ability to dissolve more easily in water and can be more useful practically.

4.1.3 Creatine-Dosage

A loading phase can be used to supplement creatine monohydrate. In the loading phase, take 0.3 grams per kilogram of body weight per day or 20 g/day for a week, then follow with at least 0.03 g/kg of body weight per day or 2-5 g/day either for three weeks if cycling or indefinitely. There are no additional loading phases required if not cycling [54].

However, research has also shown that full creatine saturation can also be achieved with only 3 grams per day. By loading phase, you can achieve full muscle creatine saturation in 6 days but with only 3 g/ day it takes around 28 days to reach full saturation.

4.2 Protein powder

The effectiveness of protein powder is determined by mainly the amount of protein per serving, biological value, and amino acid profile. Biological value is the measurement of a protein's value based on its level of absorbability. The more protein our body can absorb, the more it can be used to make bodily proteins. The amino acid profile is a protein's composition of amino acids. Protein sources that contain all essential amino acids are known as complete proteins. For muscle building, the body needs more of the essential amino acids known as branched-chain amino acids, especially Leucine. Despite the overwhelming amount of different protein powders in the market research has made it clear that whey protein comes out on the top [55]. This is because whey protein is both higher in leucine, one of the most important amino acids for muscle growth, and more effectively absorbed and used by the body when compared to various other protein powders and other protein sources in general.

4.3 Whey Protein

Whey protein is a group of proteins found in whey, a byproduct of cheese production. When milk is treated with a coagulant (typically renin), the curds (casein) and whey separate; whey protein is the water-soluble component of milk. It's sold as a supplement in the form of dry powders with different levels of processing that impact how

concentrated a source of protein it is and how quickly it's absorbed [56].

Whey protein can be further broken down into three different types: Whey Concentrate, Whey Isolate, and Whey Hydrolysate. Whey Concentrate can range anywhere from 35-80% protein and typically contain the highest amount of lactose, carbs, and fats. Whey Isolates, although typically a bit more costly, go through additional filtration processes as are required to be at least 90% protein by weight, and therefore have considerably less fat and carbs. Hydrolysates are whey concentrates or isolates that have been "pre-digested" to help with its absorption but have not been shown to be any more effective at increasing muscle size or strength, yet are typically the most expensive option. For most people, whey isolate is the best option, as it delivers the highest amount of protein and is slightly better for those dealing with digestive issues or who are lactose intolerant.

Table 1: Comparison of different types of whey protein

Whey Protein Concentrate	Whey Protein Isolate	Whey Protein Hydrolysate
35-80% rich in protein	Up to 90% rich in protein	Up to 99% rich in protein
Higher concentration of lactose	Lower concentrations of lactose	Almost zero lactose
Cheapest form of whey	Good value for money	Expensive
Excellent taste	Good enough taste	Awful taste

4.3.1 Whey protein-benefits

It's a high-quality and high bioavailable protein source that's perfect for meeting daily protein objectives. Its advantages extend to the advantages of higher protein intake in general, such as enhancing muscle building in combination with resistance exercise, preventing muscle loss during low-calorie diets, and moderately lowering fat accumulation during periods of excessive calorie intake. These benefits are not unique to whey protein, although it is likely to be more effective per gram than most other protein sources [57].

4.3.2 Whey protein-side effects

There is an increase in the kidney filtration rate by up to 30% within 1 hour of high protein intake. Thus, in people who already have kidney issues, the kidney fails to meet the extra load. Thus in long term, this can affect the functioning of the kidney and worsen kidney damage. As people with already existing kidney issues have some side effects, people thought that maybe it could also have some side effects in people who don't have any kidney issues. But this is false logic and these side effects don't reflect in healthy individuals with no kidney issues. A meta-analysis was published in 2018 which looked at high-protein diets in healthy people and they found that high-protein diets do not appear to have a negative impact on kidney functions in healthy adults. Thus, people with pre-existing kidney issues should consult a doctor before increasing their protein intake.

4.3.3 Plant protein powders

Plant-based protein powders are a good option for vegans and those who have intolerances or sensitivities to whey protein powders. The problem with plant-based proteins is that they tend to be deficient in certain essential amino acids and are less effective at promoting protein synthesis than whey is [59].

There are three very popular vegan protein powders in the market soy protein, pea protein, and rice protein. All these vegan protein powders have been shown to increase markers of muscle growth quite effectively. The mixture of 70% pea plus 30% rice protein is the best option. This blend has all the essential amino acids and also the quantity of leucine is also high thus best for muscle growth.

5. Conclusions

Obesity and overweight have considerable effects on morbidity, mental health, and quality of life. In addition, it also has a significant, negative impact on disease risk. While several weight loss methods have had short-term success, many have failed to produce long-term weight loss and weight management. The loss of LBM that takes place while losing weight is the main factor contributing to this lack of long-term success. As a result, the current emphasis in the weight reduction literature is not just on overall weight loss but also on LBM retention while losing fat. Emphasizing the effects of any weight loss method on body composition changes is critical since what is more important than short-term weight loss is lowering FM while maintaining LBM and not regaining the weight.

Calorie deficit along with 1.5-2.2 g/kg of bodyweight protein and resistance training which stimulates muscle hypertrophy is required for losing fat while maintaining lean body mass or at least minimizing the loss of lean body mass. There are some dietary supplements that can help indirectly to preserve LBM during weight loss or to reduce the loss of LBM while losing fat mass. Creatine and whey protein are two supplements that show great results in improving body composition.

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