WHEY PROTEINS AND BODY COMPOSITION

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Recent studies show that consumption of whey protein, in combination with resistance training exercise, is a safe and effective strategy that will help adults build and maintain valuable muscle mass, and preserve their health throughout the aging process.

THE CRITICAL IMPORTANCE OF MUSCLE MASS MAINTENANCE

Body composition is the relative proportion of body fat and fat-free mass (organs, bone and muscle tissue) that makes up the human body. Unlike body weight, an individual's body composition has a profound influence on health and longevity.[7] With advancing age, people increase adiposity (the rate of fat accumulation) and lose fat-free mass, mostly in the form of muscle.[8] Studies now confirm that these undesirable changes in body composition have severe, long term consequences to health.[11]

Muscles are a dynamic reservoir of bound and unbound proteins (amino acids) that are constantly broken down and regenerated to meet all the metabolic demands of the body.[3] Muscle is also the metabolic furnace that burns fat for fuel and drives the metabolism.[9] Metabolic rate is simply the rate at which the body burns calories; an individual's metabolism ultimately determines their body composition.[10] The controlled process of breakdown and synthesis of muscle proteins diminishes with aging.[28] Additionally, the body's ability to utilize fat for fuel also decreases. The result is a slower metabolic rate that predisposes the older adult to further muscle loss and unwanted fat gain.[11]

However, research now shows that the age-related decline in metabolic rate and increase in body fat accumulation is related specifically to a decrease in muscle mass and not aging per se.[8,10] For an individual in his 20's, muscle comprises up to 60% of the fat-free mass, when one reaches 70, this drops to less than 40%.[1] As fat-free mass diminishes, body fat levels steadily increase, and so does the risk of a shorter lifespan.[11] A high level of body fat (often linked to being over weight) is directly associated with a much higher risk of heart disease, stroke, adult-onset diabetes and other conditions that may reduce the lifespan.[12]

Simply by preserving or increasing fat-free (muscle) mass, older adults can protect themselves against undesirable changes in body composition as well as many ailments that are usually associated with aging.[7,10,12] In fact, some evidence suggests that the decline in resting metabolism and increase in body fat accumulation that occurs with age, may be eliminated if muscle mass is maintained.[10] Striving to build and/or preserve muscle not only leads to a better body composition (less body fat and more fat-free mass); it also increases the chance of a longer, healthier life.[11,12]

BODY COMPOSITION AND EXERCISE

Research that has examined body composition changes in older adults indicates that a person's body fat level throughout their lifespan is influenced more so by the amount of muscle mass they possess rather than their level of physical fitness.[8-11] The past decade has seen an explosion in the awareness of exercise as part of a healthy lifestyle.

Although, regular aerobic exercise, such as walking, jogging or cycling, provides a great way to burn calories and increase fitness (cardiac efficiency), these activities do not provide an adequate stimuli to maintain muscle mass.[13] Preventing the age-related decline in muscle mass appears to be the most important determinant in avoiding excessive body fat accumulation throughout life.[8-11]

More than any other activity, resistance training exercise (using free weight devices) stimulates muscle protein synthesis rates to promote increases in strength and muscle mass that ultimately lead to an improved body composition.[14] The effectiveness of resistance training for improving body composition (reducing body fat and increasing fat-free mass) has been demonstrated in a variety of populations.[13,14] Even frail adults in their 90's respond robustly to intense resistance training programs with significant increases in strength, muscle size and anabolic hormone concentrations.[15]

Body Mass Index Chart

Weight (kg/lbs) \ Height (in)	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
(ft/in)	4'10"	4'11"	5'0"	5'1"	5'2"	5'3"	5'4"	5'5"	5'6"	5'7"	5'8"	5'9"	5'10"	5'11"	6'0"	6'1"	6'2"	6'3"	6'4"
(m)	1.47	1.49	1.52	1.54	1.57	1.60	1.62	1.65	1.67	1.70	1.72	1.75	1.77	1.80	1.82	1.85	1.87	1.90	1.93
45/100	21	20	20	19	18	18	17	17	16	16	15	15	14	14	14	13	13	13	12
48/105	22	21	21	20	19	19	18	18	17	16	16	16	15	15	14	14	14	13	13
50/110	23	22	22	21	20	20	19	18	18	17	17	16	16	15	15	15	14	14	13
52/115	24	23	23	22	21	20	20	19	19	18	18	17	17	16	16	15	15	14	14
54/120	25	24	23	23	22	21	21	20	19	19	18	18	17	17	16	16	15	15	15
57/125	26	25	24	24	23	22	22	21	20	20	19	18	18	17	17	17	16	16	15
59/130	27	26	25	25	24	23	22	22	21	20	20	19	19	18	18	17	17	16	16
61/135	28	27	26	26	25	24	23	23	22	21	21	20	19	19	18	18	17	17	16
64/140	29	28	27	27	26	25	24	23	23	22	21	21	20	20	19	19	18	18	17
66/145	30	29	28	27	27	26	25	24	23	23	22	21	21	20	20	19	19	18	18
68/150	31	30	29	28	27	27	26	25	24	24	23	22	22	21	20	20	19	19	18
70/155	32	31	30	29	28	28	27	26	25	24	24	23	22	22	21	20	20	19	19
73/160	34	32	31	30	29	28	28	27	26	25	24	24	23	22	22	21	21	20	20
75/165	35	33	32	31	30	29	28	28	27	26	25	24	24	23	22	22	21	21	20
77/170	36	34	33	32	31	30	29	28	27	27	26	25	24	24	23	22	22	21	21
79/175	37	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	23	22	21
82/180	38	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	23	22
84/185	39	37	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	23
86/190	40	38	37	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23
88/195	41	39	38	37	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24
91/200	42	40	39	38	37	36	34	33	32	31	30	30	29	28	27	26	26	25	24
93/205	43	41	40	39	38	36	35	34	33	32	31	30	29	29	28	27	26	26	25
95/210	44	43	41	40	38	37	36	35	34	33	32	31	30	29	29	28	27	26	26
98/215	45	44	42	41	39	38	37	36	35	34	33	32	31	30	29	28	28	27	26
100/220	46	45	43	42	40	39	38	37	36	35	34	33	32	31	30	29	28	28	27
102/225	47	46	44	43	41	40	39	38	36	35	34	33	32	31	31	30	29	28	27
104/230	48	47	45	44	42	41	40	38	37	36	35	34	33	32	31	30	30	29	28
107/235	49	48	46	44	43	42	40	39	38	37	36	35	34	33	32	31	30	29	29
109/240	50	49	47	45	44	43	41	40	39	38	37	36	35	34	33	32	31	30	29
111/245	51	50	48	46	45	43	42	41	40	38	37	36	35	34	33	32	32	31	30
113/250	52	51	49	47	46	44	43	42	40	39	38	37	36	35	34	33	32	31	30

Key: Under-weight Healthy-weight Over-weight Obese

WHEY—THE MOST EFFECTIVE PROTEIN FOR IMPROVING BODY COMPOSITION

Researchers have confirmed that protein supplementation enhances the results that are desired from resistance training.[38] However, a review of the scientific literature reveals that protein sources are not all the same in terms of the benefits they may contribute to health and body composition. An ever increasing amount of scientific evidence indicates that whey proteins are tailored to promote a better body composition, particularly when combined with resistance exercise.

For over 40 years, studies using rodents have shown that incorporating whey into the diet results in less fat storage, more lean tissue and greater insulin sensitivity in muscles when compared to other protein sources.[19-23]

In a variety of clinical settings such as cancer, HIV and hepatitis, the health benefits of whey supplementation are clearly documented.[24-27] Although very few clinical studies have assessed whey's impact on body composition changes, whey's unique ability to boost glutathione concentrations within various cells in the body is clear.[24-27,34] Glutathione is the center piece of the body's antioxidant defense system that protects cells against free radical damage, pollution, toxins, infection and UV exposure.[24] Glutathione levels decrease with age,[29] and this decline is associated with the onset of many age-related diseases such as Alzheimer's disease, cataracts, Parkinson's disease and arteriosclerosis.[31] Additionally, glutathione concentrations appear to govern changes in body composition.[29,30]

Whey supplementation has been shown to provide a significant decrease in body fat.

Low glutathione levels within various cells in the body forecast muscle loss, whereas adequate glutathione concentrations underline favorable changes in body composition (such as increased muscle mass and reduced fat mass).This relationship has been demonstrated clearly in a variety of unrelated medical conditions such as cancer and HIV as well as with healthy adults undertaking exercise training programs.[29,33] In comparison to other protein sources, whey has the unique capacity to increase glutathione production that leads to improvements in body composition.[24,34] A number of studies demonstrate whey's beneficial effect on body composition in direct comparison to other high quality protein sources.

Whey supplementation (proprietary product, 20 gms/day for 12 weeks) was shown to enhance glutathione status, improve athletic (anaerobic) performance and provide a significant decrease in body fat percentage in healthy, young adults.[34]

These benefits were obtained without the stimulus of exercise training.[34] However, the combination of exercise and whey supplementation appears to provide even better improvements in body composition.

One study that examined the effects of various supplements during exercise revealed that whey provided the most dramatic results in body composition.[23] Compared to casein or carbohydrate supplementation before exercise, rodents given whey displayed lower body fat levels and more muscle tissue after the six week training period. Metabolic analyses revealed that whey supplementation enabled more effective fat utilization (oxidation) and preservation of muscle. Whey supplementation enhanced the efficiency of exercise to provide better improvements in body composition.[23]

Recently, there has been a surge in interest within the scientific community regarding the beneficial effects of combining dairy protein supplementation with resistance training.[16-18,35,36]

In an open trial, Demling and De Santi[17] reported that supplementation with whey (60 grams/day) was effective at decreasing fat mass and increasing fat-free mass in overweight men following a calorie-restricted diet during 12-weeks

of resistance training. A meal replacement consisting of dairy proteins (including whey), carbohydrates, vitamins and minerals provided even better results than whey supplementation alone.[17]

One study reported that bovine colostrum supplementation (20 grams/day) during 12 weeks of resistance training resulted in greater body composition improvements (an increase in lean body mass of 1.49 kgs) than whey protein alone.[18] However, another study revealed that a whey and casein combination (75 grams/day) provided the same favorable strength, muscle fiber hypertrophy and body composition changes compared to two different colostrum supplements.[16] In both of these studies, the training programs were not supervised, and/or controlled. Exercise selection, training intensity, frequency and volume (the amount of sets, repetitions performed) are all shown to affect the type and magnitude of results obtained from resistance training.[14] Therefore, it is difficult to draw firm conclusions on the effects of supplementation from these studies. However, more rigorously controlled studies involving direct comparisons of whey to other supplements have revealed some remarkable effects on body composition.[35,36]

In a randomized, double blind trial involving athletes (bodybuilders) undertaking an identical, supervised 10 week resistance training program, the group provided with a pure whey isolate (1.5 gms/kg body wt/day) experienced a gain in fat-free mass that was five times greater than a matched group receiving a casein supplement.

DEXA body composition assessments before and after the program also revealed that the whey-supplemented group experienced a significant (1 kilo) reduction in body fat. Combined, these results demonstrated that whey supplementation provided a highly significant improvement in body composition when compared to casein supplementation.[35] Additionally, the whey-supplemented bodybuilders also achieved significantly greater strength increases in every exercise that was assessed.[35] The researchers concluded that whey supplementation (particularly isolates) may provide much better body composition and strength improvements during resistance training compared to other high quality proteins.

Whey proteins are particularly effective at stimulating muscle protein synthesis, and promote better results from training.

Another study by the same researchers on the effects of whey supplementation on body composition changes and muscle fiber adaptations was featured by The American Physiological Society.[36] In this study, four groups of resistance-trained men (20-35 years) were given either whey isolate, carbohydrate, creatine or a combination of creatine and whey supplement (1.5gms of protein/kg body wt/day). The whey-supplemented groups experienced double the gain in fat-free mass after 11 weeks of resistance training compared to males given the carbohydrate supplement. The extraordinary ability of whey to enhance muscle gains during resistance training was confirmed at the cellular level. Muscle biopsies taken from the men before and after training revealed that whey supplementation increased the size of some muscle fiber types by up to 543% compared to carbohydrate supplementation. Additionally, the greater muscle hypertrophy response from whey supplementation correlated strongly with the superior strength improvements seen in the whey supplemented groups.[36] As the researchers noted, all groups started the training program equal in strength, and they consumed an adequate protein intake aside from supplementation. Therefore, based on these studies, whey certainly appears to be a catalyst that ensures better results from resistance training.

WHEY: BIOCHEMICALLY TAILORED TO PRESERVE MUSCLE

The biochemical rationale behind whey's effectiveness to preserve muscle mass and enhance the results desired from resistance training, is sound.

Stimulating protein synthesis and minimizing protein breakdown (proteolysis) are the two cellular processes that are essential to recovery and muscle hypertrophy.[37] Increased protein synthesis rates within muscle cells are vital to creating net gains in muscle protein and subsequent improvements in body composition.[37]

The ability of a protein to stimulate muscle protein synthesis resides in the dose and composition of amino acids.[38] Whey proteins are particularly effective at stimulating muscle protein synthesis rates for a number of reasons.

- Whey's amino acid profile is almost identical to that of skeletal muscle. Whey provides all the correct amino acids in approximate proportion to their ratios in skeletal muscle.[38]
- Compared to other protein sources, whey proteins contain a higher dose (per 100 gms)[40] of the essential amino acids (those that cannot be synthesized by the body). The essential amino acids are shown to be the most effective at stimulating protein synthesis in adult muscle.[41]
- The high concentration of the branch chain amino acid leucine found in whey is of particular interest to exercise scientists. Several researchers suggest that an abundant supply of leucine to muscle after exercise may promote more efficient recovery at the cellular level to speed the adaptation process of exercise training.[44,45]

However, creating and maintaining the optimal bio-environment that builds and preserves muscle actually centers around two other amino acids; glutamine and cysteine. Although glutamine and cysteine are referred to as non-essential, a series of studies confirm that the concentration of these two amino acids within the body virtually determines the amount of muscle tissue a person carries throughout their lifespan.

- Muscle protein synthesis rates and protein accretion are essentially controlled by the amount of glutamine held within the cell.[45] However, muscle glutamine is the essential fuel that drives many indispensable processes within the body, including immune function.[43] The body's demand for glutamine is ravenous. Without the constant de novo synthesis of glutamine by muscles, glutamine stores would be depleted within seven hours.[42]
- Muscle glutamine is manufactured exclusively by the branch chain amino acids (leucine, isoleucine and valine). The branch chain amino acids are unique in muscle metabolism; they must be present to stimulate protein synthesis within muscle as well as manufacture glutamine.[47] However, these amino acids are also metabolized extensively for energy within muscle rather than the liver. This is particularly evident during periods of metabolic stress such as illness, infection, calorie restriction and exercise training.[42,43,46]
- Cysteine is the rate limiting amino acid in glutathione formation.[28] Additionally, a high concentration of cysteine in blood is required at all times to ensure correct protein metabolism that preserves muscle mass.[29] An abundant supply of cysteine (in the blood) down-regulates hepatic urea production and shifts nitrogen disposal in favor of muscle glutamine synthesis and the preservation of the muscle glutamine pool.[29] This essential metabolism of cysteine by the liver is vital to maintaining valuable muscle glutamine stores as well as the synthesis of glutathione.[30] However, this process is disrupted during periods of intense metabolic stress. Intriguingly, this tightly controlled process also diminishes with advancing age.[29] The result of this is a steady but aggressive decline in muscle tissue throughout the lifespan.[29]

Whey proteins contain a high concentration of all the amino acids that are essential to creating and maintaining the optimal bio-environment that preserves muscle mass.

- Supplementation with cysteine-rich compounds are shown to increase glutathione production, halt muscle protein breakdown, improve muscle strength and body composition during exercise training.[32,33,48] Compared to other proteins, whey is a rare, rich source of cysteine that is easily assimilated by the body.[46] In fact, whey is viewed by scientists as an effective "cysteine-donor" that restores blood cysteine concentrations and boosts glutathione levels that lead to improvements in body composition.[24,34,46,49]
- Whey is nature's richest source of branch chain amino acids.[46] Characteristically, whey's amino acid composition is 26% branch chain amino acids and 6% glutamate.[40] These are the amino acids used exclusively by muscle to manufacture glutamine.[47] That means, over one third of whey's entire amino acid profile is devoted entirely to muscle glutamine synthesis.

Additional research demonstrates that whey's beneficial effects on muscle may not reside exclusively in its amino acid profile.

- Scientists have now confirmed that blood amino acid concentrations control muscle protein synthesis rates and the ability to gain muscle from resistance training.[37] A high level of amino acids in the blood is necessary to stimulate muscle protein synthesis rates and maximize the stimulus of resistance training.[6]

Sarcopenia

Sarcopenia is the unexplainable loss of muscle that happens with aging.[1] Although sarcopenia is a common occurrence among apparently healthy older adults, new research suggests that this phenomenon initiates many of the undesirable conditions that are associated with aging, such as immobility, osteoporosis, diabetes, unwanted weight gain and increased susceptibility to illness.[1-3] The estimated, direct healthcare costs attributable to sarcopenia each year in the United States is $18.5 billion.[4]

Sarcopenia is avoidable and reversible. Lifestyle and dietary strategies that focus on maintaining muscle mass will enhance health and may prevent or reduce the severity of many aging-related illnesses. In addition, these health enhancing strategies may significantly reduce the economic burden on the health care system of developed and developing nations.[4,6] An ever-increasing amount of research suggests that whey is a protein that is biochemically tailored to preserve valuable muscle mass and enhance health. The benefits of incorporating whey proteins into the diet for improving functional strength and building muscle mass are now substantiated by scientific studies from all over the world.

Unlike other high quality protein sources, whey is rapidly absorbed and provides a significant increase in blood amino acid concentrations to stimulate muscle protein synthesis rates.[51] Additionally, when whey is consumed as part of a mixed macronutrient meal (with carbohydrate and fat), a strong and persistent inhibition of muscle breakdown (proteolysis) is witnessed along with increased muscle protein synthesis.[51] On an equal serving basis, whey supplementation results in higher protein balance and greater muscle protein gain compared to other high quality proteins such as casein.[51] For all these reasons, whey protein supplementation seems to fit the ideal dietary prescription for building muscle and limiting muscle loss during aging.

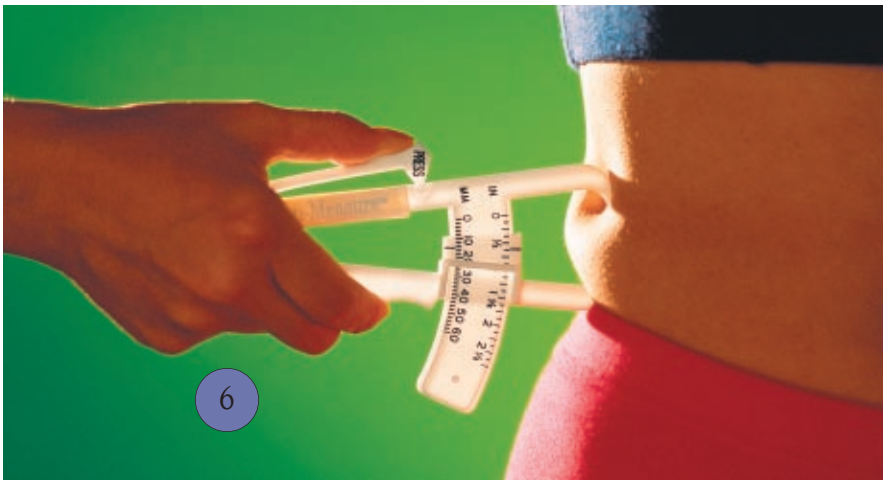
Dairy proteins and fat loss

Whey protein's beneficial effects on body composition may not pertain exclusively to building muscle. Dairy products that are rich in calcium and dairy protein are now thought to play a key role in the regulation of energy metabolism and whether an individual gains or loses body fat.[49] Diets that are rich in calcium appear to prevent fat gain as well as increase fat metabolism, thereby markedly accelerating the process of losing unhealthy body weight.[50] While the beneficial impact of a high calcium intake on body composition is clear, a review of the literature shows that calcium coming from dairy appears to provide the greatest fat-loss effect of all calcium sources.[53] Even without calorie-restriction, increasing the intake of dairy products is shown to reduce body fat and increase fat-free mass.[52] Although the bioactive constituents responsible for dairy's beneficial effects on fat metabolism remain the subject of speculation, the researchers behind these studies suggest that whey proteins are a major contributor.[49,50,52]

Whey and satiety

Of all the macronutrients, protein has the most exceptional appetite-suppressing effects. However, a recent study suggests that whey may be the most effective protein at suppressing hunger and make dieting for fat loss easier.[54] In a series of trials, consumption of whey protein before a meal significantly reduced hunger and increased the feeling of satiety from eating less food. When the participants drank a whey shake 30 minutes before a meal they felt more satisfied when consuming fewer calories.[54] The researchers discovered that whey stimulates much higher levels of two gastrointestinal hormones that control appetite; cholecystokinin and glucagon-like peptide-1. Consuming whey increased the levels of these hormones by 60% compared with drinking a regular protein (casein) supplement.[54] Therefore, consuming a small serving of whey (30-40 gms) before a meal may reduce hunger and take the difficulty out of following a calorie-restricted diet to make weight loss much easier!

Increasing the ratio of protein in the diet is now considered a safe, effective strategy that lowers blood lipid concentrations, improves insulin/glucose metabolism and enhances fat loss.[55] Due to the multitude of benefits it provides, whey should be the first protein source considered when health-conscious people choose to increase their protein intake.



APPLICATIONS: GUIDELINES TO IMPROVE BODY COMPOSITION

Using whey protein to build muscle mass

An abundant supply of the essential amino acids to muscle during resistance training is shown to enhance the anabolic stimulus by up to 400%.[56] To achieve this effect,

- Take a serving of whey protein (20-40 grams) with a dose of carbohydrates (glucose) (20-40 grams) mixed in water within the hour before resistance training exercise.
- Additionally, take the exact same mix immediately after resistance training.

A single bout of resistance training exercise can stimulate muscle protein metabolism for up to 36 hours.[37] To minimize the muscle breakdown response and maximize the anabolic stimulus that resistance training provides,

- Consume a serving of whey (20-40 grams) with a source of carbohydrates and some fat several times throughout the day. Simply mix or blend a serving of whey (concentrate of isolate) in 6-10 ounces of skim milk with some fruit and a table spoon of canola or flaxseed oil.

Research shows that when whey is consumed as part of a mixed macronutrient meal (with carbohydrate and fat), a strong and persistent inhibition of muscle breakdown is witnessed along with stimulation of protein synthesis.[51]

Using whey proteins to enhance fat loss

- As a natural appetite suppressant, take a small serving (20-30 grams) of whey protein (isolate or concentrate) mixed in 7 or 8 ounces of water, 30 minutes before a meal.

Research suggests that consuming a whey shake 30 minutes before a meal ensures greater satiety from consuming fewer calories.

- To enhance fat utilization and muscle preservation during exercise; consume a small serving of whey (isolate or concentrate) mixed in water, 30 minutes before exercise.

Research suggests that whey supplementation before exercise enables more effective fat utilization (oxidation) and preservation of muscle.

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