Cognitive Vitality Reports® are reports written by neuroscientists at the Alzheimer's Drug Discovery Foundation (ADDF). These scientific reports include analysis of drugs, drugs-in-development, drug targets, supplements, nutraceuticals, food/drink, non-pharmacologic interventions, and risk factors. Neuroscientists evaluate the potential benefit (or harm) for brain health, as well as for age-related health concerns that can affect brain health (e.g., cardiovascular diseases, cancers, diabetes/metabolic syndrome). In addition, these reports include evaluation of safety data, from clinical trials if available, and from preclinical models.

β-hydroxy β-methylbutyrate (HMB)

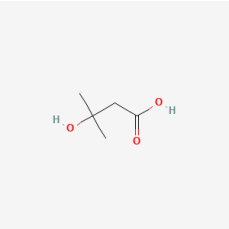
Evidence Summary

HMB has been suggested to promote muscle mass gain and may have a small benefit in older patients who are frail and/or sedentary, but there are conflicting results. There is no data on HMB and cognition.

Neuroprotective Benefit: There is no clinical evidence that HMB alone has effects on cognition. Several preclinical studies suggest that HMB could mitigate age-related deficits in cognitive function or neuronal health, but they remain to be confirmed.

Aging and related health concerns: HMB may promote muscle synthesis and prevent muscle loss, and has been explored for use in exercise, sarcopenia, frailty, and others. Several studies report modest benefits, but the data is conflicting.

Safety: There are no adverse events associated with HMB at the most common dose of 3 grams per day or higher doses. Studies up to 1 year in duration have reported no adverse events or clinically significant effects on laboratory or physical exam values.

Availability: OTC	**Dose**: 3 grams per day is the most common dose in trials	**Chemical formula:** $C_5H_{10}O_3$ **MW**: 118.13 g/mol  Source: PubChem
Half-life: 2.5 hours	**BBB**: Penetrant	
Clinical trials: The largest clinical trial that involved HMB was of a nutritional supplement with several compounds, including HMB; the study included 811 participants.	**Observational studies**: No observational studies were identified that looked at HMB monotherapy; one study of 270 individuals looked at use of an oral nutritional supplement that contained HMB and other ingredients.	

What is it?

β-hydroxy β-methylbutyrate (HMB), also known as beta-hydroxyisovaleric acid or beta-hydroxymethylbutyrate, is a leucine metabolite. Approximately 5% of leucine is converted to HMB in humans. HMB is involved in preservation of or increase in skeletal muscle via both mitigating breakdown of muscle protein and through promoting synthesis of new muscle protein. Therefore, HMB supplements are thought to increase muscle protein synthesis, muscle recovery, and body composition after exercising. HMB is also hypothesized to benefit aerobic exercise performance. In older patient populations, including sedentary adults or those who are unable to move normally due to illness or injury, HMB could improve muscle strength and function and/or reduce muscle loss. HMB has thus been of interest to both young, healthy populations and to elderly populations (Rathmacher et al., 2024).

Sarcopenia is an age-related loss of skeletal muscle mass, strength, and performance (Ardeljan & Hurezeanu, 2023); it is associated with increased risk of fall, functional decline, reduced quality of life, frailty, and death (Feng et al., 2024). Both exercise and nutritional supplements, primarily of protein, have been shown to help prevent and/or manage sarcopenia. There has been interest in whether HMB can also help prevent or treat sarcopenia or otherwise provide additional benefits.

HMB has primarily been studied for its potential benefits for muscle, whether in healthy athletic populations or in frail or critically ill populations. It is not known whether HMB has any direct effects on cognition or neurodegenerative disease.

Neuroprotective Benefit: There is no clinical evidence that HMB alone has effects on cognition. Several preclinical studies suggest that HMB could mitigate age-related deficits in cognitive function or neuronal health, but they remain to be confirmed.

Types of evidence:

- 2 randomized controlled clinical trials
- 12 laboratory studies

Human research to suggest prevention of dementia, prevention of decline, or improved cognitive function:

While far from a consensus position, some studies have found that frailty is associated with an increased risk of dementia (Ward et al., 2025). Theoretically, if HMB could significantly mitigate frailty or the specific mechanism(s) of frailty that increase risk of dementia, HMB could potentially play some indirect role in prevention of dementia or decline. However, this is purely speculative; there is no data on HMB reducing incidence of dementia or decline.

There has been very little preclinical or clinical research on potential roles of HMB in cognition. Two studies were identified that assessed the effects of HMB on a variety of outcome measures, some of which assessed cognition.

Gutiérrez-Reguero et al., 2024 describes a 12-week RCT involving a multicomponent intervention of both exercise and HMB in older, non-active adults living in nursing homes. The study utilized a cluster randomization process; that is, they recruited patients from multiple nursing homes and randomized the nursing homes to one of four groups: exercise and placebo, HMB supplementation alone, exercise plus HMB supplementation, or control (no intervention). The 72 enrolled participants were assigned to the group assignment their nursing home received. The exercise intervention was the Vivifrail exercise program; HMB supplementation was provided as a drink with 3 grams of HMB per day. Both the

exercise + placebo and the exercise + HMB group showed significant improvements in cognitive function, physical function, and relative muscle strength compared to baseline. Compared to the control group, the exercise + placebo and exercise + HMB group had significantly better cognitive function and relative muscle power, while only the exercise + HMB group had better physical function than the control group. It is worth noting that compared to the control group, the exercise + placebo group had significantly better lower self-reported disability, though whether that affected the results is not clear. It is also worth noting that the average MMSE of participants ranged from 18.4 to 21.6, all of which are in a score range indicating MCI or dementia. However, the standard deviations were large and overlapped with non-dementia MMSE scores. Taken together, in this patient population HMB did not appear to add any additional cognitive benefit to exercise over 12 weeks, though it may have provided some benefit in measures of physical function. It is not clear whether HMB did or would have had a differential effect based on baseline cognitive status.

The other study was a 12-week RCT in 148 active-duty Air Force members. The participants were randomized to receive a high-intensity interval aerobic fitness and strength training and placebo, or the same exercise program with a nutritional supplement in drink form that contained 3 grams of HMB per day along with other ingredients, including DHA, lutein, phospholipids, and select micronutrients such as vitamin B12. Compared to baseline, exercise alone improved several parameters of physical fitness and cognitive function; in total, 14 of the 23 assessment metrics showed significant changes from baseline. In the exercise + supplement group, 19 of the 23 assessment metrics showed significant changes from baseline. Compared to exercise alone, the exercise + nutritional supplement improved working memory, fluid intelligence reaction time, processing efficiency, heart rate, and lean muscle mass. Given that the nutritional supplement had a variety of ingredients that could affect cognitive function, it is far from clear whether HMB had any effect on cognition, or whether that effect would have been due to HMB alone or a specific combination of ingredients in the nutritional supplement (Zwilling et al., 2020).

Human research to suggest benefits to patients with dementia:

No studies were identified that assessed HMB in dementia populations.

Mechanisms of action for neuroprotection identified from laboratory and clinical research:

HMB has been primarily studied for effects on retaining existing muscle or new muscle synthesis, which could have indirect neuroprotective impacts by mitigating risks due to frailty or by enabling

neuroprotective activities such as exercise. Some early preclinical work has investigated whether HMB has any properties that may be more directly neuroprotective.

Preclinical work indicates that HMB does cross the blood-brain barrier (BBB) (Santos-Fandila et al., 2014; Higuchi et al., 2021). HMB is involved in several signaling pathways, and can stimulate mTOR and IGF-1 axis, among others, which could have a variety of downstream effects. HMB is also a precursor for cholesterol synthesis and could modulate cholesterol homeostasis (Kougias et al., 2016; Kougias et al., 2017). One laboratory study in a mouse model of multiple sclerosis reported that HMB was associated with preserved integrity of the BBB and blood-spinal cord barrier, reduced inflammation, maintained expression of myelin genes, and mitigated demyelination. This immunomodulation appeared to be mediated by PPARβ, a transcription factor involved in metabolism (Sheinin et al., 2023). Other studies have also found potential pro-myelination effects of HMB (Jana et al., 2024).

A laboratory study by Paidi et al., 2023 found that supplementing with HMB significantly increased dendritic spine density and spine size compared to control treatment in primary hippocampal cell culture models as well as in 5XFAD mice, which are a common model for AD. The HMB-treated neurons and mice also had higher levels of several synaptic proteins as well as BDNF and CREB. 5XFAD mice treated with HMB also had dose-dependent improvements in a spatial learning and memory task compared to control-treated mice, and HMB treatment lowered Aβ plaque burden. The authors found that these effects were mediated via PPARα, a transcription factor involved in metabolism and in a variety of neuronal processes including neuroinflammation and learning and memory (Paidi et al., 2023; Hempel et al., 2023). PPARα may also increase lysosomal biogenesis (Paidi et al., 2023).

Another preclinical study by Barranco et al., 2022 tested HMB in middle-aged rodents. They found that medium and high doses of HMB in rats had improved long-term potentiation (LTP) compared to control treatment, and mice who received HMB performed better on a working memory task compared to those who received control treatment.

Some studies have specifically looked at aging rats or mice and reported that HMB treatment mitigated some age-related effects. Kougias et al., 2016 details the results of an experiment wherein 12-month rats were dosed with HMB or control treatment; while the aged control mice showed reduced dendritic spine number and retraction of dendrites compared to middle aged rats, the HMB group did not show the same reductions. The same group also reported that HMB supplementation mitigated age-related deficits on a visuospatial learning and memory task, particularly in male mice (Kougias et al., 2017) and

also in a learning and working memory task (Hankosky et al., 2017). Another study in mice also reported that 24 weeks of HMB treatment mitigated age-related learning deficits compared to control treatment (Munroe et al., 2020).

However, not all preclinical work has shown a benefit of HMB on cognitive function in young or aged mice; one study did not identify a benefit of 5.5 weeks of HMB on fear-conditioned learning or recognition-based learning (Munroe et al., 2017). Whether this is due to dosing, duration, specific model used, or the specific cognitive function assessed requires more study. These potential anti-inflammatory, Aβ plaque-reducing, dendritic spine and cognitive function-preserving, and LTP-enhancing effects all would also need to be both confirmed in humans and shown to be clinically meaningful.

APOE4 interactions:

It is not yet known whether HMB has any differential effects based on APOE4 status.

Aging and related health concerns: HMB may promote muscle synthesis and prevent muscle loss, and has been explored for use in exercise, sarcopenia, frailty, and others. Several studies report modest benefits, but the data is conflicting.

Types of evidence:

- 3 umbrella reviews of systematic reviews and/or meta-analyses
- 10 systematic reviews and/or meta-analyses
- 15 clinical trials
- 3 observational studies
- 5 reviews
- 1professional resource
- 2 laboratory studies

HMB has been explored in many populations from healthy young athletes to elderly and frail adults, and these studies have also employed varied designs in terms of duration, whether HMB is tested with exercise or no, whether HMB is tested as part of a combination supplement or no, and looked at a variety of outcomes, including body composition, strength, and function.

While specific populations will be addressed in their own sections below, a 2025 umbrella review of meta-analyses by Bideshki et al., 2025 looked at the effects of HMB supplementation on body composition and muscle strength in all adults. This study will be discussed individually, to provide some context or clarity for the individual sections below.

Bideshki et al., 2025 included meta-analyses of RCTs of HMB supplementation compared to placebo or control in adults that looked at body composition and/or muscle strength. They included 11 meta-analyses with 41 data sets. The age ranges of the studies we 23 to 78 years, the average durations ranged from 1 week to 1 year, and the dosages ranged from 1 gram daily to 4 grams daily. Some of the studies included co-supplements such as vitamin D or calcium, and some did not.

The researchers found that HMB supplementation significantly increased fat-free mass (ES=0.22; 95% CI 0.11 to 0.34; $p<0.001$). There was significant heterogeneity, which subgroup analyses suggested was due to duration and age; trials longer than 8 weeks, or of participants who were 30 years or older, had significant increase in fat-free mass or had larger effect sizes. Similar results were found for strength index; there was a statistically significant increase in strength (ES-0.27; 95% CI 0.19 to 0.35; $p=0.04$). There was some heterogeneity in this result which subgroup analyses suggested to be due to age and duration, such that HMB had a larger effect on those 60 or older than those 30 or younger, and studies of longer than 8 weeks reported more beneficial effects. They also found that HMB given with calcium as a co-supplement had a more pronounced effect on muscle strength compared to HMB as monotherapy. When they looked at muscle mass, they found that HMB significantly increased muscle mass (ES=0.21; 95% CI 0.06 to 0.35; $p=0.004$) with acceptable heterogeneity. There was a larger effect size in those 70 years or older than those 30 years or younger, and there was a great effect in meta-analyses with an average duration of more than 8 weeks compared to shorter durations. There was no significant effect on fat mass or body mass.

With these data, the researchers hypothesized that the effect of HMB in younger adults may be less pronounced as they have higher baseline levels of muscle mass and have great capacity for muscle repair than older adults; that in middle-aged adults, there can be a moderate impact on muscle preservation in those who are active but not athletes; and that in older adults, there is the most significant benefit.

These results both conflict with and are in line with other studies below. Taken together, it appears that the existing data best support an effect in older adults, but the heterogeneity of trials hampers a full understanding.

Frailty, Sarcopenia, and Aging: THEORETICAL BENEFIT; POTENTIAL FOR SMALL BENEFIT

Some work suggests that HMB levels decrease with increasing age and that there is an inverse correlation between HMB and frailty such that low levels of HMB are associated with increased frailty (Molina-Baena et al., 2024). Phillips et al., 2022 published an umbrella review of systematic reviews that assessed the effects of HMB supplementation in aging and clinical practice. The review included 15 systematic reviews that included adults over 50 and tested HMB or a combination therapy with HMB to a control group. The researchers looked at effects on body composition / skeletal muscle mass, strength, and physical function. Their findings are summarized in the table below:

	HMB has some positive effect	HMB has no effect / no difference between groups	Insufficient evidence to come to conclusion
Body composition / muscle mass	5 of 15 studies	6 of 15 studies	4 of 15 studies
Strength	4 of 12 studies	5 of 12	3 of 12
Physical Function	0 of 10 studies	2 of 10 studies	8 of 10 studies

The authors concluded that while there may be an effect of HMB on muscle mass, the effect is minor, if present at all. They concluded the evidence of an effect of HMB on strength is conflicting, and that no studies found an effect of HMB supplementation on function. They called for more studies on HMB with larger sample sizes and more consistent study design before it can be recommended for patients with sarcopenia or in clinical care.

A 2024 systematic review and meta-analysis examined the impact of HMB or an HMB-rich nutritional supplement in sarcopenia patients. They included 6 RCTs of a total of 667 patients. They found that use of HMB or an HMB-rich nutritional supplement was associated with a significant improvement in hand grip strength compared to control (MD=1.26; 95%CI 0.41 to 2.21, p=0.004), but they did not find a difference between groups in terms of gait speed or body composition, including skeletal muscle index. Like other studies, the author reported significant heterogeneity in their results, some of which may be

due to small sample size, type of HMB used in the trial, differing diagnostic criteria for sarcopenia between countries and sexes, and individual studies not differentiating results by sex (Su et al., 2024).

Some studies have specifically assessed HMB as a combination therapy with exercise. A 2024 meta-analysis by Feng et al., 2024 included 5 RCTs of a total of 257 elderly patients with sarcopenia. The RCTs, all 12 weeks long, tested a combination approach of HMB and resistance training compared to placebo and resistance training. Their meta-analysis indicated that HMB and exercise significantly improved gait speed (SMD=0.48; 95% CI 0.15 to 0.82, p=0.005), but that there was no significant effect on the skeletal muscle index, grip strength, fat-free mass, fat mass, BMI, or five-time chair stand test, which is an assessment of physical performance and muscle strength. The individual studies included reported varying results. These authors noted that the included studies were heterogenous and small, and that larger, multicenter, high-quality RCTs are needed to fully determine whether HMB has an additional effect on muscle mass, strength, or function when added to resistance training.

Some RCTs were not included in the above analyses. For instance, Wu et al., 2023 was not included, as some participants did not have sarcopenia. The Wu et al., 2023 study describes a four-arm RCT of 112 patients admitted to the ICU. The participants were randomized to resistance training, HMB, resistance training and HMB, or standard of care. While both resistance training and combination treatment improved physical performance and muscle strength, there was no benefit seen in the group that only received HMB, or between the resistance training alone and combination therapy groups.

Overall, the meta-analyses suggest that either HMB does not have a significant effect in these populations, or that the effect is modest. Many of the individual trials do report significant benefits or trends towards significant benefits in at least one area, potentially suggesting the latter explanation. However, larger trials are required to fully explore whether HMB has a benefit for sarcopenia or frailty and if so, under what parameters (e.g. in combination therapy, at a particular dosage, in a particular patient population, for what duration).

Malnutrition is also a common issue in the elderly population; by some estimates, a quarter of all older adults are either at risk for or are malnourished. Older adults who are malnourished have increased risk of a variety of adverse outcomes, including poorer recovery from injuries, frailty, muscle wastage, cognitive impairment, and mortality (Dent et al., 2023). HMB has been tested as part of oral nutritional supplements to improve nutritional status of older adults, and some of these studies have reported improvements in nutritional status or biochemical indices in these participants (Pareja Sierra et al.,

2024; Tey et al., 2024). The effects cannot be ascribed to HMB, and the above studies did not test whether the nutritional supplement improved clinical outcomes, but the data suggest that HMB could contribute to improving health in older adults as part of a combination nutritional approach.

Exercise and Body Composition in Healthy Adults: CONFLICTING FINDINGS

As HMB is thought to promote muscle synthesis and decrease muscle loss, many groups have looked at whether these mechanisms can have clinically meaningful results with or without exercise, in non-athlete or athlete populations. It is also hypothesized that HMB can reduce body fat mass. Overall, there are conflicting results on the effects of HMB on body composition.

A 2020 meta-analysis and systematic review discusses prior meta-analyses and then includes 14 studies, 11 of which the researchers were able to meta-analyze. The studies comprised 302 participants with an average age of 27, and the studies were 7.6 weeks long on average and were exercise + HMB or exercise + placebo trials. The authors did not find any changes in muscle strength, fat-free mass, or fat mass between groups. They did see a significant increase in total body mass, but sensitivity analyses indicated this finding was strongly influenced by a single study; removing that study from the analysis resulted in the difference between treatment groups becoming non-significant. The data from this study and other meta-analyses in their systematic review suggested that HMB does not improve resistance exercise-induced gains in strength or fat-free mass in non-athlete or athlete populations at these doses, durations, and study designs (Jakubowski et al., 2020).

However, other reviews such as that from Rathmacher et al., 2024 report that HMB 'may improve' body composition including through increasing lean mass and/or decreasing fat mass, particularly in conjunction with resistance training. When discussing the differences of their conclusions compared to Jakubowski et al., 2020, Rathmacher et al., 2024 touches on studies that weren't included in Jakubowski et al., 2020; Jakubowski et al., 2020 considered them outliers, whereas Rathmacher et al., 2024 stated that the exclusions weren't based on *a priori* inclusion/exclusion criteria. It should be noted as well that Rathmacher et al., 2024 includes authors from MTI Biotech, which partners with a company that sells HMB. A meta-analysis in 2022 also reported a positive impact of HMB on muscle strength. However, they included any trial that tested HMB, even combination treatments; it is unclear whether these effects would be due to HMB or not. Moreover, they looked at older adults, including some healthy populations and some with sarcopenia or post-fracture or surgery, and not all studies were placebo controlled (Lin et al., 2022).

More work is needed to parse whether HMB has an effect on body composition, the size of this effect, and whether there are any particular populations that benefit compared to others.

Some studies suggest that HMB may have a benefit in reducing exercise-induced muscle damage (Rahimi et al., 2018; topic reviewed by Kim & Kim, 2022). The clinical benefits of these findings, if any, require further study. For instance, a network meta-analysis found a potential benefit of HMB for chronic performance enhancement in rowing, particularly in combination with creatine (Held et al., 2023). A systematic review and meta-analysis of 11 placebo-controlled trials of 279 participants found that HMB supplementation was associated with significant improvement of endurance performance and maximal oxygen consumption (Fernández-Landa et al., 2024)

Lipid Profiles: CONFLICTING FINDINGS

Early studies suggested that HMB could lower total cholesterol, LDL-c, and systolic blood pressure. A review of safety data from 9 previously unpublished RCTs included a total of 250 young and old participants. The trials all tested 3 grams a day of HMB and lasted for 3 to 8 weeks. In participants who had high cholesterol as defined as more than 200 mg/dL, those who received HMB had a 5.8% decrease in total cholesterol ($p<0.03$) and a 7.3% decrease in LDL-c ($p<0.01$). When they looked at all participants as a group regardless of starting cholesterol, there were significant decreases in total cholesterol (-3.7%, $p=0.03$) and systolic blood pressure (-4.4 mm Hg, $p<0.05$) (Nissen et al., 2000).

However, a larger meta-analysis and systematic review reported conflicting results. This meta-analysis did not include any data from the above review; all included studies were published in or after 2000. This meta-analysis included a total of 10 RCTs with 421 participants. The studies were heterogenous; durations ranged from 2 to 24 weeks, doses from 1.5 grams to 6 grams daily, and participants ranged from healthy individuals, amateur athletes, elite athletes, older adults with low muscle mass or sarcopenia, and liver cirrhosis patients with malnutrition. Some of the trials tested HMB against placebo; some tested HMB and exercise against HMB and placebo. The authors found no significant effect of HMB on any lipid parameter. They performed several subgroup analyses such as dose, baseline blood lipid concentrations, and health status, but did not find effects of HMB on any tested subgroup. They found that the GRADE quality of evidence was moderate or low (Sadeghi et al., 2024).

It is difficult to compare these two reviews, since they look at non-overlapping RCTs with different study designs with different durations, study populations, and study designs. Moreover, Nissen et al., 2000 includes some authors who founded MTI Biotech, a company that manufactures HMB. Larger studies with specific populations and more similar study design are needed to determine whether HMB has an effect on cholesterol or other lipids.

Other Indications

HMB has also been explored for other indications, including preclinical muscular dystrophy models (Nghiem et al., 2025) and liver cirrhosis (Espina et al., 2022), with potential application for MASLD/MASH (Rivera et al., 2024). A systematic review in patients with cancer found that 'although limited', the evidence thus far suggested that there may be benefits of HMB on muscle mass and function in patients with cancer, and called for well-designed trials to more fully investigate the potential of HMB in cancer patients (Prado et al., 2022).

Some studies have also looked at other combination treatments with HMB for certain indications. For instance, studies have looked at combinations of HMB and omega-3 fatty acids in patients with COPD and found the combination reduced proinflammatory cytokines and reduced body fat (Engelen et al., 2024), and another RCT in middle aged women found a combination of vitamin D3 and HMB protected or increased muscle volume in sedentary women and decreased intermuscular adipose tissue in both sedentary women and those who were assigned to resistance training (Fairfield et al., 2022). Another study from the same group tested HMB and vitamin D with or without exercise over a 12-month trial and found that the combination treatment without exercise improved lean body mass at some but not all time points, and improved physical function. There were no additional benefits to the supplements with exercise (Rathmacher et al., 2020).

Safety: There are no adverse events associated with HMB at the most common dose of 3 grams per day or higher doses. Studies up to 1 year in duration have reported no adverse events or clinically significant effects on laboratory or physical exam values.

Types of evidence:

- 10 clinical trials
- 3 reviews

- 1 laboratory studies

Very few side effects of HMB have been reported in the literature. No safety signals have been reported from lab studies, including with a dose of 2 grams per kilogram of body weight. In humans, studies of 6 grams per day for 8 weeks did not result in any changes to any laboratory values (Rathmacher et al., 2024), and an analysis of 9 clinical trials involving 250 patients reported that there was no difference in type or frequency of adverse events between HMB and control treated participants over the 3-to-8-week duration of the studies (Nissen et al., 2000). Two 12-month studies in older men and women receiving 2 or 3 grams daily of HMB and another supplement such as vitamin D_3 or arginine or lysine similarly reported no difference in adverse events (Rathmacher et al., 2024). Many more recent studies either do not report adverse events or report no adverse events (Gutiérrez-Reguero et al., 2024).

One review of side effects of amino acid supplements reported that while clinical studies report that HMB is well-tolerated with no toxic effects, two preclinical studies suggest that clinical studies should confirm that HMB does not have adverse effects on amino acid concentrations or ATP metabolism (Holeček 2022).

Drug interactions:

No drug interactions for HMB have been reported. Laboratory studies suggest that the effect of HMB on mTOR may be reduced by rapamycin (MSKCC).

Research underway:

There are 17 ongoing trials registered on clinicaltrials.gov that involve supplementation with HMB. Several of the trials are assessing the effects of HMB on muscle or motor abilities, including in older adults or adults with age-related diseases such as sarcopenia or osteoporosis. No study is enrolling patients with neurodegenerative disease or focuses on the effects of HMB on cognition, though some studies such as NCT05877846 and NCT06801808 include at least one measure of cognition as a secondary endpoint.

Search terms:

Pubmed, Google: β-hydroxy β-methylbutyrate, HMB

- Dementia, Alzheimer's, aging, longevity, fraility, sarcopenia, exercise, muscle

Websites visited for β-hydroxy β-methylbutyrate / HMB:

- Clinicaltrials.gov
- Examine.com
- WebMD.com
- PubChem
- Drugbank.ca
- ConsumerLab.com