Systematic review and meta-analysis of protein intake to support muscle mass and function in healthy adults

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Supplementary table 1 – Characteristics of the studies

Studies	Group (n)	Group Name	Sex	Age, y	Duration, wk	Resistance Exercise (Yes/ No)	Daily Protein Intake (g/kg/day)	Daily Protein Intake with Supplement (g/kg/day)	Protein Supplementation		Placebo		Outcomes
									Type of Protein	Amount, g/d	Type of Placebo	Amount, g/d	
Aas, S. N., et al., 2020[1]	Prot (11)	ST	Mixed	86.6 ± 6.0	10	YES	0.91 ± 0.1	1.21	Milk protein	34	----	----	Muscle Strength Physical Function
	Con (10)	CON	Mixed	82.6 ± 4.5	10	YES	0.83 ± 0.29	----	N/A	N/A	NP	N/A	
Aleman-Mateo, H., et al., 2014[2]	Prot (49)	IG/HD+RCH	Mixed	70.8 ± 7.6	12	NO	0.9	1.2	Ricotta cheese	18.12	----	----	Body Composition Handgrip strength Physical Function
	Con (49)	CG/HD	Mixed	69.6 ± 6.4	12	NO	0.9	----	N/A	N/A	NP	N/A	
Amasene, M., et al., 2019[3]	Prot (13)	Protein	Mixed	82.9 ± 5.59	12	YES	----	----	Whey protein	20 + 3g leucine	----	----	Body Composition Handgrip strength Physical Function
	Con (13)	Placebo	Mixed	81.7 ± 6.45	12	YES	----	----	N/A	N/A	Maltodextrin	Isocaloric	
Antonio, J., et al., 2014[4]	Prot (20)	High Protein	Mixed	25.2 ± 6.3	8	YES	2.3 ± 1	4.4 ± 0.8	Whey and casein protein	Amount to reach 4.4 g/kg/day when added to normal dietary protein	----	----	Body Composition Muscle Strength
	Con (10)	Control	Mixed	22.0 ± 2.6	8	YES	1.8 ± 0.4	----	N/A	N/A	NP	N/A	

Antonio, J., et al., 2015[5]	Prot 1 (31)	HP	Mixed	22.9 ± 3.1 y	8	YES	2.1 ± 0.7	3.4 ± 0.6	Whole food or protein powder	instructed to consume ≥ 3g/kg/d	----	----	Body Composition Muscle Strength
	Con (17)	NP	Mixed	24.8 ± 6.9	8	YES	2.3 ± 0.6	----	N/A	N/A	NP	N/A	
Aristizabal, J. C., et al., 2015[6]	Prot 1 (18)	Whey	Mixed	22.8 ± 3.7	36	YES	1	1.3	Whey	21.6	----	----	Body Composition
	Prot 2 (21)	Soy	Mixed	24.0 ± 2.9	36	YES	1	1.3	Soy	20	----	----	
	Con (22)	Carb	Mixed	22.3 ± 3.1	36	YES	1	----	N/A	N/A	Maltodextrin	45.2	
Arnarson, A., et al., 2013[7]	Prot (83)	Whey	Mixed	73.3 ± 6.0	12	YES	1.00 ± 0.2	1.06 ± 0.23	Whey	20	----	----	Body Composition Muscle Strength
	Con (78)	Carbohydrates	Mixed	74.6 ± 5.8	12	YES	0.89 ± 0.23	----	N/A	N/A	Carbohydrate	40	
Babault, N., et al., 2014[8]	Prot 1 (22)	Soluble Milk protein	Men	22.5 ± 4.1	10	YES	----	----	Soluble Milk protein	24.29	----	----	Muscle Strength
	Prot 2 (22)	Micellar Casein protein	Men	22.2 ± 3.9	10	YES	----	----	Micellar Casein protein	24.29	----	----	
	Con (24)	Placebo	Men	22.0 ± 3.9	10	YES	----	----	N/A	N/A	Sucrose, Maltodextrine	10.5, 19.5	
Bartholomae, E., et al., 2019[9]	Prot (11)	PRO	Mixed	31.2	8	NO	0.756	1.03	Mung Bean protein	18	----	----	Body Composition Handgrip strength
	Con (14)	CON	Mixed	31.2	8	NO	0.8167	----	N/A	N/A	Control Biscuit	----	

Bridge, A., et al., 2019[10]	Prot (15)	GY	Men	20.6 ± 2.2	12	YES	----	1.74	Greek Yogurt	48.5714	----	----	Body Composition Muscle Strength
	Con (15)	PP	Men	20.6 ± 2.2	12	YES	1.22	----	N/A	N/A	Placebo Pudding (2 parts maltodextrin, 1 part chocolate pudding powder, and water)	114.14	
Brown, E. C., et al., 2004[11]	Prot 1 (9)	Soy	Men	21.67 ± 0.24	9	YES	----	----	Soy	33	----	----	Body Composition
	Prot 2 (9)	Whey	Men	20.36 ± 0.34	9	YES	----	----	Whey	33	----	----	
	Con (9)	Control	Men	20.44 ± 0.63	9	YES	----	----	N/A	N/A	NP	N/A	
Burke, D. G., et al., 2001[12]	Prot (10)	Whey	Men	25	6	YES	2.1 ± 0.3	3.3	Whey	1.2g/kg/d	----	----	Body Composition Muscle Strength
	Con (5)	Placebo	Men	25	6	YES	1.2 ± 0.2	----	N/A	N/A	Maltodextrin	1.2g/kg/d	
Campbell, B. I., et al., 2018[13]	Prot (8)	High PRO	Women	21.2 ± 2.1	8	**YES**	1.5 ± 0.5	2.5 ± 0.2	Whey	50	----	----	Muscle Strength
	Con (9)	Low PRO	Women	21.2 ± 2.1	8	**YES**	1.5 ± 0.5	0.9 ± 0.1	Whey	10	----	----	
Candow, D. G., et al., 2006a[14]	Prot 1 (9)	W	Mixed	23.16	6	YES	1.6 ± 1.3	2.95	Whey	83.16	----	----	Body Composition Muscle Strength
	Prot 2 (9)	S	Mixed	23.16	6	YES	1.8 ± 1.6	3	Soy	86.16	----	----	

	Con (9)	P	Mixed	23.16	6	YES	1.7 ± 1.5	----	N/A	N/A	maltodextrin, sucrose powder	83.16, 20.79	
Candow, D. G., et al., 2006b[15]	Prot 1 (9)	PRO-A	Men	63.3 ± 3.3	12	YES	1.4	1.56	whey protein concentrate and whey protein isolate, calcium caseinate, milk protein isolate, sodium caseinate, and egg albumin.	25.59	----	----	Body Composition Muscle Strength
	Prot 2 (10)	PRO-B	Men	66.5 ± 5.376	12	YES	1.26	1.7	whey protein concentrate and whey protein isolate, calcium caseinate, milk protein isolate, sodium caseinate, and egg albumin.	26.25	----	----	
	Con (10)	PLA	Men	64.6 ± 4.11	12	YES	1.376	----	N/A	N/A	maltodextrin /sucrose/cho colate cocoa,	54.9	
Chale, A., et al., 2013[16]	Prot (42)	Whey	Mixed	78.0 ± 4.0	24	YES	0.986	1.47	Whey	40	----	----	Body Composition Muscle Strength Physical Function
	Con (38)	Control	Mixed	77.3 ± 3.9	24	YES	0.9437	----	N/A	N/A	maltodextrin	45	

Coburn, J. W., et al., 2006[17]	Prot (11)	SUPP	Men	21.3 ± 2.0	8	YES	----	----	Whey	28.57 + 8.857g leucine	----	----	Body Composition Muscle Strength
	Con (12)	PLA	Men	23.2 ± 1.9	8	YES	----	----	N/A	N/A	maltodextrin	37.43	
Deibert, P., et al., 2011[18]	Prot (13)	RTS (resistance training with soy protein supplementation)	Men	55.9 ± 3.5	12	YES	----	----	Soy and Milk protein	13.35	----	----	Body Composition
	Con (13)	RT (resistance training only)	Men	55.5 ± 4.8	12	YES	----	----	N/A	N/A	NP	N/A	
Dulac, M. C., et al., 2020[19]	Prot 1 (21)	F-PROT+MPT (whey)	Men	68.3 ± 5.3	12	YES	----	----	Whey	30	----	----	Body Composition Handgrip strength Muscle Strength Physical Function
	Prot 2 (20)	S-PROT+MPT (casein)	Men	69.0 ± 6.1	12	YES	----	----	Casein	30	----	----	
	Con (19)	Placebo+MPT	Men	70.7 ± 8.6	12	YES	----	----	N/A	N/A	Maltodextrin	30	
Eliot, K. A., et al., 2008[20]	Prot (11)	Whey protein	Men	65	14	YES	0.95 ± 1.66	1.04 ± 1.66	Whey	28	----	----	Body Composition
	Con (10)	Placebo	Men	65	14	YES	0.945 ± 1.58	----	N/A	N/A	Gatorade	480	
Erskine, R. M., et al., 2012[21]	Prot (17)	PRO (whey)	Men	23.1 ± 3.0	12	YES	1.28 ± 0.37	1.56 ± 0.33	Whey	17.1	----	----	Body Composition

	Con (16)	PLA	Men	23.7 ± 2.9	12	YES	1.36 ± 0.35	----	N/A	N/A		Lactose		6.8	
Farup, J., et al., 2014[22]	Prot 1 (11)	eccentric + WHD	Men	23.7 ± 4.64	12	YES	----	----	Whey		19.5	----	----		Muscle Strength
	Prot 2 (11)	concentric + WHD	Men	23.7 ± 4.64	12	YES	----	----	Whey		19.5	----	----		
	Con 1 (11)	eccentric + PLA	Men	24.1 ± 2.98	12	YES	----	----	N/A	N/A		Carbohydrate		39	
	Con 2 (11)	concentric + PLA.	Men	24.1 ± 2.98	12	YES	----	----	N/A	N/A		Carbohydrate		39	
Gryson, C., et al., 2014[23]	Prot 1 (9)	TMP10t	Men	60.8 ± 9.7	16	YES	----	----	Milk protein		10	----	----		Body Composition Muscle Strength
	Prot 2 (10)	PRO10	Men	60.8 ± 9.7	16	YES	----	----	Soluble milk protein rich in leucine		10	----	----		
	Prot 3 (8)	PRO10t	Men	60.8 ± 9.7	16	YES	----	----	Soluble milk protein rich in leucine		10	----	----		
	Prot 4 (9)	TMP4t	Men	60.8 ± 9.7	16	YES	----	----	N/A		N/A	Milk protein	4		
	Prot 5 (9)	TMP4	Men	60.8 ± 9.7	16	YES	----	----	N/A		N/A	Milk protein	4		
Hartman, J. W., et al., 2007[24]	Prot 1 (18)	Milk	Men	25	12	YES	1.2± 0.42	1.8± 0.42	Milk protein		25	----	----		Body Composition Muscle Strength
	Prot 2 (18)	Soy	Men	25	12	YES	1.4 ± 0.42	1.65± 0.42	Soy protein		25	----	----		
	Con (19)	Control	Men	25	12	YES	1.56 ± 0.44	----	N/A	N/A		Maltodextrin		45	

Haun, C. T., et al., 2018[25]	Prot 1 (17)	Whey	Men	20.87 ± 6.59	12	YES	1.1 ± 0.41	1.8± 0.41	Whey	52.6	----	----	Body Composition
	Prot 2 (15)	Soy	Men	20.85 ± 6.66	12	YES	1.1 ± 0.38	2.1± 0.38	Soy	78.4	----	----	
	Con (15)	PLA	Men	20.85 ± 4.41	12	YES	1.3 ± 0.38	----	N/A	N/A	Maltodextrin	Isocaloric	
Herda, A. A., et al., 2013[26]	Prot 1 (22)	BWPMV	Men	21.2 ± 2.7	8	YES	1.3 ± 1.1	1.8 ± 0.1	Polyethylene glycosylated whey protein concentrate	22.857 + 8g leucine	----	----	Body Composition Muscle Strength
	Prot 2 (22)	SWPMV	Men	21.0 ± 1.6	8	YES	1.4 ± 0.1	2.0 ± 0.1	Whey	22.857	----	----	
	Con (21)	PLA	Men	20.9 ± 1.7	8	YES	1.3 ± 0.1	----	N/A	N/A	Maltodextrin	27	
Hida, A., et al., 2012[27]	Prot (15)	Prot	Women	20	8	YES	1.08 ± 0.27	1.23 ± 0.27	Egg White protein	15	----	----	Body Composition Muscle Strength
	Con (15)	Carb	Women	20	8	YES	1.00± 0.27	----	N/A	N/A	Maltodextrin	17.5	
Hoffman, J. R., et al., 2007[28]	Prot (11)	PR	Men	20.3 ± 1.6	12	**YES**	----	2 ± 0.12	proprietary blend of milk protein concentrate, whey protein concentrate, L-glutamine, and dried egg white	66	----	----	Body Composition Muscle Strength
	Con (10)	PL	Men	21.0 ± 1.2	12	**YES**	1.24 ± 0.12	----	N/A	N/A	Maltodextrin	63	

Hoffman, J. R., et al., 2009[29]	Prot 1 (13)	AM/PM	Men	19.6 ± 1.3	10	YES	1.40 ± 0.22	2.28 ± 0.78	proprietary blend of protein (enzymatically hydrolyzed collagen protein isolate, whey protein isolate, and casein protein isolate)		84	----	----	Body Composition Muscle Strength
	Prot 2 (13)	PRE/POST	Men	19.9 ± 1.3	10	YES	1.80 ± 0.98	2.16 ± 0.67	proprietary blend of protein (enzymatically hydrolyzed collagen protein isolate, whey protein isolate, and casein protein isolate)		84	----	----	
	Con (7)	CTR	Men	20.7 ± 1.1	10	YES	1.67 ± 0.70	----	N/A	N/A		NP	N/A	
Iglay, H. B., et al., 2009[30]	Prot (18)	HP	Mixed	65	12	YES	1.1 ± 0.424	1.2 ± 0	Increase from Diet	----		----	----	Body Composition
	Con (18)	LP	Mixed	65	12	YES	0.9 ± 0.424	----	Decrease from Diet	----		NP	N/A	
Kerksick, C. M., et al., 2006[31]	Prot (10)	WC	Men	31 ± 8	10	YES	2.1 ± 0.3	2.2 ± 0.6	Whey, casein	40, 8		----	----	Body Composition Muscle Strength
	Con (11)	P	Men	31 ± 8	10	YES	1.6 ± 0.5	----	N/A	N/A		Carbohydrate	48	

Kim, H. H., et al., 2014[32]	Prot (9)	RE + HP diet	Men	25.0 ± 2.4	12	YES	----	----	Increase from Diet (30% protein)	----	----	----	Body Composition
	Con (9)	RE + St diet	Men	23.6 ± 2.8	12	YES	----	----	Standard Diet (15% protein)	----	NP	N/A	
Kim, D. and Park, Y., 2020[33]	Prot 1 (32)	Tertile 2	Mixed	76.79 ± 3.42	12	NO	0.79 ± 0.21	1.2	Whey	Enough to reach 1.2g/kg/d when added to habitual diet	----	----	Physical Function
	Prot 2 (32)	Tertile 3	Mixed	77.06 ± 3.80	12	NO	0.72 ± 0.20	1.5	Whey	Enough to reach 1.5g/kg/d when added to habitual diet	----	----	
	Con (32)	Tertile 1	Mixed	76.97 ± 3.78	12	NO	0.8	----	N/A	N/A	Maltodextrin	----	
Kirmse, M., et al., 2019[34]	Prot (29)	Col	Men	24 ±2	12	YES	----	1.81 ± 0.42	collagen peptides	15	----	----	Body Composition Muscle Strength
	Con (28)	Pla	Men	24 ± 3	12	YES	1.74 ± 0.50	----	N/A	N/A	noncaloric silicon dioxide	15	
Leenders, M., et al., 2013[35]	Prot 1 (12)	Women Protein	Women	72 ± 6.92	24	YES	1.2 ± 0.49	1.44	Milk protein	15	----	----	Body Composition Muscle Strength
	Prot 2 (15)	Men Protein	Men	70 ± 3.87	24	YES	1.1 ± 0.54	1.28	Milk protein	15	----	----	
	Con 1 (12)	Women Placebo	Women	69 ± 3.46	24	YES	1.2 ± 0.49	----	N/A	N/A	Lactose, calcium	7.13, 0.42	

	Con 2 (14)	Men Placebo	Men	70 ± 3.74	24	YES	1.1 ± 0.54	----	N/A	N/A	Lactose, calcium	7.13, 0.42	
Lockwood, C. M., et al., 2017[36]	Prot 1 (13)	WPC	Men	21.3	8	YES	1.1 ± 0.54	1.85 ± 0.36	80% whey protein concentrate	30	----	----	Body Composition Muscle Strength
	Prot 2 (15)	WPC-L	Men	21.8	8	YES	1.31 ± 0.58	1.97 ± 0.35	high-lactoferrin-containing whey protein concentrate 80%	30	----	----	
	Prot 3 (13)	WPH	Men	21.5	8	YES	1.33 ± 0.61	1.9 ± 0.4	extensively hydrolyzed whey protein concentrate 80%	30	----	----	
	Con (15)	PLA	Men	20.9	8	YES	1.58 ± 0.77	----	N/A	N/A	Dextrose	30	
Maesta, N., et al., 2007[37]	Prot 1 (10)	SP	Women	61.3 ± 5.3	16	NO	----	----	Soy protein in skimmed milk	12.2	----	----	Body Composition
	Prot 2 (14)	SPE	Women	57.6 ± 6.7	16	YES	----	----	Soy protein in skimmed milk	12.2	----	----	
	Con 1 (11)	PL	Women	57.9 ± 6.9	16	NO	----	----	N/A	N/A	Maltodextrin	25	
	Con 2 (11)	PLE	Women	60.7 ± 7.1	16	YES	----	----	N/A	N/A	Maltodextrin	25	

Mobley, C. B., et al., 2017[38]	Prot 2 (17)	WPC	Men	21± 4.12	12	YES	1.1 ± 0.41	1.8 ± 0.41	Whey protein concentrate	52.6	----	----	Body Composition Muscle Strength
	Prot 3 (14)	WPH	Men	21± 3.74	12	YES	1.2 ± 0.37	1.9 ± 0.37	Whey protein hydrolysate	50.8	----	----	
	Prot 4 (15)	SPC	Men	21± 3.87	12	YES	1.1 ± 0.39	2.1± 0.39	Soy protein concentrate	78.4	----	----	
	Con 1 (15)	PLA	Men	21± 3.87	12	YES	1.3 ± 0.39	----	N/A	N/A	Maltodextrin	88	
Mori, H. and Tokuda, Y., 2018[39]	Prot (25)	EX+PRO	Women	70.6± 4.2	24	YES	1.3 ± 0.0	1.82	Whey	22.3	----	----	Handgrip strength Muscle Strength Physical Function
	Con (25)	EX	Women	70.6± 4.6	24	YES	1.4 ± 0.0	----	N/A	N/A	NP	N/A	
Nabuco, H. C. G., et al., 2018[40]	Prot 1 (24)	WP-PLA	Women	67.5± 5.2	12	YES	0.92 ± 0.20	1.38 ± 0.26	Whey	35	----	----	Body Composition Muscle Strength Physical Function
	Prot 2 (23)	PLA-WP	Women	66.2± 9.4	12	YES	0.94 ± 0.36	1.49 ± 0.46	Whey	35	----	----	
	Con (23)	PLA-PLA	Women	66.5± 7.2	12	YES	0.95 ± 0.27	----	N/A	N/A	Maltodextrin	35	
Nabuco, H. C. G., et al., 2019a[41]	Prot 1 (24)	WP-PLA	Women	67.5± 5.2	12	YES	0.92 ± 0.20	1.4	Whey	35	----	----	Body Composition
	Prot 2 (23)	PLA-WP	Women	66.2± 9.4	12	YES	0.94 ± 0.36	1.4	Whey	35	----	----	

	Con (23)	PLA-PLA	Women	66.5± 7.2	12	YES	0.95 ± 0.27		N/A			Sugar Free Drinks			
Nabuco, H. C. G., et al., 2019b[42]	Prot (15)	PRO	Women	69.2 ± 4.1	12	YES	0.94 ± 0.3	1.48	Whey		35	----	----		Muscle Strength
	Con (15)	CON	Women	68.4 ± 4.5	12	YES	0.96 ± 0.22	----	N/A	N/A		Maltodextrin		35	
Naclerio, F., et al., 2017a[43]	Prot 1 (8)	Beef	Men	26 ± 8	8	YES	1.49 ± 0.46	1.69 ± 0.47	hydrolyzed beef protein powder		16.4	----	----		Body Composition Muscle Strength
	Prot 2 (8)	Whey	Men	26 ± 4	8	YES	1.52 ± 0.45	1.72 ± 0.52	whey isolate		18	----	----		
	Con (8)	CHO	Men	29 ± 5	8	YES	1.45 ± 0.24	1.44 ± 0.24	N/A	N/A		Carbohydrates		45	
Naclerio, F., et al., 2017b[44]	Prot 1 (9)	Beef	Mixed	25.6 ± 5.3	8	YES	1.45 ± 0.66	1.70 ± 0.70	hydrolyzed beef protein powder		16.4	----	----		Body Composition Muscle Strength
	Prot 2 (9)	Whey	Mixed	27.6 ± 5.2	8	YES	1.47 ± 0.75	1.77 ± 0.92	whey isolate		18	----	----		
	Con (9)	CHO	Mixed	24.4 ± 7.1	8	YES	1.12 ± 0.56	----	N/A	N/A		Carbohydrates		45	
Nahas, P. C., et al., 2019[45]	Prot (22)	HP	Women	64.7 ± 13.13	10	YES	0.76 ± 0.23	1.17 ± 0.28	Increase from Diet to reach ~1.2g/kg/d	----		----	----		Body Composition Muscle Strength Physical Function
	Con (25)	NP	Women	62.0 ± 13	10	YES	0.76 ± 0.3	0.85 ± 0.2	Increase from Diet to reach ~0.8g/kg/d	----		NP	N/A		

Nakayama, K., et al., 2020[46]	Prot (61)	Milk	Mixed	71.4 ± 6.25	24	YES	1.28	1.48	acidified milk protein drink		10	----	----	Body Composition Handgrip strength Physical Function
	Con (61)	Pla	Mixed	70.4 ± 5.47	24	YES	1.27	----	N/A	N/A		maltodextrin	16	
Negro, M., et al., 2014[47]	Prot (12)	FG	Men	23.7 ± 2.5	8	YES	----	1.29	Lean beef protein		20	----	----	Body Composition Muscle Strength
	Con (14)	CG	Men	23.9 ± 4.2	8	YES	1	----	N/A	N/A		NP	N/A	
Norton, C. et al., 2016[48]	Prot (31)	Pro	Mixed	62.2 ± 4.7	31	NO	1.2 ± 0.3	1.6 ± 0.3	Milk protein matrix	N/A		----	N/A	Body Composition
	Con (29)	Con	Mixed	59.5 ± 5.8	29	NO	1.2 ± 0.3		N/A	N/A		Maltodextrin	N/A	
Obradovic, J., et al., 2020[49]	Prot 1 (10)	WP	Men	23±4	8	YES	----	----	Whey	79.5		----	----	Muscle Strength
	Con (10)	PLA	Men	23±4	8	YES	----	----	N/A	N/A		maltodextrin	10	
Oertzen-Hagemann, V., et al., 2019[50]	Prot (12)	COL	Men	24.4± 2.3	12	YES	----	1.66	collagen hydrolysate		15	----	----	Body Composition Muscle Strength
	Con (13)	PLA	Men	23.9± 2.9	12	YES	1.86	----	N/A	N/A		non-caloric silicon dioxide supplement	----	
Ormsbee, M. J., et al., 2018[51]	Prot (29)	Protein	Mixed	21.0 ± 3.23	24	YES	1.1 ± 0.54	2.3 ± 0.54	Protein supplement		84	----	----	Body Composition
	Con (22)	Control	Mixed	20.3 ± 2.35	24	YES	1.0 ± 0.47	----	N/A	N/A		Carbohydrates	isocaloric	

Orsatti, F. L., et al., 2018[52]	Prot (16)	SOY+RT	Women	56.8 ± 6.6	16	YES	1 ± 0.3	1.4 ± 0.3	soy protein	31.4	----	----	Body Composition Muscle Strength
	Con (16)	PL+RT	Women	58.8 ± 8.9	16	YES	1 ± 0.3	----	N/A	N/A	maltodextrin	25	
Ottestad, I., et al., 2017[53]	Prot (17)	Protein	Women	76.8 ± 6.2	12	NO	1.0 ± 0.3	1.4 ± 0.5	protein-enriched milk	40	----	----	Body Composition Handgrip strength Muscle Strength Physical Function
	Con (19)	Control	Women	77.1 ± 4.7	12	NO	0.9 ± 0.4	----	N/A	N/A	carbohydrate	isocaloric	
Ozan, M., et al., 2020[54]	Prot (10)	PR	Men	21.29 ± 2.44	10	YES	----	----	Whey	106.7	----	----	Body Composition
	Con (10)	PLA	Men	20.14 ± 2.19	10	YES	----	----	N/A	N/A	Colored water	----	
Paoli, A., et al., 2015[55]	Prot (9)	HP	Men	24.9 ± 5.3	8	YES	----	1.8	Whey	35	----	----	Body Composition Handgrip strength
	Con (9)	NP	Men	24.9 ± 5.3	8	YES	0.85	----	N/A	N/A	Water	----	
Pihoker, A. A., et al., 2019[56]	Prot 1 (17)	PRE	Women	20.5 ± 2.2	6	YES	----	1.21	Protein shake	7.14	----	----	Body Composition Muscle strength
	Prot 2 (17)	POST	Women	20.5 ± 2.2	6	YES	----	1.21	Protein shake	7.14	----	----	
	Con (9)	CON	Women	20.5 ± 2.2	6	YES	1.1	----	N/A	N/A	NP	N/A	
Planella-Farrugia, C., et al., 2019[57]	Prot (9)	RENS	Mixed	71.2 ± 3.3	16	YES	----	1.08	calcium caseinate powder	12.86	----	----	Body Composition Handgrip strength
	Con (14)	RE	Mixed	64.9 ± 5.5	16	YES	0.9	----	N/A	N/A	NP	N/A	

Rankin, J. W., et al., 2004[58]	Prot (10)	Milk	Men	20.5 ± 1.96	10	YES	1.2 ± 0.38	1.41	Milk protein	16.6	----	----	Body Composition Muscle strength
	Con (9)	CHO	Men	21 ± 0.36	10	YES	1.2 ± 0.36	----	N/A	N/A	Gatorade	----	
Reidy, P. T., et al., 2016[59]	Prot 1 (23)	PB	Men	24 ± 4.8	12	YES	1.33 ± 0.48	1.54 ± 0.48	soy-dairy blend	22	----	----	Body Composition Muscle strength
	Prot 2 (22)	WP	Men	25 ± 4.69	12	YES	1.29 ± 0.47	1.64 ± 0.52	Whey protein isolate	22	----	----	
	Con (23)	MDP	Men	25 ± 4.8	12	YES	1.23 ± 0.53	----	N/A	N/A	Maltodextrin	22	
Rossato, L. T., et al., 2017[60]	Prot (11)	HP	Women	63.4 ± 7.6	10	YES	0.82 ± 0.29	1.18 ± 0.3	Increase from Diet to reach ~1.2g/kg/d	----	----	----	Body Composition Muscle strength
	Con (12)	NP	Women	63.0 ± 8.6	10	YES	0.87 ± 0.29	----	Increase from Diet to reach ~0.8g/kg/d	----	NP	N/A	
Rozenek, R., et al., 2002[61]	Prot 1 (26)	CHO/PRO	Men	23 ± 4.6	8	YES	1.4 ± 0.7	3.11	Milk + protein supplement	106	----	----	Body Composition Muscle strength
	Con 1 (25)	CHO	Men	23.4 ± 4.7	8	YES	1.4 ± 0.6	1.64	Milk	24	----	----	
	Con 2 (21)	CTRL	Men	23.1 ± 3.9	8	YES	1.3 ± 0.6	----	N/A	N/A	NP	N/A	
Sharp, M. H., et al., 2018[62]	Prot 1 (10)	WPC	Mixed	19 ± 2	8	YES	----	2.2 ± 0.3	Whey Protein Concentrate	46	----	----	Body Composition Muscle strength

	Prot 2 (10)	Beef	Mixed	22 ± 4	8	YES	----	2.2 ± 0.2	isolated beef protein	46	----	----	
	Prot 3 (11)	Chx	Mixed	21 ± 2	8	YES	----	2.1 ± 0.3	hydrolyzed chicken protein	46	----	----	
	Con (10)	Control	Mixed	21 ± 2	8	YES	2 ± 0.2	----	N/A	N/A	Maltodextrin	48	
Snijders, T., et al., 2015 [63]	Prot (20)	PRO	Men	23 ± 4.47	12	YES	1.4 ± 0.45	1.9	casein hydrolysate, casein	13.75, 13.75	----	----	Body Composition Muscle Strength
	Con (19)	PLA	Men	21 ± 4.36	12	YES	1.3 ± 0.44	----	N/A	N/A	Non-caloric placebo beverage	----	
Spillane, M. and Willoughby, D. S., 2016[64]	Prot (11)	HPC	Men	21.38 ± 4.07	8	YES	----	2.42	Whey	94	----	----	Body Composition
	Con (10)	HC	Men	19.38 ± 1.18	8	YES	1.03	----	N/A	N/A	maltodextrose	312	
Taylor, L. W., et al., 2016[65]	Prot (8)	WP	Women	20 ± 2	8	YES	----	1.37	Whey	48	----	----	Body Composition Muscle Strength
	Con (6)	MD	Women	21 ± 3	8	YES	1.12	----	N/A	N/A	maltodextrin	48	
van Dongen, E. J. I., et al., 2020[66]	Prot (82)	Intervention	Mixed	74.7 ± 5.8	12	YES	1.12	1.46	Increase from Diet to reach ~1.2g/kg/d	25	----	----	Body Composition Muscle Strength Physical Function
	Con (86)	Control	Mixed	75.9 ± 6.5	12	YES	1.04	----	N/A	N/A	NP	N/A	

Vangsoe, M. T., et al., 2018[67]	Prot (9)	Pro	Men	24.2 ± 2.6	8	YES	1.6 ± 0.3	2.3 ± 0.3	Insect protein	32	----	----	Body Composition Muscle strength
	Con (9)	Con	Men	24.2 ± 2.6	8	YES	1.7 ± 0.3	----	N/A	N/A	Potato flour and Maxim Sport drink	Isocaloric	
Verdijk, L. B., et al., 2009[68]	Prot (13)	Protein	Men	72 ± 2	12	YES	1.1 ± 0.36	1.35	casein hydrolysate	20	----	----	Body Composition Muscle strength
	Con (13)	Placebo	Men	72 ± 2	12	YES	1.1 ± 0.36	----	N/A	N/A	Water	----	
Volek, J. S., et al., 2013[69]	Prot 1 (19)	Whey	Mixed	22.8 ± 3.7	40	YES	1.27 ± 0.4	1.39 ± 0.18	Whey	21.6	----	----	Body Composition Muscle strength
	Prot 2 (22)	Soy	Mixed	24.0 ± 2.9	40	YES	1.27 ± 0.4	1.35 ± 0.13	Soy	20	----	----	
	Con (22)	Carb	Mixed	22.3 ± 3.1	40	YES	1.06 ± 0.13	----	N/A	N/A	maltodextrin	isocaloric	
Walker, T. B., et al., 2010[70]	Prot (18)	WPL	Men	26.9	8	YES	----	----	Whey Protein, leucine	39.4, 12.4	----	----	Body Composition Muscle strength
	Con (12)	Placebo	Men	26.9	8	YES	----	----	N/A	N/A	CHO	isocaloric	
Watanabe, K., et al., 2018[71]	Prot 1 (13)	APP-CN	Mixed	69.2 ± 4.1	6	NO	1.3 ± 0.4	1.5 ± 0.4	fish protein (in soup)	5	----	----	Body Composition Muscle strength Physical Function
	Prot 2 (12)	APP-RT	Mixed	69.8 ± 5.5	6	YES	1.4 ± 0.6	1.6 ± 0.7	fish protein (in soup)	5	----	----	
	Con 1 (12)	PLA-CN	Mixed	69.5 ± 2.9	6	NO	1.3 ± 0.4	----	N/A	N/A	Placebo soup	----	
	Con 2 (13)	PLA-RT	Mixed	68.3 ± 5.9	6	YES	1.4 ± 0.3	----	N/A	N/A	Placebo soup	----	

Weisgarber, K. D., et al., 2012[72]	Prot (9)	PRO	Mixed	24.58 ± 1.8	8	YES	----	1.53	Whey	26.49	----	----	Body Composition Muscle strength
	Con (8)	PLA	Mixed	23.6 ± 4.4	8	YES	0.99	----	N/A	N/A	Maltodextrin , sucrose	16.52, 8.26	
Willoughby, D. S., et al., 2007[73]	Prot (10)	PRO	Men	19 ± 1.58	10	YES	2.31 (0.82)	2.76	Whey and casein mix, free amino acids	28,12	----	----	Body Composition Muscle strength
	Con (9)	PLC	Men	19 ± 1.58	10	YES	2.24 (0.85)	----	N/A	N/A	dextrose	40	
Zhu, K., et al., 2015[74]	Prot (101)	Protein	Women	74.2 ± 2.8	108	NO	1.2 ± 0.3	1.6	Whey protein in skim milk	30	----	----	Handgrip strength Muscle Strength Physical Function
	Con (95)	Placebo	Women	74.3 ± 2.6	108	NO	1.1 ± 0.3	----	N/A	N/A	skim milk	2.1	

NP: No Placebo; PLC : Placebo; WP: Whey Protein

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