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Appendix A. Methods

Search Strategy and Data Sources

Search Details and Sources

The search strategy was designed and conducted by an experienced systematic review Librarian with input from the investigators. Another Librarian peer reviewed the draft MEDLINE search strategy using the PRESS Checklist. The MEDLINE search included a combination of relevant keywords and MeSH search terms, the search was translated in each database's specified controlled vocabulary. To find additional relevant studies, included studies from relevant systematic reviews were manually screened. We applied the following limits or filters to the database searches:

- Date. Investigators considered a literature search starting in 2000 sufficient for the purpose of this review.
- Language. Publications were excluded if they were written in a language other than English. This was due to resource constraints.
- Publication status. We searched for published studies.
- Human or organism. The search was limited to human studies.
- Study design. The search was restricted to randomized controlled trials and observational cohort studies.
- Filters. For Embase (Ovid), we created a modified filter based on a EMBASE RCT filter for Ovid. Reference: ISSG Search Filter Resource [Internet]. Glanville J, Lefebvre C, Manson P, Robinson S, Brbre I and Woods L, editors. York (UK): The InterTASC Information Specialists' Sub-Group; 2006 [updated 18 February 2024; cited 18 February 2024]. Available from https://sites.google.com/a/york.ac.uk/issg-search-filters-resource/home
- Filters. For Scopus, we created a modified RCT filter based on a CADTH search filter All Clinical Trials Scopus. Reference: CADTH Search Filters Database. Ottawa: CADTH; 2023: https://searchfilters.cadth.ca/link/106. Accessed 2023-12-05.
- Filters: We created a modified filter based on a CADTH search filter to remove Embase and MEDLINE records in Scopus. Reference: Scopus NOT Medline/PubMed NOT Embase -Scopus. In: CADTH Search Filters Database. Ottawa: CADTH; 2024: https://searchfilters.cadth.ca/link/97. Accessed 2024-03-08. (https://searchfilters.cadth.ca/link/97)

We conducted a comprehensive literature search in May 2023, January 2024, and March 2024. We searched the following databases:

- MEDLINE (Ovid) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily Date searched May 31, 2023, January 17, 2024, and March 26, 2024
- Embase (Ovid) Date searched: May 31, 2023, January 17, 2024, and March 26, 2024
- Agricola (Ovid) Date searched: May 31, 2023, January 17, 2024, and March 26, 2024
- Scopus (Elsevier) Date serached: May 31, 2023, January 17, 2024, and March 26, 2024

Ovid MEDLINE(R) ALL <1946 to March 26, 2024>

1 animal proteins, dietary/ or dietary proteins/ or egg proteins, dietary/ or fish proteins, dietary/ or fruit proteins/ or grain proteins/ or meat proteins/ or milk proteins/ or nut proteins/ or plant proteins, dietary/ or pea proteins/ or poultry proteins/ or shellfish proteins/ or Soybean Proteins/ or whey proteins/ or Diet, High-Protein/ or diet, high-protein low-carbohydrate/ or (protein? adj3 (ate or animal? or bean? or beef or cheese? or consume* or consumption or content or dairy or diet* or eat or eating or egg? or fish or food or foods or fruit? or goat or grain? or high or increase* or intake* or lacto-vegetarian or lamb or legume? or lentils or macronutrient? or meat? or milk or miso or nut? or nutrition* or nutrient* or pea or peas or pescatarian or pescavegan or plant? or poultry or pork or recommend* or seed? or shellfish? or soy? or soybean? or supplement* or tofu or tempeh or veal or vegan or vegetable? or vegetarian or whey or yog?urt or yolk?)).ti,ab.

2 "Bone and Bones"/ or Bone Density/ or bone diseases/ or bone diseases, metabolic/ or bone demineralization, pathologic/ or bone resorption/ or Fractures, Bone/ or (bone disease? or bone densit* or bone demineralization or bone health or bone mass or bone mineral or bone resorption or bone fracture* or osteoporosis or osteopenia).ti,ab.

3 kidney calculi/ or Kidney Diseases/ or kidney failure, chronic/ or nephrolithiasis/ or renal insufficiency/ or renal insufficiency, chronic/ or ureterolithiasis/ or ureteral calculi/ or (chronic kidney failure or kidney calculi or kidney disease? or kidney function or kidney insufficiency or kidney stone? or nephrolithiasis or ureteral calculi or ureteral stone? or ureterolithiasis or renal calculi or renal disease? or renal function or renal insufficiency).ti,ab.

4 Muscular Atrophy/ or exp Muscle Strength/ or Muscle Weakness/ or sarcopenia/ or (muscle adj3 (atrophy or loss or mass or strength or wasting or weak* or sarcopenia)).ti,ab. 5 or/2-4

6 1 and 5

7 (randomized controlled trial or controlled clinical trial).pt. or randomi?ed.ti,ab. or placebo.ti,ab. or randomly.ab. or trial.ab. or groups.ab.

- 8 allocated.ti.ab.hw.
- 9 ((singl* or doubl* or triple) adj (blind* or dumm* or mask*)).ti,ab,hw,kf.

10 ((equivalence or superiority or non-inferiority or noninferiority) adj3 (study or studies or trial*)).ti,ab,hw,kf.

11 (Nonrandom* or non random* or non-random* or quasi-random* or quasirandom*).ti,ab,hw,kf.

12 or/7-11

13 case-control studies/ or clinical trial/ or cohort studies/ or controlled before-after studies/ or cross-over studies/ or pragmatic clinical trial/ or prospective studies/ or (before-after or between group* or clinical study or clinical trial or crossover design or cross-over design or crossover study or cross-over study or nested case-control* or prospectiv* or quasiexperiment*).mp.

- 14 Cohort analy*.tw.
- 15 (Follow up adj (study or studies)).tw.
- 16 (observational adj (study or studies)).tw.
- 17 or/13-16
- 18 12 or 17
- 19 6 and 18
- 20 limit 19 to (english language and yr="2000 -Current")

- 21 case reports/ or comment/ or editorial/ or letter/
- 22 20 not 21
- 23 Animals/ not (Animals/ and Humans/)
- 24 22 not 23

Embase <1974 to 2024 March 26>

1 animal protein/ or avian protein/ or fish protein/ or meat protein/ or milk protein/ or pea protein/ or plant protein/ or protein diet/ or protein intake/ or shellfish protein/ or soybean protein/ or whey protein/ or high-protein low-carbohydrate diet/ or (protein? adj3 (ate or animal? or bean? or beef or cheese? or consume* or consumption or content or dairy or diet* or eat or eating or egg? or fish or food or foods or fruit? or goat or grain? or high or increase* or intake* or lacto-vegetarian or lamb or legume? or lentils or macronutrient? or meat? or milk or miso or nut? or nutrition* or nutrient* or pea or peas or pescatarian or pescavegan or plant? or pork or poultry or recommend* or seed? or shellfish? or soy? or soybean? or supplement* or tofu or tempeh or veal or vegan or vegetable? or vegetarian or whey or yog?urt or yolk?)).ti,ab.

2 bone/ or bone density/ or bone disease/ or demineralization/ or fracture/ or metabolic bone disease/ or osteolysis/ or (bone disease? or bone densit* or bone demineralization or bone health or bone mass or bone mineral or bone resorption or bone fracture* or osteolysis or osteoporosis or osteopenia).ti,ab.

3 kidney disease/ or "chronic kidney disease-mineral and bone disorder"/ or exp chronic kidney failure/ or nephrolithiasis/ or ureter stone/ or urolithiasis/ or (kidney disease? or kidney function or kidney insufficiency or kidney stone? or nephrolithiasis or ureter* calculi or ureter* stone? or ureterolithiasis or renal calculi or renal disease? or renal function or renal insufficiency).ti,ab.

4 muscle atrophy/ or muscle function/ or muscle strength/ or muscle weakness/ or sarcopenia/ or (muscle adj3 (atrophy or loss or mass or strength or wasting or weak*)).ti,ab. or sarcopenia.ti,ab.

5 or/2-4

6 1 and 5

7 controlled clinical trial/ or intermethod comparison/ or exp randomized controlled trial/ or randomization/ or (placebo or random*).ti,ab.

8 (compare or compared or comparison).ti.

9 ((evaluated or evaluate or evaluating or assessed or assess) and (compare or compared or comparing or comparison)).ab.

10 ((open adj label) or ((double or single or doubly or singly) adj (blind or blinded or blindly))).ti,ab. or double blind procedure/ or parallel group\$1.ti,ab. or (crossover or cross over).ti,ab. or ((assign* or match or matched or allocation) adj5 (alternate or group? or intervention* or patient? or subject? or participant?)).ti,ab.

11 (assigned or allocated or (controlled adj7 (study or design or trial))).ti,ab.

12 human experiment/ or trial.ti.

13 or/7-12

14 6 and 13

15 case control study/ or clinical trial/ or clinical trial/ or cohort analysis/ or crossover procedure/ or pragmatic trial/ or (before-after or between group* or crossover design or cross over design or crossover procedure or crossover study or cross over study or nested case-control* or prospectiv* or quasi-experiment*).ti,ab. 16 Cohort analy*.tw.

17 (Follow up adj (study or studies)).tw.

18 (observational adj (study or studies)).tw.

19 or/15-18

20 13 or 19

21 6 and 20

22 ((rat or rats or mouse or mice or swine or porcine or murine or sheep or lambs or pigs or piglets or rabbit or rabbits or cat or cats or dog or dogs or cattle or bovine or monkey or monkeys).ti. and animal experiment/) or (Animal experiment/ not (human experiment/ or human/))

23 21 not 22

24 limit 23 to (english language and yr="2000 -Current")

25 (Book or Chapter or Conference Abstract or Conference Paper or Conference Review or Preprint).pt. or book/ or case report/ or editorial/ or letter/ or note/

26 24 not 25

AGRICOLA <1970 to March 2024>

1 animal source protein/ or dairy protein/ or egg source protein/ or high protein foods/ or legume protein/ or meat protein/ or exp high protein diet/ or exp plant source protein/ or soy protein/ or textured proteins/ or (protein? adj3 (ate or animal? or bean? or beef or consume* or consumption or content or dairy or diet* or eat or eating or egg? or fish or food or foods or fruit? or goat or grain? or high or increase* or intake* or lacto-vegetarian or lamb or legume? or lentil? or macronutrient? or meat? or milk or nut? or nutrition* or nutrient* or pea or peas or pescatarian or pescavegan or plant? or poultry or pork or recommend* or seafood or seed? or shellfish or soy? or soybean? or supplement* or tempeh or tofu or veal or vegan or vegetable? or vegetarian or whey or yog?urt or yolk?)).ti,ab.

2 bone diseases/ or bone density/ or bone fractures/ or bone health/ or bone resorption/ or osteopenia/ or osteoporosis/ or (bone disease? or bone densit* or bone demineralization or bone health or bone mass or bone resorption or fracture* or osteoporosis or osteopenia).ti,ab.

3 kidney diseases/ or renal calculi/ or ureteral calculi/ or (kidney disease? or kidney function or kidney stone? or nephrolithiasis or ureteral calculi or ureteral stone? or ureterolithiasis or renal calculi or renal disease? or renal function or renal insufficiency).ti,ab.

4 muscular atrophy/ or muscle strength/ or hand strength/ or sarcopenia/ or (muscle adj3 (atrophy or loss or mass or strength or wasting or weak* or sarcopenia)).ti,ab.

5 or/2-4

6 1 and 5

7 limit 6 to (english language and yr="2000 -Current")

8 clinical trials/ or cross-over studies/ or randomized clinical trials/ or (cross-over study or nonrandom* or non-random* or quasi-random* or quasi-random* or quasirandom* or random* or placebo or trial or groups).ti,ab,hw.

9 allocated.ti,ab,hw.

10 ((singl* or doubl*) adj (blind* or dumm* or mask*)).ti,ab,hw.

11 ((equivalence or superiority or non-inferiority or noninferiority) adj3 (study or studies or trial*)).ti,ab,hw.

12 case-control studies/ or cohort studies/ or observational studies/ or prospective studies/

13 (observational adj (study or studies)).tw.

- 14 (Follow up adj (study or studies)).tw.
- 15 Cohort analy*.tw.
- 16 or/8-15
- 17 7 and 16
- 18 exp human nutrition/ or exp people/
- 19 17 and 18

Scopus (Elsevier)

((INDEXTERMS ("Muscular Atrophy") OR INDEXTERMS ("Muscle Strength") OR INDEXTERMS ("Muscle Weakness") OR INDEXTERMS (sarcopenia) OR TITLE-ABS ((muscle OR muscular) W/3 (atrophy OR loss OR mass OR strength OR wasting OR weak*)) OR TITLE-ABS (sarcopenia)) OR (INDEXTERMS ("kidney calculi") OR INDEXTERMS ("Kidney Diseases") OR INDEXTERMS ("kidney failure, chronic") OR INDEXTERMS (nephrolithiasis) OR INDEXTERMS ("renal insufficiency") OR INDEXTERMS ("renal insufficiency, chronic") OR INDEXTERMS (ureterolithiasis) OR INDEXTERMS ("ureteral calculi") OR TITLE-ABS ("chronic kidney failure" OR "kidney calculi" OR "kidney disease*" OR "kidney function" OR "kidney insufficiency" OR "kidney stone*" OR nephrolithiasis OR "ureteral calculi" OR "ureteral stone*" OR ureterolithiasis OR "renal calculi" OR "renal disease*" OR "renal function" OR "renal insufficiency")) OR (INDEXTERMS ("Bone and Bones") OR INDEXTERMS ("Bone Density") OR INDEXTERMS ("bone diseases") OR INDEXTERMS ("bone diseases, metabolic") OR INDEXTERMS ("bone demineralization, pathologic") OR INDEXTERMS ("bone resorption") OR INDEXTERMS ("Fractures, Bone") OR TITLE-ABS ("bone disease*" OR "bone densit*" OR "bone demineralization" OR "bone health" OR "bone mass" OR "bone mineral" OR "bone resorption" OR "bone fracture*" OR osteoporosis OR osteopenia))) AND (INDEXTERMS ("Dietary Proteins") OR INDEXTERMS ("dairy proteins") OR INDEXTERMS ("egg protein") OR INDEXTERMS ("Diet, High-Protein") OR INDEXTERMS ("diet, high-protein low-carbohydrate") OR INDEXTERMS ("animal protein") OR INDEXTERMS ("soy proteins") OR INDEXTERMS ("plant proteins") OR TITLE-ABS ((protein*) W/3 (ate OR animal* OR bean* OR beef OR beverage* OR cheese OR consume* OR consumption OR content OR dairy OR diet* OR drink* OR eat OR eating OR egg* OR fish OR food OR foods OR fruit* OR goat OR grain* OR high OR increase* OR intake* OR lacto-vegetarian OR lamb OR legumes OR lentils OR macronutrient* OR meat* OR milk OR nut* OR nutrition* OR nutrient* OR pea OR peas OR pescatarian OR pescavegan OR plant* OR pork OR poultry OR recommend* OR seeds OR shellfish OR soy* OR soybean OR supplement* OR tempeh OR tofu OR veal OR vegan OR vegetable* OR vegetarian OR whey OR vogurt OR volk*))) AND PUBYEAR > 1999 AND PUBYEAR < 2024 AND NOT INDEX (medline) AND NOT (PMID (0* OR 1* OR 2* OR 3* OR 4* OR 5* OR 6* OR 7* OR 8* OR 9*)) AND NOT INDEX (embase)) AND (((INDEXTERMS ("clinical trial") OR INDEXTERMS ("cross-over studies") OR INDEXTERMS ("pragmatic clinical trial") OR INDEXTERMS ("case-control studies") OR INDEXTERMS ("cohort studies") OR INDEXTERMS ("prospective studies") OR INDEXTERMS ("controlled before-after studies") OR TITLE-ABS-KEY (observational W/3 (study OR studies OR design OR analysis OR analyses)) OR TITLE-ABS-KEY (prospective W/7 (study OR studies OR design OR analysis OR

analyses)) OR TITLE-ABS-KEY ("follow up" OR followup W/7 (study OR studies OR design OR analysis OR analyses)) OR TITLE-ABS-KEY (cohort AND analy*) OR TITLE-ABS-KEY (nested AND case AND control*) OR TITLE-ABS-KEY (quasi W/1 (experiment OR experiments OR experimental)) OR TITLE-ABS-KEY (cohort AND analy*)) OR (TITLE-ABS-KEY (random* OR sham OR placebo*) OR TITLE-ABS-KEY ((singl* OR doubl*) W/1 (blind* OR dumm* OR mask*)) OR TITLE-ABS-KEY ((tripl* OR trebl*) W/1 (blind* OR dumm* OR mask*)) OR TITLE-ABS-KEY(control* W/3 (study OR studies OR trial* OR group*)) OR TITLE-ABS-KEY (clinical W/3 (study OR studies OR trial*)) OR TITLE-ABS-KEY (nonrandom* OR "non random*" OR non-random* OR quasi-random* OR quasirandom*) OR TITLE-ABS-KEY (phase W/3 (study OR studies OR trial*)) OR TITLE-ABS-KEY ((crossover OR cross-over) W/3 (study OR studies OR trial*)) OR TITLE-ABS-KEY ((multicent* OR multi-cent*) W/3 (study OR studies OR trial*)) OR TITLE-ABS (allocated) OR TITLE-ABS-KEY (("open label" OR open-label) W/5 (study OR studies OR trial*)) OR TITLE-ABS-KEY ((equivalence OR superiority OR non-inferiority OR noninferiority) W/3 (study OR studies OR trial*)) OR TITLE-ABS-KEY ("pragmatic study" OR "pragmatic studies") OR TITLE-ABS-KEY ((pragmatic OR practical) W/3 trial*) OR TITLE-ABS-KEY ((quasiexperimental OR quasi-experimental) W/3 (study OR studies OR trial*)) OR TITLE(trial) OR KEY(trial))) OR (TITLE-ABS-KEY(observational W/3 (study OR studies OR design OR analysis OR analyses)) OR TITLE-ABS-KEY (prospective W/7 (study OR studies OR design OR analysis OR analyses)) OR TITLE-ABS-KEY ("follow up" OR followup W/7 (study OR studies OR design OR analysis OR analyses)) OR TITLE-ABS-KEY (cohort AND analy*) OR TITLE-ABS-KEY (nested AND case AND control*) OR TITLE-ABS-KEY (quasi W/1 (experiment OR experiments OR experimental)) OR TITLE-ABS-KEY (cohort AND analy*))) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English"))

Appendix B. References Excluded at Full Text

P= Population

- I= Intervention
- C=Comparison

O=Outcome

- S=Study Design
- X= Other Reason
- Adams KF, Newton KM, Chen C, et al. Soy isoflavones do not modulate circulating insulin-like growth factor concentrations in an older population in an intervention trial. J Nutr. 2003;133(5):1316-9. doi: 10.1093/jn/133.5.1316. PMID: 12730416. I
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- Ahmad AH, Ong MLY, Ooi FK. Combined effects of plant-based protein supplementation with 8-week resistance training on muscular strength, protein catabolism, immune functions and bone metabolism markers in adult males. Mal J Med Health Sci. 2020;16(4):202-10. doi: <u>https://medic.upm.edu.my/upload/dok</u> <u>umen/2020120209452728 MJMHS 02</u> <u>32.pdf</u>. X

- Alekel DL, St. Germain A, Peterson CT, et al. Isoflavone-rich soy protein isolate attenuates bone loss in the lumbar spine of perimenopausal women. Am J Clin Nutr. 2000;72(3):844-52. doi: 10.1093/ajcn/72.3.844. PMID: 10966908. x
- Aleman-Mateo H, Carreon VR, Macias L, et al. Nutrient-rich dairy proteins improve appendicular skeletal muscle mass and physical performance, and attenuate the loss of muscle strength in older men and women subjects: a single-blind randomized clinical trial. Clin Interv Aging. 2014;9:1517-25. doi: 10.2147/CIA.S67449. PMID: 25258523. x
- Alexy U, Remer T, Manz F, et al. Long-term protein intake and dietary potential renal acid load are associated with bone modeling and remodeling at the proximal radius in healthy children. Am J Clin Nutr. 2005;82(5):1107-14. doi: 10.1093/ajcn/82.5.1107. PMID: 16280446. S
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- Antonio J, Ellerbroek A, Evans C, et al. High protein consumption in trained women: bad to the bone? J Int Soc Sports Nutr. 2018;15:6. doi: 10.1186/s12970-018-0210-6. PMID: 29434529. S

- Aoe S, Koyama T, Toba Y, et al. A controlled trial of the effect of milk basic protein (MBP) supplementation on bone metabolism in healthy menopausal women. Osteoporos Int. 2005 Dec;16(1):2123-8. doi: 10.1007/s00198-005-2012-3. PMID: 16133638. X
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- Bihuniak JD, Simpson CA, Sullivan RR, et al. Dietary protein-induced increases in urinary calcium are accompanied by similar increases in urinary nitrogen and urinary urea: a controlled clinical trial. J Acad Nutr Diet. 2013 Mar;113(3):447-51. doi: 10.1016/j.jand.2012.11.002. PMID: 23438496. x
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Appendix C. Evidence Tables for All Eligible Studies

Table C1. Evidence table for Bone Disease Randomized Controlled Trials (Adults and Children and Adolescents)

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		administrator and duration)	administration and	of assessment)
			assessment)	
PMID: NR	Study of: Adults	Intervention: High Protein	Intervention: High	Bone Turnover Marker (Overall
Aoyagi	Total sample N: 79		Protein	Turnover) - Osteocalcin
2010 ¹		Intended Protein Amount: 40		
Location/Country: Japan	Intervention: High	mg of milk basic protein	How protein was	Measure/Method of Assessment:
HDI: Very high	Protein	Carbohydrate: NR	administered:	Blood assays
Setting: Community	Experimental: 40 mg MBP	Fat: NR	Participants drank 1 bottle	
dwelling	Supplement		(50 mL) a day of 40mg	Bone Formation Marker - Bone
Urban/ Rural: NR	N: 44	Baseline Protein Amount	milk basic protein	specific alkaline phosphatase
Study design: RCT	% Female: 100%	Mean (SD): 71.9 (17.8) g/d	(Mainichi Hone Kea MBP®	
(parallel)	Mean Age (SD): 72 (4) y	Carbohydrate Mean (SD): NR	Snow Brand Milk	Measure/Method of Assessment:
Funding source: Nonprofit	Race/ Ethnicity: Japanese	Fat Mean (SD): NR	Products Co., Ltd.,	Blood and urine assays
Risk of bias score: High	Menopausal status:		Shinjuku, Tokyo, Japan)	
	Postmenopausal	Actual Protein Amount at the		Bone Resorption Marker - Urinary
	Obesity status: NR	end of the study	Protein Assessment	excretion of deoxypyridinoline
	Mean BMI (SD): NR	Mean (SD): NR	Method: Baseline protein	
	Income level: NR	Carbohydrate Mean (SD): NR	was determined through a	Measure/Method of Assessment:
	Education level: NR	Fat Mean (SD): NR	1-wk retrospective dietary	Blood and urine assays
	Mean physical activity		questionnaire	
	level (SD): 17.5 (10.3)	Dietary Protein Intake		Bone Resorption Marker – NTx (N-
	year-averaged duration of	Compliance (%): 88%	Dietary Protein Intake	teleopeptides of type I collagen)
	exercise		Compliance: Participants	
	Health status/	Protein type/source: Animal;	kept diaries and returned	Measure/Method of Assessment:
	Comorbidities: No history	milk basic protein	empty bottles at their	Blood assay
	of conditions affecting		monthly laboratory visits.	
	bone metabolism (e.g.,	Energy balance status:		
	ovariectomy, cancer,	Eucaloric	Actual Protein Amount	BMD of the Appendicular Skeleton
	renal disease or		was not calculated,	- Bone mineral density (forearm, total)
	rheumatoid arthritis).	Comparator: Normal Protein	though empty bottles	
	Medication use: No		returned by participants	Measure/Method of Assessment:
	current treatment with	Intended Protein Amount: NR	were counted and food	Peripheral DXA, using a bone
	normonal preparations	Carbonydrate: NR	diaries were kept by	aensitometer ([DIX-200, Osteometer
	(e.g., estrogens) or other	Fat: NR	participants to ensure	weaii ⊨cn, inc.]).
	arugs (e.g.,	Descline Destain America (compliance with intended	
	bisphosphonates) likely to	Baseline Protein Amount	treatment.	
	influence bone nealth.	Wean (SD): 74.1 (19.6) g/d		
	Supplement use: NR	Carbonydrate Mean (SD): NR		

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
-	-	Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
			assessment)	
	Pregnant or lactating: NA	Fat Mean (SD): NR	Comparator: Normal	
			Protein	
	Comparator: Normal	Actual Protein Amount at the		
	Protein	end of the study	How protein was	
	N: 35	Mean (SD): NR	administered:	
	% Female: 100%	Carbonydrate Mean (SD): NR	Participants were	
	Mean Age (SD): 72 (6) y	Fat Mean (SD): NR	instructed to keep their	
	Race/ Ethnicity: Japanese	Distant Dratain Intella	dietary habits the same	
	Menopausal status:	Dietary Protein Intake	Dratain Assessment	
	Posimenopausai	Compliance (%): 40%	Mothod: Some as above	
	Moon PMI (SD): NP	Brotain type/seuroe: Mixed	wethou. Same as above	
		Protein type/source. Mixed	Diotany Protoin Intako	
	Education level: NR	Energy balance status:	Compliance: Same as	
	Mean physical activity	Eucoloric	above	
	level (SD): $14.5(9.2)$	Lucalone	above	
	vear-averaged duration of	Study duration: 12 months		
	exercise			
	Health status/Co-			
	morbidities: No history of			
	conditions affecting bone			
	metabolism (e.g.,			
	ovariectomy, cancer,			
	renal disease or			
	rheumatoid arthritis).			
	Medication use: No			
	current treatment with			
	hormonal preparations			
	(e.g., estrogens) or other			
	drugs (e.g.,			
	bisphosphonates) likely to			
	influence bone health.			
	Supplement use: NR			
DNUD (5707000	Pregnant or lactating: NA			
PMID: 15/2/682	Study of: Adults	Intervention: High Protein	Intervention: High	I otal Body BMD - Bone mineral
Arjmandi	Total sample N: 62	Internals of Directoria, Americante OF	Protein	density (total body)
	Intervention, High	ritiended Protein Amount: 25		Magguro (Mathed of Assessments
Location/Country: USA	Protoin	g/u or supplement	now protein was	DXA (Hologic ODP 4500C)
Setting: Community		Eat NP	Participante etc. a test	
dwelling	% Female: 100%		food of 25 a soy products	
Arjmandi 2005 ² Location/Country: USA HDI: Very high Setting: Community dwelling	Total sample N: 62 Intervention: High Protein N: 35 % Female: 100%	Intended Protein Amount: 25 g/d of supplement Carbohydrate: NR Fat: NR	Protein How protein was administered: Participants ate a test food of 25 g soy products	density (total body) Measure/Method of Assessment: DXA (Hologic QDR-4500C)

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and	Outcome (Measures and methods of assessment)
Urban/ Rural: NR Study design: RCT	Mean Age (SE): 53 (6) y Race/ Ethnicity: NR	Baseline Protein Amount Mean (SE): 75.8 (3.6) g/d	assessment) (donated by DrSoy Nutrition Irvine, CA) in the	BMD of the Axial Skeleton - Bone mineral density (L1-L4 (lumbar
(parallel) Funding source: Industry,	Menopausal status: Postmenopausal	Carbohydrate Mean (SE): 243 (12) g/d	form of a snack bar, drink mix, or cereal	spine))
state agency Risk of bias score: High	Obesity status: NR Mean BMI (SE): 28.6	Fat Mean (SE): 62.5 (4.1) g/d	Protein Assessment	DXA (Hologic QDR-4500C)
	Income level: NR Education level: NR Physical activity level: NR	end of the study Mean (SE): 87.3 (3.6) g/d Carbohydrate Mean (SE): 202	Baseline and end-of-study protein was obtained from a 1-wk food frequency	BMD of the Appendicular Skeleton - Bone mineral density (hip, total)
	Health status/ Comorbidities: Women with cancer, liver disease,	(12) g/d Fat Mean (SE): 57.0 (4.2) g/d	questionnaire via interview by a registered dietitian. Actual protein	Measure/Method of Assessment: DXA (Hologic QDR-4500C)
	hypo- or hyperthyroidism, gastrointestinal disorders, insulin-dependent	Dietary Protein Intake Compliance (%): NR	was determined by analysis of customized calendars for participants	Total Body BMC - Bone mineral content (total body)
	diabetes mellitus, pelvic inflammatory disease, and endometrial polyps	Protein type/source: Plant; soy products	to record amount of test food consumed.	Measure/Method of Assessment: DXA (Hologic QDR-4500C)
	were excluded from the study Medication use: Study	Energy balance status: Eucaloric	Dietary Protein Intake Compliance: Participants recorded how much of	BMC of the Axial Skeleton - Bone mineral content (L1-L4 (lumbar spine))
	participants were not on any prescription medication.	Comparator: Normal Protein Intended Protein Amount: NR	each of the cereal, the snack bar, or the drink mix they consumed on a	Measure/Method of Assessment: DXA (Hologic QDR-4500C)
	Supplement use: Herbal supplement was exclusion criteria	Fat: NR	Customized calendar. Participants also returned any unconsumed foods.	BMC of the Appendicular Skeleton - Bone mineral content (hip, total)
	Comparator: Normal	Mean (SE): 64.2 (4.1) g/d Carbohydrate Mean (SE): 207	Comparator: Normal Protein	Measure/Method of Assessment: DXA (Hologic QDR-4500C)
	Protein N: 27 % Female: 100%	Fat Mean (SE): 56.6 (4.8) g/d	How protein was administered:	Bone Turnover Marker (Overall Turnover) - Osteocalcin
	Mean Age (SE): 56 (5) y Race/ Ethnicity: NR Menopausal status:	Actual Protein Amount at the end of the study Mean (SE): 87.8 (4.1) g/d	comparative controls	Measure/Method of Assessment: Blood sample (serum)
	Postmenopausal Obesity status: NR Mean BMI (SE): 27.3 (1.0) kg/m ²	Carbohydrate Mean (SE): 247 (14) g/d Fat Mean (SE): 59.0 (4.8) g/d	Protein Assessment Method: Same as above	Bone Formation Marker - Bone specific alkaline phosphatase

Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: Women with cancer, liver disease, hypo- or hyperthyroidism, gastrointestinal disorders, insulin-dependent diabetes mellitus, pelvic inflammatory disease, and endometrial polyps were excluded from the study Medication use: Study participants were not on any prescription medication. Supplement use: Herbal supplement was exclusion criteria	Dietary Protein Intake Compliance (%): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 1 y	Dietary Protein Intake Compliance: Same as above	Measure/Method of Assessment: Blood sample (serum) Bone Resorption Marker - Urinary excretion of deoxypyridinoline Measure/Method of Assessment: Blood sample (serum)
Study of: Adults Total sample N: 71 Intervention: Treated group N: 36 % Female: 100% Mean Age (SD): 57.1 (3.9) y Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 23.1 (2.2) kg/m ² Income level: NR Education level: NR Physical activity level: NR	Intervention: Treated group Intended Protein Amount: Test food supplement: 13.8 g protein Carbohydrate: NR Fat: NR Baseline Protein Amount Mean (SD): 72 (17) g/d Carbohydrate Mean (SD): 193 (73) g/d Fat Mean (SD): 79 (19) g/d Actual Protein Amount at the end of the study (change) Mean (SD): 11.4 (18.5) g/d Carbohydrate (change) Mean	Intervention: Treated group How protein was administered: Dairy (skimmed-milk, soft, plain cheese fortified with vitamin D and calcium) test food given to participants, 2 servings, 100 g each, once daily. Protein Assessment Method: Baseline protein, intermediary, and post protein amounts were derived from a dietary follow-up questionnaire	Bone Resorption Marker - CTX (carboxy terminal crosslinked telopeptide of type I collagen) Measure/Method of Assessment: Blood sample serum Bone Resorption Marker - TRAP (5b, tartrate resistant acid phosphatase, isoform 5) Measure/Method of Assessment: Blood sample serum Bone Turnover Marker (Overall Turnover) - Osteoclacin Measure/Method of Assessment:
	Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: Women with cancer, liver disease, hypo- or hyperthyroidism, gastrointestinal disorders, insulin-dependent diabetes mellitus, pelvic inflammatory disease, and endometrial polyps were excluded from the study Medication use: Study participants were not on any prescription medication. Supplement use: Herbal supplement was exclusion criteria Pregnant or lactating: NA Study of: Adults Total sample N: 71 Intervention: Treated group N: 36 % Female: 100% Mean Age (SD): 57.1 (3.9) y Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status NR Mean BMI (SD): 23.1 (2.2) kg/m ² Income level: NR Education level: NR Physical activity level: NR	ParticipantsInterventions/Exposure and Comparator (Content, administrator, and duration)Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: Women with cancer, liver disease, pypo- or hyperthyroidism, gastrointestinal disorders, insulin-dependent diabetes mellitus, pelvic inflammatory disease, and endometrial polyps were excluded from the study Medication use: Study participants were not on any prescription medication. Supplement use: Herbal supplement was exclusion criteria Pregnant or lactating: NADietary Protein Intake Compliance (%): NRIntervention: Treated group N: 36 % Female: 100% Mean Age (SD): 57.1 (3.9) yIntervention: Treated group Intended Protein Amount: Test food supplement: 13.8 g protein Carbohydrate: NR Fat Mean (SD): 72 (17) g/d Carbohydrate Mean (SD): 79 (19) g/dIncome level: NR Henopausal activity level: NR Physical activity level: NRActual Protein Amount at the end of the study (change) Mean (SD): 11.3 (61.4) g/d	ParticipantsInterventions/Exposure and administrator, and duration)Interventions/Exposure and administration and assessment)Income level: NR Education level: NR Phalath status/ Comorbidities: Women with cancer, liver disease, hypo- or hyperthyroiding inflammatory disease, and endometrial polyps were excluded from the study Participants were not on any prescription medication. Supplement was exclusion criteria Pregnant or lactating: NADietary Protein Intake Compliance (%): NR Protein type/source: MixedDietary Protein Intake Compliance: Same as aboveIntervention: 1 yStudy duration: 1 yStudy duration: 1 yDietary Protein Intake Compliance: Same as aboveStudy of Aduts Total sample N: 71Intervention: Treated group protein (Aduts Carbohydrate: NR Parenapaus of SD): 72 (17) g/d Carbohydrate Mean (SD): 79 (19) g/dIntervention: Treated group each, once daily. (73) g/dN: 36 Obesity status: NR Education level: NR Potsia activity level: NRIntervention: and mount at the end of the study (change) Mean (SD): 71. (14.10 y ddProtein Reversional (Does ity status: NR Potsia activity level: NRIntervention and the end of the study (change) Mean (SD): 11.4 (18.5) g/d Carbohydrate (change) Mean (SD): 11.4 (14.01 y ddProtein amounts were derived from a dietary follow-up questionnaire follow-up questionnaire follow-up questionnaire (SD): 11.4 (14.01 y dd

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
	Health status/	Fat (change) Mean (SD): 9.4	Dietary Protein Intake	
	Comorbidities: Exclusion	(24.4) g/d	Compliance: Participants	Bone Formation Marker – Bone
	criteria: disorders		completed a self-rating	specific alkaline phosphatase
	influencing calcium-	Dietary Protein Intake	diary, which had to be	
	phosphate and/or bone	Compliance (%): 100%	completed every day.	Measure/Method of Assessment:
	metabolism, such as			Blood sample serum
	hyperparathyroidism,	Protein type/source: Animal;	Comparator: Usual diet	
	Paget disease, or chronic	skimmed-milk, soft, plain		Bone Formation Marker – P1NP
	condition requiring	cheese	How protein was	(Procollagen type 1 N-terminal
	cortisone therapy.	Energy holenes status	administered:	propeptide)
	criteria: no	Ellergy balance status.	maintain their usual diet	Measure/Method of Assessment:
	antiosteoporotic			Blood sample serum
	medication, such as	Comparator: Usual diet	Protein Assessment	Blood sample seram
	bisphosphonates.		Method: Same as above	
	raloxifen, strontium	Intended Protein Amount: NR		
	ranelate, teriparatide,	Carbohydrate: NR	Dietary Protein Intake	
	and/or denosumab	Fat: NR	Compliance: Same as	
	Supplement use:		above	
	exclusion criteria: use of	Baseline Protein Amount		
	calcium and or vitamin D	Mean (SD): 199 (79) g/d		
	supplement, taken as	Carbohydrate Mean (SD): 199		
	pharmaceutical	(79) g/d Eat Maan (SD): 78 (28) g/d		
	foods during the	Fat Mean (SD). 76 (26) g/u		
	preceding 6 months	Actual Protein Amount at the		
	Pregnant or lactating: NA	end of the study (change)		
		Mean (SD): 0.9 (16.5) g/d		
	Comparator: Usual diet	Carbohydrate (change) Mean		
	N: 35	(SD): -11.6 (61.4) g/d		
	% Female: 100	Fat (change) Mean (SD): 5.5		
	Mean Age (SD): 56.1	(22.3) g/d		
	(3.9) y			
	Race/ Ethnicity: NR	Dietary Protein Intake		
	Nienopausal status:	Compliance (%): 100%		
	Obesity status: NR	Protein type/source: Mixed		
	Mean BMI (SD): 22.9			
	$(2.5) \text{ kg/m}^2$	Energy balance status:		
	Income level: NR	Eucaloric		
	Education level: NR			

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
	Physical activity level: NR	Study duration: 6 weeks		
	Health status/			
	Comorbidities: Exclusion			
	criteria: disorders			
	influencing calcium-			
	phosphate and/or bone			
	metabolism, such as			
	hyperparathyroidism,			
	Paget disease, or chronic			
	condition requiring			
	cortisone therapy.			
	Medication use: Inclusion			
	criteria: no			
	antiosteoporotic			
	medication, such as			
	bisphosphonates,			
	raloxiten, strontium			
	ranelate, teriparatide,			
	and/or denosumab			
	Supplement use:			
	exclusion chiena. use of			
	supplement, taken as			
	preparation or fortified			
	foods during the			
	preceding 6 months			
	Pregnant or lactating: NA			
PMID: 24047916	Study of: Adults	Intervention: High Protein	Intervention: High	BMD of the Axial Skeleton - Bone
Jesudason	Total sample N: 323	3	Protein	mineral density L2-L4 (lumbar spine
2013* ⁴		Intended Protein Amount:		vertebra)
Location/Country: Australia	Intervention: High	32% of energy	How protein was	
HDI: Very high	Protein	Carbohydrate: 44% of energy	administered:	Measure/Method of Assessment:
Setting: Community	N: 164	Fat: 24% of energy	Participants received	DXA (Norland XR-800)
dwelling	% Female: 100%		monthly group dietetic	
Urban/Rural: NR	Mean Age (SE): 59.5	Baseline Protein Amount	education and support for	BMD of the Appendicular Skeleton
Study Design: RCT	(0.4) y	Mean (SE): 92.5 (2.2) g/d;	the first 6 months and	- Bone mineral density (distal
(parallel)	Race/ Ethnicity: NR	18.6 (0.2) % of energy	then every 3 months for	forearm, total)
Funding source:	Menopausal status:	Carbohydrate Mean (SE): 230	the next 18 months.	
Government	Postmenopausal	(6) g/d; 42.9 (0.5) % of energy	Sample food packs of \$20	Measure/Method of Assessment:
Risk of bias score: High	Obesity status: Obese		vouchers were provided	DXA (Norland XR-800)

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
			assessment)	
	(0.4) kg/m ²	rat Mean (SE): 79.2 (2.7) g/d;	to participants at baseline	RMD of the Annondicular Skeleter
	l (U.4) Ky/III-	55.5 (0.4) % of energy	Each diat group was	Bono minoral donsity (hin total)
	Education level: NR	Actual Protein Amount at the	allocated to a protein	
	Physical activity level: NR	and of the study	target that was based on	Measure/Method of Assessment:
	Health status/	Mean (SE): 91 5 (2.2) d/d	key protein foods as a	DXA (Norland XR-800)
	Comorbidities: Subjects	21.9(0.3)% of energy	compliance measure	
	with parathyroid disease	Carbohydrate Mean (SE): 196		BMD of the Appendicular Skeleton
	a vitamin D concentration	(6) g/d^2 43.9 (0.7) % of energy	Protein Assessment	- Bone mineral density (femoral neck)
	60 nmol/L with secondary	Fat Mean (SE): 55.5 (2.3) g/d	Method: Participants	
	hyperparathyroidism. or	28.2 (0.7) % of energy	recorded dietary intakes	Measure/Method of Assessment:
	unstable metabolic.		using a protein counter	DXA (Norland XR-800)
	cardiac, gastrointestinal.	Dietary Protein Intake	and checklist. Protein	(
	renal, or other significant	Compliance (%): NR	compliance checklists	Bone Resorption Marker - Bone
	disease, including		were collected from each	marker (C-terminal telopeptide)
	malignancies, were	Protein type/source: Mixed	participant at each group	
	excluded		session. Subjects also	Measure/Method of Assessment:
	Medication use: Women	Energy balance status:	completed a FFQ at	Blood assay
	were ineligible if they	Hypocaloric	baseline and 1 and 2 y.	
	were taking hormone-			Bone Turnover Marker (Overall
	replacement therapy,	Comparator: Normal Protein	Dietary Protein Intake	Turnover) - Osteocalcin
	bisphosphonates,		Compliance: Compliance	
	steroids, diuretics,	Intended Protein Amount:	was assessed by (1)	Measure/Method of Assessment:
	calcium, or vitamin D	22% of energy	blood urea nitrogen and	Blood sample
	Supplement use: Women	Carbohydrate: 55% of energy	24h urine for urea	
	were ineligible if they	Fat: 23% of energy	nitrogen excretion (2)	Bone Formation Marker – Bone
	were taking calcium or		allocated to a protein	specific alkaline phosphatase
	vitamin D	Baseline Protein Amount	target for each diet group	
	Pregnant or lactating: NA	Mean (SE): 91.2 (1.9) g/day;	and (3) protein-	Measure/Method of Assessment:
	Componente a Norma al	18.4 (0.2) % of energy	compliance checklists	Blood sample
	Drotoin	Carbonydrate Mean (SE): 228	were collected from each	
		(5) g/uay; 42.9 (0.5) % of	participant at each group	
	N. 109 % Econolo: 100%	Eat Moon (SE): 77 7 (2.4)	session.	
	70 Ferriale. 100%	rat wedit (SE). 11.1 (2.1)	Comparator: Normal	
	(0.4) v	gruay, 55.4 (0.4) % of energy	Drotein	
	Race/ Ethnicity: NR	Actual Protein Amount at the		
	Menonausal status	and of the study	How protein was	
	Postmenonausal	Mean (SE): $80.6(2.2)$ d/day:	administered	
	Obesity status: Obese	189(0.3)% of energy	Participants received	
			monthly group dietetic	

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	assessment)	
	Mean BMI (SE): 33.4	Carbohydrate Mean (SE): 214	education and support for	
	(0.4) kg/m ²	(5) g/day; 47.2 (0.6) % of	the first 6 months and	
	Income level: NR	energy	then every 3 months for	
	Education level: NR	Fat Mean (SE): 57.9 (2.5)	the next 18 months.	
	Physical activity level: NR	g/day; 28.6 (0.7) % of energy	Sample food packs of \$20	
	Health status/		vouchers were provided	
	Comorbidities: Subjects	Protein type/source: Mixed	to participants at baseline	
	with parathyroid disease,	Distant Dustain Inteles	and 12 and 26 weeks.	
	a vitamin D concentration,	Dietary Protein Intake	Each diet group was	
	by https://www.secondary	Compliance (%). NR	target that was based on	
	unstable metabolic	Enorgy balance status:	kov protoin foods as a	
	cardiac dastrointestinal	Hypocaloric	compliance measure	
	renal or other significant	Typocalone	compliance measure.	
	disease including	Study duration: 24 months	Protein Assessment	
	malignancies, were		Method: Same as above	
	excluded			
	Medication use: Women		Dietary Protein Intake	
	were ineligible if they		Compliance: Same as	
	were taking hormone-		above	
	replacement therapy,			
	bisphosphonates,			
	steroids, diuretics,			
	calcium, or vitamin D			
	Supplement use: Women			
	were ineligible if they			
	were taking calcium or			
	vitamin D			
DMID: 25844610	Pregnant or lactating: NA	Intervention, High Drotain	Intervention, High	PMD of the Avial Skalaton Bana
PINID: 25844619	Study of: Adults	Intervention: High Protein	Dratein	BMD of the Axial Skeleton - Bone
2015*# ⁵	Total sample N. 200	Intended Protein Amount: 40	Protein	mineral density (lumbar spine)
Location/Country: USA	Intervention: High	g of protein from the	How protein was	Measure/Method of Assessment:
HDI: Very high	Protein	supplement; total daily protein	administered:	DXA (Hologic 4500W or Lunar
Setting: NR	N: 106	goal NR	Participants received a	Prodigy DPX-IQ)
Urban/ Rural: NR	% Female: 84%	Carbohydrate: Test food	dietary whey protein	
Study design: RCT	Mean Age (SD): 69.9	protein NR	supplement (protein	BMD of the Appendicular - Bone
(parallel)	(6.1) y	Fat: Test food protein NR	group; Provon 290;	mineral density (hip, total)
Funding source:	Race/ Ethnicity: NR		Glambia Nutritionals) that	
Government, academic	Menopausal status: NR Obesity status: NR	Baseline Protein Amount	was closely matched for composition, color,	

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
Risk of bias score: Low/High	Mean BMI (SD): 26.1 (3.4) kg/m ² Income level: NR Education level: NR	Least Square Mean (SEM): 73.8 (1.9) g Carbohydrate Least Square Mean (SEM): 214.1 (5.2) g	kilocalories, sodium, potassium, phosphorus, fiber, and calcium.	Measure/Method of Assessment: DXA (Hologic 4500W or Lunar Prodigy DPX-IQ)
	Mean Physical activity level score (SD): 6.7 (2.1) Health status/	Fat Mean (SEM): 59.4 (2.1) g Actual Protein Amount at the	Protein Assessment Method: Participants completed a 3-day food	BMD of the Appendicular - Bone mineral density (femoral neck)
	Comorbidities: Healthy older adults Medication use: Excluded if using long-term chemotherapeutic drugs, aromatase inhibitors or tamoxifen, methotrexate, phonytoin, phonobarbital	end of the study Least Square Mean (SEM): 90.7 (3.3) g Carbohydrate Least Square Mean (SEM): 196.9 (6.6) g Fat Least Square Mean (SEM): 55.6 (2.0) g	record prior to baseline, 6 months, and 18 months and were analyzed using the ESHA Food Processor software program (ESHA Research; version	Measure/Method of Assessment: DXA (Hologic 4500W or Lunar Prodigy DPX-IQ)
	or inhaled corticosteroids (greater than 800 ug/day), actively being treated for leukemia or multiple myeloma, a change in	Dietary Protein Intake Compliance (%): NR Protein type/source: Animal; whey supplement	Dietary Protein Intake Compliance: Urinary area was a compliance measure.	
	thyroid medications, medications known to affect calcium metabolism	Energy balance status: Eucaloric	Comparator: Low Protein	
	or use of proton pump inhibitors twice daily Supplement use: Daily multivitamin mineral supplement (contained 400 IU of vitamin D); Ca carbonate supplement (300 mg tablets) Pregnant or lactating: NR	Comparator: Low Protein Intended Protein Amount: Test food protein NR Carbohydrate: Test food protein NR Fat: Test food protein NR	How protein was administered: Participants received a maltodextrin supplement Maltrin M100; Grain Processing Corp) that was closely matched for composition, color, kilocalories, sodium.	
	Comparator: Low Protein N: 102 % Female: 87.3% Mean Age (SD): 70.5 (6.4) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR	Baseline Protein Amount Least Square Mean (SEM): 72.9 (1.8) g/day; 1.06 (0.03) g/kg/day (total daily) Carbohydrate Least Square Mean (SEM): 206.2 (5.8) g/day (total daily)	potassium, phosphorus, fiber, and calcium. Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above	

Study	Participants	Interventions/Exposure and	Intervention (s) (Methods of	Outcome (Measures and methods
		administrator, and duration)	administration and	
		5 () (Q) M	assessment)	
	Mean BMI (SD): 26.4 (4.0) kg/m ²	Fat Least Square Mean		
	(4.0) Kg/III-	(SEM). 61.3 (2.5) g/day (lotal		
	Education level: NR	ually)		
	Mean physical activity	Actual Protein Amount at end		
	level score (SD): 6.8 (1.9)	of the study		
	Health status/	Least Square Mean (SEM):		
	Comorbidities: Healthy	72.7 (2.4) g/day; 1.05 (0.04)		
	older adults	g/kg/day (total daily)		
	Medication use: Excluded	Carbohydrate Least Square		
	if using long-term	Mean (SEM): 229.0 (9.5)		
	chemotherapeutic drugs,	g/day (total daily)		
	aromatase inhibitors or	Fat Least Square Mean		
	tamoxifen, methotrexate,	(SEM): 58.8 (2.4) g/day (total		
	pnenytoin, pnenobarbital	dally)		
	(greater than 800 ug/day)	Diotony Protoin Intako		
	actively being treated for	Compliance (%): NR		
	leukemia or multiple			
	myeloma, a change in	Protein type/source: Mixed		
	thyroid medications,	51		
	medications known to	Energy balance status:		
	affect calcium metabolism	Eucaloric		
	or use of proton pump			
	inhibitors twice daily	Study duration: 18 months		
	Supplement use: Daily			
	multivitamin mineral			
	400 III of vitamin D): Ca			
	carbonate supplement			
	(300 mg tablets)			
	Pregnant or lactating: NR			
PMID: 21194471	Study of: Adults	Intervention: High Protein	Intervention: High	Total Body BMD - Bone mineral
Li	Total sample N: 85	5	Protein	density (total body)
2010 * ⁶		Intended Protein Amount: 2.2		
Location/Country: United	Intervention: High	g per kg of lean body mass;	How protein was	Measure/Method of Assessment:
States	Protein	30% of energy	administered:	DXA (Lunar Prodigy DEXA)
HDI: Very high	N: 44	Carbohydrate: 40% of energy	Participants received	
Setting: Community	% Female: 81.8%	Fat: 30% of energy	Isocaloric MR (Formula 1,	
aweiling	(11 0) y	Receive Protein Amount	Herballie Inti., Los	
orban/ Kurai: NK	(II.Ö) Y	Daseline Protein Amount	Angeles) with a protein	

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of administration and	of assessment)
			assessment)	
Study Design: RCT	Race/ Ethnicity:	Mean (SD): NR	supplement (Performance	
(parallel)	Asian: 9.1%	Carbohydrate Mean (SD): NR	Protein Powder, Herbalife	
Funding source: Industry	Black: 20.5%	Fat Mean (SD): NR	Intl., Los Angeles)	
Risk of bias score: High	Caucasian: 59.1%			
	Hispanic: 9.1%	Actual Protein Amount at the	Protein Assessment	
	Other: 2.2%	end of the study	Method: Protein was	
	Menopausal status: NR	Mean (SD): NR	assessed through	
	Obesity status: Obese	Carbohydrate Mean (SD): NR	qualitative food logs and	
	Mean BMI (SD): 34.7	Fat Mean (SD): NR	reviewed with dietitians at	
	(6.8) kg/m ²		follow-ups. Protein intake	
	Income level: NR	Dietary Protein Intake	was measured at each	
	Education level: NR	Compliance (%): NR	follow-up visit; baseline,	
	Physical activity level: NR		week 2, and months 1, 2,	
	Health status/	Protein type/source: Meal	3, 6, 9, 12.	
	Comorbidities: Inclusion:	replacement protein: NR		
	good health history;	Diet: Mixed	Dietary Protein Intake	
	participants reported to		Compliance: No special	
	be obese; Exclusion type	Energy balance status:	efforts were made to	
	2 diabetes or giucose	Eucaloric	assess compliance.	
	Intolerance Mediaetien user ND	Compository Normal Dratain	Compository Normal	
	Supplement use NR	comparator: Normal Protein	Drotoin	
	Supplement use. NR	Intended Dratein Amounts 1.1	Protein	
	Freghant of factating. NR	a por ka of loop body mass	How protoin was	
	Comparator: Normal	(15% total operav)	now protein was	
	Protein	(15% total energy)	Participants received the	
	N: 12	energy	isocaloric MR (Formula 1	
	% Female: 63.1%	Eat: 30% total energy	Herbalife Intl. Los	
	Mean Age (SD): 49 7	r at. 60 % total chergy	Angeles) with matched	
	(9.1) v	Baseline Protein Amount	carbohydrate placebo	
	Race/ Ethnicity:	Mean (SD): NR	containing maltodextrin	
	Asian: 2.4%	Carbohydrate Mean (SD): NR	and flavoring	
	Black: 19.5%	Fat Mean (SD): NR	5	
	Caucasian: 68.3%	· · · ·	Protein Assessment	
	Hispanic: 4.9%	Actual Protein Amount at the	Method: Same as above	
	Other: 4.9%	end of the study		
	Menopausal status: NR	Mean (SD): NR	Dietary Protein Intake	
	Obesity status: Obese	Carbohydrate Mean (SD: NR	Compliance: Same as	
	Mean BMI (SD): 34.3	Fat Mean (SD): NR	above	
	(10.3) kg/m ²			
	Income level: NR			

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and	Outcome (Measures and methods of assessment)
			assessment)	
	Education level: NR	Dietary Protein Intake		
	Physical activity level: NR	Compliance (%): NR		
	Health status/			
	Comorbidities: Inclusion:	Protein type/source: Mixed		
	good health history;			
	participants reported to	Energy balance status:		
	be obese; Exclusion type	Eucaloric		
	2 diabetes or glucose			
	Intolerance	Study duration: 12 months		
	Medication use: NR			
	Supplement use: NR			
DMID: 12055210	Pregnant or lactating: NR	Interrentions Link Drotein	Interrection: Llink	Total Dady DMC Dana minanal
PMID: 12055318	Study of: Adults	Intervention: High Protein	Dretein	I otal Body BINC - Bone mineral
SKOV 20027	Total sample N: 65	Intended Brotein Amount:	Protein	content (total body)
2002	Intervention: High	25% of operate	How protein was	Magguro/Mathad of Assagement:
HDI: Very high	Protein	Carbohydrate: NR	administorod:	DXA (Hologic 1000/M/ software
Setting: NR	N: 25	Eat: 30% of energy	Participants shopped for	version 5.61)
Urban/ Rural: NR	% Female: 76%	Tat. 50% of energy	foods from a store	
Study design: RCT	Mean Age (SD): 39.4	Baseline Protein Amount	designed for the study	BMD of the Axial Skeleton – Bone
(parallel)	(20) v	Mean (SEM): 89 1 (3 9) d/d	Dietitians assured	mineral density (regional lumbar)
Funding source:	Race/ Ethnicity: 100%	Carbohydrate Mean (SFM):	macronutrient distribution	
Foundation	White	256.2 (13.7) g/d	of selected items: energy	Measure/Method of Assessment:
Risk of bias score: Low	Menopausal status: NR	Fat Mean (SEM): 96.6 (5.8)	contents of aroceries	DXA (Hologic 1000/W. software
	Obesity status:	g/d	were unknown to	version 5.61)
	Overweight or obese		participants.	
	Mean BMI (SD): 30.8	Actual Protein Amount at the		Whole Body BMD - Bone mineral
	(0.4) kg/m ²	end of the study	Protein Assessment	density (whole body)
	Income level: NR	Mean (SEM): 102.5 (6.6) g/d	Method: Baseline protein	
	Education level: NR	Carbohydrate Mean (SEM):	assessment method was	Measure/Method of Assessment:
	Physical activity level: NR	316.5 (18.0) g/d	not reported. Actual	DXA (Hologic 1000/W, software
	Health status/Co-	Fat Mean (SEM): 76.9 (3.2)	Protein Amount during the	version 5.61)
	morbidities: Participants	g/d	intervention was derived	
	were overweight or		from dieticians scanning	Whole Body BMC - Bone mineral
	obese. Exclusion was	Dietary Protein Intake	the food participants	content (whole body)
	current or previous	Compliance (%): NR	cnose from the	
	aisorders, primarily		intervention store.	Neasure/Method of Assessment:
	concerning renai function,	Protein type/source: Mixed	Diotomy Brotoin Intoks	UTA (HOIOGIC TUUU/VV, SOTTWARE
		Energy helence statue:	Compliance: Compliance	
	Mediaction use: ND	Energy balance status:	to the diete was massived	
	medication use: NR	Eucaioric	to the diets was measured	

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
			assessment)	
	Supplement use: NR		by 24-hour urinary	
	Pregnant or lactating: NR	Comparator: Low Protein	nitrogen excretion.	
	Comparator: Low Protein	Intended Protein Amount:	Comparator: Low Protein	
	N: 25	12% of energy		
	% Female: 76%	Carbohydrate: NR	How protein was	
	Mean Age (SD): 39.8	Fat: NR	administered:	
	(1.9) y		Participants shopped for	
	Race/ Ethnicity: 100%	Baseline Protein Amount	foods from a store	
	White	Mean (SEM): 87.8 (5.0) g/day	designed for the study.	
	Menopausal status: NR	Carbohydrate Mean (SEM):	Dietitians assured	
	Obesity status:	256.5 (11.6) g/d	macronutrient distribution	
	Overweight or obese	Fat Mean (SEM): 107.6 (7.9)	of selected items; energy	
	Mean BMI (SD): 30.0	g/a	contents of groceries	
	(0.4) Kg/m ²		were unknown to	
		Actual Protein Amount at the	participants.	
	Education level: NR	end of the study	Destain Assessment	
	Physical activity level: NR	Mean (SEM): 70.5 (6.7) g/d	Protein Assessment	
	Health status/Co-	Carbonydrate Mean (SEM):	Method: Same as above	
	morbidities: Participants	302.4 (19.7) g/d	Distant Dratain Intoka	
		rat Mean (SEM). 72.9 (3.5)	Compliance: Some co	
	obese. Exclusion was	g/u	compliance: Same as	
	disorders, primorily	Diotony Brotoin Intoko	above	
	aspectning repairing	Compliance (%): NP		
	motobolic discassos, and			
	cardiovascular disease	Protein type/source: Mixed		
	Medication use: NR	T Totell'i type/source. Mixed		
	Supplement use: NR	Energy balance status:		
	Pregnant or lactating: NR	Eucaloric		
	Treghant of labtating. The	Eddalono		
		Study duration: 6 months		
PMID: 34581765	Study of: Children and	Intervention 1: Placebo-HP	Intervention 1: Placebo-	Bone Turnover Marker (Overall
Stounbjerg	adolescents		HP	Turnover) - Osteocalcin
2021*8	Total sample N: 200	Intended Protein Amount: 9.6		· · ·
Location/Country: Denmark		g/100g	How protein was	Measure/Method of Assessment:
HDI: Very high	Intervention 1: Placebo-	Čarbohydrate: 5 g/100 g	administered:	Venous blood samples
Setting: Community	HP	Fat: 0.2 g/100 g	Participants took 300g/d	'
dwelling	N: 50		for 6 days/week of a	BMD of the Axial Skeleton - Bone
Urban/ Rural: Urban	% Female: 48%	Baseline Protein Amount	drained low-fat yogurt	mineral density (L1–L4 (lumbar spine
			("skyr") with a high protein	vertebrae))
Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
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		comparator (Content,	(Methods of administration and	of assessment)
			assessment)	
Study design: RCT	Median Age (IQR): 7.8	Mean (SD): 15.4 (2.4) % of	content of 9-11 g	
(parallel)	(7.0–8.5) y	energy	protein/100 g plus a	Measure/Method of Assessment:
Funding source: Public-	Race/ Ethnicity: 100%	Carbohydrate Mean (SD):	chewable placebo (from	DXA (GE Lunar Prodigy scanner)
private partnership	White	52.5 (4.7) % of energy	Oy Verman Ab) of	
RISK OF DIAS SCORE: LOW	Pubertal status: 4% in	Fat Mean (SD): 32.1 (4.7) %	Identical appearance and	BMC Axial Skeleton - Bone mineral
	Obesity status: 14%	or energy	identical white tablet	vortebree))
	obese	Actual Protein Amount at the	bottles containing 200	vertebrae))
	Mean BML for-age z-score	end of the study	tablets	Measure/Method of Assessment:
	(SD): 0.02 (1.10)	Mean (SD): 17.7 (3.3) % of		DXA (GE Lunah Prodigy scanner)
	Income level: NR	energy	Protein Assessment	
	Parental education level:	Carbohydrate Mean (SD):	Method:	Bone Geometry and Strength
	≤Vocational or short	53.5 (5.6) % of energy	Protein amounts were	Indices - Bone area (L1–L4 (lumbar
	academic: 16%	Fat Mean (SD): 28.8 (4.9) %	derived from a dietary	spine vertebrae)
	Bachelor's degree: 36%	of energy	recording with a minimum	
	≥Master's degree: 48%		of 3 recording days (4-day	Measure/Method of Assessment:
	Physical activity level: NR	Dietary Protein Intake	dietary record coving 3	DXA (GE Lunah Prodigy scanner)
	Health status/	Compliance (%): NR	consecutive weekdays	
	Comorbidities: Exclusion		and 1 weekend day)	BMD of the Axial Skeleton - Bone
	criteria were an allergy or	Protein type/source: Animal;	where parents weighed	mineral density z-score (L1–L4
		low-tat yogurt	and recorded everything	(iumbar spine vertebrae)
	diagona	Energy belonce status:	(avaget water) in the web	Magguro/Mathad of Assessment:
	Medication use: Exclusion	Ellergy balance status.	based software Madlog (if	DXA (GE Lungh Prodigy scapper)
	criteria: use of medication	Lucaione	weighing not possible	software computed zscores
	that might affect study	Intervention 2: Vitamin D-HP	household measures	Soliware computed 2500res
	outcomes.		were used). Protein intake	
	Supplement use:	Intended Protein Amount: 9.6	was measured prior to	
	Exclusion criteria:	g/100g	baseline and at endpoint	
	habitual use of vitamin D-	Carbohydrate: 5 g/100 g	visits.	
	containing supplements	Fat: 0.2 g/100 g		
	>3 days/week for the prior		Dietary Protein Intake	
	2 months and at all in the	Baseline Protein Amount	Compliance: Parents	
	month immediately	Mean (SD): 15.7 (2.3) % of	recorded the child's daily	
	preceding the start of the	energy	Intake of the specific	
	Progrant or leateting: NA	520(4.6)% of approx	joguits during the	
	Freghant of lactating: NA	52.0 (4.0) % 01 energy	sheets	
	Intervention 2: Vitamin	of energy	3110013.	
	D-HP		Intervention 2: Vitamin	
	N: 50		D-HP	

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
			assessment)	
	% Female: 44%	Actual Protein Amount at the		
	Median Age (IQR): 7.8	end of the study	How protein was	
	(7.3–8.2) y	Mean (SD): 19.0 (3.4) % of	administered:	
	Race/ Ethnicity: 100%	energy	Participants took 300g/d	
	White	Carbohydrate Mean (SD):	for 6 days/week of a	
	Pubertal status: 4% in	49.6 (5.1) % of energy	drained low-fat yogurt	
	puberty	Fat Mean (SD): 31.4 (4.6) %	("skyr") with a high protein	
	Obesity status: 4%)	of energy	content of 9-11 g	
	obese		protein/100 g plus a	
	Mean BMI-for-age z-score	Dietary Protein Intake	chewable 20 µg of vitamin	
	(SD): - 0.15 (0.75)	Compliance (%): NR	D3 (Minisun; from Oy	
			verman Ab) of identical	
	Parental education level:	Protein type/source: Animal;	appearance and taste	
	≤Vocational or short	low-tat yogurt	were provided in identical,	
	academic: 16%		white tablet bottles	
	Bachelor's degree: 28%	Energy balance status:	containing 200 tablets.	
	≥Master's degree: 56%	Eucaloric	Ductoin According to	
	Physical activity level: NR	Componetor 1: Disasha ND	Protein Assessment	
	Health status/	Comparator 1: Placebo-NP	wethod: Same as above	
		Intended Dratein Americate 2.C	Distant Dratain Intaka	
	intelerence to mill or mill		Compliance: Some co	
		g/100g	compliance: Same as	
	diagona	Carbonydrate: 8.6 g/ 100 g	above	
	Mediaetian user Evolusion	Fat. 2.3 g/100 g	Compositor 1. Dissolo	
	oritoria: use of modioation	Pagaling Protain Amount		
	that might affect study	Moon (SD): 15.0 (2.2) % of	INF	
		Mean (SD). 15.0 (2.2) % 01	How protoin was	
	Supplement use:	Carbobydrate Mean (SD):	administored:	
	Supplement use.	54.6(4.8)% of operations	Participants took 200g/d	
	babitual use of vitamin D	54.0 (4.0) % OF effergy Eat Mean (SD): 30.3 (4.5) %	for 6 days/week of a	
	containing supplements	of energy	regular vogurt with protein	
	>3 days/week for the prior	of energy	content of $3.0 - 3.9 \text{g}$	
	2 months and at all in the	Actual Protein Amount at the	rotein/100 g plus a	
	month immediately	end of the study	chewable placebo (from	
	preceding the start of the	Mean (SD): 15.8 (2.7) % of	Ov Verman Ab) of	
	intervention	energy	identical appearance and	
	Pregnant or lactating: NA	Carbohydrate Mean (SD):	taste were provided in	
		529(49)% of energy	identical white tablet	
	Comparator 1: Placebo-	Fat Mean (SD): 31 3 (4 3) %	bottles containing 200	
	NP	of energy	tablets.	

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
Study	Participants N: 51 % Female: 53% Median Age (IQR): 7.6 (7.0–8.2) y Race/ Ethnicity: 100% White Pubertal status: 0% in puberty Obesity status: 16% obese Mean BMI-for-age z-score (SD): - 0.02 (1.12) Income level: NR Parental Education level: ≤Vocational or short academic: 20% Bachelor's degree: 59% Physical activity level: NR Health status/ Comorbidities: Exclusion criteria were an allergy or intolerance to milk or milk components, chronic disease. Medication use: Exclusion criteria: use of medication that might affect study outcomes. Supplement use: Exclusion criteria: habitual use of vitamin D- containing supplements >3 days/week for the prior	Interventions/Exposure and Comparator (Content, administrator, and duration) Protein type/source: Animal; yogurt Energy balance status: Eucaloric Comparator 2: Vitamin D-NP Intended Protein Amount: 3.6 g/100g Carbohydrate: 8.6 g/100 g Fat: 2.3 g/100 g Baseline Protein Amount Mean (SD): 15.7 (2.6) % of energy Carbohydrate Mean (SD): 54.5 (4.2) % of energy Fat Mean (SD): 29.7 (4.3) % of energy Actual Protein Amount at the end of the study Mean (SD): 16.0 (2.2) % of energy Carbohydrate Mean (SD): 51.7 (5.0) % of energy Fat Mean (SD): 32.3 (4.8) % of energy Protein type/source: Animal; yogurt	Intervention (s) (Methods of administration and assessment) Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above Comparator 2: Vitamin D-NP How protein was administered: Participants took 300g/d for 6 days/week of a regular yogurt with protein content of 3.0 – 3.9 g protein/100 g plus a chewable placebo (from Oy Verman Ab) of identical appearance and taste were provided in identical, white tablet bottles containing 200 tablets. Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above	Outcome (Measures and methods of assessment)
	2 months and at all in the month immediately preceding the start of the intervention. Pregnant or lactating: NA	Energy balance status: Eucaloric Study duration: 24 weeks		

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
			assessment)	
	Comparator 2: Vitamin			
	N. 40			
	% Female: 61%			
	(7.1–8.2) y			
	Race/ Ethnicity: 100%			
	White			
	Pubertal status: 8% in			
	puberty			
	Obesity status: 16%			
	obese			
	Mean BMI-for-age z-score			
	(SD): 0.34 (1.04)			
	Income level: NR			
	Parental education level:			
	≤Vocational or short			
	academic: 10%			
	Bachelor's degree: 24%			
	≥Master's degree: 65%			
	Physical activity level: NR			
	Health status/			
	Comorbidities: Exclusion			
	criteria were an allergy or			
	intolerance to milk or milk			
	components, chronic			
	disease.			
	Medication use: Exclusion			
	criteria: use of medication			
	that might affect study			
	outcomes.			
	Supplement use:			
	Exclusion criteria:			
	napitual use of vitamin D-			
	containing supplements			
	>3 days/week for the prior			
	2 months and at all in the			
	month immediately			
	preceding the start of the			
	intervention.			
	Pregnant or lactating: NA			

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
PMID: 21590739 Zhu 2011 ⁹	Study of: Adults Total sample N: 192	Intervention: High Protein Intended Protein Amount:	Intervention: High Protein	aBMD of the Appendicular Skeleton - Areal bone mineral density (hip, total)
Location/Country: Australia	Intervention: High	30.1 g	How protein was	
HDI: Very high Setting: Community dwelling Urban/ Rural: Metropolitan	Protein N: 101 % Female: 100% Mean Age (SD): 74.2	Carbohydrate: 13.2 g Fat: 2.3 Baseline Protein Amount	administered: 250-mL skim milk–based high- protein supplement drink reconstituted with cold	Measure/Method of Assessment: DXA (Hologic Discovery A fan-beam densitometer])
Study design: RCT (parallel) Funding source: Government, academic	(2.8) y Race/ Ethnicity: NR Menopausal status: Postmenopausal	Mean (SD): 76 (18) g/d Carbohydrate Mean (SD): 185 (45) g/d Fat Mean (SD): 63 (18) g/d	water from a powder that provided 30 g of protein (skim milk plus whey protein isolate; Alacen	aBMD of the Appendicular Skeleton - Areal bone mineral density (femoral neck)
Risk of bias score: High	Obesity status: NR Mean BMI (SD): 26.1 (3.8) kg/m ² Income level: NR	Actual Protein Amount at the end of the study Mean (SD): 95 (20) g/d	894, Fonterra Brands, Ltd., Palmerston North, New Zealand), 600mg of calcium, and 3.2 kJ/mL of	Measure/Method of Assessment: DXA (Hologic Discovery A fan-beam densitometer)
	Education level: NR Mean physical activity level (SD): 449 (391)	Carbohydrate Mean (SD): 183 (52) g/d Fat Mean (SD): 62 (21) g/d	energy. Protein Assessment	Total body vBMD - Volumetric bone mineral density (total body)
	MET-min/wk Health status/ Comorbidities: No previous osteoporotic	Dietary Protein Intake Compliance (%): 81.1%	Method: Protein was reported at baseline, 1 year, and 2 years; assessed through 3-day	Measure/Method of Assessment: QCT scans (Hologic Discovery A fan- beam densitometer)
	fracture, currently or within last year taking medication for osteoporosis apart from	Protein type/source: Animal; skim milk plus whey protein isolate	weighed food records (2 weekdays, 1 weekend day)	vBMD of the Appendicular Skeleton - Volumetric bone mineral density (femoral neck)
	calcium or vitamin D, or have taken more than 7 g in total in lifetime, metabolic bone disease	Energy balance status: Eucaloric Comparator: Normal Protein	Dietary Protein Intake Compliance: Compliance was determined from empty test drink	Measure/Method of Assessment: QCT scans (Hologic Discovery A fan- beam densitometer)
	apart from osteoporosis, total-hip bone density more than 2 SD below the	Intended Protein Amount: 2.1	containers.	Bone Geometry and Strength Indices - Femoral neck cross- sectional area
	mean for age, malabsorption disorders, celiac disease, clinical hepatic or renal	Carbonydrate: 42.3 Fat: 2.0 g Baseline Protein Amount	Protein How protein was administered: 250-mL	Measure/Method of Assessment: QCT scans (Hologic Discovery A fan- beam densitometer)
	diagnosis of diabetes	Viean (SD): 76 (16) g/d Carbohydrate Mean (SD): 190 (42) g/d	skim miik-pased nign- protein supplement drink reconstituted with cold	Bone Geometry and Strength Indices - Femoral neck buckling ratio

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		comparator (Content,	(Methods of	of assessment)
			assessment)	
	Medication use: Exclusion	Fat Mean (SD): 63 (20) g/d	water from a powder that	
	criteria: taking medication		provided 2.1 g of protein	Measure/Method of Assessment:
	for osteoporosis apart	Actual Protein Amount at the	(skim milk plus whey	QCT scans (Hologic Discovery A fan-
	from calcium or vitamin D,	end of the study	protein isolate; Alacen	beam densitometer)
	taking steroid tablets in	Mean (SD): 73 (17) g/d	894, Fonterra Brands,	
	the past 3 months or have	Carbonydrate Mean (SD): 204	Ltd., Palmerston North,	Bone Geometry and Strength
	taken more than 7 g in	(47) g/d	New Zealand), 600mg of	Indices - Femoral neck polar CSMI
	Supplement use: NR	Fat Mean (SD): 60 (17) g/d	calcium, and 3.2 kJ/mL of	(cross-sectional moment of inertia)
	Pregnant or lactating: NA	Dietary Protein Intake	energy	Measure/Method of Assessment:
	Treghant of lactating. IVA	Compliance (%): 80.8%	Protein Assessment	QCT scans (Hologic Discovery A fan-
	Comparator: Normal		Method: Same as above	beam densitometer)
	Protein	Protein type/source: Animal:		
	N: 91	skim milk plus whey protein	Dietary Protein Intake	
	% Female: 100%	isolate	Compliance: Same as	
	Mean Age (SD): 74.3		above	
	(2.6) y	Energy balance status:		
	Race/ Ethnicity: NR	Eucaloric		
	Menopausal status:			
	Postmenopausal	Study duration: 2 y		
	Obesity status: NR			
	Mean BMI (SD): 27.2			
	(4.0) kg/m²			
	Education level: NR			
	Mean physical activity			
	level (SD): 398 (376)			
	MET-min/wk			
	Health status/			
	Comorbidities: No			
	previous osteoporotic			
	fracture, currently or			
	within last year taking			
	medication for			
	osteoporosis apart from			
	calcium or vitamin D, or			
	have taken more than 7 g			
	in total in lifetime,			
	metapolic bone disease			
	apart from osteoporosis,			
	total-hip bone density		1	

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	more than 2 SD below the			
	mean for age,			
	malabsorption disorders,			
	celiac disease, clinical			
	hepatic or renal			
	insufficiency, clinical			
	diagnosis of diabetes			
	Medication use: Exclusion			
	criteria: taking medication			
	for osteoporosis apart			
	from calcium or vitamin D,			
	taking steroid tablets in			
	the past 3 months or have			
	taken more than 7 g in			
	total in lifetime			
	Supplement use: NR			
	Pregnant or lactating: NA			

Abbreviations: $\mu g/L = micrograms$ per liter; BAP = Bone alkaline phosphatase; BMI = body mass index; BMC = bone mineral content; BMD = bone mineral density; CTX = carboxy terminal crosslinked telopeptide of type I collagen; DXA = Dual-energy x-ray absorptiometry; e.g. = exempli gratia; FFQ = food frequency questionnaire; g = grams; g/100g = grams per 100 grams; g/cm2 = grams per centimeter squared; g/d = grams per day; HDI = human development index; HP = high protein; IQR = interquartile range; IU= international units; kg/m2 = kilograms per meter squared; min/wk = minutes per week; mg = milligrams; mL = milliliter; MPB = milk based protein; MR= meal replacement; NA = not applicable; NP = normal protein; NR = not reported; P1NP = Procollagen type 1 N-terminal propeptide; PMID = PubMed Identification Number; RCT = randomized controlled trail; RoB = Risk of Bias; SD = standard deviation; SE = standard error; SEM = standard error of the mean; TRAP = (5b, tartrate resistant acid phosphatase, isoform 5); USA = United States of America; wk = week; y = year

Note: *Studies overlap KQs; **Child and Adolescent study; #: Kerstetter, 2015 reported on KQ1, KQ2, and KQ3 outcomes: KQ1 outcomes were assessed as both low (including BMD lumbar, hip and femoral outcomes) and high risk of bias (including all other reported outcomes)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
PMID: 20219968	Study of: Adults	Tertile 1: Protein intake 5.7-	Protein Assessment	BMD of the Axial Skeleton -
Beasley	Total sample N: 560	14.3% of energy (low)	Method: Protein intake was	Bone mineral density (lumbar
2010 ¹⁰			measured using an FFQ	spine)
Location/Country: USA	Tertile 1: Protein intake 5.7-	Baseline Protein Amount	developed and evaluated in	
HDI: Very high	14.3% of energy (low)	Mean (SD):	the Women's Health Initiative	Measure/Method of
Setting: NR	N: 186	Animal protein: 33.2 (18.1) g	at the Fred Hutchinson	Assessment: DXA (Hologic
Urban/Rural: NR	% Female: 100%	Vegetable protein: 18.6 (10.2)	Cancer Research Center.	2000 and Hologic 4500)
	Mean Age (SD): 24.2 (6.6) y	g	Consistent with current	

Table C2. Evidence table for Bone Disease Non-Randomized Controlled Trials

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and methods assessment)
			assessment	memous assessment)
Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Race/ Ethnicity: White: 77% Black: 11% Other: 12% Menopausal status: Premenopausal Obesity status: NR Mean BMI (SD): 24.9 (5.2) kg/m ² Income level: NR Education level: NR Mean physical activity level: 78.2 physical activity score Health status/ Comorbidities: Women with conditions known to affect bone mass were excluded. Medication use: Women taking medications known to affect bone mass were excluded. Supplement use: NR Pregnant or lactating: NR Tertile 2: Protein intake 14.4-17.1% of energy (medium) N: 187 % Female: 100% Mean Age (SD): 24.3 (6.9) y Race/ Ethnicity: White: 82% Black: 10% Other 8% Menopausal status: Premenopausal Obesity status: NR Mean BMI (SD): 24.5 (5.9) kg/m ² Income level: NR Education level: NR	Carbohydrate Mean (SD): 55% of energy Fat Mean (SD): 33% of energy Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Tertile 2: Protein intake 14.4- 17.1% of energy (medium) Intended protein amount: NR Carbohydrate: NR Fat: NR Baseline Protein Amount Mean (SD): Animal protein: 43.3 (18.8) g Vegetable protein: 19.9 (9.2) g Carbohydrate Mean (SD): 52% of energy Fat Mean (SD): 33% of energy Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Tertile 3: Protein intake 17.2- 27.6% of energy (high) Intended Protein Amount: NR Carbohydrate: NR Fat: NR Baseline Protein Amount: NR Carbohydrate: NR Fat: NR Baseline Protein Amount Mean (SD): Animal protein: 58.7 (25.8) g Vegetable protein: 18.6 (8.2) g	dietary guidelines, protein was evaluated as a percentage of total energy. Protein intake was assessed at baseline and at annual follow-up visits.	 BMD of the Appendicular Skeleton - Bone mineral density (hip, total) Measure/Method of Assessment: DXA (Hologic 2000 and Hologic 4500) Total Body BMD - Bone mineral density (total body) Measure/Method of Assessment: DXA (Hologic 2000 and Hologic 4500)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
Study	Participants Mean physical activity level: 74.5 physical activity score Health status/ Comorbidities: Women with conditions known to affect bone mass were excluded. Medication use: Women taking medications known to affect bone mass were excluded. Supplement use: NR Pregnant or lactating: NR Tertile 3: Protein intake 17.2-27.6% of energy (high) N: 187 % Female: 100% Mean Age (SD): 25.4 (7.4) y Race/ Ethnicity: White: 76% Black: 15% Other 9% Menopausal status: Premenopausal Obesity status: NR Mean BMI (SD): 25.9 (5.3) kg/m ² Income level: NR Education level: NR Mean physical activity level: 81.6 physical activity score Health status/ Comorbidities: Women with conditions known to affect bone mass were excluded. Medication use: Women taking medications known to	Intervention(s) (Content) Carbohydrate Mean (SD): 49% of energy Fat Mean (SD): 32% of energy Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: Up to 3 y	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	excluded. Supplement use: NR Pregnant or lactating: NR			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
Study PMID: 24552750 Beasley 2014 ¹¹ Location/Country: USA HDI: Very high Setting: NR Urban/ Rural: NR Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Participants Study of: Adults Total sample N: 144,580 Tertile 1: Protein intake <13.3% of energy N: NR % Female: 100% Mean Age (SD): 66 (7.2) y Race/ Ethnicity: White: 77.2% Black: 14.4% Hispanic: 3.9% American Indian: 0.5% Asian/Pacific Islander: 2.3% Unknown: 1.6% Menopausal status: Postmenopausal Obesity status: 37.5% Mean BMI (SD): NR Income level: NR Education level: NR Education level: NR Mean physical activity level: 9.9 METs/wk Health status/ Comorbidities: Fair/poor: 12.5% Good: 37.8% Excellent/very good: 49.7%	Intervention(s) (Content) Tertile 1: Protein intake <13.3% of energy	Intervention(s) (Methods of assessment Protein Assessment Method: Self-administered FFQ that included 122 items for individual foods and food groups, 19 adjustment items, and summary questions. Protein intake was assessed at baseline.	Outcome (Measures and methods assessment) Total Body BMD - Bone mineral density (total body) Measure/Method of Assessment: DXA (Hologic QDR densitometer) BMD of the Appendicular Skeleton - Bone mineral density (hip, total) Measure/Method of Assessment: DXA (Hologic QDR densitometer) BMD of the Axial Skeleton - Bone mineral density (spine) Measure/Method of Assessment: DXA (Hologic QDR densitometer) Measure/Method of Assessment: DXA (Hologic QDR densitometer) Measure/Method of Assessment: DXA (Hologic QDR densitometer) Osteoporotic Fractures and Fracture Risk - Fragility fracture (osteoporotic and low-trauma fracture) Hip fracture
	Medication use: NR Supplement use: All participants supplemented with calcium and vitamin D Pregnant or lactating: NA	Baseline Protein Amount: ≥15.6% of energy Carbohydrate: NR Fat: NR		Spine fracture Forearm fracture Measure/Method of Assessment: Self-report (CTs when available)
	Tertile 2: Protein intake 14.2-14.8% of energy N: NR % Female: 100% Mean Age (SD): 63.7 (6.9) y Race/ Ethnicity: White: 84.7% Black: 7.4%	Protein Amount at the end of the study: NR Carbohydrate: NR Fat: NR Protein type/source: Mixed		

Study Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
			,
Hispanic: 3.4%	Energy balance status:		
American Indian: 0.3%	Eucaloric		
Asian/ Pacific Islander: 2.79	6		
Unknown: 1.4%	Study duration: 6 v		
Menopausal status:			
Postmenopausal			
Obesity status: 30.6%			
Mean BMI (SD): NR			
Income level: NR			
Education level: NR			
Mean physical activity level			
12.6 METs/w			
Health status/			
Comorbidities:			
Fair/poor: 8.1%			
Good: 33.0%			
Excellent/very good: 58.9%			
Medication use: NR			
Supplement use: All			
participants supplemented			
with calcium and vitamin D			
Pregnant or lactating: NA			
I ertile 3: Protein intake			
215.6% of energy			
N: NR			
Dees (Ethnicity			
Race/ Elinicity:			
Wille. 65.1%			
DidCK. 0.070 Hispanic: 4.1%			
Amorican Indian: 0.4%			
American mulan. 0.470			
Asian/ Facilie Islander. 5.15	0		
Menonausal status:			
Postmenonausal			
Obesity status: 21.1%			
Mean BMI (SD) · NP			
Education level: NR			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Mean physical activity level:			
	15.0 METs/wk			
	Health status/			
	Comorbidities:			
	Fair/poor: 6.5%			
	Good: 27.3%			
	Excellent/very good: 66.2%			
	Medication use: NR			
	Supplement use: All			
	participants supplemented			
	with calcium and vitamin D			
	Pregnant or lactating: NA			
PMID: 26988112	Study of: Adults	Arm 1: No hip fracture	Protein Assessment	Osteoporotic Fractures
Cauley	Total sample N: 5,876		Method: Block 98	and Fracture Risk - Hip
2016 ¹²		Baseline Protein Amount	semiquantitative FFQ was	fracture
Location/Country: USA	Arm 1: No hip fracture	Mean (SD): 16.13 (2.91) % of	administered. Diet quality	
HDI: Very high	N: 5,698	energy	was calculated using the	Measure/Method of
Setting: Community dwelling	% Female: 0%	Carbohydrate Mean (SD): NR	validated Quality Index	Assessment: Self-report &
Urban/ Rural: Urban	Mean Age (SD): 73.48	Fat Mean (SD): NR	Revised. Protein intake was	physician adjudicated of
Study design: Prospective	(5.81) y		assessed at baseline.	medical records
cohort study	Race/ Ethnicity: NR	Protein Amount at the end of		
Funding source: Government	Menopausal status: NA	the study		
RISK OF DIAS SCORE: HIGH	Obesity status: NR	Mean (SD): NR		
	Mean BMI (SD): NR	Carbonydrate Mean (SD): NR		
	Income level: NR	Fat Mean (SD): NR		
	Education level: 76.11%	Arma Or Line fine attune		
	≥High School	Arm 2: Hip tracture		
		Recoling Protoin Amount		
	147.56 PASE SCOLE	Macon (SD): 15.2 (2.55) % of		
	Comorbiditios: Participante	operav		
	who could not walk without	Carbobydrato Moan (SD): NP		
	the assistance of another or	Eat Mean (SD): NR		
	had hilateral hin			
	replacements excluded	Protein Amount at the end of		
	Medication use Participante	the study		
	taking osteoporosis	Mean (SD): NR		
	medications excluded	Carbohydrate Mean (SD): NR		
	Supplement use: NR	Fat Mean (SD): NR		
	Pregnant or lactating: NA			
		Protein type/source: Mixed		
	Arm 2: Hip fracture			
	replacements excluded. Medication use: Participants taking osteoporosis medications excluded. Supplement use: NR Pregnant or lactating: NA Arm 2: Hip fracture	Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed		

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	N: 178 % Female: 0% Mean Age (SD): 77.81 (6.08) y Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: 72.47% ≥High school Mean physical activity level: 131.89 PASE score Health status/ Comorbidities: Participants who could not walk without the assistance of another or had bilateral hip replacements excluded. Medication use: Participants taking osteoporosis medications excluded. Supplement use: NR Pregnant or lactating: NA	Energy balance status: Eucaloric Study duration: 8.6 y		
PMID: 21437561 Chan 2011 ¹³ Location/Country: China HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Study of: Adults Total sample N: 2,217 Arm 1: Men N: 1,225 % Female: 0% Mean Age (SD): 71.6 (4.6) y Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Mean BMI (SD): 23.5 (3.1) kg/m ² Income level: NR Education level: 41.1% secondary school or above Mean physical activity level: 101.7 PASE score	Arm 1: Men Baseline Protein Amount Mean (SD): 88.8 (35.3) g/d Carbohydrate Mean (SD): NR Fat Mean (Range): 23.4 (16.4- 28.1) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (Range): NR Arm 2: Women Baseline Protein Amount Mean (SD): 65.7 (27.5) g/d	Protein Assessment Method: Dietary intake was assessed at baseline using an FFQ. Mean nutrient quantification per day was calculated using food tables derive from McCance and Widdowson and the Chinese Medical Sciences Institute.	BMD of the AppendicularSkeleton - Bone mineraldensity (hip, total)Measure/Method ofAssessment: DXA (HologicQDR-4500 W densitometers)BMD of the AppendicularSkeleton - Bone mineraldensity (femoral neck)Measure/Method ofAssessment: DXA (HologicQDR-4500 W densitometers)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
Study	Participants Health status/ Comorbidities: Participants who had any detectable disease or medication known to affect bone mass were excluded. Medication use: Participants who were taking medication known to affect bone mass were excluded. Supplement use: 9.6% used calcium supplements Pregnant or lactating: NA Arm 2: Women N: 992 % Female: 100% Mean Age (SD): 72.0 (5.1) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 24.0 (3.5) kg/m ² Income level: NR Education level: 17.4% secondary school or above Mean physical activity level: 87.6 PASE score Health status/	Intervention(s) (Content) Carbohydrate Mean (SD): NR Fat Mean (Range): 16.4 (9.4- 21.6) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (Range): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 4 y	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	87.6 PASE score Health status/ Comorbidities: Participants who had any detectable disease or medication known to affect bone mass were excluded. Medication use: Participants who were taking medication known to affect bone mass were excluded. Supplement use: 15.0% used calcium supplements Pregnant or lactating: NR			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
PMID: 18665794 Dargent-Molina 2008 ¹⁴ Location/Country: France HDI: Very high Setting: NR Urban/ Rural: NR Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Study of: Adults Total sample N: 36,217 Arm 1: No fractures N: 33,809 % Female: 100% Mean Age (SD): 56.1 (5.5) y Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 23.2 (3.3) kg/m ² Income level: NR Education level: NR Mean physical activity level: 52.7 METS/d Health status/ Comorbidities: NR Medication use: NR Supplement use: 20.8% used calcium supplements Pregnant or lactating: NA Arm 2: Fractures N: 2,408 % Female: 100% Mean Age (SD): 57.1 (5.6) y Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 23.3 (3.4) kg/m ² Income level: NR Education level: NR Mean physical activity level: 53.7 METS/d Health status/ Comorbidities: NR Mean physical activity level: 53.7 METS/d Health status/ Comorbidities: NR Medication use: NR	Arm 1: No fractures Baseline Protein Amount Mean (SD): 45.7 (7.3) g/1000 kcal/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Fractures Baseline Protein Amount Mean (SD): 46.0 (7.6) g/1000 kcal/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 15 y	Protein Assessment Method: The dietary questionnaire was composed of two parts, the first including questions on the consumption (quantity and frequency) of food groups and the second qualitative questions allowing detailing the food groups into food items. The questionnaire assessed dietary consumption of 208 items. It was sent with a booklet of photos to facilitate the estimation of portion sizes. Protein intake was assessed at baseline.	Osteoporotic Fractures and Fracture Risk - Fragility fracture (osteoporotic and low-trauma fracture) Measure/method of assessment: Self-report

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Supplement use: 12.2% used calcium supplements Pregnant or lactating: NA			
PMID: 15941897 Devine 2005 ¹⁵ Location/Country: Australia HDI: Very high Setting: NR Urban/ Rural: NR Study design: Prospective cohort study Funding source: Nonprofit, government Risk of bias score: High	Study of: Adults Total sample N: 1,077 Arm 1: Whole cohort N: 1,077 % Female: 100% Mean Age (SD): 75 (3) y Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 27.1 (4.5) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: Participants excluded if they had significant current illness. Medication use: Participants excluded if receiving pharmaceutical agents that act on bone, including calcium supplements. Supplement use: Participants excluded if receiving pharmaceutical agents that act on bone, including calcium supplements. Pregnant or lactating: NA	Arm 1: Whole cohort Baseline Protein Amount Mean (SD): 80.5 (27.8) g Carbohydrate Mean (SD): 192 (59) g Fat Mean (SD): 64.5 (24.5) g Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 1 y	Protein Assessment Method: Each subject completed a self- administered, semiquantitative FFQ developed by the Anti- Cancer Council of Victoria (ACCV) from which information on the daily dietary intakes of energy, carbohydrate, protein, fat, and calcium was derived. Protein intake was assessed at baseline.	 BMD of the Appendicular Skeleton - Bone mineral density (hip, total) Measure/Method of Assessment: DXA (Acclaim QDR 4500A fan-beam densitometer) BMD of the Appendicular Skeleton - Bone mineral density (trochanter) Measure/Method of Assessment: DXA (Acclaim QDR 4500A fan-beam densitometer) BMD of the Appendicular Skeleton - Bone mineral density (intertrochanter) Measure/Method of Assessment: DXA (Acclaim QDR 4500A fan-beam densitometer) BMD of the Appendicular Skeleton - Bone mineral density (intertrochanter) Measure/Method of Assessment: DXA (Acclaim QDR 4500A fan-beam densitometer) BMD of the Appendicular Skeleton - Bone mineral density (femoral neck) Measure/Method of Assessment: DXA (Acclaim QDR 4500A fan-beam densitometer) BMD of the Appendicular Skeleton - Bone mineral density (femoral neck) Measure/Method of Assessment: DXA (Acclaim QDR 4500A fan-beam densitometer) BMD of the Appendicular Skeleton - Bone mineral density (femoral neck)
Hannan 2000 ¹⁶	Total sample N: 855	Ann I. Allended both exams	Method: Dietary intake was assessed using the 126-item	Bone mineral density, mean percent bone loss (spine)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			assessment	methods assessment)
Location/Country: USA HDI: Very high Setting: NR Urban/ Rural: NR Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Arm 1: Attended both exams N: 615 % Female: 64% Mean Age (SD): 74.5 (4.4) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR	Baseline Protein Amount Mean (SD): 68.5 (23.6) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR	Willett FFQ. Data were converted to food and nutrient intake data. Protein intake was assessed at baseline and two years later.	Measure/Method of Assessment: DXA (DPX-L densitometer) BMD of the Appendicular Skeleton - Bone mineral density, mean percent bone
	Mean BMI (SD): NR Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR	Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Attended only baseline exam		loss (hip) Measure/Method of Assessment: DXA (DPX-L densitometer)
	Medication use: 7% estrogen use Supplement use: NR Pregnant or lactating: NR	Baseline Protein Amount Mean (SD): 66.8 (24.4) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR		BMD of the Appendicular Skeleton - Bone mineral density, mean percent bone loss (radius)
	Arm 2: Attended only baseline exam N: 240 % Female: 55% Mean Age (SD): 77.2 (5.3) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: 3% estrogen use Supplement use: NR Pregnant or lactating: NR	Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 4 y		Measure/Method of Assessment: DXA (DPX-L densitometer)
PMID: 25192416 Hu 2014 ¹⁷ Location/Country: USA HDI: Very high	Study of: Adults Total sample N: 1,658 Quartile 1: Protein intake 6.1–13.6% of energy	Quartile 1: Protein intake 6.1– 13.6% of energy Baseline Protein Amount Mean (SD): 49.6 (24.5) g	Protein Assessment Method: A 120-item FFQ was used to assess usual food intake of specific foods and beverages over the past	vBMD of the Axial Skeleton - Volumetric bone mineral density (lumbar spine)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
				,
Setting: Community dwelling Urban/ Rural: NR Study design: Prospective cohort study Funding source: Nonprofit, government_academic	N: 414 % Female: 45.8% Mean Age (SD): 62.2 (9.9) y Race/ Ethnicity: White: 46.1% Chinese: 6.1%	Carbohydrate Mean (SD): 55.8 (10.4) % of energy Fat Mean (SD): 30.8 (7.9) % of energy	year. For each food item, the consumption frequency (times/d, week or month) and serving size (small, medium or large) were recorded. Protein intake was assessed	Measure/Method of Assessment: CT scan ([Imatron C-150 or a multi- detector CT system that utilized helical scanning with reconstruction in 5 mm thick
Risk of bias score: High	Black: 21.7% Hispanic: 26.1% Menopausal status: NR Obesity status: NR Mean BMI (SD): 28.2 (5.2)	the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	at baseline.	cuts and 350 mm field of view])
	kg/m ² Income level: NR Education level:	Quartile 2: Protein intake 13.7–15.7% of energy		
	≥College-level education: 64.4% Mean physical activity level:	Baseline Protein Amount Mean (SD): 59.2 (28.7) (g) Carbohydrate Mean (SD): 53.5		
	5,249 MET-min/week Health status/ Comorbidities: Participants	(7.8) % of energy Fat Mean (SD): 31.5 (6.6) % of energy		
	free of CVD included. Medication use: NR	Protein Amount at the end of		
	take multivitamin Pregnant or lactating: NR	the study Mean (SD): NR Carbohydrate Mean (SD): NR		
		Fat Mean (SD): NR		
	N: 415	Quartile 3: Protein intake 15.8–17.9% of energy		
	% Female: 44.5% Mean Age (SD): 63.4 (10) y Race/ Ethnicity:	Baseline Protein Amount Mean (SD): 64.5 (30.4) g		
	White: 45.2% Chinese: 8.6% Black: 21.3%	Carbohydrate Mean (SD): 52.1 (7.5) % of energy Fat Mean (SD): 31.4 (6.6) % of		
	Hispanic: 24.9%	energy		
	Obesity status: NR Mean BMI (SD): 28.2 (5.0)	Protein Amount at the end of the study		
	kg/m ²	Mean (SD): NR		
	Education level:	Fat Mean (SD): NR		

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	≥College-level education:			
	65.3%	Quartile 4: Protein intake		
	Mean physical activity level:	18.0–33.5% of energy		
	5,399 MET-min/week			
	Health status/	Baseline Protein Amount		
	Comorbidities: Participants	Mean (SD): 71.5 (35.1) g		
	free of CVD included.	Carbonydrate Mean (SD): 49.6		
	Medication use: NR	(8.2) % of energy		
	Supplement use: 61.4%	Fat Mean (SD): 30.7 (6.9) % of		
	take multivitamin	energy		
	Pregnant or lactating: NR	Dustain Amount states and of		
	Quartila 2. Drotoin intoko	the study		
	45.9.17.0% of operation	Ine study Maan (SD): ND		
	15.0–17.9% OF energy	Mean (SD). NR Carbobydrata Maan (SD): NP		
	N. 413 % Econolo: 40.6%	Eat Moon (SD): NP		
	% remains: 49.0% Moon Age (SD): 61.5 (10) v	Fat Mean (SD). NR		
	Race/ Ethnicity:	Protein type/source: Mixed		
	White: 30.2%	Trotein type/source. Mixed		
	Chinese: 15 3%	Energy balance status:		
	Black: 17 3%	Eucaloric		
	Hispanic: 28.2%	Eddalono		
	Menopausal status: NR	Study duration: 5 v		
	Obesity status: NR	olday adlation. o y		
	Mean BMI (SD): 27.9 (5.0)			
	kg/m ²			
	Income level: NR			
	Education level:			
	≥College-level education:			
	62.8%			
	Mean physical activity level:			
	5,101 MET-min/week			
	Health status/			
	Comorbidities: Participants			
	free of CVD included.			
	Medication use: NR			
	Supplement use: 59.9%			
	take multivitamin			
	Pregnant or lactating: NR			
	Quartile 4: Protein intake			
	18.0–33.5% of energy			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	N: 416 % Female: 53.4% Mean Age (SD): 62.1 (9.3) y Race/ Ethnicity: White: 36.5% Chinese: 26.0% Black: 12.5% Hispanic: 25.0% Menopausal status: NR Obesity status: NR Mean BMI (SD): 27.8 (5.2) kg/m ² Income level: NR Education level: ≥College-level education: 66.6% Mean physical activity level: 4,989 MET-min/week Health status/ Comorbidities: Participants free of CVD included. Medication use: NR Supplement use: 65.9% take multivitamin			
PMID: 17381900 Key 2007 ¹⁸ Location/Country: Australia HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study design: Prospective cohort study Funding source: Government, nonprofit Risk of bias score: High	Study of: Adults Total sample N: 34,696 Arm 1: Women N: 26,749 % Female: 100% Mean Age (SD): 45.8 (13.1) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 23.6 (3.9) kg/m ² Income level: NR Education level: NR	Arm 1: Women Baseline Protein Amount Mean (SD): 73.1 (21.6) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Men Baseline Protein Amount Mean (SD): 77.8 (22.6) g/d	Protein Assessment Method: An FFQ was used to estimate participants average frequency intake of each of 130 foods and drinks. Nutrient intakes were estimated by multiplying the nutrient content of a specific portion size of each food by the frequency of consumption, using food composition tables. Protein intake was assessed over the previous 12 months.	Osteoporotic Fractures and Fracture Risk - Fragility fracture (osteoporotic and low-trauma fracture)Fracture Measure/method of assessment: Self-report

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Physical activity level: 27.6% (≥ 3 hours vigorous exercise per week) Health status/ Comorbidities: NR Medication use: 13.5% hormone replacement therapy Supplement use: 61.2% take dietary supplements Pregnant or lactating: NR Arm 2: Men N: 7,947 % Female: 0% Mean Age (SD): 49.5 (13.5) y Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Mean BMI (SD): 24.2 (3.3) kg/m ² Income level: NR Education level: NR Physical activity level: 34.3% (≥ 3 hours vigorous exercise per week) Health status/ Comorbidities: NR Medication use: NR Supplement use: 44.2% take dietary supplements Pregnant or lactating: NA	Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Plant Energy balance status: Eucaloric Study duration: 6 y		
PMID: 26412291 Langsetmo 2015 ¹⁹ Location/Country: Canada HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study design: Prospective schort study	Study of: Adults Total sample N: 6,510 Arm 1: Men N: 1,919 % Female: 0% Mean Age (SD): NR Race/ Ethnicity: NR	Arm 1: Men Baseline Protein Amount Median (IQR): 13.6 (12.0-15.1) % of energy Carbohydrate Median (IQR): NR Fat Median (IQR): NR	Protein Assessment Method: A FFQ was derived from items on the short form Block questionnaire with modifications according to the Canadian diet. A standard portion size was specified with frequency	BMD of the Appendicular Skeleton - Bone mineral density (hip, total) Measure/Method of Assessment: DXA (Hologic densitometers)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			assessment	methods assessment)
Funding source: Government, industry, pharmaceutical Risk of bias score: High	Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: NR Supplement use: NR Pregnant or lactating: NA Arm 2: Women N: 4,591 % Female: 100% Mean Age (SD): NR Race/ Ethnicity: NR Menopausal status: Premenopausal and postmenopausal Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: NR Health status/ Comorbidities: NR Medication use: NR Supplement use: NR Pregnant or lactating: NR	Protein Amount at the end of the study Median (IQR): NR Carbohydrate Median (IQR): NR Fat Median (IQR): NR Arm 2: Women Baseline Protein Amount Median (IQR): 14.3 (12.8-15.9) % of energy Carbohydrate Median (IQR): NR Fat Median (IQR): NR Protein Amount at the end of the study Median (IQR): NR Carbohydrate Median (IQR): NR Fat Median (IQR): NR Carbohydrate Median (IQR): NR Fat Median (IQR): NR Protein type/source: Mixed Energy Balance status: Eucaloric Study duration: 5 y	once a month to 6 or more times per day. Total energy intake (TEI) and protein intake were calculated by using the frequency and specified portion size from the questionnaire together with content information from the Canadian Nutrient File. Protein intake was assessed during Year 2 follow-up.	BMD of the Axial Skeleton - Bone mineral density (L1-L4 (lumbar spine)) Measure/Method of Assessment: DXA (Hologic densitometers) Osteoporotic Fractures and Fracture Risk – Fragility fracture (osteoporotic and low-trauma fracture) Measure/Method of Assessment: Self-report
PMID: 27943394 Langsetmo	Study of: Adults Total sample N: 5,875	Quartile 1: Protein intake 6.0- 14.1% of energy	Protein Assessment Method: Participants	Osteoporotic Fractures and Fracture Risk - Incident
2017 ²⁰			completed a modified version	fracture
Location/Country: USA	Quartile 1: Protein intake	Baseline Protein Amount	of the original Block FFQ.	
HDI: Very high	6.0-14.1% of energy	Range: 6.0-14.1% of energy	The FFQ asked 69 individual	Measure/Method of
Setting: Community dwelling	N: 1,469	Carbohydrate Range: NR	tood item questions,	Assessment: Radiographic
Urban/ Rural: Urban		Fat Range: NR	including an additional 13	reports.
Study design: Prospective	Mean Age (SD): 73.6 (5.9) y	Dratain Americant at the art of the	questions about food	
conort study	Race/ Ethnicity: 87.3% non-	Protein Amount at the end of	preparation and low-tat toods	Usteoporotic Fractures
Funding source: Government		Ine study	which were used to refine	and Fracture RISK –
RISK OT DIAS SCORE: HIGN	Obosity status: ND	Carbobydrata Bangay ND	nument calculations. 10tal	riagility fracture
		Eat Range: NR	intake, and protein intake by	(usieuporolic and low-trauma
PMID: 27943394 Langsetmo 2017 ²⁰ Location/Country: USA HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Study of: Adults Total sample N: 5,875 Quartile 1: Protein intake 6.0-14.1% of energy N: 1,469 % Female: 0% Mean Age (SD): 73.6 (5.9) y Race/ Ethnicity: 87.3% non- Hispanic white Menopausal status: NA Obesity status: NR	Quartile 1: Protein intake 6.0-14.1% of energyBaseline Protein AmountRange: 6.0-14.1% of energyCarbohydrate Range: NRFat Range: NRProtein Amount at the end ofthe studyRange: NRCarbohydrate Range: NRFat Range: NR	Protein Assessment Method: Participants completed a modified version of the original Block FFQ. The FFQ asked 69 individual food item questions, including an additional 13 questions about food preparation and low-fat foods which were used to refine nutrient calculations. Total energy intake, total protein intake, and protein intake by	Osteoporotic Fractures and Fracture Risk - Incident fracture Measure/Method of Assessment: Radiographic reports. Osteoporotic Fractures and Fracture Risk – Fragility fracture (osteoporotic and low-trauma fracture)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Mean BMI (SD): 27.3 (3.8) kg/m ² Income level: NR Education level:	Quartile 2: Protein intake 14.2- 15.8% of energy	source were derived from the responses to the questionnaire by Block Dietary Data Systems.	Hip fracture Spine fracture Measure/Method of
	Post-secondary degree: 45.3% Mean physical activity level:	Baseline Protein Amount Range: 14.2-15.8% of energy Carbohydrate Range: NR	Protein intake was assessed at baseline.	Assessment: Radiographic reports
	147.9 PASE score Health status/ Comorbidities:	Fat Range: NR Protein Amount at the end of		BMD of the Appendicular Skeleton - Bone mineral density (hip, total)
	Osteoporosis: 3.3% Medication use: Corticosteroid medication:	the study Range: NR Carbohydrate Range: NR		Measure/Method of Assessment: QDR 4500
	2.3% Supplement use: Calcium/Vitamin D	Fat Range: NR Quartile 3: Protein intake 15.9-		fanbeam densitometers
	Pregnant or lactating: NA	17.7% of energy Baseline Protein Amount		
	Quartile 2: Protein intake 14.2-15.8% of energy N: 1,469	Range: 15.9-17.7% of energy Carbohydrate Range: NR Fat Range: NR		
	% Female: 0% Mean Age (SD): 74.0 (5.8) y Race/ Ethnicity: 90.5% non- Hispanic white	Protein Amount at the end of the study Range: NR		
	Menopausal status: NA Obesity status: NR Mean BMI (SD): 27.3 (3.6)	Carbohydrate Range: NR Fat Range: NR		
	kg/m² Income level: NR Education level:	Quartile 4: Protein intake 17.8-29.3% of energy		
	Post-secondary degree: 52.0% Mean physical activity level:	Baseline Protein Amount Range: 17.8-29.3% of energy Carbohydrate Range: NR		
	Health status/ Comorbidities:	Protein Amount at the end of		
	Medication use: Corticosteroid medication: 2.0%	Range: NR Carbohydrate Range: NR Fat Range: NR		

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Supplement use:	Dratain tura / auroa Miyad		
	supplements: 36%	Protein type/source. Mixed		
	Pregnant or lactating: NA	Energy balance status: Eucaloric		
	Quartile 3: Protein intake			
	15.9-17.7% of energy	Study duration: 15 y		
	N: 1,469			
	% Female: 0%			
	Mean Age (SD): 73.6 (5.9) y			
	Hispanic white			
	Menonausal status: NA			
	Obesity status: NR			
	Mean BMI (SD): 27.4 (3.9)			
	kg/m ²			
	Income level: NR			
	Education level:			
	Post-secondary degree:			
	57.3% Maan physical activity lovel:			
	149 0 PASE score			
	Health status/			
	Comorbidities:			
	Osteoporosis: 2.8%			
	Medication use:			
	Corticosteroid medication:			
	2.5%			
	Supplement use:			
	supplements: 37.8%			
	Pregnant or lactating: NA			
	Quartile 4: Protein intake			
	17.8-29.3% of energy			
	N: 1,468			
	% Female: 0%			
	Miean Age (SD): 73.4 (5.9) y			
	Hispanic white			
	Menopausal status: NA			
	Obesity status: NR			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Mean BMI (SD): 27.5 (4.1) kg/m ² Income level: NR Education level: Post-secondary degree: 58.6% Mean physical activity level: 144.1 PASE score Health status/ Comorbidities: Osteoporosis: 4.2% Medication use: Corticosteroid medication: 1.6% Supplement use: Calcium/Vitamin D supplements: 36.7% Pregnant or lactating: NA			
PMID: 36986162 Liu 2023 ²¹ Location/Country: China HDI: High Setting: Community dwelling Urban/ Rural: Urban Study design: Prospective cohort study Funding source: Nonprofit, government, academic Risk of bias score: High	Study of: Adults Total sample N: 1,987 Quartile 1: Protein intake <0.96 g of protein/kg/d N: 497 % Female: 65.8% Mean Age (SD): 60.3 (5.0) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 26.1 (3.1) kg/m ² Income level: 58.3% (income <3,000 Yuan (month-person) Education level: NR Mean physical activity level: 24.1 METS/wk Health status/ Comorbidities: Stroke: 2.0% Hypertension: 29.4% Hypertension: 29.4%	Quartile 1: Protein intake <0.96 g of protein/kg/d Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): 14.9 (4.7) % of energy Carbohydrate Mean (SD): 57.6 (22.1) % of energy Fat Mean (SD): 21.2 (14.4) % of energy Quartile 2: Protein intake 0.96~ g of protein/kg/d Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	Protein Assessment Method: Dietary intake was assessed using a validated 79-item FFQ to estimate habitual food intakes. For each food item, its frequency (never or per year, month, week, or day) of consumption and the regular serving size were estimated. The dietary intake of total energy, protein, amino acids, and other nutrients was calculated according to the Chinese Food Composition Table 2009. Protein intake was assessed at the first follow-up.	Total Body BMD - Bone mineral density (total body) Measure/Method of Assessment: DXA (Hologic QDR1000, version 6.10) BMD of the Axial Skeleton - Bone mineral density (L1-L4 (lumbar spine)) Measure/Method of Assessment: DXA (Hologic QDR1000, version 6.10) BMD of the Appendicular Skeleton - Bone mineral density (hip, total) Measure/Method of Assessment: DXA (Hologic QDR1000, version 6.10)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
				methous assessmenty
	Medication use: NR Supplement use: Calcium supplements: 30.2% Multivitamin supplements: 17.1% Pregnant or lactating: NR Quartile 2: Protein intake ~0.96 g of protein/kg/d N: 497 % Female: 69.8% Mean Age (SD): 60.4 (4.7) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 24.1 (2.4) kg/m ² Income level: 54.1% (income <3,000 Yuan (month-person) Education level: NR Mean physical activity level: 25.3 METS/wk Health status/ Comorbidities: Stroke: 1.6% Hyperlipidemia: 41.7% Medication use: NR Supplement use: Calcium supplements: 27.8% Multivitamin supplements: 17.5% Pregnant or lactating: NR Quartile 3: Protein intake 1.10~ g of protein/kg/d N: 497 % Female: 72.2% Mean Age (SD): 60.3 (4.8) y	Protein Amount at the end of the study Mean (SD): 16.9 (4.9) % of energy Carbohydrate Mean (SD): 59.1 (25.4) % of energy Fat Mean (SD): 32.1 (16.3) % of energy Quartile 3: Protein intake ~1.10 g of protein/kg/d Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): 17.8 (5.5) % of energy Carbohydrate Mean (SD): 58.3 (24.9) % of energy Fat Mean (SD): 31.6 (14.8) % of energy Quartile 4: Protein intake ≥1.26 g of protein/kg/d Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): 20.3 (6.6) % of energy Carbohydrate Mean (SD): 61.2 (25.8) % of energy		 BMD of the Appendicular Skeleton - Bone mineral density (femoral neck) Measure/Method of Assessment: DXA (Hologic QDR1000, version 6.10) BMD of the Appendicular Skeleton - Bone mineral density (trochanter) Measure/Method of Assessment: DXA (Hologic QDR1000, version 6.10)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Race/ Ethnicity: NR	Fat Mean (SD): 32 5 (15 6) %		
	Menopausal status: NR	of energy		
	Obesity status: NR			
	Mean BMI (SD): 22.8 (2.3)	Protein type/source: Mixed		
	kg/m ²			
	Income level: 56.1%	Energy balance status:		
	(income <3,000 Yuan	Eucaloric		
	(month-person)	Otrada damatiana Car		
	Education level: NR	Study duration: 6 y		
	Health status/			
	Comorbidities:			
	Stroke: 1.8%			
	Hypertension: 25.5%			
	Hyperlipidemia: 38.0%			
	Medication use: NR			
	Supplement use:			
	Calcium supplements:			
	30.8%			
	22 3%			
	Pregnant or lactating: NR			
	r roghant of laotating. Mrt			
	Quartile 4: Protein intake			
	≥1.26 g of protein/kg/d			
	N: 496			
	% Female: 78.8%			
	Mean Age (SD): 60.1 (5.1) y			
	Race/ Ethnicity: NR			
	Obosity status: NR			
	Mean BMI (SD): $21.1(2.4)$			
	$k_{\rm R}/m^2$			
	Income level: 62.3%			
	(income <3,000 Yuan			
	(month-person)			
	Education level: NR			
	Mean physical activity level:			
	25.7 METS/wk			
	Health status/			
	Comorbidities:			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
PMID: 28179224	Stroke: 1.8% Hypertension: 25.5% Hyperlipidemia: 39.3% Medication use: NR Supplement use: Calcium supplements: 30.6% Multivitamin supplements: 22.0% Pregnant or lactating: NR Study of: Adults	Arm 1: Protein food cluster	Protein Assessment	BMD of the Appendicular
Mangano 2017* ²²	Total sample N: 2,986	(Fast food, full-fat dairy)	Method: Typical dietary intakes of foods and nutrients	Skeleton - Bone mineral density (femoral neck)
Location/Country: USA HDI: Very high Setting: NR Urban/ Rural: NR Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Arm 1: Protein food cluster (Fast food, full-fat dairy) N: 458 % Female: 44% Mean Age (SD): 39.3 (8.5) y Race/ Ethnicity: NR Menopausal status: 6% nonestrogenic Obesity status: NR Mean BMI (SD): 26.5 (5.0) kg/m ² Income level: NR Education level: NR Mean physical activity level: 37.2 PAI Health status/ Comorbidities: NR Medication use: NR Supplement use:	Baseline Protein Amount Mean (SD): 88 (31) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Protein food cluster 2 (Fish) Baseline Protein Amount Mean (SD): 90 (31) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR	were assessed with the use of the Harvard 126-item semiquantitative and validated general population 88 FFQ. Protein intake was assessed during the years 2002-2005.	Measure/Method of Assessment: GE Lunar Prodigy fan-beam densitometer BMD of the Appendicular Skeleton - Bone mineral density (hip, total) Measure/Method of Assessment: GE Lunar Prodigy fan-beam densitometer BMD of the Appendicular Skeleton - Bone mineral density (trochanter)
	Calcium supplements: 19%, Vitamin D supplements: 40% Pregnant or lactating: NR	Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Eat Mean (SD): NR		Measure/Method of Assessment: GE Lunar Prodigy fan-beam densitometer
	Arm 2: Protein food cluster 2 (Fish) N: 605 % Female: 58%	Arm 3: Protein food cluster 3 (Red meat)		BMD of the Axial Skeleton - Bone mineral density (lumbar spine)
	wean Age (SD): 42.2 (9.0) y	Baseline Protein Amount		

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			assessment	methods assessment)
	Race/ Ethnicity: NR	Mean (SD): 97 (29) g/d		Measure/Method of
	Menopausal status: 14%	Carbohydrate Mean (SD): NR		Assessment: GE Lunar
	nonestrogenic	Fat Mean (SD): NR		Prodigy fan-beam
	Obesity status: NR	· · · ·		densitometer
	Mean BMI (SD): 26.8 (5.3)	Protein Amount at the end of		
	kg/m ²	the study		
	Income level: NR	Mean (SD): NR		
	Education level: NR	Carbohydrate Mean (SD): NR		
	Mean physical activity level: 37.4 PAI	Fat Mean (SD): NR		
	Health status/	Arm 4: Protein food cluster 4		
	Comorbidities: NR	(Chicken)		
	Medication use: NR			
	Supplement use:	Baseline Protein Amount		
	Calcium supplements: 43%,	Mean (SD): 95 (35) g/d		
	Vitamin D supplements:	Carbohydrate Mean (SD): NR		
	53%	Fat Mean (SD): NR		
	Pregnant or lactating: NR			
	Arma Or Durata in face di alcuntari	Protein Amount at the end of		
	Arm 3: Protein food cluster	the study		
	3 (Red meat)	Mean (SD): NR Carbobydrata Maan (SD): ND		
	N. 040 % Famala: 48%	Carbonydrate Mean (SD). NR		
	% Female, 40%	Fat Mean (SD). NR		
	Reco/ Ethnicity: NP	Arm 5: Protoin food cluster 5		
	Monopolical status: 13%	(Low fat milk)		
	nonestrogenic			
	Obesity status: NR	Baseline Protein Amount		
	Mean BMI (SD): 27.4 (5.6)	Mean (SD): 98 (31) d/d		
	kg/m^2	Carbohydrate Mean (SD): NR		
	Income level: NR	Fat Mean (SD): NR		
	Education level: NR			
	Mean physical activity level:	Protein Amount at the end of		
	37.5 PAI	the study		
	Health status/	Mean (SD): NR		
	Comorbidities: NR	Carbonydrate Mean (SD): NR		
	Medication use: NR	Fat Mean (SD): NR `		
	Supplement use:			
	Calcium supplements: 30%	Arm 6: Protein food cluster 6		
	Vitamin D supplements:	(Legumes)		
	39%			
	Pregnant or lactating: NR	Baseline Protein Amount		

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Arm 4: Protein food cluster 4 (Chicken) N: 735 % Female: 58% Mean Age (SD): 39.3 (8.3) y Race/ Ethnicity: NR Menopausal status: 7% nonestrogenic Obesity status: NR Mean BMI (SD): 26.7 (5.3) kg/m ² Income level: NR Education level: NR Mean physical activity level: 37.0 PAI Health status/ Comorbidities: NR Medication use: NR Supplement use: Calcium supplements: 36%, Vitamin D supplements: 46% Pregnant or lactating: NR Arm 5: Protein food cluster 5 (Low-fat milk) N: 434 % Female: 58% Mean Age (SD): 40.9 (8.6) y Race/ Ethnicity: NR Menopausal status: 11% nonestrogenic Obesity status: NR Mean BMI (SD): 26.8 (5.0) kg/m ² Income level: NR Education level: NR Mean physical activity level: 37.8 PAI	Mean (SD): 83 (34) g/d Carbohydrate: NR Fat: NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 9 y	assessment	methods assessment)
	Health status/ Comorbidities: NR			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Medication use: NR Supplement use: Calcium supplements: 40%, Vitamin D supplements: 50% Pregnant or lactating: NR			
	Arm 6: Protein food cluster 6 (Legumes) N: 114 % Female: 79% Mean Age (SD): 38.6 (9.4) y Race/ Ethnicity: NR Menopausal status: 7% nonestrogenic Obesity status: NR Mean BMI (SD): 23.9 (4.6) kg/m ² Income level: NR Education level: NR Mean physical activity level: 36.1 PAI Health status/ Comorbidities: NR Medication use: NR Supplement use: Calcium supplements: 47%, Vitamin D supplements: 56% Pregnant or lactating: NR			
PMID: 19419320 Meng	Study of: Adults Total sample N: 862	Tertile 1: Protein intake <66 g/d	Protein Assessment Method: Participants	Total Body BMC - Bone mineral content (total body)
2009* ²³ Location/Country: Australia HDI: Very high Setting: Community dwelling Urban/ Rural: NR Study design: Prospective cohort study Funding source: Nonprofit, government Risk of bias score: High	Tertile 1: Protein intake <66 g/ d N: 287 % Female: 100% Mean Age (SD): 74.9 (2.5) y Race/ Ethnicity: 100% white origin Menopausal status: Postmenopausal	Baseline Protein Amount Mean (SD): 54.4 (9.1) g/d Carbohydrate Mean (SD): 146.8 (30.9) g/d Fat Mean (SD): 46.4 (13.3) g/d Protein Amount at the end of the study Mean (SD): NR	completed a self- administered, quantitative FFQ. This FFQ has been designed to measure eating habits over the past 12-mo period and calibrated and validated according to the foods and on intake for a 12- mo period. The daily dietary intakes were derived from	Measure/Method of Assessment: DXA (Hologic 4500A)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Obesity status: NR Mean BMI (SD): 26.4 (4.2) kg/m ²	Carbohydrate Mean (SD): NR Fat Mean (SD): NR	the questionnaire. Protein intake was assessed at baseline.	
	Income level: NR Education level: NR Physical activity level: 466	Tertile 2: Protein intake 66-87 g/d		
	(median kilojoules expended per day) Health status/	Baseline Protein Amount Mean (SD): 76.6 (6.2) g/d Carbohydrate Mean (SD):		
	Comorbidities: Participants were excluded if they had a medical condition likely to	186.4 (34.1) g/d Fat Mean (SD): 63.0 (13.3) g/d		
	influence 5-year survival. Medication use: Participants were excluded if they were	Protein Amount at the end of the study Mean (SD): NR		
	taking bone active medications including calcium supplements	Carbohydrate Mean (SD): NR Fat Mean (SD): NR		
	estrogen, bisphosphonates, and vitamin D. Supplement use:	Tertile 3: Protein intake >87 g/d		
	Participants were excluded if they were taking bone active medications including	Baseline Protein Amount Mean (SD): 110.9 (23.4) g/d Carbobydrate Mean (SD):		
	calcium supplements, estrogen, bisphosphonates, and vitamin D	249.5 (61.9) g/d Fat Mean (SD): 85.1 (25.7) g/d		
	Pregnant or lactating: NR	Protein Amount at the end of the study		
	87 g/d N: 287 % Female: 100%	Carbohydrate Mean (SD): NR Fat Mean (SD): NR		
	Mean Age (SD): 75.0 (2.6) y Race/ Ethnicity: 100% white	Protein type/source: Mixed		
	origin Menopausal status: Postmenopausal	Energy balance status: Eucaloric		
	Obesity status: NR Mean BMI (SD): 26.7 (4.7) kg/m ²	Study duration: 5 years		
	Participants were excluded if they were taking bone active medications including calcium supplements, estrogen, bisphosphonates, and vitamin D. Pregnant or lactating: NR Tertile 2: Protein intake 66- 87 g/d N: 287 % Female: 100% Mean Age (SD): 75.0 (2.6) y Race/ Ethnicity: 100% white origin Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 26.7 (4.7) kg/m ² Income level: NR	Baseline Protein Amount Mean (SD): 110.9 (23.4) g/d Carbohydrate Mean (SD): 249.5 (61.9) g/d Fat Mean (SD): 85.1 (25.7) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 5 years		

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Education level: NR			
	Physical activity level: 530			
	(median kilojoules expended			
	Per day) Health status/			
	Comorbidities: Participants			
	were excluded if they had a			
	medical condition likely to			
	influence 5-year survival.			
	Medication use: Participants			
	were excluded if they were			
	taking bone active			
	medications including			
	calcium supplements,			
	estrogen, bisphosphonates,			
	Supplement use:			
	Participants were excluded			
	if they were taking bone			
	active medications including			
	calcium supplements,			
	estrogen, bisphosphonates,			
	and vitamin D.			
	Pregnant or lactating: NR			
	Tertile 3: Protein intake >87			
	g/d			
	N: 288			
	% Female: 100% Moon Ago (SD): 74 7 (2 7) v			
	Race/ Ethnicity: 100% white			
	origin			
	Menopausal status:			
	Postmenopausal			
	Obesity status: NR			
	Mean BMI (SD): 27.3 (4.3)			
	kg/m ²			
	Income level: NR			
	Education level: NR			
	Physical activity level: 614			
	(median kilojoules expended			
	per day)			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Health status/ Comorbidities: Participants were excluded if they had a medical condition likely to influence 5-year survival. Medication use: Participants were excluded if they were taking bone active medications including calcium supplements, estrogen, bisphosphonates, and vitamin D. Supplement use: Participants were excluded if they were taking bone active medications including calcium supplements, estrogen, bisphosphonates, and vitamin D. Pregnant or lactating: NR			
PMID: 20442986 Misra 2011 ²⁴ Location/country: USA HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Study of: Adults Total sample N: 946 Arm 1: No hip fracture N: 846 % Female: 58.6% Mean Age (SD): 75 (5.0) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: NR Mean physical activity level: 33 PAI score Health status/ Comorbidities: NR Medication use: NR Supplement use: NR Pregnant or lactating: NR	Arm 1: No hip fracture Baseline Protein Amount Mean (SD): 64.2 g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Hip fracture Baseline Protein Amount Mean (SD): 63.6 g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Fat Mean (SD): NR	Protein Assessment Method: FFQ was used to assess usual dietary intake by self-report. Total protein intake (g/day) was adjusted for total energy (from FFQ) to reduce error due to variation in total energy requirement, body size, and portion sizes, allowing interpretation of the effect of total protein intake. Protein intake was assessed at baseline.	Osteoporotic Fractures and Fracture Risk - Hip fracture Measure/Method of Assessment: Self-report

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
PMID: 36715763 Nakano 2023 ²⁵ Location/Country: Japan HDI: Very high Setting: NR Urban/ Rural: Urban Study design: Prospective cohort study Funding source: Government Risk of bias score: High	N: 100 % Female: 80.0% Mean Age (SD): 76 (5.2) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: NR Mean physical activity level: 34 PAI score Health status/ Comorbidities: NR Medication use: NR Supplement use: NR Pregnant or lactating: NR Study of: Adults Total sample N: 1,070 Arm 1: Whole cohort N: 1,070 % Female: 100% Mean Age (SD): 69.3 (10.9) y Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 22.6 (3.4) kg/m ² Income level: NR Education level: NR Health status/ Comorbidities: Participants with critical or acute illness (e.g., terminal cancer, cardiovascular disease, or infectious diseases such as pneumonia) or secondary osteoporosis (e.g., due to primary	Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 16-17 y Arm 1: Whole cohort Baseline Protein Amount Mean (SD): 73.4 (15.1) g/d Carbohydrate Mean (SD): 200 (39) g/d Fat Mean (SD): 59.5 (12.2) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 5.8 y	Protein Assessment Method: Dietary nutrient intake was assessed by using an FFQ method for the prevention and management of osteoporosis (FFQPOP). The FFQPOP comprised a total of 28 food items. Subjects were asked to select the grade of intake frequency in the previous 1 month for each item. Nutrients and energy intakes were estimated by the frequency grade and relevant coefficients determined on the basis of the Standard Tables of Food Composition in Japan. Protein intake was assessed at baseline.	Osteoporotic Fractures and Fracture Risk - Fragility fracture (osteoporotic fracture) Measure/Method of Assessment: X-ray films

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	hyperparathyroidism, end- stage renal failure, or long- term steroid use) were excluded. Diabetes: 14.3% Dyslipidemia: 48.0% Hypertension: 58.1% Medication use: Participants under any kind of treatment for primary osteoporosis were included. Participants with long-term steroid use were excluded. Supplement use: NR Pregnant or lactating: NR			
PMID: 11914191 Promislow 2002 ²⁶ Location/Country: USA HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Study of: Adults Total sample N: 960 Arm 1: Women N: 572 % Female: 100% Mean Age (SD): 71.2 (8.7) y Race/ Ethnicity: Caucasian Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 24.6 (3.7) kg/m ² Income level: NR Education level: NR Physical activity level: Exercise ≥3x per week: 70.9% Health status/ Comorbidities: NR Medication use: Thiazides: 24.7% Thyroid hormones: 21.0% Steroids: 3.9% Estrogen: 39.9% Supplement use: NR	Arm 1: Women Baseline Protein Amount Mean (SD): 71.2 (24.8) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Men Baseline Protein Amount Mean (SD): 73.8 (23.4) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	Protein Assessment Method: Harvard-Willett diet assessment questionnaire was used to collect information on dietary intake. The questionnaire was self- administered and contained questions regarding portion size and consumption frequency of 128 common food items. Protein intake was assessed at baseline.	 BMD of the Appendicular Skeleton - Bone mineral density (hip, total) Measure/Method of Assessment: DXA (Hologic QDR, model 1000) BMD of the Appendicular Skeleton - Bone mineral density (femoral neck) Measure/Method of Assessment: DXA (Hologic QDR, model 1000) BMD of the Axial Skeleton - Bone mineral density (lumbar spine) Measure/Method of Assessment: DXA (Hologic QDR, model 1000)
Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
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	Arm 2: Men N: 388 % Female: 0% Mean Age (SD): 70.0 (8.5) y Race/ Ethnicity: Caucasian Menopausal status: NA Obesity status: NR Mean BMI (SD): 26.4 (3.4) kg/m ² Income level: NR Education level: NR Physical activity level: Exercise ≥3x per week: 78.9% Health status/ Comorbidities: NR Medication use: Thiazides: 15.0% Thyroid hormones: 4.4% Steroids: 2.1% Supplement use: NR	Energy Balance status: Eucaloric Study duration: 4 y		
PMID: 33847345 Rivera-Paredez 2021 ²⁷ Location/Country: Mexico HDI: High Setting: Community dwelling Urban/ Rural: Urban Study design: Prospective cohort study Funding source: Government Risk of bias score: Moderate	Study of: Adults Total sample N: NR Arm 1: Whole Cohort N: NR % Female: 100% Mean Age (SD): 57 y Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status: 26.5% Mean BMI (SD): 27.1 kg/m ² Income level: NR Education level: NR Mean physical activity level: 13.0 (leisure time physical activity, min/d) Health status/ Comorbidities: NR	Arm 1: Whole Cohort Baseline Protein Amount Median (IQR): 66.4 (51.1-86.0) g/d Carbohydrate Median (IQR): NR Fat Median (IQR): NR Protein Amount at the end of the study Median (IQR): 50.1 (37.8- 66.9 g/d Carbohydrate Median (IQR): NR Fat Median (IQR): NR Protein type/source: Mixed	Protein Assessment Method: A semi-quantitative FFQ was used to collect data on the consumption frequency of 116 food items during the previous year. Average daily nutrient intake was calculated by multiplying the frequency of consumption of each food by the nutrient content. Protein intake was assessed at baseline.	 BMD of the Axial Skeleton - Bone mineral density (L1-L4 (lumbar spine)) Measure/Method of Assessment: DXA Lunar DPX NT instrument (Lunar Radiation Corp.) BMD of the Appendicular Skeleton - Bone mineral density (femoral neck) Measure/Method of Assessment: DXA Lunar DPX NT instrument (Lunar Radiation Corp.)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Medication use: Hormone replacement therapy: 7.8% Supplement use: 25.2% dietary supplement Pregnant or lactating: NA	Energy balance status: Eucaloric Study duration: 6.4 y		BMD of the Appendicular Skeleton - Bone mineral density (hip, total) Measure/Method of Assessment: DXA Lunar DPX NT instrument (Lunar Radiation Corp.)
PMID: 20662074 Sahni 2010 ²⁸ Location/Country: USA HDI: Very high Setting: NR Urban/ Rural: NR Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Study of: Adults Total sample N: 3,656 Arm 1: Men N: 1,725 % Female: 0% Mean Age (SD): 55.3 (9.9) y Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Mean BMI (SD): 28.1 (4.1) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: NR Supplement use: Calcium supplements: 13.0% Pregnant or lactating: NA Arm 2: Women N: 1,931 % Female: 100% Mean Age (SD): 54.9 (9.8) y Race/ Ethnicity: NR Menopausal status: 68.9% postmenopausal Obesity status: NR	Arm 1: Men Baseline Protein Amount Mean (SD): 79.0 (27) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Women Baseline Protein Amount Mean (SD): 75.7 (27) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 7-10 y	Protein Assessment Method: Usual dietary intake was assessed with the semi- quantitative 126-item Willett FFQ. Intakes of total protein (g/day), plant protein (g/day), and animal protein (g/day) were assessed using the food list section of the FFQ. Animal/plant protein intake ratio was calculated. Protein intake was assessed at baseline.	Osteoporotic Fractures and Fracture Risk - Hip fracture Measure/Method of Assessment: Self-report & confirmed by review of medical records

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
PMID: 24168918 Sahni 2014 ²⁹ Location/Country: USA HDI: Very high Setting: NR Urban/ Rural: NR Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Mean BMI (SD): 26.8 (5.5) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: NR Supplement use: Calcium supplements: 29.2% Pregnant or lactating: NR Study of: Adults Total sample N: 1,175 Arm 1: Men N: 495 % Female: 0% Mean Age (SD): 61 (9.0) y Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Mean BMI (SD): 28.8 (4.4) kg/m ² Income level: NR Education level: NR Health status/ Comorbidities: NR Medication use: Osteoporosis medication: 0.2% Supplement use: 24% used Calcium supplements: 24% Vitamin D supplements: 40% Pregnant or lactating: NA Arm 2: Women N: 680 % Female: 100% Mean Age (SD): 60 (9.2) y	Arm 1: Men Baseline Protein Amount Mean (SD): 81 (28) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Women Baseline Protein Amount Mean (SD): 77 (26) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric	Protein Assessment Method: Usual dietary intake was assessed with a semi- quantitative, 126-item Willett FFQ. Intakes of total protein (g/d) were assessed using the food list section of the FFQ. Protein intake was assessed at baseline.	BMD of the Appendicular Skeleton - Bone mineral density (hip, total) Measure/Method of Assessment: DXA (LUNAR DPX-L) BMD of the Axial Skeleton - Bone mineral density (lumbar spine) Measure/Method of Assessment: DXA (LUNAR DPX-L)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Race/ Ethnicity: NR Menopausal status: 86% postmenopausal Obesity status: NR Mean BMI (SD): 27.4 (5.6) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: Osteoporosis medication: 3.6% Supplement use: Calcium supplements: 56% Vitamin D supplements: 53%	Study duration: 1.5-8 y		
PMID: 11124760 Sellmeyer 2001 ³⁰ Location/Country: USA HDI: Very high Setting: Community dwelling Urban/ Rural: NR Study design: Prospective cohort study) Funding source: Government Risk of bias score: High	Study of: Adults Total sample N: 1,035 Tertile 1: Low ratio of animal to vegetable protein N: NR % Female: 100% Mean Age (SD): 74.3 (5.4) y Race/ Ethnicity: 100% white Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 25.6 (4.6) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: NR Supplement use: NR	Tertile 1: Low ratio of animal to vegetable protein Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): 42.0 (15.9) g Carbohydrate Mean (SD): NR Fat Mean (SD): NR Tertile 2: Medium ratio of animal to vegetable protein Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	Protein Assessment Method: Nutrient intake data were obtained from a 24-h dietary recall and an FFQ. The 24-h dietary recall consisted in registering all the meals and beverages consumed during the 24 h before the subject awoke on the day of the interview, assessing, for each food item, the portion sizes and their weight correspondence according to a book of photographs. Food intake data were estimated from a detailed FFQ, the frequency of consumption of 148 foods and nonalcoholic beverages for each of the three main meals and three between- meals snacks was recorded	BMD of the Appendicular Skeleton - Bone mineral density (hip and subregions) Measure/Method of Assessment: DXA (Hologic QDR-1000, version 6.10) Osteoporotic Fractures and Fracture Risk - Hip fracture Measure/Method of Assessment: Self-report & confirmed with radiographs

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Tertile 2: Medium ratio of animal to vegetable protein N: NR % Female: 100% Mean Age (SD): 73.2 (4.9) y Race/ Ethnicity: 100% white Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 26.5 (4.7) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: NR Supplement use: NR Pregnant or lactating: NR Tertile 3: High ratio of animal to vegetable protein N: NR % Female: 100%	Protein Amount at the end of the study Mean (SD): 49.2 (16.9) g Carbohydrate Mean (SD): NR Fat Mean (SD): NR Tertile 3: High ratio of animal to vegetable protein Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): 58.3 (20.0) g Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric	in 11 classes. Protein intake was assessed at baseline.	
PMID: 33677533	Mean Age (SD): 72.5 (4.5) y Race/ Ethnicity: 100% white Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 26.7 (4.9) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: NR Supplement use: NR Pregnant or lactating: NR	Study duration: 7 y	Protein Assessment	BMD of the Appendicular
Weaver 2021 ³¹	Total sample N: 2,160	of energy	Method: Participants completed a 108-item,	Skeleton - Bone mineral density (hip, total)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
Location/Country: USA HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Tertile 1: Protein intake <13% of energy N: 718 % Female: 47.0% Mean Age (SD): 73.5 (2.9) y Race/ Ethnicity: Black: 47.0% Menopausal status: NR Obesity status: NR Mean BMI (SD): 27.1 (4.7) kg/m ² Income level: NR Education level: Less than high school: 23.3% High school: 35.1% Postsecondary education: 41.7% Physical activity level: 0 min walking/wk: 43.9% 1–149 min walking/wk: 29.3% >150 min walking/wk: 26.8% Health status/ Comorbidities: Participants free of life-threatening illness were included Medication use: Osteoporosis medication: 3.4% Supplement use: 15.0% Calcium supplements: 15.0% Vitamin D supplements: 6.6% Pregnant or lactating: NR Tertile 2: Protein intake 13- 15% of energy N: 703 % Female: 52.2% Mean Age (SD): 73.4 (2.8) y	Baseline Protein Amount Mean (SD): 12 (1) % of energy Carbohydrate Mean (SD): 55 (8) % of energy Fat Mean (SD): 34 (7) % of energy Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Tertile 2: Protein intake 13- 15% of energy Baseline Protein Amount Mean (SD): 14 (1) % of energy Carbohydrate Mean (SD): 53 (8) % of energy Fat Mean (SD): 34 (7) % of energy Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Tertile 3: Protein intake >15% of energy Baseline Protein Amount Mean (SD): 18 (2) % of energy Carbohydrate Mean (SD): 52 (8) % of energy Fat Mean (SD): 32 (8) % of energy Protein Amount at the end of the study Mean (SD): 32 (8) % of energy Protein Amount at the end of the study Mean (SD): 32 (8) % of energy Protein Amount at the end of the study Mean (SD): NR	interviewer-administered modified version of the FFQ. Wood blocks, food models, standard kitchen measures, and flash cards were used by trained interviewers to assist participants in estimating food portion sizes. Energy intake and macronutrient and micronutrient content were calculated from the FFQ by Block Dietary Data Systems (Berkeley, CA). Total protein intake, as well as the source of protein (e.g., animal or vegetable), was computed. Protein intake was assessed one year from baseline.	Measure/Method of Assessment: DXA (Hologic 4500A, software v.9.03) BMD of the Appendicular Skeleton - Bone mineral density (femoral neck) Measure/Method of Assessment: DXA (Hologic 4500A, software v.9.03) aBMD of the total body – Areal bone mineral density (total body) Measure/Method of Assessment: DXA (Hologic 4500A, software v.9.03) Osteoporotic Fractures and Fracture Risk - Fragility fracture (low-trauma) Measure/Method of Assessment: Self-report & confirmed with radiographs Osteoporotic Fractures and Fracture Risk - Incident hip fracture Measure/Method of Assessment: Self-report & confirmed with radiographs

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Race/ Ethnicity: Black: 52.2%	Carbohydrate Mean (SD): NR Fat Mean (SD): NR		
	Obesity status: NR Mean BMI (SD): 27.0 (4.4)	Protein type/source: Mixed		
	kg/m ² Income level: NR Education level:	Energy balance status: Eucaloric		
	Less than high school: 21.7%	Study duration: 5 y		
	Postsecondary education: 47.1%			
	Physical activity level: 0 min walking/wk: 40.1% 1–149 min walking/wk:			
	33.8% >150 min walking/wk: 26.2% Health status/			
	Comorbidities: Participants free of life-threatening illness were included			
	Medication use: Osteoporosis medication: 5.2%			
	Supplement use: Calcium supplements:			
	Vitamin D supplements: 9.8%			
	Pregnant or lactating: NR			
	Tertile 3: Protein intake >15% of energy N: 739			
	% Female: 55.3% Mean Age (SD): 73.7 (2.9) y Race/ Ethnicity: Black: 55.3%			
	Menopausal status: NR Obesity status: NR			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of assessment	Outcome (Measures and methods assessment)
	Mean BMI (SD): 27.5 (4.8)			
	kg/m ²			
	Income level: NR			
	Education level:			
	Less than high school:			
	19.8%			
	High school: 33.6%			
	Postsecondary education:			
	46.6%			
	Physical activity level:			
	0 min walking/wk: 37.0%			
	1–149 min walking/wk:			
	30.3%			
	>150 min walking/wk: 32.7%			
	Health status/			
	Comorbidities: Participants			
	free of life-threatening			
	illness were included.			
	Medication use:			
	Osteoporosis medication:			
	5.2%			
	Supplement use:			
	Calcium supplements:			
	24.0%			
	Vitamin D supplements:			
	10.5%			
	Pregnant or lactating: NR			

Abbreviations: BMC = bone mineral content; BMD = bone mineral density; BMI = body mass index; CT = computed tomography; CVD = cardiovascular disease; d = day; DXA = Dual-energy x-ray absorptiometry; e.g. = exempli gratia; FFQ = food frequency questionnaire; FFQPOP = food frequency questionnaire method for the prevention and management of osteoporosis; HDI = human development index; g = grams; g/100g = grams per 100 grams; g/cm² = grams per centimeter squared; g/d = grams per day; h = hour; IU = international units; IQR = interquartile range; kcal = kilocalories; kg/m² = kilograms per meter squared; METs = metabolic equivalents; min/d = minutes per day; mg = milligrams; mL = milliliter; MPB = milk based protein; MR= meal replacement; NA = not appliable; NR = not reported; PA = physical activity; PAI = physical activity index; PASE = Physical activity scale for the elderly; PMID = PubMed Identification Number; RCT = randomized controlled trail; RoB = Risk of Bias; SD = standard deviation; SE = standard error of the mean; $\mu g/L$ = micrograms per liter; USA = United States of America; wk = week; vBMD = volumetric bone mineral density; y = year

Note:* Studies overlap KQs

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
			assessment)	
PMID: 20578205	Study of: Adults	Intervention: High Protein	Intervention: High	Kidney Function — Blood urea
Flechtner-Mors	Total sample N: 110		Protein	nitrogen
2010 * ³²		Intended Protein Amount:		
Location/Country: Germany	Intervention: High	1.34 g/kg/d; 30% of energy	How protein was	Measure/Method of Assessment:
HDI: Very high	Protein	Carbohydrate: 40% of energy	administered:	Venous blood samples were collected
Setting: Outpatient clinic	N: 55	Fat: 30% of energy	First 3 months:	every three months to measure blood
Urban/Rural: NR	% Female: 78.2%		Consumed two protein-	urea nitrogen and serum creatinine
Study design: RCT	Mean Age (SD): 49.3	Baseline Protein Amount	enriched meal	using standard assays.
(parallel)	(12.3) y	Mean (SD):18.0 (4.9) % of	replacements, one	
Funding source: Industry,	Race/ Ethnicity: NR	energy; 72.7 (24.3) g/d	conventional meal, and	Kidney Function — Serum
academic	Menopausal status: NR	Carbohydrate Mean (SD):	two snacks as either a	creatinine
Risk of bias score: High	Obesity status: Obese	46.7 (9.4) % of energy; 194	protein bar or a low-fat	
	Mean BMI (SD): 36.2	(73) g/d	curd with fruit.	Measure/Method of Assessment:
	(4.4) kg/m ²	Fat: 35.2 (7.6) % of energy;		Venous blood samples were collected
	Income level NR	64 (25) g/d	After the first 3 months:	every three months to measure blood
	Education level: NR		Consumed one protein-	urea nitrogen and serum creatinine
	Physical activity level:	Actual Protein Amount at the	enriched meal	using standard assays.
	Received instructions to	end of the study	replacement, two meals,	
	maintain their usual	Mean (SD): 30.0 (7.0) % of	and two snacks	
	physical activity during	energy; 92.2 (14.8) g/d		
	the study and not to	Carbohydrate Mean (SD):	Protein Assessment	
	undertake any new	36.9 (7.9) % of energy; 119	Method: Subjects kept 3-	
	exercise programs, but	(45) g/d	day food records at	
	exercise was not	Fat Mean (SD): 29.9 (5.7) %	baseline, 3 months, 6	
	monitored	of energy; 42 (13) g/d	months, 9 months, and 12	
	Health status/		months. Food quantities	
	Comorbidities: Included:	Dietary Protein Intake	were recorded using	
	Those that met the criteria	Compliance (%): 56.3%	standard household	
	for metabolic syndrome		measures, and a trained	
	Medication use: Exclude:	Protein type/source: Mixed	assessment dietician	
	anti-obesity medications		reviewed the food records	
	Supplement use: NR	Energy balance status:	in person. Nutrient	
	Pregnant or lactating:	Hypocaloric	calculations were carried	
	Excluded		out using the PRODI	
		Comparator: Conventional	program which is based	
	Comparator:	Diet	on German food-	
	Conventional Diet		composition tables.	
	N: 55	Intended Protein Amount: 0.8		
	% Female: 81.2%	g/kg/d; 15% energy		

 Table C3. Evidence table for Kidney Disease Randomized Controlled Trials

Study	Participants	Interventions/Exposure and Comparator (Content,	Intervention (s) (Methods of	Outcome (Measures and methods of assessment)
		administrator, and duration)	administration and	
			assessment)	
	Mean Age (SD): 50 (13) y	Carbohydrate: 30% energy	Dietary Protein Intake	
		Fat: 55% energy	Compliance: Food	
	Menopausal status: NR	Deceline Drotein Americat	records yielded data that	
	Obesity status: Obese	Baseline Protein Amount	revealed adherence to the	
	(50) kg/m ²	(SD): 17.0 (4.7) % OI	dictary recommendations	
		Carbobydrata Maan (SD):	during the study	
		48.2 (0.4) % of operative 189	Comparatory	
	Physical activity level:	(64) a/d	Conventional Diet	
	Received instructions to	Eat Mean (SD): 34 6 (7 3) %	Conventional Diet	
	maintain their usual	of energy: 60 (26) g/d	How protein was	
	nonsical activity during		administered:	
	the study and not to	Actual Protein Amount at the	First 3 months	
	undertake any new	end of the study	Consumed three meals	
	exercise programs, but	Mean (SD): 21.4 (7.4) % of	and two snacks with no	
	exercise was not	energy; 65.7 (14.7) g/d	replacements	
	monitored	Carbohydrate Mean (SD):		
	Health status/	47.6 (7.5) % of energy; 154	After 3 months:	
	Comorbidities: Included:	(44) g/d	Consumed one standard	
	Those that met the criteria	Fat: 29.6 (5.7) % of energy;	meal replacement, two	
	for metabolic syndrome	44 (16) g/d	meals, and two snacks	
	Medication use: Exclude:		per day	
	anti-obesity medications	Dietary Protein Intake		
	Supplement use: NR	Compliance (%): NR	Protein Assessment	
	Pregnant or lactating:		Method: Same as above	
	Excluded	Protein type/source: Mixed		
			Dietary Protein Intake	
		Energy balance status:	Compliance: Same as	
		Hypocaloric	above	
		Study duration: 12 months		

Study	Participants	Interventions/Exposure and Comparator (Content,	Intervention (s) (Methods of	Outcome (Measures and methods of assessment)
		auministrator, and uuration)	assessment)	
PMID: 18371214	Study of: Adults	Intervention: Prolibra	Intervention: Prolibra	Kidney Function — Blood urea
Frestedt	Total sample N: 59	later de l'Dreteire Arecevete		nitrogen
	Intervention, Duclibus	Intended Protein Amount:	How protein was	Manager (Mathed of Assessment)
Location/Country: USA		(1, 10g protein supplement	Drelibre supplement	Measure/Method of Assessment:
ADI. Very high	N. 31 % Econolo: NP	twice daily): 15% of operav	before breakfast and one	from each subject at weeks 0 and 12
dwolling	Moon Ago (SE): 43.6	Carbobydrate: 55% of operav	before dipper. Each	to measure blood uros pitrogen
Lirban/Rural: NR	$(1 \ 1)_{V}$	Eat: 30% of energy	supplement contained 10	to measure blood drea mitrogen.
Study design: RCT	Race/ Ethnicity: NR	1 at. 50 % of energy	a of protein Subjects	
(narallel)	Menonausal status: NR	Baseline Protein Amount	were assigned a diet plan	
Funding source: Industry	Obesity status: Obese	Mean (SD): 73 (3) g/d: 0.74	with a certain number of	
Risk of bias score: High	Mean BMI (SF): 35.7	a/ka/d	servings for various food	
	$(0.7) \text{ kg/m}^2$	Carbohydrate Mean (SD): 222	groups similar to the	
	Income level NR	(11) g/d	standard paradigm set by	
	Education level: NR	Fat Mean (SD): 75 (5) g/d	the American Heart	
	Physical activity level: NR		Association.	
	Health status/	Actual Protein Amount at the		
	Comorbidities: NR	end of the study	Protein Assessment	
	Medication use: NR	Mean (SD): 0.81 g/kg/d (with	Method: Total protein in	
	Supplement use: NR	supplement); 0.60 g/kg/d and	Prolibra was measuring	
	Pregnant or lactating: NR	57 (3) g/d (w/o supplement)	using Kjeldahl (AOAC	
		Carbohydrate Mean (SD): 178	945.01). Subjects	
	Comparator: Placebo	(8) g/d (w/o supplement)	completed diet diaries on	
	N: 28	Fat Mean (SD): 49 (3) g/d	at least 5 days each	
	% Female: NR	(w/o supplement)	month.	
	Mean Age (SE): 42 (1.2) y			
	Race/ Ethnicity: NR	Dietary Protein Intake	Dietary Protein Intake	
	Menopausal status: NR	Compliance (%): NR	Compliance: Compliance	
	Obesity status: Obese		was assessed by	
	Mean BMI (SE): 35.4	Protein type/source: Animal;	supplement	
		wney protein	count and diet diary	
	Income level NR	Energy helence status	review. Participants	
	Develoal activity level: ND	Energy balance status.	telephone between	
	Health status/	Пуросаюнс	visite to review diet and	
		Comparator: Placebo	supplement	
	Medication use: NR		compliance	
	Supplement use: NR	Intended Protein Amount		
	Pregnant or lactating NR	15% of energy	Comparator: Placebo	
		Carbohydrate: 55% of energy		
		Fat: 30% of energy		

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
		Baseline Protein Amount Mean (SD): 74 (4) g/d; 0.76 g/kg/d Carbohydrate Mean (SD): 211 (10) g/d Fat Mean (SD): 71 (5) g/d Actual Protein Amount at the end of the study Mean (SD): 0.61 g/kg/d (with supplement); 58 (2) g/d (w/o supplement) Carbohydrate Mean (SD): 182 (9) g/d (w/o supplement) Fat Mean (SD): 47 (3) g/d (w/o supplement) Dietary Protein Intake Compliance (%): NR Protein type/source: Mixed Energy balance status: Hypocaloric Study duration: 12 weeks	How protein was administered: Subjects received an iso-caloric beverage containing maltodextrin. Subjects were assigned a diet plan with a certain number of servings for various food groups similar to the standard paradigm set by the American Heart Association. Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above	

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and	Outcome (Measures and methods of assessment)
			assessment)	
PMID: 19167797 Jacobs	Study of: Adults Total sample N: 378	Intervention: DASH Diet	Intervention: DASH Diet	Proteinuria — Urinary albumin excretion
2009 ³⁴		Intended Protein Amount:	How protein was	
Location/Country: USA	Intervention: DASH Diet	17.9% of energy	administered: NR	Measure/Method of Assessment: In
HDI: Very high	N: 127	Carbohydrate: 56.5% of		24-hour urine samples, albumin
Setting: Community	% Female: 50%	energy	Protein assessment	concentration was measured by a
dwelling	Mean Age (SD): 44.2	Fat: 25.6% of energy	method: NR	nephelometer with an enhanced
Urban/ Rural: NR	(10.2) y			sensitivity and a coefficient of
Study design: RC1	Race/ Ethnicity:	Baseline Protein Amount	Dietary Protein Intake	variation in 50 masked duplicate
(parallel)	White: 35%	Mean (SD): NR	Compliance: NR	samples; albumin excretion rate was
Funding Source:	African American: 60%	Carbonydrate: NR	Commenter 4:	computed as the urinary albumin
Bick of bice secret High	Menopousel status: NP	Fall NR	Comparator 1:	concentration (mg/L) times the unne
RISK OF DIAS SCORE. HIGH	Obesity status: NR	Actual Protein Amount at the	Fiult/vegetable diet	bours
	Mean BMI (SD): 28.5	end of the study: 17.8% of	How protein was	
	$(4 0) \text{ kg/m}^2$	energy	administered: NR	
	Income level: NR	Carbohydrate: 56.5% of	uuiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	
	Education level: NR	energy		
	Physical activity level: NR	Fat: 25.6% of energy	Protein assessment	
	Health status/		method: NR	
	Comorbidities:	Dietary Protein Intake		
	Considered healthy but	Compliance (%): NR	Dietary Protein Intake	
	with untreated		Compliance: NR	
	prehypertension or stage	Protein type/source: Mixed		
	I hypertension (32%		Comparator 2: Control	
	hypertensive). Those with	Energy balance status:	diet	
	diabetes and decreased	Eucaloric		
	giomerular filtration rate		How protein was	
	Mediaction uses lies of	Comparator 1:	administered: NR	
	medications that could	Fruit/vegetable diet	Protoin assossment	
	affect blood pressure		method: NR	
	were excluded: no other	Intended Protein Amount:	method. Nix	
	medication use was	15.1% of energy	Dietary Protein Intake	
	reported		Compliance: NR	
	Supplement use: Use of	Eat: 35.7% of energy		
	nutritional supplements	Fat. 55.7% of energy		
	that could affect blood	Baseline Protein Amount: NR		
	pressure were excluded;	Carbohydrate: NR		
	no other nutritional	Fat: NR		

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	supplement use was reported Pregnant or lactating: Excluded if current or planned pregnancy prior to end of study or breast- feeding	Actual Protein Amount at the end of the study: 15.1% of energy Carbohydrate: 49.2% of energy Fat: 35.7% of energy		
	Comparator 1: Fruit/vegetable diet N: 127 % Female: 49% Mean Age (SD): 45.7 (10.6) y Race/ Ethnicity: White: 38% African American: 57% Other: 5% Menopausal status: NR Obesity status: NR Mean BMI (SD): 28.3 (3.9) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: Considered healthy but with untreated prehypertension or stage I hypertensive). Those with diabetes and decreased glomerular filtration rate were excluded Medication use: Use of medications that could affect blood pressure	Dietary Protein Intake Compliance (%): NR Protein type/source: Mixed Energy balance status: Eucaloric Comparator 2: Control diet Intended Protein Amount: 13.8% of energy Carbohydrate: 50.5% of energy Fat: 35.7% of energy Baseline Protein Amount: NR Carbohydrate: NR Fat: NR Actual Protein Amount at the end of the study: 14.0% of energy Carbohydrate: 50.5% of energy Fat: 35.7% of energy Dietary Protein Intake Compliance (%): NR		

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		comparator (Content,	(Methods of administration and	of assessment)
		administrator, and duration)	assessment)	
	medication use was	Study Duration/Follow up: 8	·····	
	reported	weeks		
	Supplement use: Use of			
	nutritional supplements			
	that could affect blood			
	pressure were excluded;			
	no other nutritional			
	supplement use was			
	reported			
	Pregnant or lactating:			
	Excluded if current or			
	planned pregnancy prior			
	to end of study or breast-			
	feeding			
	Comparator 2: Control			
	diet			
	N: 127			
	% Female: 45%			
	Mean Age (SD): 49 (11.1)			
	У			
	Race:			
	White: 38%			
	African American: 57%			
	Other: 5%			
	Menopausal status: NR			
	Obesity status: NR			
	Mean BMI (SD): 27.9			
	(3.8) kg/m ²			
	Income level: NR			
	Education level: NR			
	Physical activity level: NR			
	Health status/			
	Considered bastby but			
	with untroated			
	with uniteated			
	Levrentension (22%			
	hypertensive) Those with			
	diabetes and decreased			
	diabetes and decreased			

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	glomerular filtration rate were excluded Medication use: Use of medications that could affect blood pressure were excluded; no other medication use was reported Supplement use: Use of nutritional supplements that could affect blood pressure were excluded; no other nutritional supplement use was reported Pregnant or lactating: Excluded if current or planned pregnancy prior to end of study or breast- facting.			
PMID: 23219108	Study of: Adults	Intervention: Protein diet	Intervention: Protein diet	Kidney function — Serum creatinine
Juraschek 2013 ³⁵ Location/Country: USA HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study Design: RCT (crossover) Funding source: Government Risk of bias score: High	I otal sample N: 164 Overall N: 164 % Female: 45% Mean Age (SD): 53.5 (10.8) y Race/ Ethnicity: African American: 55% Non-Hispanic White: 40% Other: 5% Menopausal status: NR Obesity status: NR Mean BMI (SD): 30.2 (6.1) kg/m ² Income level: NR Education level: Education level: Education less than or equal to a HS diploma: 20.1%	Intended Protein Amount: 25% of energy Carbohydrate: 48% of energy Fat: 27% of energy Baseline Protein Amount: NR Carbohydrate: NR Fat: NR Actual Protein Amount at the end of the study: 25% of energy Carbohydrate: 48% of energy Fat: 27% of energy Dietary Protein Intake Compliance (%): NR. Overall compliance in the trial was 83.8%	How protein was administered: A 7-day menu cycle at 5 caloric levels was developed for each diet. Participants were provided all of their food, which was prepared in research kitchens. For each day of controlled feeding, participants completed a diary in which they indicated whether they ate any nonstudy foods and whether they did not eat all study foods. Protein Assessment Method: For each menu	Measure/Method of Assessment: Serum creatinine was measured from serum specimens using standardized laboratory assays. Kidney function — eGFR Measure/Method of Assessment: eGFR was calculated using the CKD Epidemiology Collaboration (CKD- EPI) cystatin C equation Creatinine-based eGFR was calculated using the CKD-EPI creatinine equation. eGFR measurement (with or without race): with race

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
	Physical activity level:		of each diet sample	
	Participants encouraged	Protein type/source: Mixed	validation meals were	
	to maintain the same		prepared and composited.	
	activity level	Energy balance status:	The nutrient profile of	
	Health status/Co-	Eucaloric	each composite was	
	morbidities: Generally		analyzed for all target	
	healthy	Comparator 1: Carbohydrate	nutrients at Covance	
	Medication use: NR;	diet	Laboratories	
	excluded if taking	luter de d. Dreteir, Areconst	Distant Dratain Intels	
	medications that affect	15% of operation	Compliance: Dertisinente	
	lipid levels	Carbohydrate: 58% of energy	kept a diary in which they	
	Supplement use:	Eat: 27% of energy	listed their consumption of	
	Excluded if unwilling to	rat. 27 % of chergy	nonprotocol foods: in	
	stop taking vitamin and	Baseline Protein Amount: NR	other words, any foods	
	mineral supplements	Carbohydrate: NR	not given by study staff.	
	Pregnant or lactating: NR	Fat: NR		
			Comparator 1:	
		Actual Protein Amount at the	Carbohydrate diet	
		end of the study: 15% of		
		energy	How protein was	
		Carbohydrate: 58% of energy	administered: A 7-day	
		Fat: 27% of energy	menu cycle at 5 caloric	
		Diotony Protoin Intako	evels was developed for	
		Compliance (%): NR Overall	were provided all of their	
		compliance in the trial was	food which was prepared	
		83.8%.	in research kitchens. For	
			each day of controlled	
		Protein type/source: Mixed	feeding, participants	
			completed a diary in	
		Energy balance status:	which they indicated	
		Eucaloric	whether they ate any	
			nonstudy foods and	
		diot	whether they did not eat	
		ulet	all study loous.	
		Intended Protein Amount	Protein Assessment	
		15% of energy	Method: Same as above	
		Carbohydrate: 48% of energy		
		Fat: 37% of energy		

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
		Baseline Protein Amount: NR Carbohydrate: NR Fat: NR Actual Protein Amount at the end of the study: 15% of energy Carbohydrate: 48% of energy Fat: 37% of energy	Dietary Protein Intake Compliance: Participants kept a diary in which they listed their consumption of nonprotocol foods; in other words, any foods not given by study staff. Comparator 2: Unsaturated diet	
		 Dietary Protein Intake Compliance (%): NR. Overall compliance in the trial was 83.8%. Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 6 weeks Crossover details: Number of intakes per participant: 3 Total intakes: 468 Wash out period: 2-4 weeks 	How protein was administered: A 7-day menu cycle at 5 caloric levels was developed for each diet. Participants were provided all of their food, which was prepared in research kitchens. For each day of controlled feeding, participants completed a diary in which they indicated whether they ate any nonstudy foods and whether they did not eat all study foods. Protein Assessment Method: Same as above	
			Dietary Protein Intake Compliance: Participants kept a diary in which they listed their consumption of nonprotocol foods; in other words, any foods not given by study staff.	
PMID: 25844619 Kerstetter	Study of: Adults Total sample N: 208	Intervention: High Protein	Intervention: High Protein	Kidney Function — eGFR
2015"#"				ineasure/inethod of Assessment:

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
Location/Country: USA HDI: Very high Setting: NR Urban/ Rural: NR Study design: RCT (parallel) Funding source: Government, academic Risk of bias score: High	Intervention: High Protein N: 106 % Female: 84% Mean Age (SD): 69.9 (6.1) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 26.1 (3.4) kg/m ² Income level: NR Education level: NR Mean physical activity	Intended Protein Amount: 40 g of protein from the supplement; total daily protein goal NR Carbohydrate: Test food protein NR Fat: Test food protein NR Baseline Protein Amount Least Square Mean (SEM): 73.8 (1.9) g/d Carbohydrate Least Square Mean (SEM): 214.1 (5.2) g/d Fat Least Square Mean	How protein was administered: Participants received a dietary whey protein supplement (protein group; Provon 290; Glambia Nutritionals) that was closely matched for composition, color, kilocalories, sodium, potassium, phosphorus, fiber, and calcium. Protein Assessment	Serum creatinine measured using an ACE Wasserman autoanalyzer, eGFR calculated from serum creatinine, age, sex, and race using the National Kidney Foundation online calculator. eGFR measurement (with or without race): with race
	level score (SD): 6.7 (2.1) Health status/ Comorbidities: Healthy older adults Medication use: Excluded if using long-term chemotherapeutic drugs, aromatase inhibitors or tamoxifen, methotrexate, phenytoin, phenobarbital or inhaled corticosteroids	(SEM): 59.4 (2.1) g/d Actual Protein Amount at the end of the study Least Square Mean (SEM): 90.7 (3.3) g/d Carbohydrate Least Square Mean (SEM): 196.9 (6.6) g/d Fat Least Square Mean (SEM): 55.6 (2.0) g/d	Method: Participants completed a 3-day food record prior to baseline, 6 months, and 18 months and were analyzed using the ESHA Food Processor software program (ESHA Research; version 10.1.0).	
	(greater than 800 ug/day), actively being treated for leukemia or multiple myeloma, a change in thyroid medications, medications known to affect calcium metabolism or use of proton pump inhibitors twice daily Supplement use: Daily	Dietary Protein Intake Compliance (%): NR Protein type/source: Animal; whey supplement Energy balance status: Eucaloric Comparator: Low Protein	Dietary Protein Intake Compliance: Urinary area was a compliance measure. Comparator: Low Protein How protein was administered: Participants received a	
	multivitamin mineral supplement (contained 400 IU of vitamin D); Ca carbonate supplement (300 mg tablets) Pregnant or lactating: NR	Intended Protein Amount: Test food protein NR Carbohydrate: Test food protein NR Fat: Test food protein NR	maltodextrin supplement Maltrin M100; Grain Processing Corp) that was closely matched for composition, color, kilocalories, sodium,	

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
			assessment)	
	Comparator: Low Protoin	Basalina Protain Amount	fibor, and calcium	
	N: 102	Loost Square Mean (SEM):		
	N. 102 % Eemale: 87.3%	72.9(1.8) a/d 1.06(0.03)	Protoin Assassment	
	Mean Age (SD): 70.5	a/ka/d (total daily)	Method: Same as above	
	(6 4) v	Carbohydrate Least Square		
	Race/ Ethnicity: NR	Mean (SFM): 206.2 (5.8) g/d	Dietary Protein Intake	
	Menopausal status: NR	(total daily)	Compliance: Same as	
	Obesity status: NR	Fat Least Square Mean	above	
	Mean BMI (SD): 26.4	(SEM): 61.3 (2.5) g/d (total		
	(4.0) kg/m ²	daily)		
	Income level: NR			
	Education level: NR	Actual Protein Amount at end		
	Mean physical activity	of the study		
	level score (SD): 6.8 (1.9)	Least Square Mean (SEM):		
	Health status/	72.7 (2.4) g/d; 1.05 (0.04)		
	Comorbidities: Healthy	g/kg/d (total daily)		
	older adults	Carbonydrate Least Square		
	if using long torm	(tetal daily)		
	chemotherapeutic drugs	(Iolal dally) Eat Least Square Mean		
	aromatase inhibitors or	(SEM): 58 8 (2.4) d/d (total		
	tamoxifen methotrexate	daily)		
	phenytoin, phenobarbital	dally		
	or inhaled corticosteroids	Dietary Protein Intake		
	(greater than 800 ug/day),	Compliance (%): NR		
	actively being treated for	,		
	leukemia or multiple	Protein type/source: Mixed		
	myeloma, a change in			
	thyroid medications,	Energy balance status:		
	medications known to	Eucaloric		
	affect calcium metabolism			
	or use of proton pump	Study duration: 18 months		
	Supplement use: Dally			
	supplement (contained			
	400 III of vitamin D). Ca			
	carbonate supplement			
	(300 mg tablets)			
	Pregnant or lactating: NR			

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and	Outcome (Measures and methods of assessment)
			assessment)	
PMID: 21194471	Study of: Adults	Intervention: High Protein	Intervention: High	Kidney Function — Serum
Li	Total sample N: 85		Protein	creatinine
2010 ^{*6}		Intended Protein Amount: 2.2		
Location/Country: United	Intervention: High	g per kg of lean body mass;	How protein was	Measure/Method of Assessment:
States	Protein	30% of energy	administered:	Standard laboratory blood serum
HDI: Very high	N: 44	Carbohydrate: 40% of energy	Participants received	assay methods
Setting: Community	% Female: 81.8%	Fat: 30% total energy	isocaloric MR (Formula 1,	
dwelling	Mean Age (SD): 48.9		Herbalife Intl., Los	Kidney Function — Urinary urea
Urban/ Rural: NR	(11.8) y	Baseline Protein Amount	Angeles) with a protein	nitrogen
Study design: RCT	Race/ Ethnicity:	Mean (SD): NR	supplement (Performance	
(parallel)	Asian: 9.1%	Carbohydrate Mean (SD): NR	Protein Powder, Herbalife	Measure/Method of Assessment:
Funding source: Industry	Black: 20.5%	Fat Mean (SD): NR	Intl., Los Angeles)	Twenty-four hour urine samples were
Risk of bias score: High	Caucasian: 59.1%			collected for urinary urea nitrogen.
	Hispanic: 9.1%	Actual Protein Amount at the	Protein Assessment	Urinary urea nitrogen was measured
	Other: 2.2%	end of the study	Method: Protein was	with an enzymatic method.
	Menopausal status: NR	Mean (SD): NR	assessed through	
	Obesity status: Obese	Carbohydrate Mean (SD): NR	qualitative food logs and	
	Mean BMI (SD): 34.7	Fat Mean (SD): NR	reviewed with dietitians at	Kidney Function — Creatinine
	(6.8) kg/m²		follow-ups. Protein intake	clearance
	Income level: NR	Dietary Protein Intake	was measured at each	
	Education level: NR	Compliance (%): NR	follow-up visit; baseline,	Measure/Method of Assessment:
	Physical activity level: NR		week 2, and months 1, 2,	Twenty-four hour urine samples and
	Health status/	Protein type/source: Meal	3, 6, 9, 12.	standard laboratory blood serum
	Comorbidities: Inclusion:	replacement protein: NR,		assay methods
	good health history;	Diet: Mixed	Dietary Protein Intake	
	participants reported to		Compliance: No special	Kidney Function — Serum urea
	be obese; Exclusion type	Energy balance status:	efforts were made to	nitrogen
	2 diabetes or glucose	Eucaloric	assess compliance.	
	Intolerance			Measure/Method of Assessment:
	Medication use: NR	Comparator: Normal Protein	Comparator: Normal	Standard laboratory blood serum
	Supplement use: NR		Protein	assay methods
	Pregnant or lactating: NR	Intended Protein Amount: 1.1		
		g per kg of lean body mass	How protein was	
	Comparator: Normal	(15% total energy)	administered:	
	Protein	Carbonydrate: 55% total	Participants received the	
	IN: 42	Energy	Isocaloric IVIR (Formula 1,	
	% remale: 63.4%	Fat: 30% total energy	Herbalite Intl., Los	
	Mean Age (SD): 49.7	Deseline Destairs Amount	Angeles) with matched	
	(9.1) y	Baseline Protein Amount		
	Race/ Ethnicity:	Mean (SD): NR	containing maltodextrin	
	Asian: 2.4%	Carbonydrate Mean (SD): NR	and flavoring	

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	Black: 19.5% Caucasian: 68.3% Hispanic: 4.9% Other: 4.9% Menopausal status: NR Obesity status: Obese Mean BMI (SD): 34.3 (10.3) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: Inclusion: good health history; participants reported to be obese; Exclusion type 2 diabetes or glucose intolerance Medication use: NR Supplement use: NR	Fat Mean (SD): NR Actual Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD: NR Fat Mean (SD): NR Dietary Protein Intake Compliance (%): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 12 months	Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above	
PMID: 33871558 Murphy 2021 * ³⁶ Location/Country: Ireland HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study design: RCT (parallel) Funding source: Government Risk of bias score: High	Study of: Adults Total sample N: 107 Intervention 1: Leucine- enriched Protein N: 38 % Female: 52.6% Mean Age (SD): 70 (5) y Race/Ethnicity: 100% White Menopausal status: NR Obesity status: NR Mean BMI (SD): 24.8 (3.4) kg/m ² Income level: NR Education level: NR Mean physical activity level (SD): 8354 (4125) steps/day	Intervention 1: Leucine- enriched Protein Intended Protein Amount: 21.2 g in supplemental protein per day; total intake goals NR Carbohydrate: NR Fat: NR Baseline Protein Amount Mean (SD): 84 (26) g/d; 17.1 (3.9) % of energy Carbohydrate Mean (SD): 226 (78) g/d; 45.0 (9.7) % of energy Fat Mean (SD): 82 (32) g/d; 36.3 (7.7) % of energy Actual Protein Amount at the	Intervention 1: Leucine- enriched Protein How protein was administered: Two supplements daily equaling 21.2 g protein per day (including 6.2 g leucine); one was consumed before breakfast and one before their second light meal of the day with habitual diet Protein Assessment Method: Dietary intake was assessed via a 24-h recall using the 5-step multiple-pass method at	 Kidney Function — eGFR Measure/Method of Assessment: Serum creatinine measured using a chemical autoanalyzer with standardized assays. eGFR was derived using CKD Epidemiology Collaboration (CKD-EPI) cystatin C equation. eGFR measurement (with or without race): with race Kidney Function — Serum creatinine Measure/Method of Assessment: Measured using a chemical autoanalyzer with standardized

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and	Outcome (Measures and methods of assessment)
			assessment)	
	Health status/ Comorbidities: Included: Low skeletal	Mean (SD): 100 (23) g/d; 19.6 (3.3) % of energy Carbohydrate Mean (SD): 229	pre-, mid-, and post intervention visits	Kidney Function — Serum cystatin C
	muscle mass; generally	(60) g/d; 44.6 (6.7) % of	Dietary Protein Intake	
	healthy according to responses to a standard health screening questionnaire	energy Fat Mean (SD): 80 (24) g/d; 34.8 (6.3) % of energy	Compliance: Compliance was derived using the self-report supplement logs	Measure/Method of Assessment: Measured using a chemical autoanalyzer with standardized assays
	Excluded: malignancy in the past 5 years, diabetes, advanced renal disease, neuromuscular	Dietary Protein Intake Compliance (%): Median (IQR): 89% (83-94%)	Intervention 2: Normal Protein	Kidney Function — Blood urea nitrogen
	disease, total walking incapacity Medication use: Mean (SD) number of	Protein type/source: Whey protein and a peptide carrier enriched with free leucine	How protein was administered: Two supplements daily equaling 21.2 g protein	Measure/Method of Assessment: Measured using a chemical autoanalyzer with standardized assays
	mediations: 1 (2); Excluded if taking medications that interfere	Energy balance status: Eucaloric	per day (including 6.2 g leucine and 4 g LC n-3 PUFAs); one was	
	with the nutrition intervention - corticosteroids for	Intervention 2: Leucine- enriched Protein +PUFAS	consumed before breakfast and one before their second light meal of	
	systemic use, hormone replacement therapy,	Intended Protein Amount: 21.2 g in supplemental protein	the day with habitual diet	
	insulin, high-dose anti- inflammatories, simvastatin	per day; total intake goals NR Carbohydrate: NR Fat: NR	Protein Assessment Method: Same as above	
	Supplement use: Excluded if consumed LC n-3 PUFA	Baseline Protein Amount Mean (SD): 77 (25) g/d; 17.6	Dietary Protein Intake Compliance: Same as above	
	supplementation and were not willing to cease consumption \geq 6 weeks prior to and for the	(4.5) % of energy Carbohydrate Mean (SD): 200 (66) g/d; 45.6 (8.4) % of energy	Comparator: Normal Protein	
	duration of the 24-wk study Pregnant or lactating: NR	Fat Mean (SD): 69 (25) g/d; 35.4 (8.8) % of energy	How protein was administered: Isocaloric maltodextrin supplement	
	Intervention 2. Louis	Actual Protein Amount at the	Drotoin Accessment	
	enriched Protein+ PUFAs N: 38	Mean (SD): 92 (25) g/d; 19.9 (4.0) % of energy	Method: Same as above	

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and	Outcome (Measures and methods of assessment)
	% Female: 55.3%	Carbohvdrate Mean (SD): 200	assessment) Dietarv Protein Intake	
	Mean Age (SD): 73 (6) y	(57) g/d; 43.5 (8.0) % of	Compliance: Same as	
	Nace/Ethnicity: 100%	Eat Moon (SD): 76 (28) a/d:	above	
	Menonausal status: NR	36 2 (7 8) % of epergy		
	Obesity status: NR	30.2 (7.0) % of energy		
	Mean BMI (SD): 26.7	Dietary Protein Intake		
	$(3.2) \text{ kg/m}^2$	Compliance (%): Median		
	Income level: NR	(IQR): 92% (87-97%)		
	Education level: NR			
	Mean physical activity	Protein type/source: Animal;		
	level (SD): 8257 (3906)	whey protein and a peptide		
	steps/d	carrier enriched with free		
	Health status/	leucine		
	Comorbidities:			
	Included: Low skeletal	Energy balance status:		
	muscle mass; generally	Eucaloric		
	healthy according to	Compository Normal Distain		
	health acrooning	Comparator: Normal Protein		
		Intended Protein Amount: NP		
	Evoluted: malignancy in	Carbobydrate: NR		
	the past 5 years	Eat: NR		
	diabetes advanced renal			
	disease, neuromuscular	Baseline Protein Amount		
	disease, total walking	Mean (SD): 79 (34) g/d: 16.7		
	incapacity	(5.3) % of energy		
	Medication use: Mean	Carbohydrate Mean (SD): 214		
	(SD) number of	(62) g/d; 45.6 (7.5) % of		
	medications: 2 (2);	energy		
	Excluded if taking	Fat Mean (SD): 80 (34) g/d;		
	medications that interfere	37.4 (9.3) % of energy		
	with the nutrition			
	intervention -	Actual Protein Amount at the		
	corticosteroids for	end of the study		
	systemic use, normone	(32) (3D): 83 (23) g/d; 15.2		
	replacement therapy,	(3.2) % Of energy		
	inflammatories	(68) d/d $(40.8 (5.6) % of$		
	simvastatin	energy		
	Invean physical activity level (SD): 8257 (3906) steps/d Health status/ Comorbidities: Included: Low skeletal muscle mass; generally healthy according to responses to a standard health screening questionnaire Excluded: malignancy in the past 5 years, diabetes, advanced renal disease, neuromuscular disease, neuromuscular disease, total walking incapacity Medication use: Mean (SD) number of medications: 2 (2); Excluded if taking medications that interfere with the nutrition intervention - corticosteroids for systemic use, hormone replacement therapy, insulin, high-dose anti- inflammatories, simvastatin	 Protein type/source: Animal; whey protein and a peptide carrier enriched with free leucine Energy balance status: Eucaloric Comparator: Normal Protein Intended Protein Amount: NR Carbohydrate: NR Fat: NR Baseline Protein Amount Mean (SD): 79 (34) g/d; 16.7 (5.3) % of energy Carbohydrate Mean (SD): 214 (62) g/d; 45.6 (7.5) % of energy Fat Mean (SD): 80 (34) g/d; 37.4 (9.3) % of energy Actual Protein Amount at the end of the study Mean (SD): 83 (23) g/d; 15.2 (3.2) % of energy Carbohydrate Mean (SD): 268 (68) g/d; 49.8 (5.6) % of energy 		

Study	Participants	Interventions/Exposure and Comparator (Content,	Intervention (s) (Methods of	Outcome (Measures and methods of assessment)
		administrator, and duration)	administration and assessment)	
	Supplement use: Excluded if consumed LC n-3 PUFA	Fat Mean (SD): 85 (30) g/d; 34.8 (5.4) % of energy		
	were not willing to cease consumption ≥ 6 weeks prior to and for the	Compliance (%): Median (IQR): 93% (87-95%)		
	duration of the 24-wk study	Protein type/source: Mixed		
	Pregnant or lactating: NR	Energy balance status: Eucaloric		
	Comparator: Normal Protein N: 31 % Female: 45.2% Mean Age (SD): 73 (7) y Race/Ethnicity: 100% White Menopausal status: NR Obesity status: NR Mean BMI (SD): 25.4 (2.8) kg/m ² Income level: NR Education level: NR Mean physical activity	Study duration: 24 weeks		
	steps/day Health status/ Comorbidities: Included: Low skeletal muscle mass; generally healthy according to responses to a standard health screening			
	questionnaire Excluded: malignancy in the past 5 years, diabetes, advanced renal disease, neuromuscular disease, total walking incapacity			

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	Medication use: Mean (SD) number of medications: 2 (3); Excluded if taking medications that interfere with the nutrition intervention - corticosteroids for systemic use, hormone replacement therapy, insulin, high-dose anti- inflammatories, simvastatin Supplement use: Excluded if consumed LC n-3 PUFA supplementation and were not willing to cease consumption ≥ 6 weeks prior to and for the duration of the 24-wk study Pregnant or lactating: NB			
PMID: 34098214	Study of: Adults	Intervention: High Protein	Intervention: High Protein	Kidney Function — eGFR
2021* ³⁷ Location/Country: Taiwan/China HDI: High Setting: Community dwelling Urban/ Rural: NR Study design: RCT (parallel) Funding source: Academic, industry Risk of bias score: High	Intervention: High Protein N: 27 % Female: 48.1% Mean Age (SD): 53.4 (8.1) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 25.1 (3.9) kg/m ² Income level: NR Mean education level (SD): 14.1 (2.9) y	Intended Protein Amount: 25% of energy Carbohydrate: NR Fat: NR Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Actual Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	 How protein was administered: Received 10 frozen meals per week for 12 weeks containing 25% energy in protein. Protein Assessment Method: NR Dietary Protein Intake Compliance: Insufficient compliance to the study protocol (e.g low meal complete rate and 	Measure/Method of Assessment: Serum creatinine measured using a chemical autoanalyzer with standardized assays. Measurement methods for eGFR were not reported eGFR cut off (with or without race): NR Kidney Function — Serum creatinine Measured using a chemical autoanalyzer with standardized assays.

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	Mean physical activity level (SD): 1567.3 (1244.9) kcal/wk Health status/ Comorbidities: Excluded:	Dietary Protein Intake Compliance (%): 91.2% Protein type/source: Mixed	vigorous changes of lifestyle) Comparator: Normal Protein	Kidney Function — Blood urea nitrogen Measure/Method of Assessment:
	(1) history of fracture or severe arthritis in recent 6 months, (2) known history of chronic kidney disease stage III and over, i.e. estimated glomerular filtered rate (eGER) < 60	Energy balance status: Eucaloric Comparator: Normal Protein Intended Protein Amount: 15% of energy	How protein was administered: Received 10 frozen meals per week for 12 weeks containing 15% energy in protein.	autoanalyzer with standardized assays Serum creatinine, eGFR, blood urea nitrogen.
	ml/min/1.73 m ² , (3) contraindicated for magnetic resonance	Carbohydrate: NR Fat: NR	Protein Assessment Method: Same as above	
	imaging, (4) using anabolic hormones in the past 3 months, (5) were disability or limited functional ability, (6)	Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	Dietary Protein Intake Compliance: Same as above	
	or uncontrolled diseases, and (6) dementia, cognitive impairment or other sensory impairment that limited	end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR		
	communication and understanding of the study Medication use: Excluded	Dietary Protein Intake Compliance (%): 79.5%		
	those using anabolic hormones Supplement use: NR Pregnant or lactating: NR	Energy balance status: Eualoric		
	Comparator: Normal Protein N: 25 % Female: 44% Mean Age (SD): 54 (8.6) y	Study duration: 12 weeks		

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
	Race/Ethnicity: NR			
	Menopausal status: NR			
	Obesity status: NR			
	Mean BMI (SD): 25.6			
	$(3.8) \text{ kg/m}^2$			
	Income level: NR			
	Mean education level			
	(SD): 15.5 (2.7) v			
	Mean physical activity			
	level (SD): 1954.0			
	(1646.4) kcal/wk			
	Health status/			
	Comorbidities: Excluded:			
	(1) history of fracture or			
	severe arthritis in recent 6			
	months, (2) known history			
	of chronic kidney disease			
	stage III and over, i.e.			
	estimated glomerular			
	filtered rate (eGFR) < 60			
	ml/min/1.73 m ² , (3)			
	contraindicated for			
	magnetic resonance			
	imaging, (4) using			
	anabolic hormones in the			
	past 3 months, (5) were			
	disability or limited			
	functional ability, (6)			
	having advanced, active			
	or uncontrolled diseases,			
	and (6) dementia,			
	cognitive impairment or			
	other sensory impairment			
	that limited			
	communication and			
	understanding of the			
	study			
	Medication use: Excluded			
	those using anabolic			
	hormones			
	Supplement use: NR			

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	Pregnant or lactating: NR			
PMID: 22406907 Wycherley 2012* ³⁸	Study of: Adults Total sample N: 68	Intervention: High Protein	Intervention: High Protein	Kidney Function — Creatinine Clearance
Vycheney 2012* ³⁸ Location/Country: Australia HDI: Very high Setting: Community dwelling Urban/Rural: NR Study design: RCT (parallel) Funding source: Industry Risk of bias score: Moderate	Intervention: High Protein N: 33 % Female: 0% Mean Age (SD): 51.3 (9.4) y Race/Ethnicity: NR Menopausal status: NA Obesity status: 100% overweight or obese Mean BMI (SD): 33.0 (3.9) kg/m ² (total study population mean) Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: Excluded: diabetes, uncontrolled hypertension; history of GI, renal, coronary, metabolic, or hepatic disease or malignancy Medication use: Excluded those taking hypoglycemic medication or drugs which affect insulin sensitivity Supplement use: NR Pregnant or lactating: NA	Intended Protein Amount: 35% of energy; 142 g/d; ~1.30 g/kg/d Carbohydrate: 40% of energy; 135 g/d Fat: 25% of energy (total 53 g/d, saturated 14 g/d) Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Actual Protein Amount at the end of the study: Mean (SD): 0-12 weeks: 131.1 (15.4) g/d; 32.5 (3.3) % of energy 12-52 weeks: 132 (13.9) g/d; 30.7 (3.1) % of energy Carbohydrate Mean (SD): 0-12 weeks: 154.4 (31.8) g/d; 37.4 (3.8) % of energy 12-52 weeks: 157.9 (28.1) g/d; 35.9 (3.4) % of energy Fat Mean (SD): 0-12 weeks: 50.6 (6.5) g/d; 27.3 (3.0) % of energy 12-52 weeks: 60.0 (12.6) g/d; 29.8 (3.6) % of energy Dietary Protein Intake Compliance (%): NR – good	How protein was administered: Participants met with dietitian and received detailed dietary prescription, meal planning advice, and recipe information every 2 weeks for the first 12 weeks. They were supplied with a 2-week provision of diet-specific key foods (60% of energy intake) for the first 12 weeks. Participants met with dietician monthly and received detailed dietary prescription, meal planning advice, and recipe information for remainder of study duration. Protein Assessment Method: Participants kept a daily semi-quantitative food record. Dietary intake was assessed using a computerized database (Foodworks Professional Edition, version 4, 1998; Xyris	Clearance Measure/Method of Assessment: Creatinine clearance was calculated as (urine creatinine (mmol-1) x urine volume (ml))/(plasma creatinine (mmol-1) x minutes) and corrected for body surface.
	% Female: 0%		Australia) based on the	
	Mean Age (SD): 50.2 (9.3) y	Protein type/source: Mixed	analysis of 3 non- consecutive days (1	

Study	Participants	Interventions/Exposure and	Intervention (s)	Outcome (Measures and methods
		Comparator (Content,	(Methods of	of assessment)
		administrator, and duration)	administration and	
		-	assessment)	
	Race/Ethnicity: NR	Energy balance status:	weekend day and 2	
	Menopausal status: NA	Hypocaloric	weekdays) of each 2-	
	Obesity status: 100%		week period. The intake	
	overweight or obese	Comparator: Low Protein	was calculated as an	
	Wean BIVII (SD): 33.0	Intended Dratein Americati	average of the 2-week	
	(3.9) Kg/m² (lotal sludy	17% of one rate 29 and 0.05	diel record data blocks for	
	population mean)	17% of energy; 88 g/d; ~0.85	U-12 weeks and 12-52	
		g/Kg/d	weeks.	
	Education level: NR	Carbonydrate: 58% of energy;	Distant Dratain Intaka	
	Hoolth status/	190 g/u Eat: 25% of operay (total 51	Compliance: Food	
	Comorbidition: Evoluded:	ral. 25% of energy (lotal 51	compliance. Food	
	diabetes uncontrolled	g/u, saturateu 14 g/u)	CHECKIISI	
	hypertension: history of	Baseline Protein Amount	Comparator: Low Protein	
	Gl renal coronary	Mean (SD) [.] NR		
	metabolic, or hepatic	Carbohydrate Mean (SD): NR	How protein was	
	disease or malignancy	Fat Mean (SD): NR	administered:	
	Medication use: Excluded		Participants met with	
	those taking	Actual Protein Amount at the	dietitian and received	
	hypoglycemic medication	end of the study	detailed dietary	
	or drugs which affect	Mean (SD):	prescription, meal	
	insulin sensitivity	0-12 weeks: 82.7 (6.7) a/d:	planning advice, and	
	Supplement use: NR	20.5 (1.4) % of energy	recipe information every 2	
	Pregnant or lactating: NA	12-52 weeks: 83.3 (10.3) g/d;	weeks for the first 12	
	5 5	20.4 (1.0) % of energy	weeks. They were	
		Carbohydrate Mean (SD):	supplied with a 2-week	
		0-12 weeks: 208.4 (16.3) g/d;	provision of diet-specific	
		51.0 (3.6) % of energy	key foods (60% of energy	
		12-52 weeks: 195.2 (23.4)	intake) for the first 12	
		g/d; 47.3 (3.9) % of energy	weeks. Participants met	
		Fat Mean (SD):	with dietician monthly and	
		0-12 weeks: 46.7 (7.5) g/d;	received detailed dietary	
		25.0 (3.3) % of energy	prescription, meal	
		12-52 weeks: 52.2 (8.7) g/d;	planning advice, and	
		27.7 (3.2) % of energy	recipe information for	
			remainder of study	
		Dietary Protein Intake	duration.	
		Compliance (%): NR – good		
		compliance rate stated	Protein Assessment	
			Method: Same as above	
		Protein type/source: Mixed		

Study	Participants	Interventions/Exposure and Comparator (Content, administrator, and duration)	Intervention (s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
		Energy balance status: Hypocaloric Study duration: 52 weeks	Dietary Protein Intake Compliance: Same as above	

Abbreviations: AER = albumin excretion rate; BMI = Body Mass Index; CKD = chronic kidney disease; d = days; DASH = Dietary Approaches to Stop Hypertension; e.g. = exempli gratia; eGFR = estimated glomerular filtration rate; g = grams; HDI = human development index; IU = international units; kg = kilogram; $kg/m^2 = kilogram$ per meters squared; kcal = kilocalories; LC n-3 PUFA = n-3 long chain polyunsaturated fatty acids; mg = milligrams; NA = not applicable; NR = not reported; PMID = PubMed Identification Number; PUFA = polyunsaturated fatty acids; RCT = randomized controlled trial; RoB = Risk of Bias; SD = Standard deviation; SE = standard error; SEM = standard error of the mean; USA = United States of America; wk = week; y = year

Note: * Studies overlap KQs

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
			of assessment)	methods of assessment)
PMID: 33203389	Study of: Adults	Tertile 1: Lower protein intake	Protein Assessment	Kidney Function — Incident
Alvirdizadeh	Total sample N: 1630		Method: The dietary intakes	CKD
2020 ³⁹		Baseline Protein Amount	were assessed using a valid	
Location/Country: Iran	Tertile 1: Lower protein	Mean (SD): 50.36 (9.83) g	and reliable semi-quantitative	Measure/Method of
HDI: High	intake	Carbohydrate Mean (SD):	FFQ by trained dietitians	Assessment: CKD derived
Setting: Community dwelling	N: 544	58.1 (7.6) % of energy	during face-to-face	from MDRD equation with
Urban/ Rural: Urban	% Female: 55.7%	Fat Mean (SD): 31. (7.7) %	interviews. The United States	serum creatinine, using
Study Design: Prospective	Mean Age (SD): 43.3 (11.3) y	energy	Department of Agriculture	eGFR < 60 ml/min/1.73 m ²
cohort study	Race/ Ethnicity: NR		food composition table was	
Funding source:	Menopausal status: NR	Protein Amount at the end of	applied. Protein intake was	eGFR CKD cut off point:
Government	Obesity status: NR	the study	only assessed at baseline	eGFR< 60 ml/min/1.73m ²
Risk of bias score: High	Mean BMI (SD): 27.4 (4.5)	Mean (SD): NR	-	
-	kg/m ²	Carbohydrate Mean (SD): NR		eGFR measurement (with or

Table C4. Evidence table for Kidney Disease Non-Randomized Controlled Trials

HDI: High	intake	Carbohydrate Mean (SD):	FFQ by trained dietitians	Assessment: CKD derived
Setting: Community dwelling	N: 544	58.1 (7.6) % of energy	during face-to-face	from MDRD equation with
Urban/ Rural: Urban	% Female: 55.7%	Fat Mean (SD): 31. (7.7) %	interviews. The United States	serum creatinine, using
Study Design: Prospective	Mean Age (SD): 43.3 (11.3) y	energy	Department of Agriculture	eGFR < 60 ml/min/1.73 m ²
cohort study	Race/ Ethnicity: NR		food composition table was	
Funding source:	Menopausal status: NR	Protein Amount at the end of	applied. Protein intake was	eGFR CKD cut off point:
Government	Obesity status: NR	the study	only assessed at baseline	eGFR< 60 ml/min/1.73m ²
Risk of bias score: High	Mean BMI (SD): 27.4 (4.5)	Mean (SD): NR		
_	kg/m ²	Carbohydrate Mean (SD): NR		eGFR measurement (with or
	Income level: NR	Fat Mean (SD): NR		without race): with race
	Education level: NR			
	Physical activity level: 68.2%	Tertile 2: Moderate protein		
	low physical activity	intake		
	Health status/ Comorbidities:			
	No history of myocardial	Baseline Protein Amount		
	infarction or stroke or CKD	Mean (SD): 74.23 (6.43) g		
	Medication use: NR	Carbohydrate Mean (SD):		
	Supplement use: NR	57.6 (6.8) % of energy		
	Pregnant or lactating: NR	Fat Mean (SD): 31.4 (6.9) %		
		of energy		

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
	Tortilo 2: Moderate protein			methous of assessment)
	intake	Protein Amount at the end of		
	N: 542	the study		
	% Female: 52.8%	Mean (SD): NR		
	Moon Age (SD): 42.8 (10.0) v	Carbobydrata Maan (SD): NP		
	Paco/ Ethnicity: NP	Eat Moon (SD): NP		
	Mononousol status: NP	Fat Mean (SD). NR		
	Obosity status: NP	Tortilo 3: Higher protein		
	Moon BMI (SD): 27.6 (4.7)	intako		
	kg/m^2	lillane		
	Income level NR	Baseline Protein Amount		
	Education level: NR	Mean (SD): 114.44 (29.42) g		
	Physical activity level: 65.2%	Carbohydrate Mean (SD):		
	low physical activity	57.5 (7.3) % of energy		
	Health status/ Comorbidities:	Fat Mean (SD): 30.5 (6.5) %		
	no history of myocardial	of energy		
	infarction or stroke or CKD	55		
	Medication use: NR	Protein Amount at the end of		
	Supplement use: NR	the study		
	Pregnant or lactating: NR	Mean (SD): NR		
	5 5	Carbohydrate Mean (SD): NR		
	Tertile 3: Higher protein	Fat Mean (SD): NR		
	intake			
	N: 544	Protein source/type: Mixed		
	% Female: 43%	51		
	Mean Age (SD): 42.4 (11.4) v	Energy balance: Eucaloric		
	Race/ Ethnicity: NR			
	Menopausal status: NR	Study duration: 6 years		
	Obesity status: NR	, ,		
	Mean BMI (SD): 27.6 (4.7)			
	kg/m ²			
	Income level NR			
	Education level: NR			
	Physical activity level: 67.1%			
	low physical activity			
	Health status/ Comorbidities:			
	no history of myocardial			
	infarction or stroke or CKD			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
PMID: 29439930	Study of: Adults	Arm 1: Low urine urea	Protein Assessment	Kidney Function — eGFR
Cirillo	Total sample N: 4307	nitrogen (lowest quintile)	Method: Overnight urinary	

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
2018 ⁴⁰			sodium and potassium were	Measure/Method of
Study 2018 ⁴⁰ Location/Country: Italy HDI: Very high Setting: Community dwelling Urban/ Rural: NR Study Design: Prospective cohort study Funding source: Government, pharmaceutical Risk of bias score: High	Participants Arm 1: Low urine urea nitrogen (lowest quintile) N: 861 % Female: 54.7% Mean Age (SD): 52 (20) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: 12.3% Obese Mean BMI (SD): 25.5 (4.2) kg/m ² Income level: NR Education level: NR Median physical activity level (95% CI): 0.10 (0.19-0.25) h/d Health status/ Comorbidities: Hypercholesterolemia: 29.3% Diabetes: 4.6% Previous cardiovascular disease: 6.4% Medication use: NR Supplement use: NR Pregnant or lactating: NR Arm 2: Non-low urine urea nitrogen (quintile 2-5)	Intervention(s) (Content) Baseline Protein Amount Mean (SD): 34.0 g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Non-low urine urea nitrogen (quintile 2-5) Baseline Protein Amount Mean (SD): UUN quintile 2: 52.7 g/d UUN quintile 3: 65.0 g/d UUN quintile 3: 65.0 g/d UUN quintile 4: 78.6 g/d UUN quintile 5: 117.0 g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR	Intervention (s) (Methods of assessment) sodium and potassium were used as indices of their dietary intake. Protein intake was only assessed at baseline.	Outcome (Measures and methods of assessment) Measure/Method of Assessment: eGFR was calculated by the Chronic Kidney Disease Epidemiology Collaboration equation with serum creatinine. eGFR measurement (with or without race): with race
	Arm 2: Non-low urine urea nitrogen (quintile 2-5)	Mean (SD): NR Carbohydrate Mean (SD): NR Eat Mean (SD): NP		
	% Female: 54.8%			
	Mean Age (SD): 49 (17) y Race/ Ethnicity: NR	Protein type/source: Mixed		
	Menopausal status: NR Obesity status: 22.1% Obese	Energy balance: Eucaloric		
	Mean BMI (SD): 27.0 (4.4) kg/m ²	Study duration: 15.9 y		
	Income level NR Education level: NR			
	Median physical activity level (95% CI): 0.10 (0.28-0.32) h/d			
	UUN quintile 2:			

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	Hypertension: 34.1% Hypercholesterolemia: 31.3% Diabetes: 4.2% Previous cardiovascular disease: 5.5% UUN quintile 3: Hypertension: 31.9% Hypercholesterolemia: 29.9% Diabetes: 3.4% Previous cardiovascular disease: 5.4% UUN quintile 4: Hypertension: 33.7% Hypercholesterolemia: 29.2% Diabetes: 5.9% Previous cardiovascular disease: 4.7% UUN quintile 5: Hypertension: 36.1% Hypercholesterolemia: 32.7% Diabetes: 8.0% Previous cardiovascular disease: 3.7% Medication use: NR Supplement use: NR			
PMID: 30579675 Farhadnejad 2019 ⁴¹ Location/Country: Iran HDI: High Setting: Community dwelling Urban/ Rural: Urban Study Design: Prospective cohort study Funding Source: Academic Risk of bias score: High	Study of: Adults Total sample N: 1797 Tertile 1: Lower Low- Carbohydrate High-Protein Diet Score N: 691 % Female: 41.4% Mean Age (SD): 39.0 (12.5) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 26.9 (4.8) kg/m ² Income level: NR Education level: NR	Tertile 1: Lower Low- Carbohydrate High-Protein Diet Score Baseline Protein Amount: 3 (1-4) score Carbohydrate: NR Fat: NR Protein Amount at the end of the study Mean (SD): 12.9 (1.7) % of energy Carbohydrate Mean (SD): 64.1 (4.0) % of energy Fat Mean (SD): 25.6 (4.2) % of energy	Protein Assessment Method: Food intakes of participants over the previous year were assessed using a valid and reliable semiquantitative food- frequency questionnaire, by expert interviewers in the third survey of the TLGS as baseline phase of the present study. This food- frequency questionnaire consisted of 168 food items commonly consumed by Iranians, with standard	Kidney Function — Incident CKD Measure/Method of Assessment: Measured using eGFR < 60 ml/min/1.73 m ² from MDRD equation with serum creatinine. eGFR CKD cut off point: eGFR<60 mL/minute/1.73 m2 eGFR measurement (with or without race): with race

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
			or assessment)	methods of assessment)
	Median physical activity level	Tautile O. Madagata Laws	serving size. Their	
	(IQR): 46.1 (31.7-56.4) MET-	lertile 2: Moderate Low-	consumption frequency for	
	h/week	Carbohydrate High-Protein	each food item during	
	Health status/ Comorbidities:	Diet Score	the previous year on a daily,	
	Diabetes: 11.5%		weekly, or monthly basis.	
	Hypertension: 19.0%	Baseline Protein Amount: 7	The portion sizes of	
	Medication use: NR	(7-8) score	consumed foods were	
	Supplement use: NR	Carbohydrate: NR	reported in household	
	Pregnant or lactating: NR	Fat: NR	measures and then	
			converted to grams. The	
	Tertile 2: Moderate Low-	Protein Amount at the end of	United States Department of	
	Carbohydrate High-Protein	the study	Agriculture (USDA) Food	
	Diet Score	Mean (SD): 13.0 (2.2) % of	Composition Table (FCT)	
	N: 685	energy	was used. For protein, those	
	% Female: 56%	Carbohydrate Mean (SD):	with the highest and lowest	
	Mean Age (SD): 37.1 (12.1) y	54.5 (5.2) % of energy	protein intakes received 4	
	Race/ Ethnicity: NR	Fat Mean (SD): 35.0 (6.5) %	and 0 points, respectively.	
	Menopausal status: NR	of energy	Protein intake was only	
	Obesity status: NR		assessed at baseline.	
	Mean BMI (SD): 26.7 (4.7)	Tertile 3: Higher Low-		
	kg/m²	Carbohydrate High-Protein		
	Income level NR	Diet Score		
	Education level: NR			
	Median physical activity level	Baseline Protein Amount: 10		
	(IQR): 49.1 (37.3-59.7) ME1-	(9-11)		
	h/week	Carbohydrate: NR		
	Health status/ Comorbidities:	Fat: NR		
	Diabetes: 11.0%			
	Hypertension: 15.9%	Protein Amount at the end of		
	Medication use: NR	the study		
	Supplement use: NR	Mean (SD): 15.8 (2.1) % of		
	Pregnant or lactating: NR	energy		
		Carbonydrate Mean (SD):		
	lertile 3: Higher Low-	51.0 (4.1) % of energy		
	Carbohydrate High-Protein	Fat Mean (SD): 35.5 (4.3) %		
	Diet Score	or energy		
	N: 421	Ductoin truck (c.c. 14)		
		Protein type/source: Mixed		
	Mean Age (SD): 36.6 (12.3) y			
	Race/ Ethnicity: NR	Energy balance status:		
	Menopausal status: NR	Eucaloric		
	Obesity status: NR			
		Study duration: 6.1 years		

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
PMID: 19443643 Halbesma 2009 ⁴² Location/Country: Netherlands HDI: Very high Setting: Community dwelling Urban/ Rural: NR Study Design: Prospective cohort study Funding Source: Nonprofit Risk of bias score: Very high	Mean BMI (SD): 26.6 (4.8) kg/m ² Income level NR Education level: NR Median physical activity level (IQR): 49.2 (49.1-67.4) MET- h/week Health status/ Comorbidities: Diabetes: 12.6% Hypertension: 18.3% Medication use: NR Supplement use: NR Pregnant or lactating: NR Study of: Adults Total sample N: 8461 Quintile 1: 0.26-0.99 g of protein/kg/d (combined male and female) N: 1692 % Female: NR Mean Age (SD): 49.0 (13.3) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 24.6 (3.8) kg/m ² Income level: NR Education level: NR Health status/ Comorbidities: Cardiovascular disease history: 13.8% Medication use: NR Pregnant or lactating: NR Quintile 2: 0.96 to 1.13 g of protein/kg/d (combined male and female)	Quintile 1: 0.26-0.99 g of protein/kg/d (combined male and female) Baseline Protein Amount Mean (SD): 0.26-0.99 g of protein/kg/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Quintile 2: 0.96 to 1.13 g of protein/kg/d (combined male and female) Baseline Protein Amount: Mean (SD: 0.96 to 1.13 g of protein/kg/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of	of assessment) Protein Assessment Method: Protein intake was calculated by the method of Maroni and colleagues, in each of the two 24-h urine collections obtained during the first screening round. Protein intake was only assessed at baseline.	Methods of assessment) Kidney Function — eGFR Measure/Method of Assessment: Derived using the MDRD study equation with serum creatinine. eGFR measurement (with or without race): with race
	N: 1692	Mean (SD): NR		
Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
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	% Formala: ND	Carbabydrata Maan (SD): ND	of assessment)	methods of assessment)
	$\frac{1}{2}$ Female. NK	Eat Moon (SD): NR		
	Reac/ Ethnicity: NP	Fat Mean (SD). NR		
	Monopolical status: NP	Quintile 3: 1 10 to 1 26 g of		
		protoin/kg/d (combined male		
	Moon BMI (SD): 25.3 (2.6)	and fomate)		
	ka/m^2	and lemale)		
	Income level: NR			
		Baseline Protein Amount:		
	Physical activity level: NR	mean: 1 10 to 1 26 d of		
	Health status/ Comorbidities:	protein/kg/d		
	Cardiovascular disease	Carbohydrate Mean (SD): NR		
	history: 12 1%	Fat Mean (SD): NR		
	Medication use: NR			
	Supplement use: NR	Protein Amount at the end of		
	Pregnant or lactating: NR	the study		
	· · · g. · · · · · · · · · · · · · · · ·	Mean (SD): NR		
	Quintile 3: 1.10 to 1.26 g of	Carbohydrate Mean (SD): NR		
	protein/kg/d (combined male	Fat Mean (SD): NR		
	and female)			
	N: 1693	Quintile 4: 1.22 to 1.42 g of		
	% Female: NR	protein/kg/d (combined male		
	Mean Age (SD): 49.7 (12.9) y	and female)		
	Race/ Ethnicity: NR			
	Menopausal status: NR	Baseline Protein Amount1.22		
	Obesity status: NR	to 1.42 g of protein/kg/d		
	Mean BMI (SD): 25.7 (3.8)	Carbohydrate Mean (SD): NR		
	kg/m ²	Fat Mean (SD): NR		
	Income level: NR			
	Education level: NR	Protein Amount at the end of		
	Physical activity level: NR	the study		
	Health status/ Comorbidities:	Mean (SD): NR		
	Cardiovascular disease	Carbohydrate Mean (SD): NR		
	history: 11.9%	Fat Mean (SD): NR		
	Medication use: NR			
	Supplement use: NR	Quintile 5: 1.38 to 3.27 g of		
	Pregnant or lactating: NR	protein/kg/d (combined male		
	protoin/kg/d (combined melo	Pagalina Drotain Amount: 1.29		
	and fomale)	to 2.27 g of protoin/kg/d		
		(combined male and formale)		
	% Female: NR	Carbohydrate Mean (SD) NR		
	Medication use: NR Supplement use: NR Pregnant or lactating: NR Quintile 4: 1.22 to 1.42 g of protein/kg/d (combined male and female) N: 1692 % Female: NR	Quintile 5: 1.38 to 3.27 g of protein/kg/d (combined male and female) Baseline Protein Amount: 1.38 to 3.27 g of protein/kg/d (combined male and female) Carbohydrate Mean (SD): NR		

Mean Age (SD): 50.0 (12.4) y Fat Mean (SD): NR Race/ Ethnicity: NR Protein Amount at the end of Menopausal status: NR Protein Amount at the end of	,
Race/ Ethnicity: NR Menopausal status: NR Protein Amount at the end of Obsolity atotus: NR the study	
Menopausal status: NR Protein Amount at the end of	
Obogity status: NP I the study	
Upesity status, NR the study	
Mean BMI (SD): 26.6 (4.0) Mean (SD): NR	
kg/m ² Carbonydrate Mean (SD): NR	
Education level: NR Fal Mean (SD): NR	
Physical activity level: NP Protein type/source: Mixed	
Health status/ Comorbidities:	
Cardiovascular disease Energy balance status:	
history: 9.7% Eucaloric	
Medication use: NR	
Supplement use: NR Study duration: 6.4 y	
Pregnant or lactating: NR	
Quintile 5: 1.38 to 3.27 g of	
protein/kg/d (combined male	
and female)	
N: 1692	
% Female: NR	
Mean Age (SD): 50.2 (11.4) y	
Race /Ethnicity: NR	
Menopausal status: NR	
Obesity status: NR	
(4.2) ka/m ²	
(4.2) Kg/m Income level: NR	
Education level: NR	
Physical activity level: NR	
Health status/ Comorbidities:	
Cardiovascular disease	
history: 10.1%	
Medication use: NR	
Supplement use: NR	
Pregnant or lactating: NR	
PMID: 28065493 Study of: Adults Quintile 1: Protein intake 41.1 Protein Assessment Kidney Function — Inclusion	ident
Haring I otal sample N: 11952 (7.3) g/d Method: Interviewer- CKD	
2017 administered, bb-item tood	
Location/Country. USA Quintine 1: Protein intake Baseline Protein Amount I requency questionnaire. The Measure/Method of HDI: Vonv bide	
Setting: Community dwelling N: 2391 Carbohydrate Mean (SD): Subjects at visit 1 (baseline calculated using the 200	a
Urban/ Rural: Other % Female: 64.2% 135.2 (54.3) d/d 1987–1989) and visit 3 Chronic Kidney Disease	3

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
Study Design: Prospective cohort study Funding Source: Government Risk of bias score: High	Mean Age (SD): 53.8 (5.8) y Race/ Ethnicity: Black: 23.3% White: 76.7% Menopausal status: NR Obesity status: NR Mean BMI (SD): 26.6 (5.1) kg/m ² Income level: NR Education level: Less than high school: 24.8% High school or equivalent: 45.3% College or above: 29.9% Mean physical activity level (SD): Baecke's physical activity index: 2.4 (0.8) Health status/ Comorbidities: Hypertension: 30.7% Medication use: Antihypertensive medication: 22.6%, Lipid lowering medication: 2.1% Supplement use: NR Pregnant or lactating: NR	Fat Mean (SD): 35.8 (11.3)g/dProtein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NRQuintile 2: Protein intake 57.2 (3.6) g/dBaseline Protein Amount Mean (SD): 57.2 (3.6) g/d Carbohydrate Mean (SD): 155.7 (55.1) g/d Fat Mean (SD): 47.7 (13.0) g/dProtein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Carbohydrate Mean (SD): NR Carbohydrate Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NRQuintile 3: Protein intake 69.0 (3.3) g/d	of assessment) (1993–1995). Protein intake was assessed at baseline and visit 3.	methods of assessment) Epidemiology (CKD-EPI) equation using serum creatinine. eGFR CKD cut off point: eGFR<60 mL/minute/1.73 m2 eGFR measurement (with or without race): with race
	Quintile 2: Protein intake 57.2 (3.6) g/d N: 2390 % Female: 56.9% Mean Age (SD): 53.8 (5.7) y Race/ Ethnicity: Black: 22.6% White: 77.4% Menopausal status: NR Obesity status: NR Mean BMI (SD): 26.8 (4.9) kg/m ² Income level: NR Education level: Less than high school: 20.3%	Baseline Protein Amount Mean (SD): 69.0 (3.3) g/d Carbohydrate Mean (SD): 178.4 (59.6) g/d Fat Mean (SD): 56.6 (14.7) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Quintile 4 : Protein intake 82.3 (4.5) g/d		

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
Study	Participants High school or equivalent: 42.9% College or above: 36.8% Mean physical activity level (SD): Baecke's physical activity index: 2.5 (0.8) Health status/ Comorbidities: Hypertension: 30.8% Medication use: Antihypertensive medication: 22.2% Lipid lowering medication 2.3% Supplement use: NR Pregnant or lactating: NR Quintile 3: Protein intake 69.0 (3.3) g/d N: 2391 % Female: 57.8% Mean Age (SD): 53.8 (5.7) y Race/ Ethnicity: Black: 22.7% White: 77.3% Menopausal status: NR Obesity status: NR Mean BMI (SD): 27.1 (5.0) kg/m ² Income level: NR Education level: Less than high school: 18.9% High school or equivalent: 40.2% College or above: 41.0%	Intervention(s) (Content) Baseline Protein Amount Mean (SD): 82.3 (4.5) g/d Carbohydrate Mean (SD): 199.9 (62.2) g/d Fat Mean (SD): 66.2 (16.6) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Quintile 5: Protein intake 109.5 (18.3) g/d Baseline Protein Amount Mean (SD): 109.5 (18.3) g/d Carbohydrate Mean (SD): 244.6 (76.0) g/d Fat Mean (SD): 87.7 (25.2) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	40.2% College or above: 41.0% Mean physical activity level	Energy balance status: Eucaloric		
	(SD): Baecke's physical activity index: 2.5 (0.8) Health status/ Comorbidities: Hypertension: 32.6% Medication use: Antibypertensive medication:	Study duration: 25 years		
	24.5%			

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and methods of assessment)
	Lipid lowering medication:			
	2.4%			
	Supplement use: NR			
	Pregnant or lactating: NR			
	5 5			
	Quintile 4: Protein intake			
	82.3 (4.5) g/d			
	N: 2390			
	% Female: 55.4%			
	Mean Age (SD): 53.8 (5.7) y			
	Race/ Ethnicity:			
	Black: 22.1%			
	White: 77.9%			
	Menopausal status: NR			
	Obesity status: NR			
	Mean BMI (SD): 27.2 (5.0)			
	kg/m²			
	Income level: NR			
	Education level:			
	Less than high school. 10.9%			
	College or above: 40.8%			
	Mean physical activity level			
	(SD): Baecke's physical			
	activity index: 2.5 (0.8)			
	Health status/ Comorbidities:			
	Hypertension: 31.0%			
	Medication use:			
	Antihypertensive medication:			
	23.1%			
	Lipid lowering medication			
	2.0%			
	Supplement use: NR			
	Pregnant or lactating: NR			
	Quintile 5: Protein intake			
	109.5 (18.3) g/d			
	N: 2390			
	% Female: 47.0%			
	Mean Age (SD): 53.7 (5.6) y			
	Race/ Ethnicity:			
	Black: 23.5%			

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	White: 76.5% Menopausal status: NR Obesity status: NR Mean BMI (SD): 27.6 (5.1) kg/m ² Income level: NR Education level: Less than high school: 19.1% High school or equivalent: 40.1% College degree or above: 40.8% Mean physical activity level (SD): Baecke's physical activity index: 2.5 (0.8) Health status/ Comorbidities: Hypertension: 28.7% Medication use: Antihypertensive medication: 20.3% Lipid lowering medication 2.1% Supplement use: NR Pregnant or lactating: NR			
PMID: 27935525 Herber-Gast 2016 ⁴⁴ Location/Country: Netherlands HDI: Very high Setting: Community dwelling Urban/ Rural: NR Study Design: Prospective cohort study Funding Source: Nonprofit Risk of bias score: High	Study of: Adults Total sample N: 3763 Tertile 1: Lower energy- adjusted total dairy intake N: 1213 % Female: 42.1% Mean Age (SD): 45 (9) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: 10% Obese Mean BMI (SD): 25.5 (3.7) kg/m ² Income level: NR Education level: Low education: 46.0% Physical activity level: Inactive: 4.6%	Tertile 1: Lower energy- adjusted total dairy intake Baseline Protein Amount Mean (SD): 76.7 (9.6) g/d Carbohydrate: NR Fat Mean (SD): Monounsaturated fat: 33.8 (5.4) g/d Polyunsaturated fat: 17.6 (4.0) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	Protein Assessment Method: Diet was assessed at rounds 2–4 with the use of a self- administered semiquantitative food- frequency questionnaire (FFQ) that was developed for the European Prospective Investigation into Cancer and Nutrition study. Participants reported their usual in- takes of 178 food and beverage items over the previous 12 mo. Colored photographs were used to facilitate the estimation of portion sizes, and the seasonal variation in food consumption was taken into	Kidney function — eGFR Measure/Method of Assessment: Cystatin C was based on a particle- enhanced turbidimetric immunoassay; eGFR was estimated with the use of the Chronic Kidney Disease Epidemiology Collaboration equation with cystatin C. eGFR measurement (with or without race): with race

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and methods of assessment)
Study	ParticipantsModerately inactive: 20.4%Moderately active: 27.1%Active: 47.9%Health status/ Comorbidities:Hypertension: 30.1%Hypercholesterolemia: 23.1%Diabetes: 1.2%Obesity: 10.0%Medication use: NRSupplement use: NRPregnant or lactating:pregnant women werecensored at the round inwhich they reported to bepregnantTertile 2: Moderate energy-adjusted total dairy intakeN: 1297% Female: 48.8%Mean Age (SD): 45 (10) yRace/ Ethnicity: NRMenopausal status: NRObesity status: 7.2% ObeseMean BMI (SD): 26.7 (4.7)kg/m²Income level NREducation level:Low education: 39.5%Physical activity level:Inactive: 2.7%Moderately inactive: 17.1%Moderately active: 26.7%Active: 53.5%Health status/ Comorbidities:Hypercholesterolemia: 21.2%Diabetes: 1.0%Obesity: 7.2%Medication use: NRSupplement use: NRSupplement use: NRSupplement use: NR	Intervention(s) (Content)Tertile 2: Moderate energy- adjusted total dairy intakeBaseline Protein Amount Mean (SD): 81.4 (8.7) g/d Carbohydrate: NR Fat Mean (SD): Monounsaturated fat: 32.7 (4.7) g/dPolyunsaturated fat: 32.7 (4.7) g/dPolyunsaturated fat: 16.9 (3.7) g/dProtein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NRTertile 3: Higher energy- adjusted total dairy intakeBaseline Protein Amount Mean (SD): 88.8 (9.6) g/d Carbohydrate: NR Fat Mean (SD): Monounsaturated fat: 30.8 (4.7) g/dPolyunsaturated fat: 15.4 (3.4) g/dProtein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): Monounsaturated fat: 15.4 (3.4) g/dProtein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NRProtein type/source: MixedEnergy balance status: EucaloricDial of the study: Eucaloric	account. The consumption of food items (in grams per day) and nutrient intakes were calculated with the use of an extended version of the Dutch Food Composition database of 1996. Protein intake was assessed at study visits 2 (baseline for this analysis), 3, and 4.	outcome (Measures and methods of assessment)
		 _ ,		

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	Tertile 3: Higher energy- adjusted total dairy intake N: 1253 % Female: 64.3% Mean Age (SD): 45 (10) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: 9.1% Obese Mean BMI (SD): 25.3 (3.6) kg/m ² Income level NR Education level: Low education: 41.2% Physical activity level: Inactive: 2.7% Moderately inactive: 15.9% Moderately active: 26.5% Active: 54.9% Health status/ Comorbidities: Hypertension: 26.6% Hypercholesterolemia: 21.4% Diabetes: 1.5% Obesity: 9.1% Medication use: NR Supplement use: NR			
PMID: 30115136 Hruby 2018 ⁴⁵ Location/Country: USA HDI: Very high Setting: Community dwelling Urban/ Rural: NR Study Design: Prospective cohort study Funding Source: Nonprofit, government Risk of bias score: High	Study of: Adults Total sample N: 3066 Quartile 1: Average 62.7 g of protein/d N: 940 % Female: 40% Mean Age (SE): 55.1 (0.3) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: 23.8% Obese Mean BMI (SE): 26.7 (0.2) kg/m ² Income level: NR Education level: NR	Quartile 1: Average 62.7 g of protein/d Baseline Protein Amount Median: 62.7 g/d Carbohydrate Mean: 253.9 g/d Fat Mean: 59.8 g/d Protein Amount at the end of the study Median: NR Carbohydrate Mean: NR Fat Mean: NR	Protein Assessment Method: The Harvard semi- quantitative, 126-item FFQ. Protein intake (g/d) was adjusted for total energy intake using the residual method. Quartile categories were created of the average of the reported intake at the beginning and end of each exam interval (e.g. mean of intake reported at exams 5 and 6, for change in outcome between exams 5 and 6). Protein was measured in	Kidney function — eGFR Measure/Method of Assessment: Derived using the CKD Epidemiology Collaboration Equation with serum creatinine. eGFR measurement (with or without race): without race
	Mean physical activity level (SE): 35.3 (0.2) MET-h/wk	Quartile 2: Average 73.7 g of protein/d	exams five through nine, and each exam takes four years.	

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	Health status/ Comorbidities: Treatment for hypertension:	Baseline Protein Amount	· · · · · · · · · · · · · · · · · · ·	······································
	Treatment of CVD: 25.0%	Carbohydrate Mean: 242.8		
	Treatment of diabetes: 2.0% History of cancer: 16.0%	g/d Fat Mean: 63.1 g/d		
	Nedication use: NR Supplement use: NR	Protein Amount at the end of		
	Pregnant or lactating: NR	the study		
		Median: NR		
	Quartile 2: Average 73.7 g	Fat: NR		
	of protein/d			
	N: 742	Quartile 3: Average 82.4 g of		
	% Female: 55% Mean Age (SE): 54.4 (0.3) v	protein/d		
	Race/ Ethnicity: NR	Baseline Protein Amount		
	Menopausal status: NR	Median: 82.4 g/d		
	Mean BMI (SE): 23.8% Obese	Carbonydrate Mean: 232.8		
	kg/m ²	Fat Mean: 63.7 g/d		
	Income level: NR			
	Education level: NR Mean physical activity level	Protein Amount at the end of		
	(SE): 34.6 (0.2) MET-h/wk	Median: NR		
	Health status/ Comorbidities:	Carbohydrate: NR		
	Treatment for hypertension:	Fat: NR		
	Treatment for CVD: 24.0%	Quartile 4: Average 94.5 g of		
	Treatment for diabetes: 2.0%	protein/d		
	History of cancer: 16.0% Medication use: NR	Baseline Protein Amount		
	Supplement use: NR	Median: 94.5 g/d		
	Pregnant or lactating: NR	Carbohydrate Mean: 219.1g/d		
	Quartile 3: Average 82.4 g	Fat Mean: 65.0 g/d		
	of protein/d	Protein Amount at the end of		
	N: 650	the study		
	% Female: 59%	Median: NR Carbobydrate: NR		
	Race/ Ethnicity: NR	Fat: NR		
	Menopausal status: NR			
	Obesity status: 23.8% Obese	Protein type/source: Mixed		

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
	Maan BML (SE): 27.6 (0.2)		of assessment)	methods of assessment)
	ka/m^2	Energy helence status		
		Energy balance status.		
		Eucaione		
		Study dynation, 20 y		
		Study duration: 20 y		
	(SE): 34.0 (U.2) IVIET-N/WK			
	Health status/ Comorbidities:			
	I reatment for hypertension:			
	17.0%			
	Treatment for CVD: 25.0%			
	I reatment for diabetes: 4.0%			
	History of cancer: 18.0%			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
	Quartile 4: Average 94.5 g			
	of protein/d			
	N: 734			
	% Female: 62%			
	Mean Age (SE): 53.7 (0.4) y			
	Race/ Ethnicity: NR			
	Menopausal status: NR			
	Obesity status: 23.8% Obese			
	Mean BMI (SE): 28.2 (0.2)			
	kg/m²			
	Income level: NR			
	Education level: NR			
	Mean physical activity level			
	(SE): 34.7 (0.2) MET-h/wk			
	Health status/ Comorbidities:			
	Treatment for hypertension:			
	19.0%			
	I reatment for CVD: 27.0%			
	I reatment for diabetes: 5.0%			
	History of cancer: 15.0%			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
PMID: 31172186	Study of: Adults	Quartile 1: Protein intake 0.6	Protein Assessment	Hyperfiltration
Jnee	i otal sample N: 9226	д/кд/а	wethod: I rained dietitians	
2020**			with a semiquantitative food	Measure/Method of
		Baseline Protein Amount	trequency questionnaire.	Assessment: Hyperfiltration

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and mothods of assessment)
Location/Country: South Korea HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study Design: Prospective cohort study Funding Source: Government Risk of bias score: Verv	Quartile 1: Protein intake 0.6 g/kg/d N: 2305 % Female: 63.5% Mean Age (SD): 54.7 (8.9) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 24.3 (3.3) kg/m ²	Mean (SD): 0.6 (0.1) g/kg/day Carbohydrate Mean (SD): 4.3 (1.2) g/kg/day Fat Mean (SD): 0.2 (0.1) g/kg/day Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR	Based on the FFQ, the subjects were categorized into four groups according to quartiles of daily amount of protein intake at baseline. Protein intake was only assessed at baseline.	was defined as a logarithm transformed eGFR larger than the 95th percentile in the distribution of residuals from the multivariable linear regression after the adjustment for logarithm- transformed age, sex, history of hypertension and/or diabetes, height and weight
high	Income level: Low: 52.2% Intermediate: 37.9% High: 9.9% Education level: Low: 50% Intermediate: 43.4% High: 6.6% Physical activity level: 28.1% Health status/ Comorbidities: Hypertension: 17.4% Diabetes: 5.6% Dyslipidemia: 2.2% MI: 0.9% CHF: 0.2% CAD: 0.9% Medication use: NR Supplement use: NR Pregnant or lactating: NR	Fat Mean (SD): NR Quartile 2: Protein intake 0.9 g/kg/d Baseline Protein Amount Mean (SD): 0.9 (0.1) g/kg/day Carbohydrate Mean (SD): 5.1 (1.3) g/kg/day Fat Mean (SD): 0.4 (0.1) g/kg/day Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR		eGFR measurement (with or without race): with race Kidney Function — eGFR Measure/Method of Assessment: Derived using the CKD Epidemiology Collaboration Equation with serum creatinine. eGFR measurement (with or without race): with race
	Quartile 2: Protein intake 0.9 g/kg/d N: 2307 % Female: 52.4% Mean Age (SD): 52.2 (8.9) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 24.6 (3.1) kg/m ² Income level: Low: 33.1%	Baseline Protein Amount Mean (SD): 1.1 (0.2) g/kg/day Carbohydrate Mean (SD): 5.7 (1.5) g/kg/day Fat Mean (SD): 0.5 (0.1) g/kg/day Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR		

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and methods of assessment)
Study	Participants Intermediate: 49.2% High: 17.7% Education level: Low: 34.9% Intermediate: 52.5% High:12.6% Physical activity level: 38.4% Health status/ Comorbidities: Hypertension: 13.8% Diabetes: 6.5% Dyslipidemia: 2.5% MI: 0.7% CHF: 0.2% CAD: 0.8% Medication use: NR Supplement use: NR Pregnant or lactating: NR Quartile 3: Protein intake 1.1 g/kg/d N: 2307 % Female: 48% Mean Age (SD): 50.8 (8.5) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 24.6 (3.0) kg/m ² Income level: Low: 2.2% Intermediate: 50.6% High: 22.1% Education level: Low: 24.3% Intermediate: 58.2% High: 17.5% Physical activity level: 45.0% Health status/ Comorbidities: Hypertension: 14.0% Diabetes: 6.7% Dyslipidemia: 2.5%	Intervention(s) (Content) Quartile 4: Protein intake 1.7 g/kg/d Baseline Protein Amount Mean (SD): 1.7 (0.6) g/kg/day Carbohydrate Mean (SD): 7.3 (2.8) g/kg/day Fat Mean (SD): 0.9 (0.5) g/kg/day Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 13 y	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	MI: 0.7% CHF: 0.1%			

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	CAD: 0.6%		,	
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
	Quartile 4: Protein intake 1.7			
	g/kg/d			
	N: 2307			
	% Female: 62%			
	Mean Age (SD): 50.2 (8.2) y			
	Race/ Ethnicity: NR			
	Menopausal status: NR			
	Maar DML (CD): 24.7 (2.4)			
	ka/m^2			
	kg/III-			
	Intermediate: 49.8%			
	High: 25.2%			
	Education level:			
	Low: 22.2%			
	Intermediate: 58.8%			
	High: 19.0%			
	Physical activity level: 47.5%			
	Health status/ Comorbidities:			
	Hypertension: 12.3%			
	Diabetes: 7.0%			
	Dyslipidemia: 2.4%			
	MI: 0.9%			
	CHF: 0.3%			
	CAD: 0.6%			
	Medication use: NR			
	Supplement use: NR			
DMID (0000070	Pregnant or lactating: NR			
PMID: 12639078	Study of: Adults	Arm 1: Participants with	Protein Assessment	Kianey Function — eGFR
	i otal sample N: 1624	Normal Kenal Function (GFR $> 90 \text{ m}$ /min part 1.72 m ²)	wethoa: Reported frequency	Magguro/Mathad of
2003"	Arm 1: Darticipanta with	$\sim 00 \text{ mL/min per } 1.73 \text{ m}^2$	or consumption or each	Accompant: Derived using
HDI: Very high	Normal Renal Function (GEP	Baseline Protein Amount	beverage by using published	the CKD Enidemiology
Setting: Community dwelling	$>80 \text{ ml}/\text{min per } 1.73 \text{ m}^2$	Mean (SD): 76.7 (13.6) a/d	data on the nutrient content	Collaboration Equation with
Urban/ Rural: NR	N. 1135	Carbohydrate Mean (SD): NR	of the specified portions	serum creatinine
Study Design: Prospective	% Female: 100%	Fat Mean (SD): 29.9 (9.1) g/d	Protein were measured twice	
cohort study	Mean Age (SD): 54.8 (6.6) y		in 1990 and 1994.	

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
Funding Source: Government Risk of bias score: Very high	Race/ Ethnicity: White: 98% African American: 1% Menopausal status: NR Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: Hypercholesterolemia: 50% Diabetes: 5% Hypertension: 36% Medication use: NR Supplement use: NR Pregnant or lactating: NR	Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Participants with Mild Renal Insufficiency (estimated GFR>55 mL/min per 1.73 m ²) but<80 mL/min per 1.73 m ²) Baseline Protein Amount Mean (SD): 76.2 (13.3) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): 30.0 (8.1) g/day		eGFR measurement (with or without race): with race
	Arm 2: Participants with Mild Renal Insufficiency (estimated GFR>55 mL/min per 1.73 m ² but<80 mL/min per 1.73 m ²) N: 489 % Female: 100% Mean Age (SD): 56.8 (6.5) y Race/ Ethnicity: White: 98% African American: 1% Menopausal status: NR Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: NR Health status/ Comorbidities: Hypercholesterolemia: 62% Diabetes: 3% Hypertension: 42% Medication use: NR Supplement use: NR	Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 11 y		

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
DMID: 07014000	Otradia of Askalto	Oursettle de Destain inteles	of assessment)	methods of assessment)
PMID: 37211392	Study of: Adults	Quartile 1: Protein Intake	Mothed: Brief type colf	Kidney Function — Incident
202248	Total sample N. 3277	12 % Of energy	administered dist history	CKD
Location/Country: Japan	Quartila 1: Protoin intako	Rasolino Protoin Amount	questionnaire (RDHO) at the	Moasuro/Mothod of
HDI: Vory high	12% of operate	Moon (SD): 12% (1.2) % of	duestionnaire (DDTQ) at the	Assessment: oCEP was
Setting: Community dwelling	N· 810	energy	2002 and 2006 Protein was	calculated using the Chronic
Urban/ Rural: Other	% Female: 66.4%	Carbohydrate Mean (SD):	measured only at baseline	Kidney Disease
Study Design: Prospective	Mean Age (SD): 58 8 (7 4) v	58.6(8.0) % of energy	visit	Enidemiology Collaboration
cohort study	Race/ Ethnicity: NR	Fat Mean (SD): 21.3 (4.8) %	Violt	(CKD-EPI) equation with
Funding Source: Other	Menopausal status: NR	of energy		serum creatinine and the
Risk of bias score: High	Obesity status: NR			Japanese coefficient:
5	Mean BMI (SD): 23.2 (3.1)	Protein Amount at the end of		Incidence of CKD was
	kg/m ²	the study		defined as appearance of
	Income level: NR	Mean (SD): NR		reduced eGFR (<60
	Education level: NR	Carbohydrate Mean (SD): NR		mL/min/1.73m2) during
	Physical activity level: NR	Fat Mean (SD): NR		follow up.
	Health status/ Comorbidities:			
	Diabetes mellitus: 4.4%	Quartile 2: Protein intake		eGFR CKD cut off point:
	Medication use:	14.2% of energy		eGFR< 60 ml/min/ 1.73m2
	Cholesterol-lowering			
	medication: 8.3%	Baseline Protein Amount		eGFR measurement (with or
	Antihypertensive medication:	Mean (SD): 14.2 (0.5) % of		without race): with race
	17.5%	energy		
	Supplement use: NR	Carbohydrate Mean (SD):		
	Pregnant or lactating: NR	56.1 (5.7) % of energy		
		Fat Mean (SD): 25.3 (4.1) %		
	Quartile 2: Protein intake	of energy		
	14.2% of energy			
	N: 819	Protein Amount at the end of		
	% Female: 63.9%	the study		
	Recolution Recolution (0.5) y	Carbobydrata Maan (SD): NR		
	Monopolical status: NP	Eat Moon (SD): NP		
	Obosity status: NP	Fat Mean (SD). NR		
	Mean BMI (SD): $23 / (3.1)$	Quartile 3: Protein intake		
	k_0/m^2	15.9% of energy		
	Income level: NR			
	Education level: NR	Baseline Protein Amount		
	Physical activity level: NR	Mean (SD): 15.9 (0.6) % of		
	Health status/ Comorbidities:	energy		
	Diabetes mellitus: 6.7%	Carbohydrate Mean (SD):		
	Medication use:	53.6 (5.0) % of energy		

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
Study	Participants Cholesterol-lowering medication: 9.3% Antihypertensive medication: 18.8% Supplement use: NR Pregnant or lactating: NR Quartile 3: Protein intake 15.9% of energy N: 820 % Female: 65% Mean Age (SD): 58.6 (8.5)	Intervention(s) (Content) Fat Mean (SD): 27.4 (4.1) % of energy Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Quartile 4: Protein intake 18.9% of energy Pageling Protein Amount	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	year Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 23.4 (3.1) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: Diabetes mellitus: 5.2% Medication use: Cholesterol-lowering medication: 10.6% Antihypertensive medication: 17.6% Supplement use: NR	Baseline Protein Amount Mean (SD): 18.9 (2.0) % of energy Carbohydrate Mean (SD): 49.1 (5.4) % of energy Fat Mean (SD): 29.4 (4.3) % of energy Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/source: Mixed Energy balance status: Eugeleric		
	Quartile 4: Protein intake 18.9% of energy N: 819 % Female: 64.4% Mean Age (SD): 58.9 (8.5) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 23.4 (3.1) kg/m ² Income level: NR Education level: NR	Study duration: 12 y		

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	Physical activity level: NR Health status/ Comorbidities: Diabetes mellitus: 6.2% Medication use: Cholesterol-lowering medication: 9.7% Antihypertensive medication: 17.3% Supplement use: NR Pregnant or lactating: NR			
PMID: 35947164	Study of: Adults	Tertile 1: Protein intake <0.8	Protein Assessment	Kidney Function — Incident
Kwon 2022 ⁴⁹	Total sample N: 7339	g/kg/d	semi-quantitative food	CKD
Location/Country: Korea HDI: Very high Setting: Community dwelling Urban/ Rural: Other Study Design: Prospective cohort study Funding Source: Government Risk of bias score: High	Tertile 1: Protein intake <0.8 g/kg/d N: 2140 % Female: 52.9% Mean Age (SD): 53.1 (8.8) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: 56.1% obese Mean BMI (SD): 25.5 (3.2) kg/m ² Income level: NR Education level: NR Physical activity level: <7.5 METs-h/wk: 8.1% 7.5–30 METs-h/wk: 56.6% >30 METs-h/wk: 56.6% >30 METs-h/wk: 35.2% Health status/ Comorbidities: Hypertension: 44.8% Diabetes mellitus: 12.7% Medication use: NR Mean supplement use (SD): Calcium intake: 279.7 (119.2) mg/day Phosphorus intake: 670.7 (156.5) mg/day Pregnant or lactating: NR	Baseline Protein Amount Mean (SD): 11.9 (2.1) % of energy Carbohydrate Mean (SD): 72.5 (6.2) % of energy Fat Mean (SD): 13.9 (5.1) % of energy Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Tertile 2 : Protein intake 0.8– 1.3 g/kg/d Baseline Protein Amount Mean (SD): 13.5 (1.9) % of energy Carbohydrate Mean (SD): 67.2 (6.2) % of energy Fat Mean (SD): 18.1 (5.1) % of energy Protein Amount at the end of the study Mean (SD): NR	frequency questionnaire (FFQ) with 103 items to assess dietary intake through in-person interviews conducted by well-trained dietitians every two years. Protein measurement from only baseline visit were used in this study.	Measure/Method of Assessment: Incident CKD was defined as eGFR < 60 ml/min/ 1.73m ² and eGFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation with serum creatinine. eGFR CKD cut off point: eGFR < 60 ml/min/ 1.73m2 eGFR measurement (with or without race): with race Proteinuria Measure/Method of Assessment: presence of proteinuria determined with a dipstick urine test result of protein level equal to trace or more.
	Tertile 2: Protein intake 0.8– 1.3 g/kg/d	Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR		

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	N: 3531			methous of ussessment)
	% Female: 50.6%	Tertile 3: Protein intake >1.3		
	Mean Age (SD): 51 4 (8 5) v	a/ka/d		
	Race/ Ethnicity: NR	gring a		
	Menopausal status: NR	Baseline Protein Amount		
	Obesity status: 41.6% obese	Mean (SD): 14.9 (2.2) % of		
	Mean BMI (SD): 24.5 (2.9)	energy		
	kg/m ²	Carbohvdrate Mean (SD):		
	Income level: NR	62.5 (7.5) % of energy		
	Education level: NR	Fat Mean (SD): 21.8 (6.0) %		
	Physical activity level:	of energy		
	<7.5 METs-h/wk: 6.9%			
	7.5–30 METs-h/wk: 64.1%	Protein Amount at the end of		
	>30 METs-h/wk: 29.1%	the study		
	Health status/ Comorbidities:	Mean (SD): NR		
	Hypertension: 34.8%	Carbohydrate Mean (SD): NR		
	Diabetes mellitus: 12.5%	Fat Mean (SD): NR		
	Medication use: NR			
	Mean supplement use (SD):	Protein type/source: Mixed		
	Calcium intake: 463.2 (167.6)			
	mg/day;	Energy balance status:		
	Phosphorus Intake: 1003.1	Eucaloric		
	(192.6) mg/day	Chudu dunatian. 10 v		
	Pregnant or lactating: NR	Study duration: To y		
	Tertile 3: Protein intake >1.3			
	g/kg/d			
	N: 1668			
	% Female: 57.1%			
	Mean Age (SD): 51.1 (8.6) y			
	Race/ Ethnicity: NR			
	Menopausal status: NR			
	Mean BMI (SD): $23.6(3.0)$			
	Kg/m²			
	Education lovel: NP			
	Physical activity level			
	$<7.5 \text{ MFTs}-h/wk \cdot 7.0\%$			
	7 5_30 METs-h/wk 59 3%			
	>30 MFTs-h/wk: 33 7%			
	Health status/ Comorbidities			
	Hypertension: 32.0%			

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	Diabetes mellitus: 10.4% Medication use: NR Mean supplement use (SD): Calcium intake: 748.4 (294.9) mg/day Phosphorus intake: 1508.6 (360.4) mg/day Pregnant or lactating: NR			
PMID: 27416946 Lew 2017 ⁵⁰ Location/Country: Singapore HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study Design: Prospective cohort study Funding Source: Government Risk of bias score: High	Study of: Adults Total sample N: 60,198 Quartile 1: 12.5 g/d median red meat intake N: 15,143 % Female: 50% Mean Age (SD): 56.5 (7.8) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 23.0 (3.3) kg/m ² Income level: NR Education level: Secondary school or higher: 31% Physical activity level: 39% with weekly moderate activity, vigorous activity or strenuous sports lasting at least 30 minutes. Health status/ Comorbidities: Hypertension: 24% Diabetes: 7% 649 Coronary heart disease: 4%, Stroke: 2% Medication use: NR Supplement use: NR Pregnant or lactating: NR Quartile 2: 24.2 g/d median red meat intake N: 15,199	Quartile 1: 12.5 g/d median red meat intake Baseline Protein Amount Mean (SD): 53.1 (10.3) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Quartile 2: 24.2 g/d median red meat intake Baseline Protein Amount Mean (SD): 57.6 (7.9) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Guartile 3: 33.4 g/d median red meat intake Baseline Protein Amount Mean (SD): 60.5 (7.6) g/d Carbohydrate Mean (SD): NR	Protein Assessment Method: Semiquantitative food frequency questionnaire, the dietary nutrients of the food items were derived from the Singapore Food Composition Database, which was developed together with this cohort study and is a food- nutrient database that lists the levels of 96 nutritive/non- nutritive compounds per 100 g of cooked food and beverages in the Singaporean Chinese diet. Protein was measured at baseline.	Kidney Function — Incident ESRD Measure/Method of Assessment: ESRD was defined using the following criteria: 1) serum creatinine level >880 mmol/L (10 mg/dl), 2) eGFR <15 ml/min per 1.73 m2, 3) hemodialysis or peritoneal dialysis, or 4) kidney transplant. Criteria 1– 3 had to be persistent for 3 months to qualify as ESRD eGFR ESRD cut off point: eGFR <15 ml/min per 1.73 m ² eGFR measurement (with or without race): with race

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
Study	Participants Mean Age (SD): 56.9 (8.1) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 23.1 (3.2) kg/m ² Income level: NR Education level: Secondary school or higher: 27% Physical activity level: 33% with weekly moderate activity, vigorous activity or strenuous sports lasting at least 30 minutes. Health status/ Comorbidities: Hypertension: 25% Diabetes: 9% Coronary heart disease: 4%, Stroke: 2% Medication use: NR Supplement use: NR Pregnant or lactating: NR Quartile 3: 33.4 g/d median red meat intake N: 14,909 % Female: 56% Mean Age (SD): 56.5 (8.1) y Race/ Ethnicity: NR Menopausal status: NR	Intervention(s) (Content) Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Quartile 4: 48.8 g/d median red meat intake Baseline Protein Amount Mean (SD): 65.3 (9.0) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Fat Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Study duration: 5 y	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	Obesity status: NR Mean BMI (SD): 23.2 (3.2) kg/m ²			
	Education level: Secondary school or higher:			
	26% Physical activity level: 30% with weekly moderate activity, vigorous activity or strenuous sports lasting at			
	least 30 minutes.			

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	Health status/ Comorbidities: Hypertension: 23% Diabetes: 10% Coronary heart disease: 4%, Stroke: 1% Medication use: NR Supplement use: NR Pregnant or lactating: NR			
	Quartile 4: 48.8 g/d median red meat intake N: 14,947 % Female: 55% Mean Age (SD): 55.7 (7.9) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 23.2 (3.3) kg/m ² Income level: NR Education level: Secondary school or higher: 30%, Physical activity level: 31% with weekly moderate activity, vigorous activity or strenuous sports lasting at least 30 minutes Health status/ Comorbidities: Hypertension: 22% Diabetes: 9% Coronary heart disease: 4% Stroke: 1% Medication use: NR Supplement use: NR			
PMID: 27562875 Malhotra	Study of: Adults	Arm 1: Incident end-stage	Protein Assessment Method: Dietary intake was	Kidney Function — Incident
2016 ⁵¹			assessed using a validated	
Location/Country: USA	Arm 1: Incident end-stage	Baseline Protein Amount	tood trequency questionnaire	Measure/Method of
Setting: Community dwelling	N: 1057	energy	strong agreement for protein	ESRD derived from the US
Urban/ Rural: NR	% Female: 54.4%	Carbohydrate Mean (SD):	intake estimated from the	Renal Data System
	Mean Age (SD): 54.5 (9.1) y	49.7 (9.1) % of energy	FFQ and 24 hour dietary	

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
			of assessment)	methods of assessment)
Study Design: Prospective	Race/ Ethnicity: 86.7% Black	Fat Mean (SD): 31.1 (6.4) %	recalls. Protein was	(USRDS), a national disease
cohort study	Menopausal status: NR	of energy	measured at baseline only.	registry.
Funding Source:	Obesity status: NR			
Government	Mean BMI (SD): 31.8 (8.2)	Protein Amount at the end of		eGFR measurement (with or
Risk of bias score: Very	kg/m ²	the study		without race): not reported
high	Income level:	Mean (SD): NR		
	<\$15,000 annually: 68.3%	Carbohydrate: NR		
	Education level:	Fat: NR		
	<hs: 36.8%<="" td=""><td></td><td></td><td></td></hs:>			
	Physical activity level: NR	Arm 2: Control group		
	Health status/ Comorbidities:			
	Hypertension: 84.2%	Baseline Protein Amount		
	Diabetes: 63.7%	Mean (SD): 15.1 (3.1) % of		
	Medication use: NR	energy		
	Supplement use: NR	Carbohydrate Mean (SD):		
	Pregnant or lactating: NR	49.6 (9.1) % of energy		
		Fat Mean (SD): 30.9 (6.8) %		
	Arm 2: Control group	of energy		
	N: 3198			
	% Female: 55.2%	Protein Amount at the end of		
	Mean Age (SD): 54.6 (8.8) y	the study		
	Race/ Ethnicity: 86.8% Black	Mean (SD): NR		
	Menopausal status: NR	Carbohydrate: NR		
	Obesity status: NR	Fat: NR		
	Mean BMI (SD): 30.3 (7.2)			
	kg/m ²	Protein type/source: Mixed		
	Income level:			
	<\$15,000 annually: 59.6%	Energy balance status:		
	Education level:	Eucaloric		
	<hs: 34.2%<="" td=""><td></td><td></td><td></td></hs:>			
	Physical activity level: NR	Study duration: 7 y		
	Health status/ Comorbidities:			
	Hypertension: 61.4%			
	Diabetes: 23.0%			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
PMID: 29452887	Study of: Adults	Quintile 1: 10.4 % of Enerav	Protein Assessment	Kidney Function — eGFR
Malhotra	Total sample N: 3165	From Protein Intake at	Method: Protein intake was	
2018 ⁵²		Baseline	estimated from a validated	Measure/Method of
Location/Country: USA	Quintile 1: 10.4 % of Energy		FFQ administered at visit 1.	Assessment: eGFR was
HDI: Very high	From Protein Intake at	Baseline Protein Amount		calculated using the Chronic
Setting: Community dwelling	Baseline			Kidney Disease

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
	NL 000		of assessment)	methods of assessment)
Urban/ Rural: NR	N: 633	Mean (SD): 10.4 (1.3) % of		Epidemiology Collaboration
Sludy Design: Prospective	% Female: 69%	Contracts Magnet (CD): ND		(CKD-EPI) equation with
Conort study	Deee (Ethnicity: ND	Carbonydrate Mean (SD): NR		serum creaunine.
Funding Source.	Mananaural status ND	Fat Mean (SD). NR		oCER massurement (with or
Bisk of bias score: Vory	Obosity status: NP	Protoin Amount at the end of		without race): with race
high	Moon BMI (SD): $30.5(7.0)$	the study		without face). with face
ingri	$k_{\rm a}/m^2$	Mean (SD): NR		
	Income level: NR	Carbohydrate Mean (SD): NR		
		Eat Mean (SD): NR		
	Physical activity level: NR			
	Health status/ Comorbidities:	Quintile 2: 12.8% of Energy		
	Hypertension: 54%	From Protein Intake at		
	Diabetes: 11%	Baseline		
	Medication use: NR			
	Supplement use: NR	Baseline Protein Amount		
	Pregnant or lactating: NR	Mean (SD): 12.8 (0.5) % of		
	5 5	energy		
	Quintile 2: 12.8% of Energy	Carbohydrate Mean (SD): NR		
	From Protein Intake at	Fat Mean (SD): NR		
	Baseline			
	N: 633	Protein Amount at the end of		
	% Female: 65%	the study		
	Mean Age (SD): 55 (12) y	Mean (SD): NR		
	Race/ Ethnicity: NR	Carbohydrate Mean (SD): NR		
	Menopausal status: NR	Fat Mean (SD): NR		
	Obesity status: NR			
	Mean BMI (SD): 31.1 (6.9)	Quintile 3: 14.3% of Energy		
	kg/m²	From Protein Intake at		
	Income level: NR	Baseline		
	Education level: NR	Deceline Drotein Americat		
	Physical activity level: NR	Magn (SD): 14.2 (0.4) % of		
	Health Status/ Comorbidities.	operav		
	Diabetes: 13%	Carbobydrate Mean (SD): NP		
	Medication use: NR	Fat Mean (SD): NR		
	Supplement use: NR			
	Pregnant or lactating: NR	Protein Amount at the end of		
		the study		
	Quintile 3: 14.3% of Energy	Mean (SD): NR		
	From Protein Intake at	Carbohydrate Mean (SD): NR		
	Baseline	Fat Mean (SD): NR		
	N: 633			

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
Study	Participants % Female: 63% Mean Age (SD): 54 (12) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 32.1 (7.2) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: Hypertension: 57% Diabetes: 18% Medication use: NR Supplement use: NR Pregnant or lactating: NR Quintile 4: 16.0% of Energy From Protein Intake at Baseline N: 633 % Female: 58% Mean Age (SD): 54 (11) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 32.2 (7.2) kg/m ² Income level: NR Physical activity level: NR Health status/ Comorbidities: Hypertension: 59% Diabetes: 20% Medication use: NR	Intervention(s) (Content) Quintile 4: 16.0% of Energy From Protein Intake at Baseline Baseline Protein Amount Mean (SD): 16.0 (0.6) % of energy Carbohydrate: NR Fat: NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Quintile 5: 19.4% of Energy From Protein Intake at Baseline Baseline Baseline Protein Amount Mean (SD): 19.4 (2.5) % of energy Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Protein type/source: Mixed Energy balance status: Eucaloric	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	Medication use: NR Supplement use: NR	Energy balance status: Eucaloric		
	Quintile 5: 19.4% of Energy	Study duration: 4 y		
	From Protein Intake at Baseline N: 633 % Female: 66%			

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	Mean Age (SD): 54 (11) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 33.1 (6.8) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: Hypertension: 59% Diabetes: 31% Medication use: NR Supplement use: NR Pregnant or lactating: NR			
PMID: 35142012 Sekiguchi 2022 ⁵³ Location/Country: Japan HDI: Very high Setting: Community dwelling Urban/ Rural: Other Study Design: Prospective cohort study Funding Source: Government, academic Risk of bias score: High	Study of: Adults Total sample N: 1960 Quartile 1: 1.01 g/kg/d Protein intake at baseline N: 290 % Female: 13% Mean Age (SD): 74.8 (5.4) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 24.3 (2.95) kg/m ² Income level: NR Education level: NR Health status/ Comorbidities: Hypertension: 54% Diabetes: 11% Dyslipidemia: 35% Stroke: 6.0% Heart disease: 17% Medication use: NR Supplement use: NR Pregnant or lactating: NR	Quartile 1: 1.01 g/kg/dProtein intake at baselineBaseline Protein AmountMean (SD): 1.01 (0.16) g/kg/dCarbohydrate Mean (SD): NRFat Mean (SD): NRProtein Amount at the end ofthe studyMean (SD): NRCarbohydrate Mean (SD): NRFat Mean (SD): NRCarbohydrate Mean (SD): NRFat Mean (SD): NRCarbohydrate Mean (SD): NRFat Mean (SD): NRBaseline Protein AmountMean (SD): 1.32 (0.07) g/kg/dCarbohydrate Mean (SD): NRFat Mean (SD): NRProtein Amount at the end ofthe studyMean (SD): NRProtein Amount at the end ofthe studyMean (SD): NRFat Mean (SD): NR	Protein Assessment Method: Dietary intakes of protein (g/day) and other nutrients during the previous month were assessed using a brief-type self-administered diet history questionnaire (BDHQ) at the baseline survey.	Kidney Function — eGFR Measure/Method of Assessment: eGFR was derived from an equation of the Japanese Society of Nephrology using serum creatinine: eGFR measurement (with or without race): with race

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	N: 290	Quartile 3: 1 59 g/kg/d		includes of assessmenty
	% Female: 39%	Protein intake at baseline		
	Mean Age (SD) : 76.5 (5.8) y			
	Race/ Ethnicity: NR	Baseline Protein Amount		
	Menonausal status: NR	Mean (SD) : 1.59 (0.08) g/kg/d		
	Obesity status: NR	Carbobydrate Mean (SD): NR		
	Mean BMI (SD): 23 1 (2 72)	Eat Mean (SD): NR		
	$k_{\rm a}/m^2$			
	Income level: NR	Protein Amount at the end of		
	Education level: NR	the study		
	Physical activity level: NR	Mean (SD): NR		
	Health status/ Comorbidities:	Carbohydrate Mean (SD): NR		
	Hypertension: 54%	Fat Mean (SD): NR		
	Diabetes: 12%			
	Dyslipidemia: 33%	Quartile 4: 2.07 g/kg/d		
	Stroke: 5.9%	Protein intake at baseline		
	Heart disease: 17%			
	Medication use: NR	Baseline Protein Amount		
	Supplement use: NR	Mean (SD): 2.07 (0.30) g/kg/d		
	Pregnant or lactating: NR	Carbohydrate Mean (SD): NR		
	5 5	Fat Mean (SD): NR		
	Quartile 3: 1.59 g/kg/d			
	Protein intake at baseline	Protein Amount at the end of		
	N: 290	the study		
	% Female: 70%	Mean (SD): NR		
	Mean Age (SD): 76.5 (5.8) y	Carbohydrate Mean (SD): NR		
	Race/ Ethnicity: NR	Fat Mean (SD): NR		
	Menopausal status: NR			
	Obesity status: NR	Protein type/source: Mixed		
	Mean BMI (SD): 22.4 (2.51)			
	kg/m ²	Energy balance: Eucaloric		
	Income level: NR			
	Education level: NR	Study duration: 3 y		
	Physical activity level: NR			
	Health status/ Comorbidities:			
	Hypertension: 46%			
	Diabetes: 10%			
	Dyslipidemia: 39%			
	Stroke: 4.8%			
	Heart disease:16%			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
PMID: 31430246 Shu 2019 ⁵⁴ Location/Country: China HDI: High Setting: Community dwelling Urban/ Rural: Urban Study Design: Prospective cohort study Funding Source: Government Risk of bias score: High	Quartile 4: 2.07 g/kg/d Protein intake at baseline N: 290 % Female: 91% Mean Age (SD): 77.4 (6.3) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 20.7 (2.48) kg/m ² Income level: NR Education level: NR Health status/ Comorbidities: Hypertension: 46% Diabetes: 10% Dyslipidemia: 39% Stroke: 4.8% Heart disease: 16% Medication use: NR Supplement use: NR Pregnant or lactating: NR Study of: Adults Total sample N: 127,220 Arm 1: SWHS Subjects without incident kidney stones N: 67,715 % Female: NR Mean Age (SD): 52.4 (9.0) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: 5% Obese BMI: <18.5 kg/m ² : 3.4% 18.5-24.9 kg/m ² : 61.6% 25-29.9 kg/m ² : 30% ≥30 kg/m ² : 5% Income level: Low: 15.9% Middle: 74.6%	Arm 1: SWHS Subjects without incident kidney stones Baseline Protein Amount Mean (SD): 67.1 (20.6) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Fat Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Baseline Protein Amount Mean (SD): 67.5 (20.7) g/d Carbohydrate Mean (SD): NR	Protein Assessment Method: FFQ according to the China Food Composition table at baseline.	Kidney stones Measure/Method of Assessment: Incident kidney stone was ascertained as the first report of a urinary tract stone located in the kidney or the ureter during follow-up visits.

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	High: 9.5%	Fat Mean (SD): NR	,	,
	Education level:			
	Less than 12 th grade: 57.4%	Protein Amount at the end of		
	High/Vocational school:	the study		
	36.1%	Mean (SD): NR		
	College or above: 4.5%	Carbohydrate Mean (SD): NR		
	Physical activity level:	Fat Mean (SD): NR		
	Rarely/none: 65.1%			
	Low: 12.8%	Arm 3: SMHS subjects		
	Median: 11.3%	without incident kidney stones		
	High: 10.9%			
	Health status/ Comorbidities:	Baseline Protein Amount		
	History of coronary heart	Mean (SD): 78.4 (23.6) g/d		
	disease/stroke: 9.6%	Carbonydrate Mean (SD): NR		
	History of type 2 diabetes:	Fat Mean (SD): NR		
	4.1%	Dratain Amount at the and of		
		the study		
	History of cholelithiasis:	Mean (SD): NR		
		Carbohydrate Mean (SD): NR		
	Medication use: NR	Eat Mean (SD): NR		
	Supplement use:			
	Calcium supplementation:	Arm 4: SMHS Subjects with		
	19%	incident kidnev stones		
	Vitamin C supplementation:	······································		
	6.9%	Baseline Protein Amount		
	Pregnant or lactating: NR	Mean (SD): 79.6 (23.3) g/d		
	0	Carbohydrate: NR		
	Arm 2: SWHS Subjects with	Fat: NR		
	incident kidney stones			
	N: 1,451	Protein Amount at the end of		
	% Female: NR	the study		
	Mean Age (SD): 51.4 (8.3) y	Mean (SD): NR		
	Race/ Ethnicity: NR	Carbohydrate Mean (SD): NR		
	Menopausal status: NR	Fat Mean (SD): NR		
	Obesity status: 5.6% Obese			
		Protein type/source: Mixed		
	$< 10.5 \text{ Kg/m}^{-1}: 5.0\%$	Energy holonos status		
	10.3-24.9 Kg/III ² : 58.6%	Energy palance status:		
	20-29.9 Kg/111 32.0%	Eucalonc		
	Income level:	Study duration: 8 y		
	Low: 13.6%			

Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
Participants Middle: 75.9% High: 10.5% Education level: Less than 12th grade: 55.0% High/Vocational School: 39.8% College or above: 5.2% Physical activity level: Rarely/none: 67.1% Low: 12.4% Median: 11% High: 9.5% Health status/ Comorbidities: History of coronary heart disease/stroke: 11.6% History of type 2 diabetes: 4.4% History of hypertension: 25.8% History of cholelithiasis: 12.7% Medication use: NR Supplement use: Calcium supplementation: 21.4%	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
21.4% Vitamin C supplementation: 7.1% Pregnant or lactating: NR			
Arm 3: SMHS subjects without incident kidney stones N: 56,852 % Female: NR Mean Age (SD): 55.3 (9.7) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: 2.5% Obese BMI: <18.5 kg/m ² : 4.3% 18.5-24.9 kg/m ² : 62.9% 25-29.9 kg/m ² : 30.3%			
	Participants Middle: 75.9% High: 10.5% Education level: Less than 12th grade: 55.0% High/Vocational School: 39.8% College or above: 5.2% Physical activity level: Rarely/none: 67.1% Low: 12.4% Median: 11% High: 9.5% Health status/ Comorbidities: History of coronary heart disease/stroke: 11.6% History of type 2 diabetes: 4.4% History of hypertension: 25.8% History of cholelithiasis: 12.7% Medication use: NR Supplement use: Calcium supplementation: 21.4% Vitamin C supplementation: 7.1% Pregnant or lactating: NR Arm 3: SMHS subjects without incident kidney stones N: 56,852 % Female: NR Mean Age (SD): 55.3 (9.7) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: 2.5% Obese BMI: <18.5 kg/m ² : 4.3% 18.5-24.9 kg/m ² : 62.9% 25-29.9 kg/m ² : 30.3%	ParticipantsIntervention(s) (Content)Middle: 75.9%High: 10.5%Education level:Less than 12th grade: 55.0%High/Vocational School:39.8%College or above: 5.2%Physical activity level:Rarely/none: 67.1%Low: 12.4%Median: 11%High: 9.5%Health status/ Comorbidities:History of coronary heartdisease/stroke: 11.6%History of type 2 diabetes:4.4%History of cholelithiasis:12.7%Medication use: NRSupplement use:Calcium supplementation:21.4%Vitamin C supplementation:7.1%Pregnant or lactating: NRArm 3: SMHS subjectswithout incident kidneystonesN: 56,852% Female: NRMean Age (SD): 55.3 (9.7) yRace/ Ethnicity: NRMenopausal status: NRObesity status: 2.5% ObeseBMI:<18.5 kg/m²: 4.3%	Participants Intervention(s) (Content) Intervention (s) (Methods of assessment) Middle: 75.9% High: 10.5% Education level: Less than 12th grade: 55.0% High/Vocational School: 39.8% School: College or above: 5.2% Physical activity level: Rarely/none: 67.1% Low: 12.4% Median: 11% High: 9.5% Health status/ Comorbidities: History of coronary heart disease/stroke: 11.6% History of hypertension: 25.8% History of hypertension: 25.8% History of cholelithiasis: 12.7% Medication use: NR Supplement use: Calcium supplementation: 21.4% Vitamin C supplementation: 21.4% Pregnant or lactating: NR Arm 3: SMHS subjects without incident kidney stones Arm 3: SMHS subjects without incident kidney stones NR Mean Age (SD): 55.3 (9.7) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: 2.5% Obese BMI: <18.5 Kg/m ² : 4.3% 18.5-24.9 kg/m ² : 62.9% 25-29.9 kg/m ² : 30.3%

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	Income level:			
	Low: 12.6%			
	Middle: 77.8%			
	High: 9.6%			
	Education level:			
	Less than 12th grade: 41.3%			
	47.0% College or above: 11.1%			
	Physical activity level: 64.6%			
	Rarely/none: 64.6%			
	Low: 11 9%			
	Median: 12.4%			
	High: 11.1%			
	Health status/ Comorbidities:			
	History of coronary heart			
	disease/stroke: 9.0%			
	History of type 2 diabetes:			
	6.2%			
	History of hypertension:			
	30.3%			
	History of cholelliniasis: 7.4%			
	Supplement use:			
	Calcium supplementation:			
	4 7%			
	Vitamin C supplementation:			
	5.5%			
	Pregnant or lactating: NR			
	Arm 4: SMHS Subjects with			
	incident kidney stones			
	N: 1,202			
	% Female: NR			
	Nean Age (SD): 54.4 (9.1) y			
	Monopousal status: NP			
	Obesity status: 3 4% Obese			
	BMI:			
	<18.5 kg/m ² : 2.8%			
	18.5-24.9 kg/m ² : 58.3%			
	25-29.9 kg/m ² : 35.4%			
	≥30 kg/m²́: 3.4%			

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods of assessment)	Outcome (Measures and methods of assessment)
	Income level:		· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·
	Low: 11.5%			
	Middle: 78.2%			
	High:10.3%			
	Education level:			
	Less than 12th grade: 35.5%			
	High/Vocational School:			
	52.1%			
	College or above: 12.4%			
	Physical activity level:			
	Rarely/none: 66.1%			
	Low: 12.4%, 12.5%			
	Median: 12.5%			
	High: 9.0%			
	Health status/ Comorbidities:			
	discoss/stroke: 8.0%			
	History of type 2 diabetes:			
	5 0%			
	History of hypertension:			
	35.3%			
	History of cholelithiasis: 7.6%			
	Medication use: NR			
	Supplement use:			
	Calcium supplementation:			
	5.2%			
	Vitamin C supplementation:			
	6.5%			
	Pregnant or lactating: NR			
PMID: 36532536	Study of: Adults	Tertile 1: Protein score (8.2 ±	Protein Assessment	Kidney Function — Incident
Teymoori	Total sample N: 6044	2.8)	Method: Dietary data were	CKD
202255			assessed using a valid and	
Location/Country: Iran	Tertile 1: Protein score (8.2	Baseline Protein Amount	reliable semi-quantitative	Measure/Method of
HDI: High	± 2.8)	Mean (SD): 13.1 (1.8) % of	168-item food frequency	Assessment: CKD was
Setting: Community dwelling	N: 2561	energy	questionnaire. During a face-	ascertained using eGFR < 60
Urban/ Rural: Urban	% Female: 57.7%	Carbohydrate Mean (SD):	to-face interview, the	ml/min/1.73 m ² and eGFR
Study Design: Prospective	Wean Age (SD): 36.1 (12.1) y	55.9 (6.7) % OT energy	Trequency of consumption for	was calculated using the
conort study		Fat Mean (SD): 33.4 (6.5) %	each food item during the	Chronic Kidney Disease
Funding Source: Academic,	Obesity status: NR	or energy	past year on a dally, weekly,	
Biok of biog operat Uirth	Moon BML (SD): 26.4 (4.7)	Brotoin Amount at the and of	or monthly pasis was	(CKD-EPI) equation with
RISK OF DIAS SCORE: HIGH	ka/m^2	the study	skilled dioticians. Protein was	Serum creaunine.
	Income level: NR	Mean (SD): NR	masured at baseline	
cohort study Funding Source: Academic, government Risk of bias score: High	Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 26.4 (4.7) kg/m ² Income level: NR	Fat Mean (SD): 33.4 (6.5) % of energy Protein Amount at the end of the study Mean (SD): NR	each food item during the past year on a daily, weekly, or monthly basis was collected by trained and skilled dieticians. Protein was measured at baseline.	Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation with serum creatinine.

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
			of assessment)	methods of assessment)
	Education level:	Carbohydrate Mean (SD): NR		eGFR CKD cut off point:
	Academic education: 22.6%	Fat Mean (SD): NR		eGFR <60 ml/min/1.73 m2
	Mean physical activity level			
	(SD): 72.7(60.8) MET/h/wk	Tertile 2: Protein score (9.6 ±		eGFR measurement (with or
	Health status/ Comorbidities:	2.8)		without race): without race
	NR			
	Medication use: NR	Baseline Protein Amount		
	Supplement use: NR	Mean (SD): 14.8 (3.2) % of		
	Pregnant or lactating: NR	energy		
		Carbohydrate Mean (SD):		
	Tertile 2: Protein score (9.6	58.4 (6.7) % of energy		
	± 2.8)	Fat Mean (SD): 29.6 (5.7) %		
	N: 1714	of energy		
	% Female: 54.9%			
	Mean Age (SD): 37.8 (12.8) y	Protein Amount at the end of		
	Race/ Ethnicity: NR	the study		
	Menopausal status: NR	Mean (SD): NR		
	Obesity status: NR	Carbohydrate Mean (SD): NR		
	Mean BMI (SD): 27.0 (4.8)	Fat Mean (SD): NR		
	kg/m²			
	Income level: NR	Tertile 3: Protein score (12.0		
	Education level:	± 3.1)		
	Academic education: 26.1%			
	Mean physical activity level	Baseline Protein Amount		
	(SD): 74.7 (64.2) ME1/h/wk	Mean (SD): 16.1 (9.8) % of		
	Health status/ Comorbidities:	energy		
	NR Madiaatian waxa ND	Carbonydrate Mean (SD):		
	Medication use: NR	61.5 (9.8) % of energy		
		Fat Mean (SD): 27.7 (21.4) %		
	Pregnant or lactating: NR	of energy		
	Tartila 3: Protein score (12.0	Protein Amount at the and of		
	+ 3 1)	the study		
	1760	Mean (SD): NR		
	% Econolo: 48.8%	Carbobydrata Moan (SD): NP		
	$\frac{1}{12}$ Mean Age (SD): $\frac{1}{10}$ $\frac{1}{12}$ $\frac{1}{2}$ $\frac{1}{2}$	Eat Mean (SD): NR		
	Reco/ Ethnicity: NP	Tat Mean (SD). NR		
	Menonausal status: NR	Protein type/source: Mixed		
	Obesity status: NR	i rotein type/source. winted		
	Mean BMI (SD): 27 1 (4 6)	Energy balance status:		
	k_{a}/m^{2}	Fucaloric		
	Income level: NR			
	Education level	Study duration: 19 y		

Study	Participants	Intervention(s) (Content)	Intervention (s) (Methods	Outcome (Measures and
			of assessment)	methods of assessment)
	Academic education: 24.6%			
	Mean physical activity level			
	(SD): 75.4 (64.0) MET/h/wk			
	Health status/ Comorbidities:			
	NR			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			

Abbreviations: BMI = Body Mass Index; CAD = coronary artery disease; CI = Confidence Interval; CHF = congestive heart failure; CKD = chronic kidney disease; CVD = cardiovascular disease; d = day; eGFR = estimated glomerular filtration rate; ESRD = end stage renal disease; FFQ = Food frequency questionnaire; g = grams; GFR = glomerular filtration rate; h = hours; HDI = human development index; kg = kilograms; $kg/m^2 = kilogram$ per meters squared; $m^2 = meters$ squared; MDRD = Modification of Diet in Renal Disease; METs = metabolic equivalents; mg = milligrams; MI = myocardial infarction; min = minutes; ml = milliliter; mmol/L = millimols per liter; NR = not reported; PMID = PubMed Identification Number; RoB = Risk of Bias; SD = Standard deviation; SE = standard error; SMHS = Shanghai Men's Health Study; SWHS = Shanghai Women's Health Study; USA = United States of America; UUN = Urine urea nitrogen; wk = week; y = years

Note: *Studies overlap KQs

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			administration and	methods of assessment)
			assessment)	
PMID: 26471344	Study of: Adults	Intervention: High Protein	Intervention: High Protein	Muscle Strength - 1-RM leg
Backx	Total sample N: 61	diet	diet	press
2016 ⁵⁶				
Location/Country:	Intervention: High Protein	Intended Protein Amount: 1.7	How protein was	Measure/Method of
Netherlands	diet	g/kg/d	administered: Provided 90%	Assessment: Maximum leg
HDI: Very high	N: 31	Carbohydrate: NR	of diet and 2 supplements	strength was assessed by 1-
Setting: Community dwelling	% Female: 41.9%	Fat: NR	(20 g protein) per day to	RM strength tests on leg
Urban/Rural: NR	Mean Age (SD): 63 (4.8) y		consume 1.7 g of	press and leg strength
Study design: RCT (parallel)	Race/ Ethnicity: NR	Baseline Protein Amount	protein/kg/day	machine
Funding Source: Public-	Menopausal Status:	Mean (SD): 1.1 (0.4) g/kg/d;		
private partnership	Postmenopausal	14% of energy	Protein Assessment	Muscle Strength - 1-RM leg
Risk of bias score: Low	Obesity Status: All	Carbohydrate Mean: 51% of	Method: Baseline protein	extension
	overweight or obese with	energy	amount was derived from a	
	BMI between 27 and 40	Fat Mean: 31% of energy	validated 177-item food	Measure/Method of
	kg/m ²		frequency questionnaire.	Assessment: Maximum leg
	Mean BMI (SD): 31.3 (3.0)	Actual Protein Amount at the		strength was assessed by 1-
	kg/m ²	end of study	Actual Protein Amount was	RM strength tests on leg
	Income level: NR	Mean: 1.69 g/kg/d; 34% of	derived from analysis of	press and leg strength
	Education level: NR	energy	stored complete diet	machine
	Mean physical activity level	Carbohydrate Mean: 35% of	collected for each group	
	(SD): 916 (203) cpm	energy	throughout the intervention.	

Table C5. Evidence table for Sarcopenia Randomized Controlled Trials

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			administration and assessment)	methods of assessment)
	Health status/ Comorbidities: Excluded renal insufficiency, type 1 or type 2 diabetes.	Fat Mean: 27% of energy Dietary Protein Intake	Food diaries were used to assess the 10% diet chosen by the subjects.	Muscle Strength - Handgrip Strength
	cancer, COPD, previous	Compliance (%): NR – high		Measure/Method of
	gastric bypass Medication use: NR Supplement use: Excluded if	level of compliance stated for both intervention	Dietary Protein Intake Compliance: Compliance was assured via daily contact	Assessment: Measured using handgrip dynamometer
	used supplements or drugs known to interfere with	Protein type/source: Mixed	(weekdays) with the investigators and	Physical Performance - SPPB
	energy balance used within 3	Energy belonce status:	dietitians.	Magguro/Mathad of
	Pregnant or lactating: NR	Hypocaloric	Comparator: Normal Protein diet	Assessment: The SPPB consists of three
	Comparator: Normal Protein diet	Comparator : Normal Protein diet	How protein was	components: balance, gait speed and chair rise ability
	% Female: 40% Mean Age (SD): 62 (4.8) y	Intended Protein Amount: 0.9 g/kg/day	of diet and 2 supplements (25 g carbohydrates) per day	Physical Performance - 400m walk speed
	Race/ Ethnicity: NR Menopausal Status:	Carbohydrate: NR Fat: NR	to consume 0.9 g of protein/kg/day	Measure/Method of Assessment: The 400m walk
	Postmenopausal Obesity Status: All overweight or obese with	Baseline Protein Amount Mean (SD): 1.1 (0.4) g/kg/d;	Protein Assessment Method: Same as above	test assessed the time it takes to walk 400m
	BMI between 27 and 40 kg/m ² Mean BMI (SD): 31 0 (2 9)	14% of energy Carbohydrate Mean: 51% of energy	Dietary Protein Intake	Muscle Mass - Lean body mass
	kg/m ² Income level: NR	Fat Mean: 31% of energy	above	Measure/Method of Assessment: DXA (model
	Mean physical activity level	Actual Protein Amount at the end of study Mean: 0.92 g/kg/d: 19% of		DPX-L) Muscle Mass -
	Health status/ Comorbidities: Excluded renal insufficiency,	energy Carbohydrate Mean: 51% of		Appendicular lean body mass/ skeletal muscle mass
	type 1 or type 2 diabetes, cancer, COPD, previous castric bypass	energy Fat Mean: 24% of energy		Measure/Method of
	Medication use: NR Supplement use: Excluded if	Dietary Protein Intake Compliance (%): NR – high		DPX-L)
	used supplements or drugs known to interfere with	level of compliance stated for both intervention		
	energy balance used within 3 months prior	and comparator group		

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	Pregnant or lactating: NR	Protein type/source: Mixed		
		Energy balance status: Hypocaloric		
		Study duration: 12 weeks		
PMID: 33975325 Englert	Study of: Adults Total sample N: 54	Intervention: High Protein	Intervention: High Protein	Physical Performance - SPPB
Location/Country: Germany	Intervention: High Protein	a/ka/d	administered: 2 provided	Measure/Method of
HDI: Very high	N: 27	Carbohydrate: NR	meal replacement shakes.	Assessment: The SPPB
Setting: Community dwelling	% Female: 100%	Fat: NR	3 rd meal and/or snack	consists of three
Urban/Rural: NR	Mean Age (SD): 59.0 (6) y		chosen from the individual's	components: balance, gait
Study design: RCT (parallel)	Race/ Ethnicity: NR	Baseline Protein Amount	diet plan to reach 1.5 g of	speed and chair rise ability
Funding source: Academic,	Menopausal Status:	Mean (SD): NR	protein/kg/day	Physical Parformanae 400
Risk of bias score: Low	Obesity Status: All women	Eat Mean (SD): NR	Protein Assessment	m walk speed
Nisk of blus scole. Low	overweight. BMI \ge 30 or \ge 27		Method: Participants kept a	In wait speed
	and waist circumference >88	Actual Protein Amount at the	food diary after the first and	Measure/Method of
	cm	end of study	third session with dietitian for	Assessment: Walked as fast
	Mean BMI (SD): 30.5 (2.8)	Mean (SD): 113 (17) g/d	7 consecutive days and food	as they could without running
	kg/m²	Carbohydrate Mean (SD): 127	checklists on the remaining	for 400 meters
	Education level: NR	(18) g/d Eat Mean (SD): 46 (9) g/d	days. Dietary energy and	Muscle Strength - Handgrin
	Mean physical activity level	1 at mean (3D). 40 (9) g/d	were recorded in the first and	strength
	(SD): PAL 1.4 (0.1)	Dietary Protein Intake	third quarters of the	Strongth
	Health status/ Comorbidities:	Compliance (%): Compliance	intervention. The mean value	Measure/Method of
	Excluded type 2 diabetes;	was the same in both	for macronutrients was	Assessment: Measured
	thyroid disease; kidney,	intervention and	reported.	using handgrip dynamometer
	heart, or liver failure;	comparator groups – good	Distany Brotain Intaka	Musela Masa Est Erea
	electronic implants: active	both intervention and	Compliance: 4 putrition	Mass
	prostheses: life-sustaining	comparator group	training sessions for both	Madd
	electronic devices	,	groups separately and	Measure/Method of
	Medication use: Excluded	Protein type/source: Mixed	telephone interviews to	Assessment: BIA (seca
	medications like steroids,		enhance compliance	mBCA 515/514)
	diuretics, thyroid drugs,	Energy balance status:		
	statins, Weight loss	нуросаютіс	Comparator: Normal Protein	
	medication, beta blockers	Comparator: Normal Protein	How protein was administered: 2 provided	

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			administration and	methods of assessment)
	Supplement use: Excluded	Intended Protein Amount: 0.8	meal replacement shakes,	
	protein supplementation	g/kg/d	3 rd meal and/or snack	
	during the last 3 months	Carbohydrate: NR	chosen from the individual's	
	Pregnant or lactating: NR	Fat: NR	diet plan to reach 0.8 g of	
			protein/kg/day	
	Comparator: Normal Protein	Baseline Protein Amount		
	N: 27	Mean (SD): NR	Protein Assessment	
	% Female: 100%	Carbohydrate Mean (SD): NR	Method: Same as above	
	Mean Age (SD): 58.7 (6) y	Fat Mean (SD): NR		
	Race/ Ethnicity: NR		Dietary Protein Intake	
	Menopausal Status:	Actual Protein Amount at the	Compliance: Same as	
	Postmenopausal	end of study	above	
	Obesity Status: All women	Mean (SD): 63 (9) g/day		
	overweight, BMI \ge 30 or \ge 27	Carbohydrate Mean (SD): 136		
	and waist circumference >88	(29) g/day		
	cm	Fat Mean (SD): 48 (11) g/day		
	Mean BMI (SD): 31.3 (4)			
	kg/m²	Dietary Protein Intake		
	Income level: NR	Compliance (%): Compliance		
	Education level: NR	was the same in both		
	Mean physical activity level	intervention and		
	(SD): PAL 1.4 (0.1)	comparator groups – good		
	Health status/ Comorbidities:	compliance rate stated for		
	Excluded type 2 diabetes;	both intervention and		
	thyroid disease; kidney,	comparator group		
	neart, or liver failure;	Ductoin tractory Minord		
	neurological disease;	Protein type/source: Mixed		
	electronic implants; active	Energy helence statue		
	prosineses; ille-sustaining	Energy balance status:		
	Mediantian upo: Evoluded	пуросаютс		
	medication use. Excluded	Study duration: 12 wooks		
	diurotics, thuroid drugs	intervention 6 menths of		
	stating weight loss			
	modication bate blockers	ioliow-up		
	Supplement use: Excluded			
	protein supplementation			
	during the last 3 months			
	Pregnant or lactating: NP			
PMID: 20578205	Study of Adults	Intervention: High Protein	Intervention: High Protein	Muscle Mass - Est free
Flechtner-More	Total sample N: 110			mass
				111000
Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
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			autilitistration and assessment)	methous of assessment)
2010* ³²		Intended Protein Amount: 1.34	How protein was	
Location/Country: Germany	Intervention: High Protein	a/ka/d: 30% of energy	administered:	Measure/Method of
HDI: Very high	N: 55	Carbohydrate: 40% of energy	First 3 months: Consumed	Assessment: BIA
Setting: Outpatient clinic	% Female: 78.2%	Fat: 30% of energy	two protein-enriched meal	(Bioimpedance Analyzer 450,
Urban/Rural: NR	Mean Age (SD): 49.3 (12.3) y		replacements, one	Biodynamics, Seattle,
Study Design: RCT (parallel)	Race/ Ethnicity: NR	Baseline Protein Amount	conventional meal, and two	Washington, USA)
Funding source: Industry,	Menopausal status: NR	Mean (SD):18.0 (4.9) % of	snacks as either a protein	
academic	Obesity status: Obese	energy; 72.7 (24.3) g/d	bar or a low-fat curd with	
Risk of bias score: High	Mean BMI (SD): 36.2 (4.4)	Carbohydrate Mean (SD):	fruit.	
	kg/m²	46.7 (9.4) % of energy; 194		
	Income level NR	(73) g/d	After the first 3 months:	
	Education level: NR	Fat: 35.2 (7.6) % of energy; 64	Consumed one protein-	
	Physical activity level:	(25) g/d	enriched meal replacement,	
	Received instructions to		two meals, and two snacks	
	maintain their usual physical	Actual Protein Amount at the	Drotain Accomment	
	not to undertake any new	Moon (SD): $20.0 (7.0)$ % of	Mothod: Subjects kept 2 day	
		(3D), 30.0 (7.0) % Of energy: 92.2 (14.8) g/d	food records at baseline 3	
	exercise was not monitored	Carbohydrate Mean (SD):	months 6 months 9 months	
	Health status/ Comorbidities:	36.9(7.9)% of energy: 119	and 12 months Food	
	Included: Those that met the	(45) g/d	quantities were recorded	
	criteria for metabolic	Fat Mean (SD): 29.9 (5.7) %	using standard household	
	syndrome	of energy; 42 (13) g/d	measures, and a trained	
	Medication use: Exclude:		assessment dietician	
	anti-obesity medications	Dietary Protein Intake	reviewed the food records in	
	Supplement use: NR	Compliance (%): 56.3%	person. Nutrient calculations	
	Pregnant or lactating:		were carried out using the	
	Excluded	Protein type/source: Mixed	PRODI program which is	
			based on German food-	
	Comparator: Conventional	Energy balance status: Hypocaloric	composition tables.	
	N: 55% Female: 81.2%	riypodalono	Dietary Protein Intake	
	Mean Age (SD): 50 (13) v	Comparator: Conventional	Compliance: Food records	
	Race/ Ethnicity: NR	Diet	vielded data that revealed	
	Menopausal status: NR		adherence to the dietarv	
	Obesity status: Obese	Intended Protein Amount: 0.8	recommendations during the	
	Mean BMI (SD): 36.3 (5.0)	g/kg/d; 15% energy	study	
	kg/m ²	Carbohydrate: 30% energy	-	
	Income level NR	Fat: 55% energy	Comparator: Conventional	
	Education level: NR		Diet	
	Physical activity level:	Baseline Protein Amount		
	Received instructions to			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			administration and	methods of assessment)
			assessment)	,
	maintain their usual physical	Mean (SD): 17.0 (4.7) % of	How protein was	
	activity during the study and	energy; 66.4 (22.7) g/d	administered:	
	not to undertake any new	Carbohydrate Mean (SD):	First 3 months: Consumed	
	exercise programs, but	48.2 (9.4) % of energy; 188	three meals and two snacks	
	exercise was not monitored	(64) g/d	with no replacements	
	health status/ Comorbidities.	of operaty: 60 (26) a/d	After 2 menthe: Consumed	
	criteria for metabolic	of energy, ou (20) g/d	one standard meal	
	syndrome	Actual Protein Amount at the	replacement two meals and	
	Medication use: Exclude:	end of the study	two snacks per day	
	anti-obesity medications	Mean (SD): 21.4 (7.4) % of		
	Supplement use: NR	energy; 65.7 (14.7) g/d	Protein Assessment	
	Pregnant or lactating:	Carbohydrate Mean (SD):	Method: Same as above	
	Excluded	47.6 (7.5) % of energy; 154		
		(44) g/d	Dietary Protein Intake	
		Fat: 29.6 (5.7) % of energy; 44	Compliance: Same as	
		(16) g/d	above	
		Dietary Protein Intake		
		Compliance (%): NR		
		Protein type/source: Mixed		
		Enorgy balance status:		
		Energy balance status.		
		Typecalone		
		Study duration: 12 months		
PMID: 18371214	Study of: Adults	Intervention: Prolibra	Intervention: Prolibra	Muscle Mass - Lean muscle
Frestedt	l otal sample N: 59			mass
	Intervention, Drolibro	Intended Protein Amount:	How protein was	Maggurg (Mathad of
Location/Country: USA		(1 10g protein supplement	auministered: One Prolibra	Accessment: DXA (Luper
Setting: Community dwelling	% Female: NR	twice daily): 15% of energy	and one before dinner Each	Prodigy Advance Plus
Urban/Rural: NR	Mean Age (SE): 43.6 (1.1) v	Carbohydrate: 55% of energy	supplement contained 10 g	General Electric Madison
Study Design: RCT (parallel)	Race/ Ethnicity: NR	Fat: 30% of energy	of protein. Subjects were	WI)
Funding source: Industrv	Menopausal status: NR		assigned a diet plan with a	,
Risk of bias score: High	Obesity status: Yes	Baseline Protein Amount	certain number of servings	
	Mean BMI (SE): 35.7 (0.7)	Mean (SD): 73 (3) g/d; 0.74	for various food groups	
	kg/m ²	g/kg/d	similar to the standard	
	Income level NR	Carbohydrate Mean (SD): 222	paradigm set by the	
	Education level: NR	(11) g/d	American Heart Association.	

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	Physical activity level: NR Health status/ Comorbidities: NR Medication use: NR Supplement use: NR Pregnant or lactating: NR Comparator : Placebo N: 28 % Female: NR Mean Age (SE): 42 (1.2) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: Yes Mean BMI (SE): 35.4 (0.7) kg/m ² Income level NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: NR Supplement use: NR Pregnant or lactating: NR	Fat Mean (SD): 75 (5) g/d Actual Protein Amount at the end of the study Mean (SD): 0.81 g/kg/d (with supplement); 0.60 g/kg/d and 57 (3) g/d (w/o supplement) Carbohydrate Mean (SD): 178 (8) g/d (w/o supplement) Fat Mean (SD): 49 (3) g/d (w/o supplement) Dietary Protein Intake Compliance (%): NR Protein type/source: Animal; whey protein Energy balance status: Hypocaloric Comparator: Placebo Intended Protein Amount: 15% of energy Carbohydrate: 55% of energy Fat: 30% of energy Fat: 30% of energy Baseline Protein Amount Mean (SD): 74 (4) g/d; 0.76 g/kg/d Carbohydrate Mean (SD): 211 (10) g/d Fat Mean (SD): 71 (5) g/d Actual Protein Amount at the end of the study Mean (SD): 0.61 g/kg/d (with supplement); 58 (2) g/d (w/o supplement) Carbohydrate Mean (SD): 182 (9) g/d (w/o supplement)	 Protein Assessment Method: Total protein in Prolibra was measuring using Kjeldahl (AOAC 945.01). Subjects completed diet diaries on at least 5 days each month. Dietary Protein Intake Compliance: Compliance was assessed by supplement count and diet diary review. Participants were also contacted by telephone between visits to review diet and supplement compliance. Comparator: Placebo How protein was administered: Subjects received an iso-caloric beverage containing maltodextrin. Subjects were assigned a diet plan with a certain number of servings for various food groups similar to the standard paradigm set by the American Heart Association. Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above 	

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
		Fat Mean (SD): 47 (3) g/d (w/o supplement)		
		Dietary Protein Intake Compliance (%): NR		
		Protein type/source: Mixed		
		Energy balance status: Hypocaloric		
		Study duration: 12 weeks		
PMID: 34208986 Haghighat	Study of: Adults Total sample N: 120	Intervention: High Protein	Intervention: High Protein	Muscle Mass - Skeletal Muscle Mass
2021 ⁵⁸		Intended Protein Amount: 18.2	How protein was	
Location/Country: Iran	Intervention: High Protein	g of protein during snack, no	administered: High protein	Measure/Method of
DI. Digit Setting: Community dwelling	N. 00 % Eemale: 100%	Carbobydrate: NP	sovbeans equaling 18.2 g	Model 222: Seca, Cermany)
Urban/Rural: NR	Mean Age (SD): 24 (3) v	Fat: NR	protein) daily at 10 a.m.	
Study design: RCT (parallel)	(total sample average)		·····	
Funding source: Academic	Race/ Ethnicity: NR	Baseline Protein Amount	Protein Assessment	
Risk of bias score:	Menopausal Status:	Mean (SD): 51.37 (7.36) g/d;	Method: 24-h dietary recalls	
Moderate	Premenopausal	0.84 (0.15) g/kg/d	were completed by all	
	Obesity Status: Normal	Carbohydrate Mean (SD):	participants on three	
	weight obesity (body fat	253.48 (39.24) g/d	occasions over a week time	
	Moon BMI (SD): NP	rat mean (SD). 40.07 (5.42)	weekend days) prior to and	
	Income level: NR	g/u	at the end of study. Calorie	
	Education level: NR	Actual Protein Amount at the	and macronutrient	
	Physical activity level: 26%	end of the study	combinations were assessed	
	low, 63% moderate	Mean (SD): 74.94 (6.40) g/d;	using the Nutritionist IV for	
	Health status/ Comorbidities:	1.28 (0.2) g/kg/d	Windows software program	
	Excluded history or presence	Carbohydrate Mean (SD):	(The Hearst Corporation,	
	of bariatric surgery, any	195.04 (33.47) g/d	San Bruno, CA)	
	acute or chronic diseases,	Fat Mean (SD): 45.88 (8.37)		
	psychiatric disorders	g/a	Dietary Protein Intake	
	medication use: Excluded	Distant Protain Inteka	two other economic (of the	
	Supplement use: Evoluded	Compliance (%): 86.6%	and of months 2 and 4) to	
	those that consumed more		report snack compliance	
	than 300 mg of caffeine daily	Protein type/source: Plant	Additional snack compliance	

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	Pregnant or lactating: Excluded	Energy balance status: Eucaloric	reporting was performed once per week by phone or WhatsApp software.	
	Excluded Comparator: Low Protein N: 60 % Female: 100% Mean Age (SD): 24 (3) y (total sample average) Race/ Ethnicity: NR Menopausal Status: Premenopausal Obesity Status: Normal weight obesity (body fat percentage >30%) Mean BMI (SD): NR Income level: NR Education level: NR Physical activity level: 31% low, 69% moderate Health status/ Comorbidities: Excluded history or presence of bariatric surgery, any acute or chronic diseases, psychiatric disorders Medication use: Excluded "medication use" Supplement use: Excluded those that consumed more than 300 mg of caffeine daily Pregnant or lactating: Excluded	Energy balance status: Eucaloric Comparator : Low Protein Intended Protein Amount: <2 g of protein during snack, no goal for total dietary protein Carbohydrate: NR Fat: NR Baseline Protein Amount Mean (SD): 48.80 (7.21) g/d; 0.79 (0.14) g/kg/d Carbohydrate Mean (SD): 247.05 (57.55) g/d Fat Mean (SD): 46.36 (7.97) g/d Actual Protein Amount at the end of the study Mean (SD): 55.02 (6.30) g/d; 0.87 (0.12) g/kg/d Carbohydrate Mean (SD): 253.45 (55.55) g/d Fat Mean (SD): 50.91 (9.56) g/d Dietary Protein Intake Compliance (%): 91.6% Protein type/source: Mixed	once per week by phone or WhatsApp software. Comparator: Low Protein How protein was administered: Low protein content snack (~3.5 servings of fruit equaling <2 g protein) daily at 10 a.m. Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above	
		Eucaloric Study duration: 6 months		
PMID: 24047916 Jesudason 2013*4	Study of: Adults Total sample N: 323	Intervention: High protein	Intervention: High protein	Muscle Mass - Lean Mass

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			administration and	methods of assessment)
			assessment)	
Location/Country: Australia	Intervention: High protein	Intended Protein Amount:	How protein was	Measures/Method of
HDI: Very high	N: 164	32% of energy	administered: Participants	Assessment: NR
Setting: Community dwelling	% Female: 100%	Carbohydrate: 44% of energy	received monthly group	
Urban/Rural: NR	Mean Age (SE): 59.5 (0.4) y	Fat: 24% of energy	dietetic education and	
Study Design:	Race/ Ethnicity: NR		support for the first 6 months	
RCT (Parallel)	Menopausal status:	Baseline Protein Amount	and then every 3 months for	
Funding source: Government	Postmenopausal	Mean (SD): 92.5 (2.2) g/day;	the next 18 months. Sample	
Risk of bias score: High	Pubertal status: NA	18.6 (0.2) % of energy	food packs of \$20 vouchers	
	Obesity status: Obese	Carbohydrate Mean (SD): 230	were provided to participants	
	Mean BMI (SD): 34.0 (0.4)	(6) g/day; 42.9 (0.5) % of	at baseline and 12 and 26	
	kg/m²	energy	weeks. Each diet group was	
	Income level: NR	Fat Mean (SD): 79.2 (2.7)	allocated to a protein target	
	Education level: NR	g/day; 33.3 (0.4) % of energy	that was based on key	
	Physical activity level: NR		protein foods as a	
	Health status/Co-morbidities:	Actual Protein Amount at the	compliance measure.	
	Subjects with paratnyroid	end of the study	Ductain Accession	
	disease, a vitamin D	Mean (SD): $91.5 (2.2) g/day;$	Protein Assessment	
	concentration, 60 nmol/L with	21.9(0.3) % of energy	Method: Participants	
	secondary	Carbonydrale Mean (SD): 196	recorded dietary intakes	
	nyperparatnyroidism, or	(6) g/day; 43.9 (0.7) % of	using a protein counter and	
		Energy	checklist. Protein compliance	
	gastrointestinal, renal, or	Fat Mean $(5D)$: 55.5 (2.3)	from each participant at each	
	other significant disease,	g/day, 20.2 (0.7) % of energy	rom each participant at each	
	avaluded	Diatony Brotain Inteles	group session. Subjects also	
	Modication use: Women	Compliance (%): NP	and 1 and 2 y	
	were included if they were	Compliance (70). NR	anu i anu z y.	
	taking hormone-replacement	Protein type/source: Mixed	Dietary Protein Intake	
	therapy hisphosphonates	Trotein type/source. Mixed	Compliance: Compliance	
	steroids diuretics calcium	Energy balance status:	was assessed by (1) blood	
	or vitamin D	Hypocaloric	urea nitrogen and 24h urine	
	Supplement use: Women	riypoodiono	for urea nitrogen excretion	
	were ineligible if they were	Comparator: Normal protein	(2) allocated to a protein	
	taking calcium or vitamin D		target for each diet group	
	Pregnant or lactating: NA	Intended Protein Amount	and (3) protein-compliance	
		22% of energy	checklists were collected	
	Comparator: Normal protein	Carbohydrate: 55% of energy	from each participant at each	
	N: 159	Fat: 23% of energy	group session.	
	% Female: 100%			
	Mean Age (SD): 59.4 (0.4) v	Baseline Protein Amount	Comparator: Normal protein	
	Race/Ethnicity: NR	Mean (SD): 91.2 (1.9) g/dav;		
	· · · · · · · · · · · · · · · · · · ·	18.4 (0.2) % of energy		

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			administration and	methods of assessment)
	Menopausal status: Postmenopausal Pubertal status: NA Obesity status: Obese Mean BMI at baseline: 33.4 (0.4) kg/m ² Income level: NR Education level: NR Physical activity level: NR Health status/Co-morbidities: Subjects with parathyroid disease, a vitamin D concentration, 60 nmol/L with secondary hyperparathyroidism, or unstable metabolic, cardiac, gastrointestinal, renal, or other significant disease, including malignancies, were excluded Medication use: Women were ineligible if they were taking hormone-replacement	Carbohydrate Mean (SD): 228 (5) g/day; 42.9 (0.5) % of energy Fat Mean (SD): 77.7 (2.1) g/day; 33.4 (0.4) % of energy Actual Protein Amount at the end of the study Mean (SD): 80.6 (2.2) g/day; 18.9 (0.3) % of energy Carbohydrate Mean (SD): 214 (5) g/day; 47.2 (0.6) % of energy Fat Mean (SD): 57.9 (2.5) g/day; 28.6 (0.7) % of energy Dietary Protein Intake Compliance (%): NR Protein type/source: Mixed Energy balance status: Hypocaloric	assessment) How protein was administered: Participants received monthly group dietetic education and support for the first 6 months and then every 3 months for the next 18 months. Sample food packs of \$20 vouchers were provided to participants at baseline and 12 and 26 weeks. Each diet group was allocated to a protein target that was based on key protein foods as a compliance measure. Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above	
	therapy, bisphosphonates, steroids, diuretics, calcium, or vitamin D Supplement use: Women were ineligible if they were taking calcium or vitamin D Pregnant or lactating: NA	Study duration: 24 months		
PMID: 25844619	Study of: Adults	Intervention: High Protein	Intervention: High Protein	Muscle Mass - Total lean
Kerstetter 2015*# ⁵	Total sample N: 208	Intended Protein Amount: 40 g	How protein was	body mass
Location/Country: USA HDI: Very high Setting: NR Urban/ Rural: NR Study design: RCT (parallel) Funding source: Government, academic Risk of bias score: Low	Intervention: High Protein N: 106 % Female: 84% Mean Age (SD): 69.9 (6.1) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR	of protein from the supplement; total daily protein goal NR Carbohydrate: Test food protein NR Fat: Test food protein NR Baseline Protein Amount	administered: Participants received a dietary whey protein supplement (protein group; Provon 290; Glambia Nutritionals) that was closely matched for composition, color, kilocalories sodium	Measure/Method of Assessment: DXA using either a Hologic 4500W machine (Yale University School of Medicine) or a Lunar Prodigy DPX-IQ (University of Connecticut Health Center)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			administration and assessment)	methods of assessment)
	Mean BMI (SD): 26.1 (3.4)	Least Square Mean (SEM):	potassium, phosphorus,	
	kg/m²	73.8 (1.9) g/d	fiber, and calcium.	
	Income level: NR	Carbohydrate Least Square		
	Education level: NR	Mean (SEM): 214.1 (5.2) g/d	Protein Assessment	
	Mean physical activity level	Fat Least Square Mean	Method: Participants	
	score (SD): 6.7 (2.1)	(SEM): 59.4 (2.1) g/d	completed a 3-day food	
	Health status/ Comorbidities:		record prior to baseline, 6	
	Healthy older adults	Actual Protein Amount at the	months, and 18 months and	
	Medication use: Excluded if	end of the study	were analyzed using the	
	using long-term	Least Square Mean (SEM):	ESHA Food Processor	
	chemotherapeutic drugs,	90.7 (3.3) g/d	software program (ESHA	
	aromatase inhibitors or	Carbohydrate Least Square	Research; version 10.1.0).	
	tamoxifen, methotrexate,	Mean (SEM): 196.9 (6.6) g/d		
	phenytoin, phenobarbital or	Fat Least Square Mean	Dietary Protein Intake	
	inhaled corticosteroids	(SEM): 55.6 (2.0) g/d	Compliance: Urinary area	
	(greater than 800 ug/day),		was a compliance measure.	
	actively being treated for	Dietary Protein Intake	O a man a mata mula ava Durata in	
	ieukemia or multiple	Compliance (%): NR	Comparator: Low Protein	
	myeloma, a change in inyroid	Dratain tura (agunagu Arimalu		
	medications, medications	Protein type/source: Animal;	How protein was	
	known to allect calcium	whey supplement	Derticipante reacived e	
	nielabolism or use or proton	Energy belonce status:	Participants received a	
	Supplement use: Daily	Energy balance status.	Maltrin M100: Croin	
	Supplement use. Daily	Eucaione	Processing Corp) that was	
	supplement (contained 400	Comparator: Low Protoin	closely matched for	
	Supplement (contained 400	Comparator. Low Protein		
	carbonate supplement (300	Intended Protein Amount: Test	kilocalories sodium	
	ma tablets)	food protein NR	notassium phosphorus	
	Pregnant or lactating: NR	Carbobydrate: Test food	fiber and calcium	
	r regnant of labtating. With	protein NR		
	Comparator: Low Protein	Fat: Test food protein NR	Protein Assessment	
	N: 102		Method: Same as above	
	% Female: 87.3%	Baseline Protein Amount		
	Mean Age (SD): 70.5 (6.4) y	Least Square Mean (SEM):	Dietary Protein Intake	
	Race/ Ethnicity: NR	72.9 (1.8) g/d; 1.06 (0.03)	Compliance: Same as	
	Menopausal status: NR	g/kg/d (total daily)	above	
	Obesity status: NR	Carbohydrate Least Square		
	Mean BMI (SD): 26.4 (4.0)	Mean (SEM): 206.2 (5.8) g/d		
	kg/m²	(total daily)		
	Income level: NR			
	Education level: NR			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	Mean physical activity level score (SD): 6.8 (1.9)	Fat Least Square Mean (SEM): 61.3 (2.5) g/d (total		
	Healthy older adults	dany)		
	Medication use: Excluded if	Actual Protein Amount at end		
	using long-term	of the study		
	chemotherapeutic drugs,	Least Square Mean (SEM):		
	tamovifen methotrevate	72.7 (2.4) g/d, 1.05 (0.04) g/kg/d (total daily)		
	phenytoin, phenobarbital or	Carbohvdrate Least Square		
	inhaled corticosteroids	Mean (SEM): 229.0 (9.5) g/d		
	(greater than 800 ug/day),	(total daily)		
	actively being treated for	Fat Least Square Mean		
	myeloma a change in thyroid	(SEM): 56.6 (2.4) g/d (total daily)		
	medications, medications	danyy		
	known to affect calcium	Dietary Protein Intake		
	metabolism or use of proton	Compliance (%): NR		
	pump inhibitors twice daily	Protein type/source: Mixed		
	multivitamin mineral	r rotein type/source. Mixed		
	supplement (contained 400	Energy balance status:		
	IU of vitamin D); Ca	Eucaloric		
	carbonate supplement (300	Chudu dunation, 10 months		
	Pregnant or lactating: NR	Study duration: 18 months		
PMID: 37739678	Study of: Adults	Intervention 1: Deer Milk	Intervention 1: Deer Milk	Muscle Mass - Fat-free
Kruger	Total sample N: 114			mass
2023 ⁵⁹		Intended Protein Amount:	How protein was	
Location/Country: New	Whole cohort	Protein supplement contained	administered: Participants	Measure/Method of
HDI: Very high	N. 103 % Female: 100%	Carbohydrate: Supplement	milk	320 Secul Korea)
Setting: Community dwelling	Mean Age (SD):70.1 (3.51) v	contained 9.0 g of		
Urban/ Rural: NR	Race/ Ethnicity:	carbohydrate per 200 ml	Protein Assessment	Muscle Mass – Skeletal
Study design: RCT (parallel)	89% New Zealand European	Fat: Supplement contained	Method: Habitual dietary	muscle mass
Funding source: Industry	Menopausal Status: NR	19.6 g of fat per 200 ml	Intake data was collected by	Moasuro/Mothed of
RISK OF DIAS SCORE: HIGH	Mean BMI (SD) [,] 24 8 (2 65)	Baseline Protein Amount	baseline Average energy	Assessment: BIA (Inbody
	kg/m ²	(whole cohort):	and macronutrient intake was	320, Seoul, Korea)
	Income level: NR	<1 g/kg: 29%	assessed using FoodWorks	
	Education level:	1-3 g/kg: 39%	Professional Edition 10.	

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and	Outcome (Measures and methods of assessment)
			assessment)	
	Tertiary level of education: 34% Percent physical activity level: Light: 38% Moderate: 55% Vigorous: 7% Health status/ Comorbidities: History of cancer: 18% Cardiovascular disease: 8% Hypertension: 24% Hypercholesterolemia: 30% Musculoskeletal conditions: 27% Diabetes: 1% Gastrointestinal conditions: 16% Respiratory conditions: 8% Renal diseases: 1% Thyroid diseases: 6% Autoimmune diseases: 3% Psychological conditions: 16% Medication use: Cholesterol medication: 14% Supplement use: NR Pregnant or lactating: NR	 ≥1.3 g/kg: 32% Carbohydrate Mean (SD): NR Fat Mean (SD): NR Actual Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD) NR Fat Mean (SD): NR Dietary Protein Intake Compliance (%): 98.7% Protein type/source: Animal Energy balance status: Eucaloric Comparator: Oral Nutritional Supplement Intended Protein Amount: Protein supplement contained 12.0 g of protein per 200 ml Carbohydrate: Supplement contained 36.8 g of carbohydrate per 200 ml Fat: Supplement contained 11.6 g of fat per 200 ml Baseline Protein Amount (whole cohort): <1 g/kg: 29% 1-3 g/kg: 32% Carbohydrate Mean (SD): NR Fat Mean (SD): NR Actual Protein Amount at the end of the study Mean (SD): NR 	Dietary Protein Intake Compliance: Throughout the study period, participants were also asked to complete a diary to record consumption of the beverages. Comparator: Oral Nutritional Supplement How protein was administered: Participants consumed 200 ml of oral nutritional supplement Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above	Muscle Strength - Handgrip strength Measure/Method of Assessment: Hand dynamometer Muscle Strength - Chair stand test Measure/Method of Assessment: Maximum number of chair stand repetitions possible in 30 s period was recorded Physical Performance - 40 m fast-paced walk test Measure/Method of Assessment: Fast-paced walking was timed over 4 x 10 m for a total of 40 m.

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
		Carbohydrate Mean (SD) NR Fat Mean (SD): NR Dietary Protein Intake Compliance (%): 96.8%		
		Protein type/source: Animal		
		Energy balance status: Eucaloric		
		Study duration: 11 weeks		
PMID: 33612439 Li	Study of: Adults Total sample	Intervention 1: Whey Protein	Intervention 1: Whey Protein	Muscle Mass - Total body lean mass
Location/Country: China HDI: High Setting: Community dwelling Urban/ Rural: Urban Study design: RCT (parallel) Funding source: Nonprofit, government, academic Risk of bias score: Low	Intervention 1: Whey Protein N: 31 % Female: 48.4% Mean Age (SD): 71 (4) y Race/ Ethnicity: NR Menopausal Status: NR Obesity Status: NR Mean BMI (SD): 21.8 (2.0) kg/m ² Income level: NR Education level:	Protein supplement contained 7.98 g of protein; dosage intended to increase participant protein consumption to 1.5 g/kg/d Carbohydrate: NR Fat: NR Baseline Protein Amount Mean (SD): 62.7 (20.7) g/d; 1.14 (0.36) g/kg/d Carbohydrate Mean (SD): 200.9 (65.9) g/d	How protein was administered: Participants consumed a whey protein supplement twice daily Protein Assessment Method: Measured at baseline and at 6 months using a 79-item semi quantitative FFQ. Baseline FFQ was used to collect dietary intake in the past year. FFQ at 6 months was	Measure/Method of Assessment: DXA (Discovery W; Hologic Inc) Muscle Mass - Appendicular lean mass/ skeletal muscle mass Measure/Method of Assessment: DXA (Discovery W; Hologic Inc) Muscle Mass –
	High school or below: 67.7% College or above: 32.3% Mean physical activity level (SD): 38.8 (13.0) MET-h/d Health status/ Comorbidities: Low lean muscle mass; excluded disease with movement disorders such as stroke, fracture, and arthritis; previous osteoporotic fracture or joint replacement; musculoskeletal injuries; allergies to whey or soy protein supplements	Fat Mean (SD): 56.0 (21.2) g/d Actual Protein Amount at the end of the study Mean (SD): 75.3 (13.8) g/d; 1.39 (0.24) g/kg/d (total) Carbohydrate Mean (SD): 185.5 (43.1) g/d Fat Mean (SD): 50.1 (11.7) g/d Dietary Protein Intake Compliance (%): 99%	used to collect the dietary intake during the 6-month intervention. Daily dietary intakes calculated based on the China Food Composition Table 2004. Dietary Protein Intake Compliance: For Whey Protein, Soy Protein, and Whey- Soy protein groups compliance was assessed by counting the number of	Appendicular skeletal muscle index Measure/Method of Assessment: Appendicular lean mass divided by height squared Muscle Strength - Handgrip strength Measure/Method of Assessment: Measured using handgrip dynamometer

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
-	-		administration and	methods of assessment)
			assessment)	
	Medication use: NR		protein packets returned by	
	Supplement use: Excluded	Protein type/source: Animal;	the participants.	Physical Performance - 4 m
	those that used protein and	whey		gait speed
	antioxidant supplements		Intervention 2: Soy Protein	
	within the past 12 months	Energy balance status:		Measure/Method of
	prior to enrollment	Eucaloric	How protein was	Assessment: Walk 8m at
	Pregnant or lactating: NR	Intervention 2. Sour Drotain	administered: Participants	usual pace and time used for
	Intervention 2: Sou Protoin	Intervention 2: Soy Protein	consumed a soy protein	m was massured
	N: 21	Intended Protein Amount:	supplement twice daily	III was measured
	N. 51 % Eemale: 51.6%	Protein supplement contained	Protoin Assossment	Muscle Strength - Chair
	Mean Are (SD) : 69 (1) v	8 80 g of protein: dosage	Method: Same as above	stand test
	Race/ Ethnicity: NR	intended to increase	Method. Game as above	
	Menopausal Status: NR	participant protein	Dietary Protein Intake	Measure/Method of
	Obesity Status: NR	consumption to 1.5 g/kg/d	Compliance: Same as	Assessment: Participants to
	Mean BMI (SD): 21.2 (2.3)	Carbohvdrate: NR	above	stand up from a chair and sit
	kg/m ²	Fat: NR		down 5 times as quickly as
	Income level: NR		Intervention 3: Whey-soy	possible with arms folded
	Education level:	Baseline Protein Amount	protein group	across their chests.
	High school or below: 58%	Mean (SD): 59.6 (19.1) g/d;		
	College or above: 42%	1.11 (0.33) g/kg/d	How protein was	Physical Performance -
	Mean physical activity level	Carbohydrate Mean (SD):	administered: Participants	SPPB
	(SD): 35.5 (15.7) MET-h/d	191.9 (56.5) g/d	consumed a whey-soy	
	Health status/ Comorbidities:	Fat Mean (SD): 52.8 (26.8)	supplement (1:1 ratio) twice	Measure/Method of
	Low lean muscle mass;	g/d	daily	Assessment: The SPPB
	excluded disease with			consists of three
	movement disorders such as	Actual Protein Amount at the	Protein Assessment	components: balance, gait
	stroke, fracture, and arthritis;	end of the study	Method: Same as above	speed and chair rise ability
	previous osteoporotic	Mean (SD): 79.3 (20.5) g/d;	Distant Drotsin Intoka	
	iracture or joint replacement;	1.51 (U.41) g/kg/d (lotal)	Compliance: Some co	
	allergies to whow or sov	(3D)	compliance. Same as	
	protein supplements	Fat Mean (SD): 50.8 (16.8)	above	
	Medication use: NR	a/d	Comparator: Control	
	Supplement use: Excluded	9,4	Comparator: Control	
	those that used protein and	Dietary Protein Intake	How protein was	
	antioxidant supplements	Compliance (%): 91.5%	administered: Participants	
	within the past 12 months		consumed habitual diet	
	prior to enrollment	Protein type/source: Plant; sov		
	Pregnant or lactating: NR		Protein Assessment	
		Energy balance status:	Method: Same as above	
		Eucaloric		

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and	Outcome (Measures and methods of assessment)
			assessment)	
	Intervention 3: Whev-Sov		Dietary Protein Intake	
	protein group	Intervention 3: Whev-Sov	Compliance: Same as	
	N: 31	protein group	above	
	% Female: 45.2%			
	Mean Age (SD): 70 (4) y	Intended Protein Amount:		
	Race/ Ethnicity: NR	Protein supplement contained		
	Menopausal Status: NR	8.39 g of protein; dosage		
	Obesity Status: NR	intended to increase		
	Mean BMI (SD): 20.6 (1.8)	participant protein		
	kg/m²	consumption to 1.5 g/kg/d		
	Income level: NR	Carbohydrate: NR		
	Education level:	Fat: NR		
	High school or below: 54.8%			
	College or above: 45.2%	Baseline Protein Amount		
	Mean physical activity level	Mean (SD): 61.1 (19.1) g/d;		
	(SD): 38.9 (11.5) MET-n/d	1.14 (0.37) g/kg/d		
	Health status/ Comorbidities:	Carbonydrate Mean (SD):		
	Low lean muscle mass;	188.0 (30.9) g/d		
	excluded disease with	Fat Mean (SD). 51.7 (19.5)		
	atroke freeture and arthritic:	g/d		
	provious estecoporatio	Actual Protain Amount at the		
	fracture or joint replacement:	and of the study		
	musculoskeletal injuries.	Mean (SD): 80 2 (18 2) a/d:		
	allergies to whey or sov	1.49 (0.34) g/kg/d (total)		
	protein supplements	Carbohydrate Mean (SD)		
	Medication use: NR	197 5 (51 8) g/d		
	Supplement use: Excluded	Fat Mean (SD): 51.1 (16.9)		
	those that used protein and	a/d		
	antioxidant supplements			
	within the past 12 months	Dietary Protein Intake		
	prior to enrollment	Compliance (%): 94.5%		
	Pregnant or lactating: NR	,		
		Protein type/source: Mixed;		
	Comparator: Control N: 30	whey and soy (1:1 ratio)		
	% Female: 56.7%	Energy balance status:		
	Mean Age (SD): 71 (4) y	Eucaloric		
	Race/ Ethnicity: NR			
	Menopausal Status: NR	Comparator: Control		
	Obesity Status: NR			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	Mean BMI (SD): 20.8 (2.2) kg/m ² Income level: NR Education level: High school or below: 63.3% College or above: 36.7% Mean physical activity level	Intended Protein Amount: Followed habitual diet; total daily protein goal NR Carbohydrate: NR Fat: NR Baseline Protein Amount		
	(SD): 33 (14) MET-h/d Health status/ Comorbidities: Low lean muscle mass; excluded disease with movement disorders such as stroke, fracture, and arthritis; previous osteoporotic	Mean (SD): 59.3 (18.8) g/d; 1.17 (0.30) g/kg/d Carbohydrate Mean (SD): 221 (45.4) g/d Fat Mean (SD): 49.0 (17.3) g/d		
	fracture or joint replacement; musculoskeletal injuries; allergies to whey or soy protein supplements Medication use: NR Supplement use: Excluded those that used protein and antioxidant supplements	Actual Protein Amount at the end of the study Mean (SD): 56.3 (11.0) g/d; 1.11 (0.25) g/kg/d (total) Carbohydrate Mean (SD): 212.0 (88.1) g/d Fat Mean (SD): 49.0 (11.3) g/d		
	prior to enrollment Pregnant or lactating: NR	Dietary Protein Intake Compliance (%): NA		
		Protein type/source: Mixed Energy balance status: Eucaloric		
		Study duration: 6 months		
PMID: 33871558 Murphy 2021* ³⁶	Study of: Adults Total sample N: 107	Intervention 1: Leucine- enriched Protein	Intervention 1: Leucine- enriched Protein	Muscle Mass - Adjusted appendicular lean mass/ skeletal Muscle Mass
Location/Country: Ireland HDI: Very high Setting: Community dwelling Urban/ Rural: Urban Study design: RCT (parallel) Funding source:	Intervention 1: Leucine- enriched Protein N: 38 % Female: 52.6% Mean Age (SD): 70 (5) y Race/Ethnicity: 100% White	Intended Protein Amount: 21.2 g in supplemental protein per day; total intake goals NR Carbohydrate: NR Fat: NR	How protein was administered: Two supplements daily equaling 21.2 g protein per day (including 6.2 g leucine); one was consumed before	Measure/Method of Assessment: DXA (GE- LUNAR iDXA; Aymes Medical)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
-	•		administration and	methods of assessment)
			assessment)	
Government	Menopausal status: NR	Baseline Protein Amount	breakfast and one before	Muscle Strength - Handgrip
Risk of bias score: High	Obesity status: NR	Mean (SD): 84 (26) g/d; 17.1	their second light meal of the	strength
	Mean BMI (SD): 24.8 (3.4)	(3.9) % of energy	day with habitual diet	
	kg/m ²	Carbohydrate Mean (SD): 226		Measure/Method of
	Income level: NR	(78) g/d; 45.0 (9.7) % of	Protein Assessment	Assessment: Measured
	Education level: NR	energy	Method: Dietary intake was	using handgrip dynamometer
	Mean physical activity level	Fat Mean (SD): 82 (32) g/d;	assessed via a 24-h recall	
	(SD): 8354 (4125) steps/day	36.3 (7.7) % of energy	using the 5-step multiple-	Muscle Strength - Isometric
	Health status/ Comorbidities:		pass method at pre-, mid-,	knee extension peak torque
	Included: Low skeletal	Actual Protein Amount at the	and post intervention visits	
	muscle mass; generally	end of the study		Measure/Method of
	healthy according to	Mean (SD): 100 (23) g/d; 19.6	Dietary Protein Intake	Assessment: Self-reported
	responses to a standard	(3.3) % of energy	Compliance: Compliance	dominant leg using a
	nealth screening	Carbonydrate Mean (SD): 229	was derived using the self-	dynamometer; warm-up and
	questionnaire	(60) g/d; 44.6 (6.7) % of	report supplement logs	4 maximal leg extensions at
	Excluded. malignancy in the	Eat Moon (SD): 90 (24) a/d:	Intervention 2: Normal	90 degrees with ous between
	advanced renal disease	74 8 (6 3) % of energy	Protein	(also ulu 3 fourius at ou
	neuromuscular disease, total	54.0 (0.5) % of energy	Totem	highest result used in
	walking incapacity	Dietary Protein Intake	How protein was	analysis
	Medication use: Mean (SD)	Compliance (%): Median	administered: Two	anarysis
	number of mediations: 1 (2):	(IQR): 89% (83-94%)	supplements daily equaling	Muscle Strength - Isometric
	Excluded if taking		21.2 g protein per day	knee flexion peak torque
	medications that interfere	Protein type/source: Whey	(including 6.2 g leucine and 4	
	with the nutrition intervention	protein and a peptide carrier	g LC n-3 PUFAs); one was	Measure/Method of
	- corticosteroids for systemic	enriched with free leucine	consumed before breakfast	Assessment: Self-reported
	use, hormone replacement		and one before their second	dominant leg using a
	therapy, insulin, high-dose	Energy balance status:	light meal of the day with	dynamometer; warm-up and
	anti-inflammatories,	Eucaloric	habitual diet	4 maximal leg flexion at 90
	simvastatin			degrees with 60s between;
	Supplement use: Excluded if	Intervention 2: Leucine-	Protein Assessment	highest result used in
	consumed LC n-3 PUFA	enriched Protein +PUFAS	Method: Same as above	analysis
	supplementation and were			
	not willing to cease	Intended Protein Amount: 21.2	Dietary Protein Intake	Physical Performance -
	consumption \geq 6 weeks prior	g in supplemental protein per	Compliance: Same as	SPPB
	to and for the duration of the	day; total intake goals NR	above	
	24-wk study	Carbohydrate: NR		Measure/Method of
	Pregnant or lactating: NR	Fat: NR	Comparator: Normal Protein	Assessment: The SPPB
	Intervention Orlandia	Deceline Drotein American		consists of three
	Intervention 2: Leucine-	Baseline Protein Amount	now protein was	components: palance, gait
	enriched Protein+ PUFAS	(4.5) % of an arrive	auministerea: isocaloric	speed and chair rise ability
	N: 38	(4.5) % of energy	maitodextrin supplement	

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
	-		administration and	methods of assessment)
			assessment)	
	% Female: 55.3%	Carbohydrate Mean (SD): 200		Physical Performance -
	Mean Age (SD): 73 (6) y	(66) g/d; 45.6 (8.4) % of	Protein Assessment	Gait speed
	Race/Ethnicity: 100% White	energy	Method: Same as above	
	Menopausal status: NR	Fat Mean (SD): 69 (25) g/d;		Measure/Method of
	Obesity status: NR	35.4 (8.8) % of energy	Dietary Protein Intake	Assessment: Per standard
	Mean BMI (SD): 26.7 (3.2)		Compliance: Same as	SPPB protocols
	kg/m²	Actual Protein Amount at the	above	
		end of the study		Physical Performance -
	Education level: NR	Mean (SD): 92 (25) g/d; 19.9		TUG
	Wean physical activity level	(4.0) % of energy		Maggura/Mathad of
	(SD). 6257 (3906) steps/day	(5D), 200		Accessment: Der standard
	health status/ Comorbidities.	(37) g/u, 43.3 (8.0) % 01		Assessment. Fer standard
	muscle mass: generally	Eat Mean (SD): 76 (28) g/d:		with the average of the tests
	healthy according to	36.2(7.8)% of energy		used in analysis
	responses to a standard	30.2 (1.0) / 01 chergy		
	health screening	Dietary Protein Intake		Muscle Strength- 5 times
	questionnaire	Compliance (%): Median		sit-to-stand
	Excluded: malignancy in the	(IQR): 92% (87-97%)		
	past 5 years, diabetes,			Method/Measure of
	advanced renal disease,	Protein type/source: Animal;		Assessment: Per standard
	neuromuscular disease, total	whey protein and a peptide		SPPB protocols
	walking incapacity	carrier enriched with free		-
	Medication use: Mean (SD)	leucine		
	number of medications: 2 (2);			
	Excluded if taking	Energy balance status:		
	medications that interfere	Eucaloric		
	with the nutrition intervention			
	- corticosteroids for systemic	Comparator: Normal Protein		
	use, hormone replacement	laterale d Dreteire Arresunt, ND		
	therapy, insulin, high-dose	Intended Protein Amount: NR		
	anti-inflammatories,			
	Simvasialin Supplement use: Excluded if	Fal. NR		
		Pagalina Drotain Amount		
	supplementation and were	Mean (SD): 70 (31) a/d : 16 7		
	not willing to cease	(53) % of energy		
	consumption ≥ 6 weeks prior	Carbohydrate Mean (SD): 214		
	to and for the duration of the	(62) g/d: 45.6 (7.5) % of		
	24-wk study	energy		
	Pregnant or lactating: NR	Fat Mean (SD): 80 (34) d/d:		
		37.4 (9.3) % of energy		

Intervention(s) (Cont	ent) Intervention(s) (Methods of	Outcome (Measures and
	assessment)	methous of assessment)
Protein		
Actual Protein Amount	at the	
end of the study		
) y Mean (SD): 83 (23) g/c	l; 15.2	
White (3.2) % of energy		
R Carbohydrate Mean (S	SD): 268	
(68) g/d; 49.8 (5.6) % d	of	
(2.8) energy		
Fat Mean (SD): 85 (30) g/d;	
34.8 (5.4) % of energy		
level Dietary Protein Intake		
ps/day Compliance (%): Medi	an	
oldities: (IQR): 93% (87-95%)		
	ive d	
Protein type/source: M	Ixed	
rd Enorgy balance status		
Ellergy balance status		
Edealone		
in the Study duration: 24 wee	aks	
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se, total		
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(SD)		
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of the		
	Intervention(s) (ContProteinActual Protein Amount end of the study Mean (SD): 83 (23) g/d (3.2) % of energy (3.2) % of energy Fat Mean (SD): 85 (30) 34.8 (5.4) % of energy Fat Mean (SD): 85 (30) 34.8 (5.4) % of energy Protein Intake Compliance (%): Media (IQR): 93% (87-95%)/ level eps/day bidities: IIDietary Protein Intake Compliance (%): Media (IQR): 93% (87-95%)/ laEnergy balance status Eucaloric/ in the s, se, total n (SD) us: 2 (3);Study duration: 24 weak stemic ement doseluded if FA wereFA were	Intervention(s) (Content)Intervention(s) (Methods of administration and assessment)ProteinActual Protein Amount at the end of the study (SD): 83 (23) g/d; 15.2 (3.2) % of energy (Carbohydrate Mean (SD): 268 (68) g/d; 49.8 (5.6) % of energy Fat Mean (SD): 85 (30) g/d; 34.8 (5.4) % of energy(2.8)Dietary Protein Intake Compliance (%): Median (IQR): 93% (87-95%)IlyDietary Protein Intake Compliance (%): Median (IQR): 93% (87-95%)IlyProtein type/source: MixedardEnergy balance status: Eucaloricy in the S, se, ise, totalStudy duration: 24 weeksn (SD) is: 2 (3); fere vention ment doseluded if FA wereIndex in the index in the index in the index in the index in

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	Pregnant or lactating: NR			
PMID: 34098214 Peng 2021 * ³⁷ Location/Country:	Study of: Adults Total sample N: 52 Intervention: High Protein	Intervention: High Protein Intended Protein Amount: 25% of energy	Intervention: High Protein How protein was administered: Received 10	Muscle Strength - Handgrip strength Measure/Method of
Taiwan/China HDI: High Setting: Community dwelling	N: 27 % Female: 48.1% Mean Age (SD): 53.4 (8.1) y	Carbohydrate: NR Fat: NR	frozen meals per week for 12 weeks containing 25% energy in protein.	Assessment: Measured using handgrip dynamometer
Study design: RCT (parallel) Funding source:	Menopausal status: NR Obesity status: NR Mean BMI (SD): 25 1 (3.9)	Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	Protein Assessment Method: NR	chair rise test
Risk of bias score: High	kg/m ² Income level: NR Mean education level (SD):	Actual Protein Amount at the end of the study	Dietary Protein Intake Compliance: Insufficient compliance to the study	Assessment: NR Physical Performance - 6
	14.1 (2.9) y Mean physical activity level (SD): 1567.3 (1244.9)	Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	protocol (e.g low meal complete rate and vigorous changes of lifestyle)	min walking distance
	kcal/wk Health status/ Comorbidities:	Dietary Protein Intake	Comparator: Normal Protein	Assessment: NR
	fracture or severe arthritis in recent 6 months, (2) known	Protein type/source: Mixed	How protein was administered: Received 10	meter walking speed
	disease stage III and over, i.e. estimated glomerular	Energy balance status: Eucaloric	weeks containing 15% energy in protein.	Measure/Method of Assessment: Usual pace
	filtered rate (eGFR) < 60 ml/min/1.73 m ² , (3) contraindicated for magnetic	Comparator: Normal Protein	Protein Assessment Method: Same as above	Muscle Mass - Lean body mass
	resonance imaging, (4) using anabolic hormones in the past 3 months, (5) were disability or limited functional	Intended Protein Amount: 15% of energy Carbohydrate: NR Fat: NR	Dietary Protein Intake Compliance: Same as above	Measure/Method of Assessment: BIA (Inbody S10, Biospace device, USA)
	ability, (6) having advanced, active or uncontrolled diseases, and (6) dementia, cognitive impairment or other	Baseline Protein Amount Mean (SD): NR Carbobydrate Mean (SD): NR		Muscle Mass - Relative Appendicular Skeletal Muscle mass
	sensory impairment that limited communication and understanding of the study	Fat Mean (SD): NR Actual Protein Amount at the end of the study		Measure/Method: Appendicular muscle mass divided by squared height in meters.

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and	Outcome (Measures and methods of assessment)
			assessment)	methous of assessment)
	Medication use: Excluded	Mean (SD): NR		
	those using anabolic	Carbohydrate Mean (SD): NR		
	hormones	Fat Mean (SD): NR		
	Supplement use: NR			
	Pregnant or lactating: NR	Dietary Protein Intake Compliance (%): 79.5%		
	Comparator: Normal Protein			
	N: 25	Protein type/source: Mixed		
	% Female: 44%			
	Mean Age (SD): 54 (8.6) y	Energy balance status:		
	Race/Ethnicity: NR	Eualoric		
	Menopausal status: NR	Chudu duration, 10 wasks		
	Obesity status: NR Moon RML (SD): 25.6 (2.8)	Study duration: 12 weeks		
	ka/m^2			
	Income level: NR			
	Mean education level (SD):			
	15.5 (2.7) v			
	Mean physical activity level			
	(SD): 1954.0 (1646.4)			
	kcal/wk			
	Health status/ Comorbidities:			
	Excluded: (1) history of			
	fracture or severe arthritis in			
	recent 6 months, (2) known			
	history of chronic kidney			
	disease stage III and over,			
	i.e. estimated glomerular			
	filtered rate (eGFR) < 60			
	$ml/min/1.73 m^2$, (3)			
	contraindicated for magnetic			
	resonance imaging, (4) using			
	anabolic normones in the			
	dischility or limited functional			
	ability (6) baying advanced			
	active or uncontrolled			
	diseases, and (6) dementia			
	cognitive impairment or other			
	sensory impairment that			
	limited communication and			
	understanding of the study			

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
	Medication use: Excluded			
	those using anabolic			
	hormones			
	Supplement use: NR			
	Pregnant or lactating: NR			
PMID: 34609621	Study of: Adults	Intervention: Protein advice	Intervention: Protein advice	Physical Performance - 400
Reinders	Total sample N: 187			m walk speed
		Intended Protein Amount: ≥1.2	How protein was	
Location/Country: Finland,	Intervention: Protein advice	g/kg aBVV/d	administered: Participants	Measure/Method of
Netherlands	N: 96	Carbohydrate: NR	received personalized dietary	Assessment: After 40-m
HDI: Very High	% Female: 52.1%	Fat: NR	advice by nutritionist to	warmup, participants were
Setting: Community Dweiling,	Mean Age (SD): 75.9 (5.0) y	Deseline Destain Americat	Increase protein intake to \geq	Instructed to walk as fast as
Study Design RCT (Decellel)		Baseline Protein Amount	1.2 g/kg aBVV/d using regular	possible at a pace they could
Sludy Design. RCT (Parallel)	Obesity Status NR	0.82(0.01) = 0.4(1.3) g/d	by the reconcidents and	maintain for 400 m
Covernment	Moon RMI (SD): 26.3 (2.0)	Carbobydrato Moan (SD): NP	by the respondents and	Physical Porformanco
Bisk of bias score: Low	ka/m^2	Eat Moon (SD): NP	products frooly provided by	
RISK OF DIAS SCOLE. LOW	Income level: NR	Fat Mean (SD). NR	the research team	SFFD
	Education level:	Actual Protein Amount at the		Measure/Method of
	Lower education: 5.2%	end of the study	Protein Assessment	Assessment: The SPPB
	Middle education: 18.8%	Mean (SD): 89 1 (2.3) d/d	Method: Assessed prior to	consists of three
	Higher education: 76%	1.21(0.03) g/kg aBW/d	each clinic visit through a full	components: balance gait
	Physical activity level: NR	Carbohydrate Mean (SD): NR	dietary assessment using	speed and chair rise ability
	Health status/ Comorbidities:	Fat Mean (SD): NR	food diaries on three days.	opeed and chan nee ability
	Self-perceived health:		followed by a 24h dietary	Muscle Strength - Handgrip
	Very poor/poor: 0%	Dietary Protein Intake	recall to assess habitual	strength
	Not poor/not good: 19.8%	Compliance (%):	protein intake. Protein intake	5
	Good/ very good: 80.2%	<0.8 g/kg aBW/d – 4.4%	assessed at 3 months and 6	Measure/Method of
	Medication use: NR	0.8–1.0 g/kg aBW/d –14.4%	months.	Assessment: Measured
	Supplement use: NR	1.0–1.2 g/kg aBW/d – 32.2%		using handgrip dynamometer
	Pregnant or lactating: NR	≥1.2 g/kg aBW/d – 48.9%	Dietary Protein Intake	
			Compliance: Compliance of	Muscle Strength - Leg
	Comparator: Control	Protein type/source: Mixed	study participants to adhere	extension strength
	N: 91		to the advice to increase	
	% Female: 54.9%	Energy balance status:	protein intake was	Measure/Method of
	Mean Age (SD): 75.0 (4.4) y	Eucaloric	indicated by the percentage	Assessment: NR
	Race/ Ethnicity: NR		of participants reaching a	
	Menopausal Status: NR	Comparator: Control	certain protein intake (<0.8	Muscle Mass - Fat Free
	Obesity Status: NR		g/kg aBW/d, 0.8–1.0 g/kg	Mass
	Mean BMI (SD): 26.9 (2.9)	Intended Protein Amount: NR	aBW/d, 1.0–1.2 g/kg aBW/d	
	kg/m²	Carbohydrate: NR	or≥1.2 g/kg aBW/d) for each	

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			administration and	methods of assessment)
	Income level: NR Education level: Lower education: 5.5% Middle education: 24.2% Higher education: 70.3% Physical activity level: NR Health status/ Comorbidities: Self-perceived health: Very poor/poor: 0% Not poor/not good: 19.8% Good/ very good: 80.3% Medication use: NR Supplement use: NR Pregnant or lactating: NR	Fat: NR Baseline Protein Amount Mean (SD): 60.5 (1.2) g/d; 0.82 (0.01) g/kg aBW/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Actual Protein Amount at the end of the study Mean (SD): 63.7 g/d; 0.86 (0.02) g/kg aBW/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Dietary Protein Intake Compliance (%): <0.8 g/kg aBW/d – 40.5% 0.8–1.0 g/kg aBW/d – 36.9% 1.0–1.2 g/kg aBW/d – 15.5% ≥1.2 g/kg aBW/d – 7.1% Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 6 months	assessment) study group at each clinic visit. Comparator: Control How protein was administered: Did not receive any protein advice or protein enriched foods Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above	Measure/Method of Assessment: BIA (BodyStat 1500MDD, Bodystat Ltd, Douglas, Isle of Men, United Kingdom)
PMID: 29687650 Smith 2018 ⁶²	Study of: Adults Total sample N: 52	Intervention: Weight loss plus whey protein	Intervention: Weight loss plus whey protein	Muscle Mass - Total fat-free mass
Location/Country: USA HDI: Very high Setting: Community dwelling Urban/Rural: NR Study design: RCT (parallel) Funding source: Nonprofit, government Risk of bias score: Low	Intervention: Weight loss plus whey protein N: 25 % Female: 100% Mean Age (SD): NR Race/ Ethnicity: NR Menopausal Status: Postmenopausal Obesity Status: 100% Obese Mean BMI (SD): NR	Intended Protein Amount: 1.2 g/kg/d Carbohydrate: NR Fat: NR Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	How protein was administered: Two nutrition bars per day for breakfast and frozen entrees for lunch and dinner were provided to the participants. Individuals also received two servings of whey protein isolate per day with breakfast and as a midafternoon snack.	Measure/Method of Assessment: DXA (Lunar iDA; GE Healthcare Lunar; Madison, Wisconsin) Muscle Mass - Total body lean mass Measure/Method of Assessment: DXA (Lunar

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
, ,	·		administration and	methods of assessment)
			assessment)	
	Income level: NR	Actual Protein Amount at the		iDA; GE Healthcare Lunar;
	Education level: NR	end of the study	Protein Assessment	Madison, Wisconsin)
	Physical activity level:	Mean (SD): 31 (1) % of	Method: Dietary intake was	
	Excluded if engaged in \geq 1.5	energy; 105 (2) g/d; 1.22	monitored by reviewing	Muscle Strength - Sum 1-
	hours of exercise/week	(0.03) g/kg/d	subjects' daily diet records	RM strength
	Health status/ Comorbidities:	Carbohydrate Mean (SD): 44	during weekly visits with the	
	Excluded if they had serious	(1) % of energy	study dietician.	Measure/Method of
	chronic disease (e.g.	Fat Mean (SD): 24 (1) % of		Assessment: The maximal
	neuromuscular,	energy	Dietary Protein Intake	amount of weight each
	cardiopulmonary, chronic	Distant Drotsin Intelse	Compliance: Dietary	participant was able to lift just
	kidney disease, diabeles,	Compliance (%): ND	the protein supplement were	once, evaluated with a Hoist
	cancer) or a condition that	Compliance (%). NR	the protein supplement were	multi-station weight machine
	composition imaging (e.g.	Protein type/source: Mixed	subjects (2) dietany intake	Muscle Strength - Sum
	contain metal implants)	Trotein type/source. Mixed	was monitored by reviewing	knee extension neak torque
	Medication use: Excluded	Energy balance status:	subjects' daily diet records	kiec extension peak torque
	those that were taking	Hypocaloric	during weekly visits with the	Measure/Method of
	medications that could affect	Typecalene	study dietician, and (3) blood	Assessment: Peak isometric
	muscle mass and/or function	Comparator: Weight loss plus	urea nitrogen and, in a	and isokinetic (608/s &
	(e.g., HMG-CoA reductase	recommended protein	subset of participants. urinary	1808/s) torgue of the knee
	inhibitors, steroids) within 1		urea nitrogen excretion were	extensors and flexors of the
	year before enrolling in the	Intended Protein Amount: 0.8	measured as objective	dominant leg were evaluated
	study.	g/kg/d	markers of protein intake.	using Biodex 3
	Supplement use: NR	Carbohydrate: NR		dynamometer. Exercise
	Pregnant or lactating: NR	Fat: NR	Comparator: Weight loss	repeated 3x, the mean of the
			plus recommended protein	2 highest torque recordings
	Comparator: Weight loss	Baseline Protein Amount	N: 27	for each exercise used in
	plus recommended protein	Mean (SD): NR		analysis.
	N: 27	Carbohydrate Mean (SD): NR	How protein was	
	% Female: 100%	Fat Mean (SD): NR	administered: Two nutrition	Muscle Strength - Sum
	Mean Age (SD): NR		bars per day for breakfast	knee flexion peak torque
	Race/ Ethnicity: NR	Actual Protein Amount at the	and frozen entrees for lunch	
	Menopausal Status:	end of the study	and dinner were provided to	Measure/Method of
	Obasity Status 100% Obasa	$\frac{1}{2}$ (3D). 22 (1) % 01	the participants. Individuals	Assessment. Peak isometric
	Mean BMI (SD): NR	a/ka/d	compared to the whey	1808/s) torque of the knee
	Income level: NR	Carbohydrate Mean (SD): 50	nrotein isolate in the	extensors and flevors of the
	Education level: NR	(1) % of energy	increased protein group that	dominant leg were evaluated
	Physical activity level:	Eat Mean (SD): 28 (1) % of	provided mostly	using Biodex 3
	Excluded if engaged in ≥ 1.5	energy	carbohydrates and fat per	dynamometer. Exercise
	hours of exercise/week	33	day with breakfast and as a	repeated 3x, the mean of the
			midafternoon snack.	2 highest torque recordings

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and	Outcome (Measures and
			assessment)	methous of assessment)
	Health status/ Comorbidities: Excluded if they had serious chronic disease (e.g. neuromuscular, cardiopulmonary, chronic kidney disease, diabetes, cancer) or a condition that could interfere with body composition imaging (e.g., certain metal implants) Medication use: Excluded those that were taking medications that could affect muscle mass and/or function (e.g., HMG-CoA reductase inhibitors, steroids) within 1 year before enrolling in the study. Supplement use: NR Pregnant or lactating: NR	Dietary Protein Intake Compliance (%): NR Protein type/source: Mixed Energy balance status: Hypocaloric Study duration: About 6 months (when participant lost 10% of body weight)	Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above	for each exercise used in analysis.
PMID: 28492492	Study of: Adults	Intervention: Protein Group	Intervention: Protein Group	Muscle Mass - Body lean
Stojkovic 2017 ⁶³ Location/Country: USA HDI: Very high Setting: Community dwelling Urban/Rural: NR Study design: Ancillary study of an RCT (parallel) Funding Source: Academic, government Risk of bias score: High	Total sample N: 84 Intervention: Protein Group N: 38 % Female: 100% Mean Age (SD): 68.9 (0.9) y Race/ Ethnicity: NR Menopausal Status: Postmenopausal Obesity Status: NR Mean BMI (SD): 26 (0.6) kg/m ² Income level: NR Education level: NR Mean physical activity level (SD): NR Health status/ Comorbidities: NR Medication use: NR	Intended Protein Amount: NR Carbohydrate: NR Fat: NR Baseline Protein Amount Mean (SD): 73.5 (2.7) g/d Carbohydrate Mean (SD): 207.2 (9.0) g/d Fat Mean (SD): 56.1 (2.7) g/d Actual Protein Amount at the end of the study Mean (SD): 98.5 (2.8) g/d (total protein) Carbohydrate Mean (SD): 198.9 (8.9) g/d Fat Mean (SD): 51.6 (2.5) g/d	How protein was administered: Subjects consumed a minimum of 20 g of protein supplement for 18 months Protein Assessment Method: Participants completed a 3-day food record prior to each study visit. Food records were analyzed using the ESHA Food Processor software program (ESHA Research, Salem, OR, USA, version 10.1.0)	mass Measure/Method of Assessment: DXA, using either a Hologic 4500 W machine (Yale University School of Medicine) or a Lunar Prodigy DPX-IQ (University of Connecticut Health Center)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
PMID: 22406907	Pregnant or lactating: NR Comparator : Carbohydrate Group N: 46 % Female: 100% Mean Age (SD): 69.3 (0.09) y Race/ Ethnicity: NR Menopausal Status: Postmenopausal Obesity Status: NR Mean BMI (SD): 25.8 (0.6) kg/m ² Income level: NR Education level: NR Mean physical activity level (SD): NR Health status/ Comorbidities: NR Medication use: NR Supplement use: NR Pregnant or lactating: NR Study of: Adults	Dietary Protein Intake Compliance (%): NR Protein type/source: Animal; whey protein Energy balance status: Eucaloric Comparator : Carbohydrate Group Intended Protein Amount: NR Carbohydrate: NR Fat: NR Baseline Protein Amount Mean (SD): 71.5 (2.2) g/d Carbohydrate Mean (SD): 201.2 (6.9) g/d Fat Mean (SD): 62.5 (3.9) g/d Actual Protein Amount at the end of the study Mean (SD): 69.8 (2.5) g/d Carbohydrate Mean (SD): 232.3 (8.7) g/d (total) Fat Mean (SD): 57.1 (2.8) g/d Dietary Protein Intake Compliance (%): NR Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 18 months Intervention: High Protein	Dietary Protein Intake Compliance: Supplement adherence and diet were carefully monitored by dietitians. Comparator: Carbohydrate Group How protein was administered: Received an isocaloric maltodextrin control supplement Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above	Muscle Mass - Total body
Wycherley 2012 ^{*38}	Total sample N: 68		How protein was	fat free mass

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and	Outcome (Measures and methods of assessment)
			assessment)	methous of assessment)
Location/Country: Australia HDI: Very high Setting: Community dwelling Urban/Rural: NR Study design: RCT (parallel) Funding source: Industry Risk of bias score: Moderate	Intervention: High Protein N: 33 % Female: 0% Mean Age (SD): 51.3 (9.4) y Race/Ethnicity: NR Menopausal status: NA Obesity status: 100% overweight or obese Mean BMI (SD): 33.0 (3.9) kg/m ² (total study population mean) Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidites: Excluded: diabetes, uncontrolled hypertension; history of GI, renal, coronary, metabolic, or hepatic disease or malignancy Medication use: Excluded those taking hypoglycemic medication or drugs which affect insulin sensitivity Supplement use: NR Pregnant or lactating: NA Comparator: Low Protein N: 35 % Female: 0% Mean Age (SD): 50.2 (9.3) y Race/Ethnicity: NR Menopausal status: NA Obesity status: 100% overweight or obese Mean BMI (SD): 33.0 (3.9) kg/m ² (total study population mean) Income level: NR Education level: NR Physical activity level: NR	Intended Protein Amount: 35% of energy; 142 g/d; ~1.30 g/kg/d Carbohydrate: 40% of energy; 135 g/d Fat: 25% of energy (total 53 g/d, saturated 14 g/d) Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Actual Protein Amount at the end of the study: Mean (SD): 0-12 weeks: 131.1 (15.4) g/d; 32.5 (3.3) % of energy 12-52 weeks: 132 (13.9) g/d; 30.7 (3.1) % of energy Carbohydrate Mean (SD): 0-12 weeks: 154.4 (31.8) g/d; 37.4 (3.8) % of energy 12-52 weeks: 157.9 (28.1) g/d; 35.9 (3.4) % of energy Fat Mean (SD): 0-12 weeks: 50.6 (6.5) g/d; 27.3 (3.0) % of energy 12-52 weeks: 60.0 (12.6) g/d; 29.8 (3.6) % of energy Dietary Protein Intake Compliance rate stated Protein type/source: Mixed Energy balance status: Hypocaloric Comparator: Low Protein	administered: Participants met with dietitian and received detailed dietary prescription, meal planning advice, and recipe information every 2 weeks for the first 12 weeks. They were supplied with a 2-week provision of diet-specific key foods (60% of energy intake) for the first 12 weeks. Participants met with dietician monthly and received detailed dietary prescription, meal planning advice, and recipe information for remainder of study duration. Protein Assessment Method: Participants kept a daily semi-quantitative food record. Dietary intake was assessed using a computerized database (Foodworks Professional Edition, version 4, 1998; Xyris Software, Highgate Hill, Australia) based on the analysis of 3 non- consecutive days (1 weekend day and 2 weekdays) of each 2-week period. The intake was calculated as an average of the 2-week diet record data blocks for 0-12 weeks and 12-52 weeks. Dietary Protein Intake Compliance: Food checklist	Measure/Method of Assessment: DXA (Lunar Prodigy; General Electric, Madison, WI, USA)

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and	Outcome (Measures and methods of assessment)
			assessment)	
	Health status/ Comorbidities: Excluded: diabetes, uncontrolled hypertension; history of GI, renal, coronary, metabolic, or hepatic disease or malignancy Medication use: Excluded those taking hypoglycemic medication or drugs which affect insulin sensitivity Supplement use: NR Pregnant or lactating: NA	Intended Protein Amount: 17% of energy; 88 g/d; ~0.85 g/kg/d Carbohydrate: 58% of energy; 198 g/d Fat: 25% of energy (total 51 g/d, saturated 14 g/d) Baseline Protein Amount Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Actual Protein Amount at the end of the study Mean (SD): 0-12 weeks: 82.7 (6.7) g/d; 20.5 (1.4) % of energy 12-52 weeks: 83.3 (10.3) g/d; 20.4 (1.0) % of energy Carbohydrate Mean (SD): 0-12 weeks: 208.4 (16.3) g/d; 51.0 (3.6) % of energy 12-52 weeks: 195.2 (23.4) g/d; 47.3 (3.9) % of energy Fat Mean (SD): 0-12 weeks: 46.7 (7.5) g/d; 25.0 (3.3) % of energy 12-52 weeks: 52.2 (8.7) g/d; 27.7 (3.2) % of energy Dietary Protein Intake Compliance rate stated Protein type/source: Mixed Energy balance status: Hypocaloric	administration and assessment) Comparator: Low Protein How protein was administered: Participants met with dieitiian and received detailed dietary prescription, meal planning advice, and recipe information every 2 weeks for the first 12 weeks. They were supplied with a 2-week provision of diet-specific key foods (60% of energy intake) for the first 12 weeks. Participants met with dietician monthly and received detailed dietary prescription, meal planning advice, and recipe information for remainder of study duration. Protein Assessment Method: Same as above Dietary Protein Intake Compliance: Same as above	methods of assessment)
		Study duration: 52 weeks		

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of	Outcome (Measures and
			administration and	methods of assessment)
DMID 00400000			assessment)	
PMID: 26400966	Study of: Adults	Intervention: High Protein	Intervention: High Protein	Muscle Mass –
Zhu	Total sample N: 196			Appendicular lean mass/
2015 ⁶⁴		Intended Protein Amount:	How protein was	skeletal muscle mass
Location/Country: Australia	Intervention: High Protein	Supplement with 30 g of	administered: Daily whey	
HDI: Very high	N: 101	protein	supplement protein shake	Measure/Method of
Setting: Community dwelling	% Female: 100%	Carbohydrate: NR	before breakfast (30 g of	Assessment: DXA (Hologic
Urban/Rural: Metropolitan	Mean Age (SD): 74.2 (2.8) y	Fat: NR	protein)	Discovery A fan-beam
Study design: RCT (parallel)	Race/ Ethnicity: NR			densitometer)
Funding source: Academic,	Menopausal Status:	Baseline Protein Amount	Protein Assessment	
government	Postmenopausal	Mean (SD): 76 (18) g/d; 1.2	Method: 3 day weighed food	Muscle Mass - Adjusted
Risk of bias score: Low	Obesity Status: NR	(0.3) g/kg/d	record (2 weekdays and 1	appendicular lean mass/
	Mean BMI (SD): 26.1 (3.8)	Carbohydrate Mean (SD): 190	weekend day) analyzed with	skeletal muscle mass
	kg/m ²	(45) g/d	AUSNUT99 database	
	Income level: NR	Fat Mean (SD): 63 (19) g/d	(Foodworks Professional	Measure/Method of
	Education level: NR		edition version 3.02) by	Assessment: Appendicular
	Mean physical activity level	Actual Protein Amount at the	nutritionists trained in dietary	skeletal muscle mass divided
	(SD): 453 (390) MET -min/wk	end of the study	assessment.	by height squared
	Health status/ Comorbidities:	Mean (SD): 95.9 (19.9) g/d		
	Excluded those with a	Carbohydrate Mean (SD): NR	Dietary Protein Intake	Muscle Strength - Handgrip
	previous osteoporotic	Fat Mean (SD): NR	Compliance: Urinary	strength
	fracture or metabolic bone		nitrogen excretion was a	
	disease, or any other	Dietary Protein Intake	compliance measure. Empty	Measure/Method of
	condition that may affect the	Compliance (%): 87.1%	test containers returned by	Assessment: Measured
	participation of the study		the participants.	using handgrip dynamometer
	Medication use: Excluded	Protein type/source: Animal:		
	those taking medication for	whey protein isolate	Comparator: Placebo	Muscle Strength - Knee
	osteoporosis (including	supplement	supplement	flexion
	hormone replacement			
	therapy) apart from calcium	Energy balance status:	How protein was	Measure/Method of
	or vitamin D either currently	Eucaloric	administered: Dally placebo	Assessment: Maximal
	or within the last year, or	Commonatory Dissolve	supplement snake before	muscle contraction against a
	the province 2 months on had	Comparator: Placebo	breaklast (2.1 g of protein)	Strain gauge with the best of
	the previous 3 months or had	supplement	Drotain Accessment	3 attempts recorded.
	lifetime	Intended Protein Amount:	Mathadi Sama na abava	Mussle Strength Knoc
	Supplement use: Evoluded	Supplement with 2.1 g of	wellou: Same as above	ovtonsion
	these with a high protein	protoin	Diotary Protoin Intake	CALCHSIUH
	intoko ($>1.5 \text{ g/kg/d}$)	Carbobydrata: NP	Compliance: Same as	Magguro/Mathad of
	Pregnant or lactating: NP	Eat NP	above	Assessment: Maximal
				muscle contraction against a
	Comparator: Placebo	Baseline Protein Amount		strain gauge with the best of
	supplement			3 attempts recorded
	supplement			3 attempts recorded.

Study	Participants	Intervention(s) (Content)	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment)
Study	ParticipantsN: 95 % Female: 100% Mean Age (SD): 74.3 (2.6) y Race/ Ethnicity: NR Menopausal Status: Postmenopausal Obesity Status: NR 	Intervention(s) (Content) Mean (SD): 76 (16) g/day; 1.1 (0.3) g/kg/d Carbohydrate Mean (SD): 190 (42) g/d Fat Mean (SD): 61 (20) g/d Actual Protein Amount at the end of the study Mean (SD): 73.1 (16.9) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Dietary Protein Intake Compliance (%): 80.8% Protein type/source: Mixed Energy balance status: Eucaloric Study duration: 2 y	Intervention(s) (Methods of administration and assessment)	Outcome (Measures and methods of assessment) Physical Performance - TUG Measure/Method of Assessment: Timed while getting up, walking 3 meters, turning, returning to the chair, and sitting down again
	the previous 3 months or had taken >7 g in total in their lifetime Supplement use: Excluded those with a high protein intake (>1.5 g/kg/d) Pregnant or lactating: NR			

Abbreviations: aBW = adjusted body weight; BIA = bioelectrical impedance analysis; BMI = body mass index; COPD = chronic obstructive pulmonary disease; cpm = counts per minute d = days; DXA = Dual-energy x-ray absorptiometry; <math>FFQ = Food frequency questionnaire; g = gram; h = hour; HDI = human development index; kg = kilograms; $kg/m^2 = kilograms$ per meters squared; LC n-3 PUFA = long chain n-3 polyunsaturated fatty acids; m = meters; METs = metabolic equivalents; min = minutes; ml = milliliters; mg = milligrams; NA = not applicable; NR = not reported; nmol/L = nanomoles per liter; NR = not reported PMID = PubMed Identification Number; PUFA = polyunsaturated fatty acids; RCT = randomized controlled trial; RM: Rep maximum; RoB = Risk of Bias; SD = standard deviation; SE = standard error; SEM = standard error of the mean; SPPB = Short Physical Performance Battery; TUG = Timed-Up-and-Go; wk = week; w/o = without; WI = wisconsin; y = year

Note: *Studies overlap KQs

Table C6. Evidence table for Sarcopenia Non-Randomized Controlled Trials

Study	Participants	Intervention (s) (Content)	Intervention (s)	Outcome (Measures and
			(Methods (of	methods of assessment)
DMID: 04040407			assessment)	Muccle Ctremeth Onin
PINID: 24219187	Study of: Adults	Quintile 1: 0.0-13.1% 01	Protein Assessment	strength
Deasley	Total sample N. 134,961	energy	protoin amount was	strengtri
Location/Country: USA	Quintilo 1: 6 6-13 1% of	Baseline Protein Amount	derived from self-	Measure/Method of
HDI: Vony high	energy	Mean (SD): 71 5 (12 1) d/d:	administered 122-item	Assessment: Measured using
Setting: NP		0.97(0.17) a/ka/d		handarin dynamometer
Urban/Rural: NR	% Female: 100%	Carbohydrate Mean (SD):	Nutritional Biomarkers	handgrip dynamometer
Study design: Prospective	Mean Age (SD): 66 0 (7 2) v	NR	Study was conducted to	Muscle Strength - Chair
cohort study	Race/ Ethnicity:	Fat Mean (SD): NR	evaluate accuracy of self-	stand test
Funding source: Nonprofit	White: 78 1%		reported protein	
government	Black: 14.1%	Protein Amount at the end of	consumption	Measure/Method of
Risk of bias score: High	Hispanic: 3.70%	the study	consumption.	Assessment: Two 15-second
·····	American Indian: 0.54%	Mean (SD): NR		trials of repeated chair stands
	Asian/Pacific Islander: 2.32%	Carbohydrate Mean (SD):		with arms folded across the
	Other: 1.27%	NR		chest were conducted, with a
	Menopausal status:	Fat Mean (SD): NR		1–2-minute rest between
	Postmenopausal			trials.
	Obesity status: NR	Quintile 2: 13.1-13.8% of		
	Mean BMI (SD): 29.2 (7.0)	energy		Physical Performance - 6-m
	kg/m ²			timed walk
	Income level:	Baseline Protein Amount		
	< \$20,000: 25.5%	Mean (SD): 74.7 (11.0) g/d;		Measure/Method of
	\$20,000-\$49,999: 48.7%	1.03 (0.17) g/kg/d		Assessment: Duration of the
	\$50,000-\$74,999: 15.1%	Carbohydrate Mean (SD):		walk was measured at usual
	≥ \$75,000: 10.8%			pace
	Education level:	Fat Mean (SD): NR		
	\leq High school diploma or GED:	Dustain Americate the and of		
		Protein Amount at the end of		
	Some college: 40.5%	Mean (SD): ND		
	2 College degree. 51.1%	Carbobydrata Maan (SD):		
	(SD): 0.0 (12) MET br/wk			
	Health Status/ Comorbidities	Fat Mean (SD): NR		
	Arthritis: 53.0%			
	Diabetes: 4 05%	Quintile 3: 13.9-14.6% of		
	Cancer: 10.4%	energy		
	Hypertension: 39.4%			
	Emphysema: 5.40%	Baseline Protein Amount		

Study	Participants	Intervention (s) (Content)	Intervention (s)	Outcome (Measures and
			(Methods (of assessment)	methods of assessment)
	Hip fracture: 1.05%	Mean (SD): 76.7 (10.5) g/d:	assessmenty	
	Medication use:	1.07 (0.17) a/ka/d		
	Unopposed estrogen use: 20.2	Carbohydrate Mean (SD):		
	%	NR		
	Estrogen + progesterone	Fat Mean (SD): NR		
	use:11.4%			
	Supplement use: NR	Protein Amount at the end of		
	Pregnant or lactating: NR	the study		
		Mean (SD): NR		
	Quintile 2: 13.1-13.8% of	Carbohydrate Mean (SD):		
	energy	NR		
	N: 26,991	Fat Mean (SD): NR		
	% Female: 100%			
	Mean Age (SD): 64.9 (7.0) y	Quintile 4: 14.7-15.4% of		
	Race/ Ethnicity:	energy		
	White: 83.4%			
	Black: 9.04%	Baseline Protein Amount		
	Hispanic: 3.29%	Mean (SD): 79.0 (10.1) g/d;		
	American Indian: 0.46%	1.12 (0.18) g/kg/d		
	Asian/Pacific Islander: 2.66%	Carbonydrate Mean (SD):		
	Other: 1.15%	NK Fat Maan (SD): ND		
	Menopausal status:	Fat Mean (SD): NR		
	Posimenopausai	Dratain Amount at the and of		
	Moon PML (SD): 29.6 (6.1)	the study		
	ka/m^2	Moon (SD): NP		
	kg/m-	Carbobydrato Moan (SD):		
	\$20,000. 10.270 \$20,000.\$40,000.48,5%	Eat Mean (SD): NR		
	\$20,000-\$49,999.40.070 \$50,000 - \$74,999.18,4%	Tat mean (SD). NIX		
	> \$75 000 14 9%	Quintile 5: 15 4-22 3% of		
	Education level	energy		
	\leq High school diploma or GED.	shorgy		
	23.7%	Baseline Protein Amount		
	Some college: 38.8%	Mean (SD): 81.7 (9.9) a/d:		
	≥College degree: 37.5 %	1.19 (0.20) g/kg/d		
	Mean physical activity level	Carbohydrate Mean (SD):		
	(SD): 11.5 (13.1) MET-hr/wk	NR		
	Health Status/ Comorbidities:	Fat Mean (SD): NR		
	Arthritis: 49.9%	· · ·		
	Diabetes: 4.30%	Protein Amount at the end of		
	Cancer: 9.81%	the study		

includes of assessment,

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Arthritis: 18.5%			
	Diabetes: 1 15%			
	Cancer: 9 34%			
	Hypertension: 34.3%			
	Emplycoma: 3 47%			
	Hip fracture: 0.01%			
	Medication use:			
	Lipopposed estrogen use:			
	23.7%			
	Estrogen + progesterone use: 18.2%			
	Supplement use: NR			
	Pregnant or lactating: NR			
	Quintile 4: 14 7-15 4% of			
	energy			
	N: 26.992			
	% Female: 100%			
	Mean Age (SD): 61.9 (6.7) v			
	Race/ Ethnicity:			
	White: 86.5%			
	Black: 6.09%			
	Hispanic: 3.63%			
	American Indian: 0.31%.			
	Asian/Pacific Islander: 2.54%			
	Other: 0.96%			
	Menopausal status:			
	Postmenopausal			
	Obesity status: NR			
	Mean BMI (SD): 27.5 (5.4)			
	kg/m ²			
	Income level:			
	< \$20,000: 12.0%			
	\$20,000-\$49,999: 43.1%			
	\$50,000- \$74,999: 22.6%			
	≥ \$75,000: 22.3%			
	Education level:			
	≤ High school diploma or GED:			
	18.6%			
	Some college: 36.7%			
	≥ College degree: 44.8%			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Mean physical activity level			
	(SD): 13 4 (13 7) MET-hr/wk			
	Health Status/ Comorbidities:			
	Arthritis: 46.0%			
	Diabetes: 4.42%			
	Cancer: 8.84%			
	Hypertension: 31.2%			
	Emphysema: 2.96%			
	Hip fracture: 0.86%			
	Medication use:			
	Unopposed estrogen use: 24.5%			
	Estrogen + progesterone use:			
	Supplement use: NR			
	Pregnant or lactating: NR			
	Quintile 5: 15.4-22.3% of			
	energy			
	N: 26,992			
	Mean Age (SD): 59.5 \pm 6.3 y			
	Race/ Ethnicity:			
	Right E 00%			
	Diack. 5.90%			
	Amorican Indian: 0 41%			
	American Indian. 0.41%			
	Asian/i acine islander: 5.15%			
	Menonausal status:			
	Postmenonausal			
	Obesity status: NR			
	Mean BMI (SD): 26.6 (4.9)			
	kg/m ²			
	Income level			
	< \$20,000. 9,40%			
	\$20,000-\$49,999: 37.7%			
	\$50,000 -\$74,999: 24,1%			
	≥ \$75.000: 28.9%			
	Education level:			
	≤ High school diploma or GED:			
	15.6%			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Some college: 36.0% ≥ College degree: 48.5% Mean physical activity level (SD): 14.9 (14.8) MET-hr/wk Health Status/ Comorbidities: Arthritis: 40.6% Diabetes: 4.46% Cancer: 8.95% Hypertension: 27.1% Emphysema: 2.76% Hip fracture: 0.57% Medication use: Unopposed estrogen use: 24.4% Estrogen + progesterone use: 24.5% Supplement use: NR			
	Pregnant or lactating: NR			
PMID: 24522470 Chan 2014 ⁶⁶ Location/Country: Hong Kong/ China HDI: Very high Setting: Community dwelling Urban/ Rural: NR Study design: Prospective cohort study Funding source: Academic, nonprofit Risk of bias score: High	Study of: Adults Total sample N: 2,726 Quartile 1: ≤ 0.9 g of protein/kg/d N: 617 % Female: 62.1% Age Range: ≤ 69 y: 37.9% 70-74 y: 35.8% 75+ y: 26.3% Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status: NR BMI: <18.5 kg/m ² : 1.6% 18.5-<23 kg/m ² : 25.9% 23-24.9 kg/m ² : 24.8% 25-29.9 kg/m ² : 6.3% Income level: NR Education level:	Quartile 1: ≤0.9 g of protein/kg/d Baseline Protein Amount Mean (SD): Animal protein:0.35 (0.11) g/kg/d Plant protein: 0.37 (0.10) g/kg/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	Protein Assessment Method: At baseline, dietary intake was measured with a validated semi- quantitative FFQ. Using food tables from the Chinese Medical Sciences Institute and McCance and Widdowson, the mean daily quantitation of nutrients was determined. The quantity of animal and vegetable proteins consumed was calculated in addition to the overall protein intake.	 Physical Performance - 6-m timed walk Measure/Method of Assessment: Duration of the walk was measured as well as the number of steps. Physical Performance- 20 cm narrow walk Measure/Method of Assessment: Participants walked the 6-m course within a 20-cm narrow path and performance was scored for time. Muscle Mass – Appendicular lean mass/ skeletal muscle mass Measure/Method of

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Brimany or balaw: 80.0%	Moon (SD):	assessment)	ODB 4500W/ poffuero
	Secondary/matriculation:	Animal protoin: 0.56 (0.15)		Vorsion 11.2: hologic Inc
		alka/d		Waltham Ma LISA)
	Liniversity or above: 6.3%	Plant protoin: 0.50 (0.14)		
	Moon physical activity lovel	a/ka/d		
	(SD): 00.2 (28.5) DASE aporto	Garbabydrata Maan (SD):		
	(SD). 90.2 (S0.5) PASE SCOLE			
		Eat Moon (SD): NP		
	Mediaation use: NP	Fat Mean (SD). NR		
	Supplement use: NR	Brotoin Amount at the and of		
	Supplement use. NR	the study		
	Pregnant of lactating. NR	Meen (SD): ND		
		Carbobydrata Maan (SD):		
	Quartile 2: 0.91-1.2 g of	Carbonydrale Mean (SD):		
	protein/kg/a			
		Fat Mean (SD): NR		
	% Female: 52.7%			
	Age Range:	Quartile 3: 1.21-1.6 g of		
	≤ 69 y: 37.2%	protein/kg/day		
	70-74 y: 35.5			
	75+ y: 27.3%	Baseline Protein Amount		
	Race/ Ethnicity: NR	Mean (SD):		
	Menopausal status:	Animal protein: 0.77 (0.20)		
	Postmenopausal	g/kg/d		
	Obesity status: NR	Plant protein: 0.63 (0.19)		
	BMI:	g/kg/d		
	<18.5 kg/m ² : 3.1%	Carbohydrate Mean (SD):		
	18.5-<23 kg/m ² : 33.7%	NR		
	23-24.9 kg/m ² : 26.9%	Fat Mean (SD): NR		
	25-29.9 kg/m ² : 34.3%			
	≥30 kg/m²: 2.1%	Protein Amount at the end of		
	Income level: NR	the study		
	Education level:	Mean (SD): NR		
	Primary or below: 71.3%	Carbohydrate Mean (SD):		
	Secondary/matriculation:	NR		
	19.8%,	Fat Mean (SD): NR		
	University or above: 8.9%			
	Mean physical activity level	Quartile 4 : ≥1.61 g of		
	(SD): 94.5 (44.9) PASE score	protein/kg/day		
	Health status/ Comorbidities:			
	NR	Baseline Protein Amount		
	Medication use: NR	Mean (SD):		
	Supplement use: NR			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Pregnant or lactating: NR	Animal protein: 1.21 (0.48)		
	· · · · · · · · · · · · · · · · · · ·	g/kg/d		
	Quartile 3: 1.21-1.6 g or	Plant protein: 0.89 (0.36)		
	protein/kg/day	g/kg/d		
	N: 705	Carbohydrate Mean (SD):		
	% Female: 44.1%	NR		
	Age Range:	Fat Mean (SD): NR		
	≤69 y: 39.0%			
	70-74 y: 38.0%	Protein Amount at the end of		
	75+ y: 23.0%	the study		
	Race/ Ethnicity: NR	Mean (SD): NR		
	Menopausal status:	Carbohydrate Mean (SD):		
	Postmenopausal	NR		
	Obesity status: NR	Fat Mean (SD): NR		
	BMI:			
	<18.5 kg/m ² : 4.3%	Protein type/ source: Mixed		
	18.5-<23 kg/m ² : 42.0%			
	23-24.9 kg/m ² : 27.7%	Energy balance: Eucaloric		
	25-29.9 kg/m ² : 23.8%			
	≥30 kg/m ² : 2.3%	Study duration: 4 y		
	Income level: NR	, , , , , , , , , , , , , , , , , , ,		
	Education level:			
	Primary or below: 65%			
	Secondary/matriculation:			
	21.8%			
	University or above: 13.2%			
	Mean physical activity level			
	(SD): 95.7 (44.2) PASE score			
	Health status/ Comorbidities:			
	NR			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
	Quartile 4: ≥1.61 g of			
	protein/kg/day			
	N: 727			
	% Female: 36.3%			
	Age Range:			
	≤69 y: 40.7%			
	70-74 y: 35.1%			
	75+ y: 24.2%			
Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
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	Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status: NR BMI: <18.5 kg/m ² : 8.1% 18.5-<23 kg/m ² : 47.9% 23-24.9 kg/m ² : 21.5% 25-29.9 kg/m ² : 21.2% ≥30 kg/m ² : 1.4% Income level: NR Education level: Primary or below: 60.9% Secondary/matriculation: 24.2% University or above: 14.9% Mean physical activity level (SD): 103.1(47.6) PASE score Health status/ Comorbidities: NR Medication use: NR Supplement use: NR			
PMID: 37922694 Chen 2023 ⁶⁷ Location/Country: China HDI: Very high Setting: Community dwelling Urban/Rural: NR Study design: Prospective cohort study Funding source: Other Risk of bias score: High	Study of: Adults Total sample N: 2709 Arm 1: Men N: 855 % Female: 0% Mean Age (SD): 60.4 (6.4) y Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Mean BMI (SD): 23.9 (2.8) kg/m ² Income level: NR Education level: High school or below 65% College or above: 35% Mean physical activity level (SD): 34.9 (6.4) METs h/d Health status/ Comorbidities:	Arm 1: Men Baseline Protein Amount Mean (SD): 1.29 (0.24) g/d/kg Carbohydrate Mean (SD): 279.4 (49.9) g/d Fat Mean (SD): 53.5 (16.0) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Women	Protein Assessment Method: The dietary intake was assessed using a validated 79-item semi-quantitative, interviewer-administered, and paper-based food frequency questionnaire at baseline.	Muscle Mass – Appendicular lean mass/ skeletal muscle mass Measure/Method of Assessment: DXA (Hologic Inc. Discovery W, USA) Muscle Mass – ASMI Measure/Method of Assessment: Appendicular muscle mass divided by squared height in meters Muscle Strength – Handgrip strength

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Type 2 diabetes: 9.8% Dyslipidemia: 20.5% Medication use: NR Supplement use: 13.5% Pregnant or lactating: NA Arm 2: Women N: 1854 % Female: 100% Mean Age (SD): 57.5 (5.5) y Race/ Ethnicity: NR Menopausal status: 96.5% Obesity status: NR Mean BMI (SD): 23.3 (3.1) kg/m ² Income level: NR Education level: High school or below 77.5% College or above: 22.5% Mean physical activity level (SD): 34.8 (5.6) METs h/d Health status/ Comorbidities: Type 2 diabetes: 6.9% Dyslipidemia: 22.2%	Baseline Protein Amount Mean (SD): 1.43 (0.28) g/d/kg Carbohydrate Mean (SD): 217.7 (40.1) g/d Fat Mean (SD): 48.5 (13.8) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/ source: Mixed Energy balance status: Eucaloric Study duration: 3.2 y	assessment)	Measure/Method of Assessment: Hand dynamometer Muscle Strength – Chair stand test Measure/Method of Assessment: Recorded how long it took participants to stand up and sit down five times
	Medication use: NR Supplement use: 22.5% Pregnant or lactating: NR			
PMID: 32520344 Elstgeest 2020 ⁶⁸ Location/Country: USA HDI: Very high Setting: Community dwelling Urban/Rural: Metropolitan Study design: Prospective cohort study Funding source: NR Risk of bias score: High	Study of: Adults Total sample N: 3075 Arm 1: Men N: 1163 % Female: 0% Mean Age (SD): 74.8 (2.9) y Menopausal status: NA Race/ Ethnicity: White: 68.8% Obesity status: NR Mean BMI (SD): 26.9 (3.8) kg/m ² Income level: NR Education level:	Arm 1: Men Baseline Protein Amount Mean (SD): 71.3 (26.6) g/d; 0.94 (0.36) g/kg aBW/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	Protein Assessment Method: At baseline, dietary intake was assessed using a 108- item modified version of the Block FFQ. Block Dietary Data Systems were used to determine nutrient intake.	Muscle Mass - Appendicular lean mass/ skeletal muscle mass Measure/Method of Assessment: DXA (Hologic 4500A, version 8.20a) Physical Performance- 20- m walk Measure/Method of Assessment: Participants were asked to walk a 20-m

Study	Participants	Intervention (s) (Content)	Intervention (s)	Outcome (Measures and
			(Methods (of	methods of assessment)
	Less than high school: 22 E%		assessment)	course at their yourd welking
	High school graduation: 25.0%	Arm 2: Women		bace
	Postsecondary education:	Ann 2. Women		pace.
	51.6%	Baseline Protein Amount		
	Mean physical activity level	Mean (SD): 60.7 (22.3) g/d:		
	(SD): Walking 165 (295)	0.95 (0.36) g/kg aBW/d		
	min/wk	Carbohydrate Mean (SD):		
	Health status/ Comorbidities:	NR		
	0 diseases: 14.8%	Fat Mean (SD): NR		
	1 disease: 27.4%			
	≥2 diseases: 57.8%	Protein Amount at the end of		
	Medication use: Oral steroid	the study		
	use: 2.1%	Mean (SD): NR		
	Supplement use: NR	Carbohydrate Mean (SD):		
	Pregnant or lactating: NA	NR		
		Fat Mean (SD): NR		
	Arm 2: vvomen	Ductoin the of a sum of Missed		
	N: 1237	Protein type/ source: Mixed		
	% Female: 51.5%	Energy belonce status:		
	Mononausal status:	Ellergy balance status.		
	Postmenonausal	Eucalone		
	Race/ Ethnicity:	Study duration: 5 y		
	White: 59 1%			
	Obesity status: NR			
	Mean BMI (SD): 27.4 (5.4)			
	kg/m ²			
	Income level: NR			
	Education level:			
	Less than high school: 20.4%			
	High school graduation: 39.1%			
	Postsecondary education:			
	40.5%			
	Mean physical activity level			
	(SD): Walking			
	116 (228) min/wk			
	nealth status/ Comorbidities:			
	1 uisease: 28.7%			
	Medication use: Oral staroid			
	Postsecondary education: 40.5% Mean physical activity level (SD): Walking 116 (228) min/wk Health status/ Comorbidities: 0 diseases: 11.2% 1 disease: 28.7% ≥2 diseases: 60.1% Medication use: Oral steroid use: 3.2%			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
			assessment)	
	Supplement use: NR		· · · · · · · · · · · · · · · · · · ·	
	Pregnant or lactating: NR			
PMID: 27465379	Study of: Adults	Quartile 1 (Men): Protein	Protein Assessment	Muscle Mass - Lean mass
Farsijani	Total sample N: 1793	intake ≤62.12 g/d	Method: Protein intake	
201669			was assessed using 24-h	Measure/ Method of
Location/Country: Canada	Quartile 1 (Men): Protein	Baseline Protein Amount	dietary recalls. A total of	Assessment: DXA (Lunar
HDI: Very high	intake ≤62.12 g/d	Mean (SD): 64.3 (14.3) g/d	6 nonconsecutive recalls	Prodigy; GE Medical)
Setting: Community	N: 88	Carbohydrate Mean (SD):	were collected: 3 at	
dwelling	% Female: 0%	NR	baseline and 3 at the 2-y	Muscle Mass - Appendicular
Urban/Rural: Urban and	Mean Age (SD): 73.8 (4.1) y	Fat Mean (SD): NR	follow-up.	lean mass/ skeletal muscle
suburban	Race/ Ethnicity: NR		Recalls were analyzed	mass
Study design: Prospective	Menopausal status: NA	Protein Amount at the end of	with the CANDAI	
cohort study	Obesity status: NR	the study	nutrient analysis software	Measure/Method of
Funding source: Nonprofit,	Mean BMI (SD): 27.1 (4.0)	Mean (SD): NR		Assessment: Calculated as
academic Dials of his of his h	kg/m²	Carbonydrate Mean (SD):		the sum of honbone LIVI of
RISK OF DIAS: HIGH				arms and legs.
	10.8 (5.5) y	Fat Mean (SD): NR		
	Physical activity level: NR	Quartile 2 (Men): Protein		
	Health status/ Comorbidities:	intake 62.13-71.62 g/d		
	Subjects free from cognitive			
	impairment, COPD, class II	Baseline Protein Amount		
	heart failure and inflammatory	Mean (SD): 71.5 (16.0) g/d		
	digestive diseases, cancer	Carbohydrate Mean (SD):		
	Medication use: NR	NR		
	Supplement use: NR	Fat Mean (SD): NR		
	Pregnant or lactating: NA			
		Protein Amount at the end of		
	Quartile 2 (Men): Protein	the study		
	intake 62.13-71.62 g/d	Mean (SD): NR		
	N: 87	Carbohydrate Mean (SD):		
	% Female: 0%	NR		
	Mean Age (SD): 74.4 (4.4) y	Fat Mean (SD): NR		
	Race/ Ethnicity: NR			
	Menopausal status: NA	Quartile 3 (Men): Protein		
		Intake / 1.63-80.66 g/d		
	Iviean BIVII (SD): 28.5 (4.4)	Recoling Protoin Amount		
		Daseline Protein Amount		
	Mean education level (SD):	Wean (SD): $\delta 3.2$ (17.3) g/d		
	Dhysical activity layed ND	Eat Maan (SD): ND		
	Physical activity level: NR	rativiean (SD): NR		

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
	Health status/Comarbidition		assessment)	
	Subjects free from cognitive	Dratain Amount at the and of		
	impoirment COPD close II	the study		
	heart failure and inflammatory	Moon (SD): ND		
		Mean (SD). NR Carbobydrata Maan (SD):		
	Mediantian uses ND			
	Supplement use: NR	INR Eat Moon (SD): NP		
	Drogpant or lactating: NA	Tat Mean (SD). NR		
	Freghant of lactating. NA	Quartile 4 (Man): Protoin		
	Quartile 3 (Mon): Protein	intake >80.67 a/d		
	intoko 71.63.80.66 a/d	Intake 200.07 g/u		
	N: 88	Basalina Protain Amount		
	% Eemale: 0%	Mean (SD): 101.8 (21.3) a/d		
	70 Female. 070 Moon Ago (SD): 73 4 (4.3) y	Carbobydrato Moan (SD):		
	Race/ Ethnicity: NR	NP		
	Menopousal status: NA	Eat Mean (SD): NR		
	Obesity status: NR	Tat mean (SD). Nix		
	Mean BMI (SD): 28 3 (3 9)	Protein Amount at the end of		
	k_{a}/m^{2}	the study		
	Income level: NR	Mean (SD) [.] NR		
	Mean education level (SD):	Carbobydrate Mean (SD)		
	$10 \ 1 \ (4 \ 7) \ v$	NR		
	Physical activity level NR	Fat Mean (SD) [.] NR		
	Health status/ Comorbidities:			
	Subjects free from cognitive	Quartile 1 (Women): Protein		
	impairment, COPD, class II	intake ≤64.81 g/d		
	heart failure and inflammatory			
	digestive diseases, cancer	Baseline Protein Amount		
	Medication use: NR	Mean (SD): 51.1 (12.5) g/d		
	Supplement use: NR	Carbohydrate Mean (SD):		
	Pregnant or lactating: NA	NR		
	5 5	Fat Mean (SD): NR		
	Quartile 4 (Men): Protein	()		
	intake ≥80.67 g/d	Protein Amount at the end of		
	N: 88	the study		
	% Female: 0%	Mean (SD): NR		
	Mean Age (SD): 72.6 (3.8) y	Carbohydrate Mean (SD):		
	Race/ Ethnicity: NR	NR		
	Menopausal status: NA	Fat Mean (SD): NR		
	Obesity status: NR			
	Mean BMI (SD): 28.5 (4.1)	Quartile 2 (Women): Protein		
	kg/m ²	intake 64.82-73.46 g/d		

Study	Participants	Intervention (s) (Content)	Intervention (s)	Outcome (Measures and
			(methods (of assessment)	methous of assessment)
	Income level: NR			
	Mean education level (SD):	Baseline Protein Amount		
	11.5 (4.7) y	Mean (SD): 62.6 (12.0) g/d		
	Physical activity level: NR	Carbohydrate Mean (SD):		
	Health status/ Comorbidities:			
	Subjects free from cognitive	Fat Mean (SD): NR		
	heart failure and inflammatory	Protein Amount at the end of		
	digestive diseases cancer	the study		
	Medication use: NR	Mean (SD) [.] NR		
	Supplement use: NR	Carbohydrate Mean (SD):		
	Pregnant or lactating: NA	NR		
		Fat Mean (SD): NR		
	Quartile 1 (Women): Protein			
	intake ≤64.81 g/d	Quartile 3 (Women): Protein		
	N: 90	intake 73.47-82.29 g/d		
	% Female: 100%			
	Mean Age (SD): 73.6 (4.0) y	Baseline Protein Amount		
	Race/ Ethnicity: NR	Mean (SD): 69.8 (10.6) g/d		
	Obesity status: NR	NP		
	Mean BMI (SD): 27.4 (4.3)	Fat Mean (SD): NR		
	kg/m^2			
	Income level: NR	Protein Amount at the end of		
	Mean education level (SD):	the study		
	10.6 (3.4) y	Mean (SD): NR		
	Physical activity level: NR	Carbohydrate Mean (SD):		
	Health status/ Comorbidities:	NR		
	Subjects free from cognitive	Fat Mean (SD): NR		
	Impairment, COPD, class II			
	digestive diseases, cancer	intako 282 30 g/d		
	Medication use: NR	Intake 202.30 g/u		
	Supplement use: NR	Baseline Protein Amount		
	Pregnant or lactating: NR	Mean (SD): 86.7 (16.7) g/d		
		Carbohydrate Mean (SD):		
	Quartile 2 (Women): Protein	NR		
	intake 64.82-73.46 g/d	Fat Mean (SD): NR		
	N: 91			
	% Female: 100%	Protein Amount at the end of		
	Mean Age (SD): 74.6 (4.0) y	the study		
	Race/ Ethnicity: NR	Mean (SD): NR		

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
Study	Participants Menopausal status: NR Obesity status: NR Mean BMI (SD): 28.1 (5.3) kg/m² Income level: NR Mean education level (SD): 10.6 (3.6) y Physical activity level: NR Health status/ Comorbidities: Subjects free from cognitive impairment, COPD, class II heart failure and inflammatory digestive diseases, cancer Medication use: NR Supplement use: NR Pregnant or lactating: NR Quartile 3 (Women): Protein intake 73.47-82.29 g/d N: 90 % Female: 100% Mean Age (SD): 73.4 (3.9) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 27.7 (4.4) kg/m² Income level: NR Mean education level (SD): 10.5 (3.8) y Physical activity level: NR Health status/ Comorbidities: Subjects free from cognitive impairment, COPD, class II heart failure and inflammatory digestive diseases, cancer	Intervention (s) (Content) Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/ source: Mixed Energy balance status: Eucaloric Study duration: 2 y	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Supplement use: NR Pregnant or lactating: NR Quartile 4 (Women): Protein intake ≥82.30 g/d			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
PMID: 29191494 Granic 2017 ⁷⁰ Location/Country: UK HDI: Very high Setting: Community dwelling Urban/Rural: NR Study design: Prospective cohort study Funding source: Nonprofit, academic Risk of bias score: High	N: 90 % Female: 100% Mean Age (SD): 72.8 (4.0) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 28.1 (4.9) kg/m ² Income level: NR Mean education level (SD): 10.8 (3.9) year Physical activity level: NR Health status/ Comorbidities: Subjects free from cognitive impairment, COPD, class II heart failure and inflammatory digestive diseases, cancer Medication use: NR Supplement use: NR Pregnant or lactating: NR Study of: Adults Total sample N: 722 Arm 1: Low protein intake (<1 g of protein/kg aBW/d) N: 390 % Female: 66.9% Mean Age (SD): NR Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: 0-9 v: 68 0%	Arm 1: Low protein intake (<1 g of protein/kg aBW/d) Baseline Protein Intake: <1 g of protein/kg aBW/d) Baseline Protein Intake: <1 g of protein/ kg aBW/d Carbohydrate: NR Fat: NR Protein Amount at the end of the study: NR Carbohydrate: NR Fat: NR Arm 2: Good protein intake (≥1 g of protein/kg aBW/d)	Protein Assessment Method: At baseline, protein intake was estimated with a validated 24-hr multiple pass dietary recall (24-h MPR). A food code was assigned to each food and 2-day intakes were entered in a Microsoft Access based dietary data system. The codes were further grouped in118 food groups based on McCance and Widdowson's	Muscle Strength- Grip strength Measure/Method of Assessment: Measured using handgrip dynamometer Physical Performance - TUG Measure/Method of Assessment: Measures the time that takes to rise from a chair without using arms, walk 3 m at usual pace, turn, return to the chair and sit
	0-9 y: 68.0% 10-11 y: 21.4% ≥12 y:10.6% Physical activity level: Low: 18.5 % Moderate: 47.7% High: 33.8 %	Baseline Protein Intake: ≥1 g of protein/ kg aBW/d Carbohydrate: NR Fat: NR	Widdowson's composition of-foods 6th edition.	return to the chair, and sit down.

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Health status/ Co-morbidities	Protein Amount at the end of		
	Mean multimorbidity (SD): 2.28	the study: NR		
	(1.21)	Carbohydrate: NR		
	Depressive symptoms:	Fat: NR		
	0 to 5 (none): 78.1%			
	6 to 7 (mild): 13.5%	Protein type/ source: Mixed		
	>8 (severe): 8.2%			
	Arthritis in hands: 6.7%	Energy balance status:		
	Medication use: NR	Fucaloric		
	Supplement use: NR			
	Pregnant or lactating: NR	Study duration: 5 v		
	Arm 2: Good protein intake			
	(≥1 g of protein/kg aBW/d)			
	N: 390			
	% Female: 51.8%			
	Mean Age (SD): NR			
	Race/ Ethnicity: NR			
	Menopausal status:			
	Postmenopausal			
	Obesity status: NR			
	Mean BMI (SD): NR			
	Income level: NR			
	Education level:			
	0-9 y: 58.8%			
	10-11 y: 26.4%			
	≥12 y:14.8%			
	Physical activity level:			
	Low: 16.3%			
	Moderate: 42.3%			
	High: 41.4%			
	Health status/ Comorbidities:			
	Mean multimorbidity (SD): 2.19			
	(1.25)			
	Depressive symptoms:			
	0 to 5 (none): 83.2%			
	6 to 7 (mild): 10.9%			
	>8 (severe): 5.9%			
	Arthritis in hands: 6.4%			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			

Study	Participants	Intervention (s) (Content)	Intervention (s)	Outcome (Measures and methods of assessment)
			assessment)	methous of assessment)
PMID: 33515002 Hengeveld 2021 ⁷¹ Location/Country: Canada HDI: Very high Setting: Community dwelling Urban/Rural: Urban Study design: Prospective cohort study Funding source: NR Risk of bias score: High	Study of: Adults Total sample N: 1754 Arm 1 : Men N: 524 % Female: 0% Mean Age (SD): 74.8 (4.0) y Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Mean BMI (SD): 28.1 (4.0) kg/m ² Income level: NR	Arm 1: Men Baseline Protein Amount Mean (SD): 82.7 (19.4) g/d; 1.06 (0.28) g/kg/d; 1.13 (0.27) g/kg aBW/d; 16.1 (2.5) % of energy Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study	(Methods (of assessment) Protein Assessment Method: 3 nonconsecutive 24-h dietary recalls were collected.	methods of assessment)Muscle Strength - Handgrip strengthMeasure/Method of Assessment: Measured using handgrip dynamometerMuscle Strength - Knee extensorMeasure/Method of Assessment: Measured using isometric contraction of the
	Mean education level (SD): 12.0 (5.1) y Mean physical activity level (SD): 118 (55) PASE score Health status/ Comorbidities: Chronic diseases 0: 10.3% 1-2: 33.8% ≥3: 55.9% Medication use: 0: 10.7% 1-4: 49.8% ≥5: 39.5% Supplement use: NR Pregnant or lactating: NA	Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Women Baseline Protein Intake Mean (SD): 68.3 (15.0) g/d; 1.07 (0.30) g/ kg BW/d; 1.12 (.26) g/kg aBW/d; 16.6 (2.5) of energy Carbohydrate Mean (SD): NR Fat Mean (SD): NR		knee extensors. Physical Performance - TUG Measure/Method of Assessment: Measures the time that takes to rise from a chair without using arms, walk 3 m at usual pace, turn, return to the chair, and sit down.
	Arm 2: Women N: 574 % Female: 32.72% Mean Age (SD): 75.2 (4.2) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 27.4 (4.7) kg/m ² Income level: NR Mean education level (SD): 11.6 (3.9) y	Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein type/ source: Mixed Energy balance status: Eucaloric Study duration: 3 y		

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Mean physical activity level (SD): 94 (45) PASE score Health status/ Comorbidities: Chronic diseases 0: 3.5% 1–2: 26.1% ≥3: 70.4% Medication use: 0: 5.2% 1-4: 43.9% ≥5: 50.9% Supplement use: NR Pregnant or lactating: NR			
PMID: 18175749 Houston 2008 ⁷²	Study of: Adults Total sample N: 2066	Quintile 1: Protein intake cut-offs NR	Protein Assessment Method: Study participants completed a	Muscle Mass - Total body lean mass
Location/Country: USA HDI: Very high Setting: Community dwelling Urban/ Rural: Metropolitan Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Quintile 1: Protein intake cut- offs NR N: NR % Female: 53.3% Mean Age (SD): 74.4 (2.8) y Race/ Ethnicity: Black: 46.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 27.2 (4.8) kg/m ² Income level: NR Education level: <high school:<br="">25.9% Mean physical activity level (SD): Walking 115.8 (185.7) min/wk Health status/ Comorbidities: Diabetes: 15% Ischemic heart disease: 19.4%</high>	Baseline Protein Amount Mean (SD): 56.9 (18.6) g/d; 0.8 (0.3) g/kg/d; 10.9% of energy Carbohydrate Mean (SD): 55.1% of energy Fat Mean (SD): 34.8% of energy Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Quintile 2: Protein intake cut-offs NR Baseline Protein Amount	108-item interviewer- administered FFQ. The FFQ was analyzed for micronutrient and macronutrient content by Block Dietary Data Systems	Measure/Method of Assessment: DXA (Hologic 4500A, version 8.20a)
	Congestive heart failure: 1.7% Cerebrovascular disease: 7% COPD: 10.9% Cancer: 16.2% Medication use: Oral steroids use: 2.7%	Mean (SD): 53.6 (19.8) g/d; 0.7 (0.3) g/kg/d; 12.7% of energy Carbohydrate Mean (SD): 55.1% of energy		

Study	Participants	Intervention (s) (Content)	Intervention (s)	Outcome (Measures and
			(Methods (of	methods of assessment)
	Supplement use: NP	Eat Moan (SD): 33.2% of	assessment)	
	Bregnant or lactating: NP	epergy		
	r regnant of lactating. Nrt	chergy		
	Quintile 2: Protein intake cut-	Protein Amount at the end of		
	offs NR	the study		
	N: NR	Mean (SD): NR		
	% Female: 53.3%	Carbohydrate Mean (SD):		
	Mean Age (SD): 74.7 (2.9) y	NR		
	Race/ Ethnicity: Black: 36.6%	Fat Mean (SD): NR		
	Menopausal status:			
	Postmenopausal	Quintile 3: Protein intake		
	Obesity status: NR	cut-offs NR		
	Mean BMI (SD): 27.1 (4.5)			
	kg/m ²	Baseline Protein Amount		
	Income level: NR	Mean (SD): 59.2 (18.1) g/d;		
	Education level: <high school:<="" td=""><td>0.8 (0.3) g/kg/d; 14.2% of</td><td></td><td></td></high>	0.8 (0.3) g/kg/d; 14.2% of		
	20.8%	energy		
	(OD): Malling 121 5 (201 0)	Carbonydrate Mean (SD):		
	(5D): Walking 131.5 (281.0)	53.5% of energy		
	Haalth status/ Comorbiditios:	Fat Mean (SD). 33.6% Of		
	Diabetes: 17%	energy		
	Ischemic heart disease: 20.8%	Protein Amount at the end of		
	Congestive heart failure: 1.7%	the study		
	Cerebrovascular disease:	Mean (SD): NR		
	9.2%	Carbohydrate Mean (SD):		
	COPD: 11.6%	NR		
	Cancer: 18.4%	Fat Mean (SD): NR		
	Medication use:	(
	Oral steroids use: 2.2%	Quintile 4: Protein intake		
	Supplement use: NR	cut-offs NR		
	Pregnant or lactating: NR			
		Baseline Protein Amount		
	Quintile 3: Protein intake cut-	Mean (SD): 67.1 (19.2) g/d;		
	offs NR	0.9 (0.3) g/kg/d; 15.9% of		
		energy		
	% Female: 53.1%	Carbonydrate Mean (SD):		
	Niean Age (SD): $(4.5)(2.9)$ y	52.7% of energy		
	Kace/ Ethnicity: Black: 32.4%	Fat Mean (SD): 32.5% Of		
	Destmononousel	energy		
	Chesity status: NP			
	Obesity status. NR			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
			assessment)	methous of assessment)
	Mean BMI (SD): 27.0 (4.6)	Protein Amount at the end of		
	kg/m ²	the study		
	Income level: NR	Mean (SD): NR		
	Education level: <high school:<="" th=""><th>Carbohydrate Mean (SD):</th><th></th><th></th></high>	Carbohydrate Mean (SD):		
	19.8%	NR		
	Mean physical activity level (SD): Walking 137.6 (231.5)	Fat Mean (SD): NR		
	min/wk	Quintile 5: Protein intake		
	Health status/ Comorbidities: Diabetes: 20.8%	cut-offs NR		
	Ischemic heart disease: 17.6%	Baseline Protein Amount		
	Congestive heart failure: 2.4%	Mean (SD): 91.0 (27.1) g/d;		
	Cerebrovascular disease:	1.2 (0.4) g/kg/d; 18.6% of		
	6.3%	energy		
	COPD: 12.1%	Carbohydrate Mean (SD):		
	Cancer: 19.3%	50.4% of energy		
	Medication use:	Fat Mean (SD): 32.1% of		
	Oral steroid use: 3.6%	energy		
		Dratain Amount at the and of		
	Pregnant of lactating. NR	the study		
	Quintilo 4: Protein intake cut-	Mean (SD): NR		
	offe NR	Carbobydrate Mean (SD):		
	N' NR	NR		
	% Female: 53.3%	Fat Mean (SD): NR		
	Mean Age (SD): 74 6 (2.9) v			
	Race/ Ethnicity: Black: 29.8%	Protein type/ source: Mixed		
	Menopausal status:	51		
	Postmenopausal	Energy balance status:		
	Obesity status: NR	Eucaloric		
	Mean BMI (SD): 26.9 (4.3)			
	kg/m ²	Study duration: 3 y		
	Income level: NR			
	Education level: <high 20.6%<="" school:="" td=""><td></td><td></td><td></td></high>			
	Mean physical activity level (SD): Walking 147.5 (298.2)			
	min/wk			
	Health status/ Comorbidities:			
	Diabetes: 20.8%			
	Ischemic heart disease: 19.8%			
	Congestive heart failure: 2.9%			

Cerebrovascular disease: 6.8% COPD: 9.9% Supplement use: Oral steroid use: 2.9% Oral steroid use: 2.9% Supplement use: NR Pregnant or lactating: NR Quintile 5: Protein intake cut- offs NR N: NR % Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m² Kg/m² Income level: NR Education level: NR Education level: NR Health status/ Comorbidities: Disbetes: 2.8% Mean BMI (SD): 28.0 (5.1) kg/m²	Study	Participants	Intervention (s) (Content)	Intervention (s)	Outcome (Measures and
Cerebrovascular disease: 6.8% COPD: 9.9% Cancer: 18.6% Medication use: Oral steroid use: 2.9% Supplement use: NR Pregnant or lactating: NR Quintile 5: Protein intake cut- offs NR N: NR % Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (26.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>				assessment)	methous of assessment)
6.8% COPD: 9.9% Cancer: 18.6% Medication use: Oral steroid use: 2.9% Supplement use: NR Pregnant or lactating: NR Quintile 5: Protein intake cut- offs NR N: NR % Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 28 %</high>		Cerebrovascular disease:			
COPD: 9.9% Cancer: 18.6% Medication use: Oral steroid use: 2.9% Supplement use: NR Pregnant or lactating: NR Quintile 5: Protein intake cut- offs NR N: NR % Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22 8%</high>		6.8%			
Cancer: 18.6% Medication use: Oral steroid use: 2.9% Supplement use: NR Pregnant or lactating: NR Quintile 5: Protein intake cut- offs NR N: NR % Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		COPD: 9.9%			
Medication use: Oral steroid use: 2.9% Supplement use: NR Pregnant or lactating: NR Quintile 5: Protein intake cut- offs NR N: NR % Female: 53.3% Meean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<="" td=""> 18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		Cancer: 18.6%			
Oral steroid use: 2.9% Supplement use: NR Pregnant or lactating: NR Quintile 5: Protein intake cut- offs NR N: NR % Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<="" td=""> 18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Heatth status/ Comorbidities: Dibetes: 22.8%</high>		Medication use:			
Supplement use: NR Pregnant or lactating: NR Quintile 5: Protein intake cut- offs NR N: NR % Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		Oral steroid use: 2.9%			
Pregnant or lactating: NR Quintile 5: Protein intake cut- offs NR N: NR % Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		Supplement use: NR			
Quintile 5: Protein intake cut- offs NR N: NR % Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<="" td=""> 18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22 8%</high>		Pregnant or lactating: NR			
offs NR N: NR % Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		Quintile 5: Protein intake cut-			
N: NR % Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		offs NR			
% Female: 53.3% Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		N: NR			
Mean Age (SD): 74.5 (2.8) y Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		% Female: 53.3%			
Race/ Ethnicity: Black: 31.7% Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		Mean Age (SD): 74.5 (2.8) y			
Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		Race/ Ethnicity: Black: 31.7%			
Postmenopausal Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		Menopausal status:			
Obesity status: NR Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		Postmenopausal			
Mean BMI (SD): 28.0 (5.1) kg/m ² Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		Obesity status: NR			
Income level: NR Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		Mean BMI (SD): 28.0 (5.1)			
Education level: NK Education level: <high school:<br="">18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%</high>		Kg/m²			
18.2% Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%		Education level: <high school:<="" td=""><td></td><td></td><td></td></high>			
Mea physical activity level (SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%		18 2%			
(SD): Walking 155.7 (265.4) min/wk Health status/ Comorbidities: Diabetes: 22.8%		Mea physical activity level			
min/wk Health status/ Comorbidities: Diabetes: 22.8%		(SD): Walking 155 7 (265 4)			
Health status/ Comorbidities: Diabetes: 22.8%		min/wk			
Diabetes: 22.8%		Health status/ Comorbidities:			
Diddottol. LLiv /v		Diabetes: 22.8%			
Ischemic heart disease: 21.6%		Ischemic heart disease: 21.6%			
Congestive heart failure: 2.9%		Congestive heart failure: 2.9%			
Cerebrovascular disease:		Cerebrovascular disease:			
7.5%		7.5%			
COPD: 9.2%		COPD: 9.2%			
Cancer:19.4%		Cancer:19.4%			
Medication use:		Medication use:			
Oral steroids use: 3.4%		Oral steroids use: 3.4%			
Supplement use: NR		Supplement use: NR			
Pregnant or lactating: NK DMID: 26957290 Study of Adulto Tartile 4: Destain intels <0.0 Destain Assessment Muscle Mass. Last mass.	DMID: 26957290	Pregnant or lactating: NR	Tertile 4. Drotoin intelse <0.0	Drotoin Account	Mussle Mess
PiviiD. 20007 509 Siluay OF Adults I ertile 1: Protein Intake ≤0.8 Protein Assessment Muscle Mass - Lean mass	FIVILD. 2000/309	Sludy OI: Adults	a of protein/ka/d	Mothod: Baseline distant	WUSCIE MASS - Lean mass
2016 ⁷³ Intake was collected by Measure/Method of	2016 ⁷³	10tal Sample N. 332	g or protein/kg/u	intake was collected by	Measure/Method of
Location/Country: Finland Baseline Protein Amount Using 3-d food record	Location/Country: Finland		Baseline Protein Amount	using 3-d food record	

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
			assessment)	
HDI: Very high Setting: Community dwelling	Tertile 1: Protein intake ≤0.8 g of protein/kg/d N: 171	Mean (SD): 51.4 (10.3) g/d; 16.4 (3.1) % of energy Carbohydrate Mean (SD):	Subjects were instructed to write down everything they ate and drank and to	Assessment: DXA (Lunar Prodigy)
Study design: Prospective cohort study	Mean Age (SD): 68.0 (1.9) y Race/ Ethnicity: NR	Fat Mean (SD): 43.6 (14.5) g/d	food consumed using household measures.	strength
Funding source: Nonprofit,	Menopausal status:		Nutritional intake from	Measure/Method of
academic	Postmenopausal	Protein Amount at the end of	food was calculated	Assessment: Measured using
Risk of bias score: Very high	Obesity status: NR Mean BMI (SD): 29.9 (4.4)	the study Mean (SD): NR	using Nutrica program. Collected data provided.	handgrip dynamometer
	kg/m ² Income level: NR	Carbohydrate Mean (SD): NR		Muscle Strength - Knee extension
	Education level: NR	Fat Mean (SD): NR		Manager (Mathead of
		Tartila 2. Drotoin intoko		Measure/ Method of
	(SD). 100.2 (112.0)	0.91 1 10 g of protoin/kg/d		Assessment. NR
	Health status/ Comorbiditios:	0.61–1.19 g of protein/kg/d		Muscle Strength Chair rise
		Baseline Protein Amount		tost
	Medication use: NR	Mean (SD): 65.0 (10.2) d/d:		
	Supplement use: Ca and	17 4 (25) % of energy		Measure/Method of
	vitamin D	Carbohydrate Mean (SD)		Assessment: Number of chair
	Pregnant or lactating: NR	187.6 (37.0) g/d		rises in 30 seconds
	r roghant of laotating. The	Fat Mean (SD): 53.9 (15.1)		
	Tertile 2: Protein intake 0.81–	a/d		
	1.19 g of protein/kg/d	9, 4		
	N: 269	Protein Amount at the end of		
	% Female: 100%	the study		
	Mean Age (SD): 67.8 (1.9) y	Mean (SD): NR		
	Race/ Ethnicity: NR	Carbohydrate Mean (SD):		
	Menopausal status:	NR		
	Postmenopausal	Fat Mean (SD): NR		
	Obesity status: NR			
	Mean BMI (SD): 27.1 (3.9)	Tertile 3 : Protein intake ≥1.2		
	kg/m ²	g of protein/kg/d		
	Income level: NR			
	Education level: NR	Baseline Protein Amount		
	Mean physical activity level	Mean (SD): 83.4 (14.1) g/d;		
	(SD): 106.4 (72.5) times/month	18.6 (3.1) % of energy		
	x strenuousness	Carbohydrate Mean (SD):		
	Health status/ Comorbidities:	219.1 (46.3) g/d		
		Fat Mean (SD): 63.1 (18.2)		
	iviedication use: NR	g/a		

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Supplement use:			
	Ca and vitamin D	Protein Amount at the end of		
	Pregnant or lactating: NR	the study		
	5	Mean (SD): NR		
	Tertile 3: Protein intake ≥1.2 g	Carbohydrate Mean (SD):		
	of protein/kg/d	NR		
	N: 112	Fat Mean (SD): NR		
	% Female: 100%			
	Mean Age (SD): 67.7 (1.8) y Race/ Ethnicity: NR	Protein type/ source: Mixed		
	Menopausal status:	Energy balance status:		
	Postmenopausal	Eucaloric		
	Obesity status: NR			
	Mean BMI (SD): 25.3 (3.4)	Study duration: 3 y		
	kg/m ²			
	Income level: NR			
	Education level: NR			
	Mean physical activity level			
	(SD): 111.4 (140.3)			
	times/month x strenuousness			
	Health status/ Comorbidities:			
	NR Mediaetien user ND			
	Supplement use: NR			
	Vitemin D			
	Progrant or lactating: NP			
PMID: 33740517	Study of: Adults	Tortilo 1 (Malo): Protein	Protoin Assessment	Muscle Strength - Handgrin
Kim	Total sample N: 32 458	intake <0.8 $\alpha/k\alpha/d$	Method: Subjects'	strength
202174			dietary protein intake was	Strongth
Location/Country: Korea	Tertile 1 (Male): Protein intake	Baseline Protein Amount	assessed using the 103-	Measure/Method of
HDI: Very high	<0.8 a/ka/d	Median (IQR): 45.3 (38.9-	item semi-quantitative	Assessment: Measured using
Setting: NR	N: 5126	51.7) g/d: 12.5 (11.3-14.0) %	FFQ at baseline and the	handgrip dynamometer
Urban/ Rural: NR	% Female: 0%	of energy	follow-up surveys.	51 5
Study design: Prospective	Median Age (IQR): 57.0 (50.0-	Carbohydrate Median (IQR):	The FFQ is used to	
cohort study	62.0) y	73.0 (68.3-76.7) % of energy	estimate nutrient intake	
Funding source: NR	Race/ Ethnicity: NR	Fat Median (IQR): 13.1	from portion size and the	
Risk of bias score: High	Menopausal status: NA	(10.0-16.8) % of energy	frequency of food	
	Obesity status: NR		consumption. Protein	
	Median BMI (IQR): 24.9 (23.3-	Protein Amount at the end of	was estimated from the	
	26.7) kg/m ²	the study	sum of the intake of each	
	Income level:	Median (IQR): NR	food item, based on the	
	Low income: 11.4%		food composition tables.	

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
			assessment)	
	Education level:	Carbonydrate Median (IQR):		
	Selementary school: 1.3%			
	Middle of high school: 23.3%	Fat Median (IQR): NR		
	≥College: 75.4%			
	Physical activity level: NR	Iertile 2 (Male): Protein		
	Health status/ Comorbidities:	intake 0.8-1.2 g/kg/d		
	Diabetes: 11.6%			
	Hypertension: 28.9%	Baseline Protein Amount		
	Dyslipidemia:12.9%	Median (IQR): 65.6 (58.8-		
	Stroke: 2.1%	73.4) g/d; 13.1 (11.8-14.7) %		
	Coronary artery disease: 5.4%	of energy		
	Cancer: 3.1%	Carbohydrate Median (IQR):		
	Medication use: NR	70.9 (66.1-74.9) % of energy		
	Supplement use: NR	Fat Median (IQR): 14.9		
	Pregnant or lactating: NA	(11.6-18.5) % of energy		
	Tertile 2 (Male): Protein intake	Protein Amount at the end of		
	0.8-1.2 g/kg/d	the study		
	N: 4449	Median (IQR): NR		
	% Female: 0%	Carbohydrate Median (IQR):		
	Median Age (IQR): 56.0 (49.0-	NR		
	62.0) y	Fat Median (IQR): NR		
	Race/ Ethnicity: NR			
	Menopausal status: NA	Tertile 3 (Male): Protein		
	Obesity status: NR	intake >1.2 g/kg/d		
	Median BMI (IQR): 24.1 (22.5-			
	25.8) kg/m ²	Baseline Protein Amount		
	Income level:	Median (IQR): 94.8 (83.9-		
	Low income: 8.0%	109.7) g/d; 13.7 (12.3-15.6)		
	Education level:	% of energy		
	≤Elementary school: 0.9%	Carbohydrate Median (IQR):		
	Middle or high school: 17.6%	69.2 (63.7-73.3) % of energy		
	≥College: 81.5%	Fat Median (IQR): 16.2		
	Physical activity level: NR	(12.8-20.4) % of energy		
	Health status/ Comorbidities:	,,		
	Diabetes: 10.1%	Protein Amount at the end of		
	Hypertension: 23.7%	the study		
	Dyslipidemia: 12.2%	Median (IQR): NR		
	Stroke: 1.8%	Carbohydrate Median (IQR):		
	Coronary artery disease: 4.3%	NR		
	Cancer: 2.8%	Fat Median (IQR): NR		
	Medication use: NR	· · ·		

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Supplement use: NR	Tertile 1 (Female): Protein		
	Pregnant or lactating: NA	intake <0.8 g/kg/d		
	Tertile 3 (Male): Protein intake >1.2 g/kg/d N: 1783 % Female: 0 Median Age (IQR): 55.0 (48.0- 62.0) y Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Median BMI (IQR): 23.6 (21.8- 25.3) kg/m ²	Baseline Protein Amount Median (IQR): 38.5 (32.8- 43.6) g/d; 12.6 (11.2-14.3) % of energy Carbohydrate Median (IQR): 73.5 (68.5-77.7) % of energy Fat Median (IQR): 12.8 (9.4- 16.9) % of energy Protein Amount at the end of the study Modian (IQR): NR		
	Low income level: Low income: 8.3% Education level: ≤Elementary school: 1.1%, Middle or high school: 16.8%, ≥College: 82.1% Physical activity level: NR Health status/ Comorbidities:	Carbohydrate Median (IQR): NR Fat Median (IQR): NR Tertile 2 (Female): Protein intake 0.8-1.2 g/kg/d		
	Diabetes: 7.2% Hypertension: 20.5% Dyslipidemia: 9.0% Stroke: 1.1% Coronary artery disease: 2.7% Cancer: 3.5% Medication use: NR Supplement use: NR Pregnant or lactating: NA	Baseline Protein Amount Median (IQR): 55.4 (49.9- 61.7) g/d; 13.2 (11.8-14.9) % of energy Carbohydrate Median (IQR): 71.6 (66.7-75.7) % of energy Fat Median (IQR): 14.4 (11.0-18.3) % of energy		
	Tertile 1 (Female): Protein intake <0.8 g/kg/d N: 7545 % Female: 23.2% Median Age (IQR): 54.0 (49 60.0) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR	Protein Amount at the end of the study Median (IQR): NR Carbohydrate Median (IQR): NR Fat Median (IQR): NR Tertile 3 (Female): Protein intake >1.2 g/kg/d Baseline Protein Amount		

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Median BMI (IQR): 24.2 (22.4- 26.3) kg/m ² Income level: Low income: 15.3% Education level: ≤Elementary school: 3.4% Middle or high school: 40.6% ≥College: 56.0% Physical activity level: NR Health status/ Comorbidities: Diabetes: 6.9% Hypertension: 22.7% Dyslipidemia:13.4% Stroke: 0.9% Coronary artery disease: 2.5% Cancer: 4.8% Medication use: NR Supplement use: NR Pregnant or lactating: NR Tertile 2 (Female): Protein intake 0.8-1.2 g/kg/d N: 8644 % Female: 26.6% Median Age (IQR): 52.0 (47.0- 58.0) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Median BMI (IQR): 23.1 (21.5- 25.0) kg/m ² Income level: Low income: 9.1% Education level: ≤Elementary school: 1.8% Middle or high school: 29.9% ≥College: 68.3% Physical activity level: NR Health status/ Comorbidities: Diabetes: 4.5% Hypertension: 16.7%	Median (IQR): 80.4 (71.1- 3.7) g/d; 14.0 (12.5-15.7) % of energy Carbohydrate Median (IQR): 69.1 (64.0-73.8) % of energy Fat Median (IQR): 16.4 (12.6-20.3) % of energy Protein Amount at the end of the study Median (IQR): NR Carbohydrate Median (IQR): NR Fat Median (IQR): NR Protein type/ source: Mixed Energy balance status: Eucaloric Study duration: 4 y	assessment)	
	Dyslipidemia: 10.7%			

Study	Participants	Intervention (s) (Content)	Intervention (s)	Outcome (Measures and
			(Methods (of assessment)	methods of assessment)
_	Stroke: 0.6%			
	Coronary artery disease: 1.9%			
	Cancer: 4.5%			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
	Tertile 3 (Female): Protein			
	intake >1.2 g/kg/d			
	N: 4911			
	% Female: 15.1%			
	Median Age (IQR): 51.0 (46.0-			
	57.0) y Bass/Ethnisity/ND			
	Menopousal status: NR			
	Obesity status: NR			
	Median BMI (IQR): 22.3 (20.7-			
	24.1) kg/m ²			
	Income level:			
	Low income: 6.9%			
	Education level:			
	≤Elementary school: 1.1%			
	Middle or high school: 21.1%,			
	≥College: 77.8%			
	Physical activity level: NR			
	Diabetes: 3.3%			
	Hypertension: 12 4%			
	Dyslipidemia: 9.5%			
	Stroke: 0.6%			
	Coronary artery disease: 1.2%			
	Cancer: 4.6%			
	Medication use: NR			
	Supplement use: NR			
DMID: 00170004	Pregnant or lactating: NR	Arms A: Drotoin food aluator	Drotain Accessment	Mussla Mass. Lass mass.
Mangano	Study OF Adults	(East food full fat dainy)	Protein Assessment	wuscie wass - Lean mass
2017* ²²	Total sample N. 2,900	(Fast lood, luii-lat daliy)	intakes of foods and	Measure/Method of
Location/Country: USA	Arm 1: Protein food cluster	Baseline Protein Amount	nutrients were assessed	Assessment: DXA Fan beam
HDI: Very high	(Fast food, full-fat dairy)	Mean (SD): 88 (31) q/d	with the use of the	densitometer (GE Lunar
Setting: NR	N: 458	Carbonydrate Mean (SD):	Harvard 126-item	Prodigy)
Urban/ Rural: NR	% Female: 44%	NR	semiquantitative and	

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
			assessment)	
Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Mean Age (SD): 39.3 (8.5) y Race/ Ethnicity: NR Menopausal status: 6% nonestrogenic Obesity status: NR Mean BMI (SD): 26.5 (5.0) kg/m ² Income level: NR Education level: NR Mean physical activity level: 37.2 (7.4) PAI Health status/ Comorbidities: NR Medication use: NR Supplement use: Calcium supplements: 19%, Vitamin D supplements: 40% Pregnant or lactating: NR Arm 2 : Protein food cluster 2 (Fish) N: 605 % Female: 58% Mean Age (SD): 42.2 (9.0) y Race/ Ethnicity: NR Menopausal status: 14% nonestrogenic Obesity status: NR Mean BMI (SD): 26.8 (5.3) kg/m ² Income level: NR Education level: NR Mean physical activity level: 37.4 (7.6) PAI Health status/ Comorbidities: NR Medication use: NR Supplement use: Calcium supplements: 43%, Vitamin D supplements: 53% Pregnant or lactating: NR	Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2 : Protein food cluster 2 (Fish) Baseline Protein Amount Mean (SD): 90 (31) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 3 : Protein food cluster 3 (Red meat) Baseline Protein Amount Mean (SD): 97 (29) g/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	validated general population 88 FFQ. Protein intake was assessed during the years 2002-2005.	Muscle Mass - Appendicular lean mass/ skeletal muscle mass Measure/Method of Assessment: DXA Fan beam densitometer (GE Lunar Prodigy)

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
			assessment)	methous of assessment)
	Arm 3: Protein food cluster 3	Arm 4: Protein food cluster 4		
	(Red meat)	(Chicken)		
	N: 640			
	% Female: 48%	Baseline Protein Amount		
	Mean Age (SD): 41.5 (8.3) y	Mean (SD): 95 (35) g/d		
	Race/ Ethnicity: NR	Carbohydrate Mean (SD):		
	Menopausal status: 13%			
	nonestrogenic	Fat Mean (SD): NR		
	Obesity status: NR	Ductoin Amount of the and of		
	ka/m^2	the study		
	Kg/III-	Moon (SD): NP		
	Education level: NR	Carbobydrate Mean (SD):		
	Mean physical activity level:	NR		
	37 5 (8 3) PAI	Fat Mean (SD): NR		
	Health status/ Comorbidities			
	NR	Arm 5: Protein food cluster 5		
	Medication use: NR	(Low-fat milk)		
	Supplement use:			
	Calcium supplements: 30%	Baseline Protein Amount		
	Vitamin D supplements: 39%	Mean (SD): 98 (31) g/d		
	Pregnant or lactating: NR	Carbohydrate Mean (SD):		
		NR		
	Arm 4: Protein food cluster 4	Fat Mean (SD): NR		
	(Chicken)			
	N: 735	Protein Amount at the end of		
	% Female: 58%	the study		
	Mean Age (SD): 39.3 (8.3) y	Mean (SD): NR		
	Race/ Ethnicity: NR	Carbohydrate Mean (SD):		
	Menopausai status: 7%	NK Fat Maan (SD): ND		
	Obesity status: NP	Fat Mean (SD): NR		
	Mean BMI (SD): 26 7 (5 3)	Arm 6: Protein food cluster 6		
	ka/m^2	(Legumes)		
	Income level: NR	(Legumes)		
	Education level: NR	Baseline Protein Amount		
	Mean physical activity level:	Mean (SD): 83 (34) g/d		
	37.0 (7.2) PAI	Carbohydrate: NR		
	Health status/ Comorbidities:	Fat: NR		
	NR			
	Medication use: NR	Protein Amount at the end of		
	Supplement use:	the study		

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Calcium supplements: 36%	Mean (SD): NR		
	Vitamin D supplements: 46%	Carbobydrate Mean (SD):		
	Pregnant or lactating: NR	NR		
	r regnant of labtating. Nrt	Fat Mean (SD): NR		
	Arm 5: Protein food cluster 5			
	(Low-fat milk)	Protein type/source: Mixed		
	$N \cdot 434$	Trotein type/source. Mixed		
	% Female: 58%	Energy balance status:		
	Mean Age (SD): 40.9 (8.6) v	Eucaloric		
	Race/ Ethnicity: NR	Lucalone		
	Menopausal status: 11%	Study duration: 9 y		
	Obesity status: NR			
	Mean BMI (SD): 26.8 (5.0)			
	kg/m ²			
	Income level: NR			
	Education level: NR			
	Mean physical activity level:			
	37.8 (7.3) PAI			
	Health status/ Comorbidities:			
	NR			
	Medication use: NR			
	Supplement use:			
	Calcium supplements: 40%.			
	Vitamin D supplements: 50%			
	Pregnant or lactating: NR			
	Arm 6: Protein food cluster 6			
	(Legumes)			
	N: 114			
	% Female: 79%			
	Mean Age (SD): 38.6 (9.4) y			
	Race/ Ethnicity: NR			
	Menopausal status: 7%			
	nonestrogenic			
	Obesity status: NR			
	Mean BMI (SD): 23.9 (4.6)			
	kg/m ²			
	Income level: NR			
	Education level: NR			
	Mean physical activity level:			
	36.1 (5.8) PAI			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
PMID: 33829238	Health status/ Comorbidities: NR Medication use: NR Supplement use: Calcium supplements: 47%, Vitamin D supplements: 56% Pregnant or lactating: NR Study of: Adults	Pooled analysis	Protein Assessment	Physical Performance -
Mendonca 2021 ⁷⁵ Location/Country: USA, Canada, Netherlands and UK HDI: Very high Setting: Mixed Urban/ Rural: Mixed Study Design: Pooled analysis of longitudinal observational study Funding source: NR Risk of bias: Very high	Total sample N: 5725 Quartile 1: Protein intake <0.8 g/kg aBW/d N:1579 % Female: 53.8% Median Age (IQR): 75.0 (72.0– 79.0) y Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: Low: 31.1% Medium: 36.8% High: 32.1% Physical activity level: Low: 36.7% Medium: 34.1% High: 29.1% Health status/ Comorbidities: Multimorbidity: 49.6% Medication use: NR Supplement use: NR Pregnant or lactating: NR Quartile 2: Protein intake 0.8– 0.99 g/kg aBW/d N:1335 % Female: 57.7% Median Age (IQR): 75.0 (72.0– 79.2) v	Quartile 1: Protein intake <0.8 g/kg aBW/d Baseline Protein Amount Mean (SD): <0.8 g/kg aBW/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Quartile 2: Protein intake 0.8–0.99 g/kg aBW/d Baseline Protein Amount Mean (SD): 0.8–0.99 g/kg aBW/d Carbohydrate Mean (SD): NR Fat Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR	Method: Dietary intake was assessed by an FFQ and multiple 24-h recalls. Protein intake was expressed as a categorical variable using cut points of (<0.8,0.8– 0.99, 1.0–1.19, ≥1.2) based on expert recommendations for optimal protein intake on currently used RDAs for protein.	Walking speed Measure/Method of Assessment: Measured as the time taken to walk a distance that varied between cohorts. One cohort did not measure walking speed so the formula [6/TUG (s)]×1.62 was used to yield walking speed.

Study	Participants	Intervention (s) (Content)	Intervention (s)	Outcome (Measures and
			(Methous (Of assessment)	methous of assessment)
	Race/ Ethnicity: NR	Quartile 3: Protein intake		
	Menopausal status:	1.0–1.19 g/kg aBW/d		
	Postmenopausal	5 5		
	Obesity status: NR	Baseline Protein Amount		
	Mean BMI (SD): NR	Mean (SD): 1.0–1.19 g/kg		
	Income level: NR	aBW/d		
	Education level:	Carbohydrate Mean (SD):		
	Low: 33.2%	NR		
	Medium: 36.4%	Fat Mean (SD): NR		
	High: 30.4%			
	Physical activity level:	Protein Amount at the end of		
	Low: 30.0%	the study		
	Medium: 35.5%	Mean (SD): NR		
	High: 34.5%	Carbohydrate Mean (SD):		
	Health status/ Comorbidities:	NR		
	Multimorbidity: 52.6%	Fat Mean (SD): NR		
	Medication use: NR			
	Supplement use: NR	Quartile 4: Protein intake		
	Pregnant or lactating: NR	≥1.2 g/kg aBW/d		
	Quartile 3: Protein intake 1.0-	Baseline Protein Amount		
	1.19 g/kg aBW/d	Mean (SD): ≥1.2 g/kg aBW/d		
	N: 1218	Carbohydrate Mean (SD):		
	% Female: 53.5%	NR		
	Median Age (IQR): 75.0 (71.0–	Fat Mean (SD): NR		
	79.0) y			
	Race/ Ethnicity: NR	Protein Amount at the end of		
	Menopausal status:	the study		
	Postmenopausal	Mean (SD): NR		
	Obesity status: NR	Carbohydrate Mean (SD):		
	Mean BMI (SD): NR	NR		
	Income level: NR	⊦at Mean (SD): NR		
	Education level:			
	Low: 30.1%	Protein type/ source: Mixed		
	Medium: 37.8%			
	High: 32.1%	Energy balance status:		
	Physical activity level:	Eucaloric		
	LOW: 32.0%	Chudu durations 0 5.		
	Wealum: 34.1%	Sludy duration: 8.59		
	TIYII. 32.170			
	Health Status/ Comorbidities:			
	wullinordially: 53.0%			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
			assessment)	
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
	Quartile 4: Protein intake ≥1.2			
	g/kg aBW/d			
	N:1593			
	% Female: 51.3%			
	Median Age (IQR): 75.0 (71.0-			
	79.0) y			
	Race/ Ethnicity: NR			
	Menopausal status:			
	Postmenopausal			
	Obesity status: NR			
	Mean BMI (SD): NR			
	Income level: NR			
	Education level:			
	LOW: 32.8%			
	Medium: 39.5%			
	Right 27.0%			
	Low. 29.070 Modium: 31.5%			
	High: 38.0%			
	Health status/ Comorbidities:			
	Multimorbidity: 49.6%			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
PMID: 35791789	Study of: Adults	Quartile 1: Protein intake	Protein Assessment	Muscle Strenath - Grip
Mendonca	Total sample N: 5584	<0.8 g of protein/kg aBW/d	Method: Dietary intake	strength
2023 ⁷⁶			was assessed by an FFQ	
Location/Country: USA,	Quartile 1: Protein intake < 0.8	Baseline Protein Amount	and multiple 24-h recalls.	Measure/Method of
Canada, Netherlands, UK	g of protein/kg aBW/d	Mean (SD): 44.1 (10.9) g/d;	Protein intake was	Assessment: Measured using
HDI: Very high	N: 1530	0.6 (0.1) g/kg aBW/d; 13.6	expressed as a	handgrip dynamometer
Setting: Mixed	% Female: 53.5%	(2.8) % of energy	categorical variable using	
Urban/Rural: Mixed	Median Age (IQR): 75.0 (72.0-	Carbohydrate Mean (SD):	cut points of (<0.8,0.8–	
Study design:	79.0) y	NR	0.99, 1.0–1.19, ≥1.2)	
Pooled analysis of	Race/ Ethnicity: NR	Fat Mean (SD): NR	based on expert	
longitudinal observational	Menopausal status:		recommendations for	
study	Postmenopausal	Protein Amount at the end of	optimal protein intake on	
Funding source: Nonprofit	Obesity status: NR	the study		

Study	Participants	Intervention (s) (Content)	Intervention (s)	Outcome (Measures and
			(Methods (of	methods of assessment)
Risk of bias score: Verv	Mean BMI (SD) [,] 27 7 (4 5)	Mean (SD) [,] NR	currently used RDAs for	
high	kg/m ²	Carbohydrate Mean (SD)	protein	
	Income level: NR	NR	P	
	Education level:	Fat Mean (SD): NR		
	Lower: 31.8%			
	Medium: 37.0%	Quartile 2: Protein intake		
	Higher: 32.0%	0.8– <1.0g/kg aBW/d		
	Physical activity level:			
	Lower: 36.5%	Baseline Protein Amount		
	Medium: 34.2%	Mean (SD): 62.3 (9.1) g/d;		
	Higher: 29.3%	0.9 (0.1) g/kg aBW/d; 14.8		
	Health status/ Comorbidities:	(3.0) % of energy		
	Multimorbidity: 49.4%	Carbohydrate Mean (SD):		
	Medication use: NR	NR		
	Supplement use: NR	Fat Mean (SD): NR		
	Pregnant or lactating: NR			
		Protein Amount at the end of		
	Quartile 2: Protein intake 0.8–	the study		
	<1.0g/kg aBW/d	Mean (SD): NR		
	N: 1304	Carbohydrate Mean (SD):		
	% Female: 53·2%	NR		
	Median Age (IQR): 75.0 (72.0-	Fat Mean (SD): NR		
	79.5) y			
	Race/ Ethnicity: NR	Quartile 3: Protein intake		
	Menopausal status:	1.0–<1.2 g/kg aBVV/d		
		Deseline Destain Americat		
	Obesity status: NR	Baseline Protein Amount		
	Mean BMI (SD): 27.1 (4.7)	Mean (SD): 75.2(10.7) g/d;		
	Kg/m²	1.1 (0.1) g/kg aBvv/d; 15.8		
	Education level:	(2.9) % Of effergy		
	Lower: 23.4%			
	Medium: 36.3%	Eat Mean (SD): NR		
	Higher: 30.3%	Tat Mean (SD): NIX		
	Physical activity level	Protein Amount at the end of		
	Lower: 30.2%	the study		
	Medium: 35.2%	Mean (SD): NR		
	Higher: 34.6%	Carbohydrate Mean (SD):		
	Health status/ Comorbidities:	NR		
	Multimorbidity: 52.2%	Fat Mean (SD): NR		
	Medication use: NR	()·····		
	Supplement use: NR			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Pregnant or lactating: NR	Quartile 4: Protein intake		
	Quertile 2: Drotein inteke 1.0	≥1.2 g/kg aBW/d		
	Quartine 5. Protein intake 1.0-	Decelia - Dectain Americat		
	<1.2 g/kg aBvv/d	Maser (CD): 07.0 (20.4) m/dr		
	N. 1195 % Fomolo: 52.2%	1 = 10000000000000000000000000000000000		
	% Female: 53.3%	1.5 (0.3) g/kg aBvv/d; 17.1		
		(3.2) % Of effergy		
	79.0) y Dece (Ethnicity v ND	Carbonydrate Mean (SD):		
	Race/ Elinicity: NR	NK Fat Maan (SD): ND		
	Nenopausai status.	Fat Mean (SD). NR		
	Obosity status: NP	Protoin Amount at the and of		
	Moon BMI (SD): 26.0 (4.7)	the study		
	ka/m^2	Moon (SD): NP		
	Income level: NP	Carbobydrate Mean (SD):		
	Education level:	NP		
	Lower: 20.0%	Fat Mean (SD): NR		
	Medium: 38.1%			
	Higher: 32.0%	Protein type/ source: Mixed		
	Physical activity level			
	Lower: 32.6%	Energy balance status:		
	Medium: 34.4%	Eucaloric		
	Higher: 33.0%			
	Health status/ Comorbidities:	Study duration: 8.5 y		
	Multimorbidity: 52.9%	, ,		
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
	Quartile 4: Protein intake ≥1.2			
	g/kg aBW/d			
	N: 1555			
	% Female: 50.7%			
	Median Age (IQR): 74.0 (70.8-			
	79.0) y De se (Etherisiter ND			
	Nienopausal status:			
	Moon PMI (SD): 26.2 (F.0)			
	ka/m^2			
	Income level: NP			
			1	

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Education level: Lower: 32.8% Medium: 39.5% Higher: 27.7% Physical activity level: Lower: 29.4% Medium: 31.5% Higher: 39.1% Health status/ Comorbidities: Multimorbidity: 49.4% Medication use: NR Supplement use: NR Pregnant or lactating: NR			
PMID: 19419320 Meng 2009* ²³ Location/Country: Australia HDI: Very high Setting: Community dwelling Urban/ Rural: NR Study design: Prospective cohort study Funding source: Nonprofit, government Risk of bias score: High	Study of: Adults Total sample N: 862 Tertile 1 : Protein intake <66 g of protein/ d N: 287 % Female: 100% Mean Age (SD): 74.9 (2.5) y Race/ Ethnicity: 100% white origin Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 26.4 (4.2) kg/m ² Income level: NR Education level: NR Physical activity level: 466 (median kilojoules expended per day) Health status/ Comorbidities: Participants were excluded if they had a medical condition likely to influence 5-year survival. Medication use: Participants were excluded if they were taking bone active medications	Tertile 1: Protein intake <66 g of protein g/d Baseline Protein Amount Mean (SD): 54.4 (9.1) g/d Carbohydrate Mean (SD): 146.8 (30.9) g/d Fat Mean (SD): 46.4 (13.3) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Tertile 2: Protein intake 66- 87 g of protein/ d Baseline Protein Amount Mean (SD): 76.6 (6.2) g/d Carbohydrate Mean (SD): 186.4 (34.1) g/d Fat Mean (SD): 63.0 (13.3) g/d Protein Amount at the end of	Protein Assessment Method: Participants completed a self- administered, quantitative FFQ. This FFQ has been designed to measure eating habits over the past 12-mo period and calibrated and validated according to the foods and on intake for a 12-mo period. The daily dietary intakes were derived from the questionnaire. Protein intake was assessed at baseline.	Muscle Mass - Lean mass Measure/Method of Assessment: DXA (Hologic 4500A machine, Hologic, Boston, MA, USA) Muscle Mass - Appendicular lean mass/ skeletal muscle mass Measure/Method of Assessment: DXA (Hologic 4500A machine, Hologic, Boston, MA, USA)

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	supplements, estrogen,	Mean (SD): NR	· · · · · · · · · · · · · · · · · · ·	
	bisphosphonates, and vitamin	Carbohydrate Mean (SD):		
	D.	NR		
	Supplement use: Participants were excluded if they were	Fat Mean (SD): NR		
	taking bone active medications	Tertile 3: Protein intake >87		
	including calcium	g of protein/d		
	supplements, estrogen,	• .		
	bisphosphonates, and vitamin	Baseline Protein Amount		
	D.	Mean (SD): 110.9 (23.4) g/d		
	Pregnant or lactating: NR	Carbohydrate Mean (SD):		
		249.5 (61.9) g/d		
	Tertile 2: Protein intake 66-87	Fat Mean (SD): 85.1 (25.7)		
	g of protein/ d	g/d		
	N: 287	-		
	% Female: 100%	Protein Amount at the end of		
	Mean Age (SD): 75.0 (2.6) y	the study		
	Race/ Ethnicity: 100% white	Mean (SD): NR		
	origin	Carbohydrate Mean (SD):		
	Menopausal status:	NR		
	Postmenopausal	Fat Mean (SD): NR		
	Obesity status: NR			
	Mean BMI (SD): 26.7 (4.7)	Protein type/source: Mixed		
	kg/m ²			
	Income level: NR	Energy balance status:		
	Education level: NR	Eucaloric		
	Physical activity level: 530			
	(median kilojoules expended	Study duration: 5 y		
	per day)			
	Health status/ Comorbidities:			
	Participants were excluded if			
	they had a medical condition			
	likely to influence 5-year			
	survival.			
	iviedication use: Participants			
	were excluded if they were			
	including coloring			
	supplements, estrogen,			
	bisphosphonales, and vitamin			
	U.			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
	Supplement use: Participants		assessment)	
	were excluded if they were			
	taking bone active medications			
	hisphosphonatos, and vitamin			
	D. Pregnant or lactating: NR			
	Tregnant of lactating. Nr			
	Tertile 3: Protein intake >87 g			
	of protein/ d			
	N: 288			
	% Female: 100%			
	Mean Age (SD): 74.7 (2.7) y			
	Race/ Ethnicity: 100% white			
	origin			
	Menopausal status:			
	Postmenopausal			
	Obesity status: NR			
	Mean BMI (SD): 27.3 (4.3)			
	kg/m ²			
	Income level: NR			
	Education level: NR			
	Physical activity level: 614			
	(median kilojoules expended			
	per day)			
	Health status/ Comorbidities:			
	Participants were excluded if			
	they had a medical condition			
	likely to influence 5-year			
	survival.			
	Medication use: Participants			
	were excluded if they were			
	taking bone active medications			
	supplements, estrogen,			
	D. Supplement user Dertisinente			
	Supplement use. Faill/pants			
	taking hone active medications			
	including calcium			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	supplements, estrogen, bisphosphonates, and vitamin D. Pregnant or lactating: NR			
PMID: 22923606 Mulla 2013 ⁷⁷ Location/Country: UK HDI: Very high Setting: NR Urban/ Rural: NR Study design: Prospective cohort design Funding source: Nonprofit Risk of bias score: High	Study of: Adults Total sample N: 1771 Arm 1: Men N: 867 % Female: 0% Age: 36 Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: NR Supplement use: NR Pregnant or lactating: NA Arm 2 : Women N: 904 % Female: 100% Age: 36 Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): NR Income level: NR Education level: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: NR Physical activity level: NR Health status/ Comorbidities: NR Medication use: NR Physical activity level: NR Health status/ Comorbidities: NR	Arm 1: Men Baseline Protein Amount Mean (SD): 84 (19) g/d; 14.4 (2.4) % of energy Carbohydrate Mean (SD): 263 (75) g/d Fat Mean (SD):103 (30) g/d Protein Amount at the end of the study Mean (SD): 88 (21) g/d; 14.6 (2.3) % of energy Carbohydrate Mean (SD): 267 (73) g/d Fat Mean (SD): 108 (32) g/d Arm 2: Women Baseline Protein Amount Mean (SD): 64 (15) g/d; 15.7 (3.6) % of energy Carbohydrate Mean (SD): 191 (64) g/d Fat intake Mean (SD): 191 (64) g/d Protein Amount at the end of the study Mean (SD): 70 (16) g/d; 15.5 (3.0) % of energy Carbohydrate Mean (SD): 208 (60) g/d Fat Mean (SD): 82 (26) g/d Protein type/source: Mixed	Protein Assessment Method: Food record (5- day estimated diaries) nutrient intakes for both time points were calculated based on McCance and Widdowson's.	Muscle Strength - Grip strength Measure/Method of Assessment: Measured using handgrip dynamometer Muscle Strength - Chair rise test Measure/Method of Assessment: Measured as the time taken to rise from a sitting to standing position with a straight back and legs and then sit down again.

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
		Energy balance status: Eucaloric		
		Study duration: 16 y		
PMID: 31608843 Otsuka 2020 ⁷⁸ Location/Country: Japan HDI: Very high Setting: Community dwelling Urban/ Rural: NR Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Study of: Adults Total sample N: 655 Arm 1: Men N: 292 % Female: 0% Mean Age (SD): 68.8 (6) y Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Mean BMI (SD): 24.3 (2.2) kg/m ² Income level: Annual family income <3,500,000 Yen: 27.4% Education level: \leq 9 years: 27.4% Mean physical activity level (SD): 34.1 (3.80) MET x h/d Health status/ Comorbidities: Heart disease: 7.9% Hypertension: 46.9% Dyslipidemia: 23% Diabetes: 12% Medication use: NR Supplement use: NR Pregnant or lactating: NA Arm 2 : Women N: 363 % Female: 100% Mean Age (SD): 69.8 (6.5) y Race/ Ethnicity: NR Menopausal status: Postmenopausal Obesity status: NR Mean BMI (SD): 23.5 (2.8)	Arm 1: Men Baseline Protein Amount Mean (SD): 86.7 (17.4) g/d Carbohydrate Mean (SD): 317.7 (60.5) g/d Fat Mean (SD): 56.6 (15.6) g/d Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2: Women Baseline Protein Amount Mean (SD): 71.0 (13.4) g/d Carbohydrate Mean (SD): 266.3 (49.8) g/d Fat Mean (SD): 48.8 (12.4) g/d Protein Amount at the end of the study: NR Carbohydrate intake: NR Fat intake: NR Protein type/ source: mixed type. Energy balance status: Eucaloric	Protein Assessment Method: Three-day dietary record nutrient intakes were calculated according to the Standard Tables of Food Composition in Japan 2010. Within each meal sheet, i.e., the breakfast, lunch and dinner sheet, most participants recorded the time and all foods containing seasonings that they consumed.	Muscle Mass – Appendicular lean mass/ skeletal muscle mass Measure/Method of Assessment: DXA (QDR- 4500; Hologic, Bedford, MA, USA)
	kg/m²	Study duration: 2 y		

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Income level: Annual family income <3,500,000 Yen: 41.3% Education level: ≤ 9 years: 32.5% Mean physical activity level (SD): 35.1 (2.6) MET x h/d Health status/ Comorbidities: Heart disease: 4.7% Hypertension: 41.3% Dyslipidemia: 30.0% Diabetes: 11.6% Medication use: NR Supplement use: NR Pregnant or lactating: NR			
PMID: 26179475 Rahi 2016 ⁷⁹ Location/Country: Canada HDI: Very high Setting: Community dwelling Urban/ Rural: NR Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Study of: Adults Total sample N: 172 Arm 1 (Men): Protein intake ≥1 g/kg/d N: 43 % Female: 0% Mean Age (SD): 74.9 (4.4) y Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Mean BMI (SD): 28.4 (3.6) kg/m ² Income level: NR Mean education level (SD): 12.5 (5.5) y Physical activity level: NR Health status/ Comorbidities: Participants free from heart failure greater than class II, chronic obstructive pulmonary disease requiring oxygen therapy or oral steroids, inflammatory digestive diseases, or cancer treated by radiation therapy,	Arm 1 (Men): Protein intake ≥1 g/kg/d Baseline Protein Amount Mean (SD): 97.6 (18.0) g/d; 1.24 (0.22) g/kg/d; 18.7 (3.3) % of energy Carbohydrate Mean (SD): 45.9 (7.4) % of energy Fat Mean (SD): 35.3 (6.0) % of energy Protein Amount at the end of the study Mean (SD): NR Carbohydrate Mean (SD): NR Fat Mean (SD): NR Arm 2 (Men): Protein intake <1g/kg/d Baseline Protein Intake Mean (SD): 70.0 (16.0) g/d; 0.78 (0.15) g/kg/d; 16.1 (3.3) % of energy	Protein Assessment Method: Dietary assessments were conducted by three non- consecutive 24-h dietary recalls (24-HR) on two randomly chosen weekdays and 1 weekend day. Recalls were processed using the CANDAT nutrient analysis program based on the then- current Canadian Nutrient File (CNF) database version 2001b.	Muscle Strength - Knee extensors Measure/Method of Assessment: Measured using isometric contraction of the knee extensors.

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
			assessment)	
	Medication use: NR	48.1 (7.6) % of energy	·····	
	Supplement use: NR	Fat Mean (SD): 35.2 (6.4) %		
	Pregnant or lactating: NA	of energy		
	Arm 2 (Men): Protein intake	Protein Amount at the end of		
	<1 g/kg/d	the study		
	N: 63	Mean (SD): NR		
	% Female: 0%	Carbohydrate Mean (SD):		
	Mean Age (SD): 74.9 (4.4) y	NR		
	Race/ Ethnicity: NR	Fat Mean (SD): NR		
	Menopausal status: NA			
	Obesity status: NR	Arm 3 (Women): Protein		
	Mean BMI (SD): 31.4 (4.4)	intake ≥1 g/kg/d		
	kg/m ²			
	Income level: NR	Baseline Protein Amount		
	Mean education level (SD):	Mean (SD): 84.4 (20.6) g/d;		
	11.5 (5.2) y	1.32 (0.31) g/kg/d; 19.2 (3.4)		
	Physical activity level: NR	% of energy		
	Health status/ Comorbidities:	Carbohydrate Mean (SD):		
	Participants free from heart	45.8 (5.4) % of energy		
	failure greater than class II,	Fat Mean (SD): 35.3 (4.9) %		
	discose requiring engineer	of energy		
	therapy or and storaids	Drotoin Amount at the and of		
	inflammatory digastiva	the study		
	discassos, or cancer treated by	Moon (SD): NP		
	radiation therapy	Carbobydrate Mean (SD):		
	chemotherapy, or surgery	NR		
	Medication use: NR	Fat Mean (SD): NR		
	Supplement use: NR			
	Pregnant or lactating: NA	Arm 4 (Women): Protein		
		intake <1 g/kg/d		
	Arm 3 (Women): Protein			
	intake ≥1 g/kg/d	Baseline Protein Amount		
	N: 30	Mean (SD): 58.6 (12.5) g/d;		
	% Female: 100%	0.78 (0.14) g/kg/d; 16.4 (3.6)		
	Mean Age (SD): 74.2 (4.1) y	% of energy		
	Race/ Ethnicity: NR	Carbohydrate Mean (SD):		
	Menopausal status: NR	51.0 (6.9) % of energy		
	Obesity status: NR	Fat Mean (SD): 33.1 (6.1) %		
	Mean BMI (SD): 27.1 (3.2)	of energy		
	kg/m ²			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Income level: NR	Protein Amount at the end of		
	Mean education level (SD):	the study		
	10.2 (3.1) y	Mean (SD): NR		
	Physical activity level: NR	Carbohydrate Mean (SD):		
	Perticipanto free frem beert	NK Fet Maera (SD): ND		
	failure greater then along II	Fat Mean (SD). NR		
	allure greater than class II,	Brotain type/ acurae: Mixed		
	discass requiring exugen	Protein type/ source. Mixed		
	therapy or oral steroids	Energy balance status:		
	inflammatory digestive	Eucaloric		
	diseases or cancer treated by	Lucalone		
	radiation therapy	Study duration: 3 v		
	chemotherapy, or surgery.			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
	5			
	Arm 4 (Women): Protein			
	intake <1 g/kg/d			
	N: 30			
	% Female: 100%			
	Mean Age (SD): 75.8 (4.3) y			
	Race/ Ethnicity: NR			
	Menopausal status: NR			
	Obesity status: NA			
	Mean BMI (SD): 31.4 (4.6)			
	kg/m ²			
	Income level: NR			
	Mean education level (SD):			
	10.2 (3.0) y			
	Physical activity level: NR			
	Perticipanta free from boart			
	failure greater than class II			
	chronic obstructive pulmonary			
	disease requiring oxygen			
	therapy or oral steroids			
	inflammatory digestive			
	diseases or cancer treated by			
	radiation therapy			
	chemotherapy, or surgery.			
Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
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	Medication use: NR Supplement use: NR Pregnant or lactating: NR			
PMID: 21054294 Scott 2010 ⁸⁰ Location/Country: Australia HDI: Very high Setting: Community dwelling Urban/ Rural: NR Study design: Prospective cohort study Funding source: Nonprofit, government, academic Risk of bias score: High	Study of: Adults Total sample N: 1,099 Whole Cohort N: 1099 % Female: 50.1% Mean Age (SD: 61.9 (7.1) y Race/ Ethnicity: NR Menopausal status: NR Obesity status: NR Mean BMI (SD): 27.5 (4.5) kg/m ² Income level: NR Education level: NR Mean physical activity level (SD): 8,877.0 (3,546) steps/d Health status/ Comorbidities: Excluded those with contraindication for MRI or who were institutionalized Medication use: NR Supplement use: NR Pregnant or lactating: NR	Whole Cohort Baseline Protein Amount Mean (SD): 87.6 (33.7) g/d Carbohydrate Mean (SD): 213.7 (73.9) g/d Fat Mean (SD): 73.0 (29.6) g/d Protein Amount at the end of the study Mean (SD): 88.0 (33.7) g/d Carbohydrate Mean (SD): 205.3 (76.7) g/d Fat Mean (SD): 72.2 (30.9) g/d Protein type/ source: Mixed Energy balance status: Eucaloric Study duration: 3 y	Protein Assessment Method: Dietary nutrient intake was assessed using The Cancer Council Victoria's self- administered Food Frequency Ques (FFQ). The output included average daily estimates for total energy intake and for 28 dietary nutrients. Macronutrient intakes for baseline and follow-up reported.	Muscle Mass - Appendicular lean mass/ skeletal muscle mass Measure/Method of Assessment: DXA (Hologic Delphi densitometer, Hologic, Waltham, MA) Muscle Strength - Knee extension Measure/Method of Assessment: Measured using isometric contraction of the knee extensors.
So 2020 ⁸¹ Location/Country: Korea HDI: Very high Setting: Community dwelling, Urban/ Rural: Urban and rural Study design: Prospective cohort study Funding source: Government Risk of bias score: High	Total sample N: 4412 Tertile 1 (Men): Protein intake cut-offs NR N: NR % Female: 0% Mean Age (SD): 50.9 (8.2) y Race/ Ethnicity: NR Menopausal status: NA Obesity status: NR Mean BMI (SD): 24.4 (2.8) kg/m ² Income level: ≥ 3,000,000 KRW: 22.0%	Tertile 1 (Men): Protein intake cut-offs NRBaseline Protein Amount Mean (SD): 61.1 (0.9) g/d; 13.1 (0.1) % of energy Carbohydrate Mean (SD): 71.6 (0.2) % of energy Fat Mean (SD): 13.9 (0.2) % of energyProtein Amount at the end of the study Mean (SD): NR	Protein Assessment Method: Dietary intake was assessed using a 103-item, semi- quantitative FFQ. Daily nutrient intake was calculated based on the seventh edition of the Food Composition Table in Korea.	Muscle Mass - Lean mass Measure/Method of Assessment: BIA (MF-BIA, Inbody 3.0, Biospace) Muscle Mass - SMI Measure/Method of Assessment: Skeletal muscle mass estimated by dividing total lean mass by 0.52. SMI calculated as total skeletal muscle mass/weight x100.

Study	Participants	Intervention (s) (Content)	Intervention (s)	Outcome (Measures and
			(Methods (of assessment)	methods of assessment)
	Education level:	Carbohvdrate Mean (SD):	assessmenty	
	≥ College: 18.8%	NR		
	Mean physical activity level	Fat Mean (SD): NR		
	(SD): 23.9 (15.5) METs h/d			
	Health status/ Comorbidities:	Tertile 2 (Men): Protein		
	Poor dental health: 39.9%	intake cut-offs NR		
	Chronic disease: 1.8%			
	Medication use: NR	Baseline Protein Amount		
	Supplement use: NR	Mean (SD): 70.0 (0.9) q/d:		
	Pregnant or lactating: NA	13.9 (0.1) % of energy		
	5	Carbohvdrate Mean (SD):		
	Tertile 2 (Men): Protein intake	68.9(0.2) % of energy		
	cut-offs NR	Fat Mean (SD): 16.1 (0.2) %		
	N: NR	of energy		
	% Female: 0%			
	Mean Age (SD): 49.1 (7.5) y	Protein Amount at the end of		
	Race/ Ethnicity: NR	the study		
	Menopausal status: NA	Mean (SD): NR		
	Obesity status: NR	Carbohydrate Mean (SD):		
	Mean BMI (SD): 24.5 (2.8)	NR		
	kg/m ²	Fat Mean (SD): NR		
	Income level:			
	≥ 3,000,000 KRW: 29.9%	Tertile 3 (Men): Protein		
	Education level:	intake cut-offs NR		
	≥ College: 27.8%			
	Mean physical activity level	Baseline Protein Amount		
	(SD): 21.8 (13.4) METs h/d	Mean (SD): 77.9 (0.9) g/d;		
	Health status/ Comorbidities:	17.3 (0.2) % of energy		
	Poor dental health: 37.2%	Carbohydrate Mean (SD):		
	Chronic disease: 1.0%	67.5 (0.2) % of energy		
	Medication use: NR	Fat Mean (SD): 17.3 (0.2) %		
	Supplement use: NR	of energy		
	Pregnant or lactating: NA			
		Protein Amount at the end of		
	Tertile 3 (Men): Protein intake	the study		
	cut-offs NR	Mean (SD): NR		
	N: NR	Carbohydrate Mean (SD):		
	% Female: 0%	NR		
	Mean Age (SD): 50.4 (7.9) y	Fat Mean (SD): NR		
	Race/ Ethnicity: NR			
	Menopausal status: NA	Tertile 1 (Women): Protein		
	Obesity status: NR	intake cut-offs NR		

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
			assessment)	
	Mean BMI (SD): 24.3 (2.6)	Deceline Drotein Amerunt		
	Kg/III-	Mach SD): 52.7 (0.8) a/d:		
		(1010 and SD). 53.7 (0.6) g/d,		
	≥ 3,000,000 KRVV: 30.0%	12.5(0.1)% of energy		
		Carbonydrate Mean (SD):		
	≥College: 29.8%	75.1 (0.2) % of energy		
		Fat Mean (SD): 11.1 (0.2) %		
	(SD): 21.8 (13.4) METS h/d	of energy		
	Health status/ Comorbidities:	Durate in Americant states and st		
	Poor dental health: 38.8%	Protein Amount at the end of		
	Chronic disease: 1.4%	the study		
	Medication use: NR	Mean (SD): NR		
	Supplement use: NR	Carbonydrate Mean (SD):		
	Pregnant or lactating: NA			
		Fat Mean (SD): NR		
	lertile 1 (Women): Protein			
	Intake cut-offs NR	Tertile 2 (Women): Protein		
		Intake cut-offs NR		
	% Female: 100%			
	Mean Age (SD): 52.8 (9.0) y	Baseline Protein Amount		
	Race/ Ethnicity: NR	Mean (SD): 63.3 (0.8) g/d;		
	Menopausal status: NR	13.6 (0.1) % of energy		
	Obesity status: NR	Carbohydrate Mean (SD):		
	Mean BMI (SD): 24.8 (3.0)	71.4 (0.2) % of energy		
	kg/m²	Fat Mean (SD): 14.1 (0.2) %		
	Income level:	of energy		
	≥3,000,000 KRW: 10.7%			
	Education level:	Protein Amount at the end of		
	≥College: 3.7%	the study		
	Mean physical activity level	Mean (SD): NR		
	(SD): 24.4 (15.1) METs h/d	Carbohydrate Mean (SD):		
	Health status/ Comorbidities:	NR		
	Poor dental health: 45.8%	Fat Mean (SD): NR		
	Chronic disease: 6.8%			
	Medication use: NR	Tertile 3 (Women): Protein		
	Supplement use: NR	Intake cut-offs NR		
	Pregnant or lactating: NR			
		Baseline Protein Amount		
	Tertile 2 (Women): Protein	Mean (SD): 72.6 (0.8) g/d;		
	intake cut-offs NR	14.1 (0.1) % of energy		
	N: NR	Carbohydrate Mean (SD):		
	% Female: 100%	69.0 (0.2) % of energy		

Partie	ipants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
Mean	Age (SD): 49.4 (7.9) v	Fat Mean (SD): 16.1 (0.2) %		
Race	Ethnicity: NR	of energy		
Meno	pausal status: NR			
Obes	ty status: NR	Protein Amount at the end of		
Mean	BMI (SD): 24.7 (2.9)	the study		
kg/m ²		Mean (SD): NR		
Incon	ie level:	Carbohydrate Mean (SD):		
≥3,00	0,000 KRW:20.6%	NR		
Educa	ation level:	Fat Mean (SD): NR		
≥Colle	∍ge: 10.0%			
Mean (SD):	physical activity level 20.9 (12.9) METs h/d	Protein type/ source: Mixed		
Healt	۱ status/ Comorbidities:	Energy balance status:		
Poor	dental health: 39.0%	Eucaloric		
Chror	ic disease: 4.0%			
Media	ation use: NR	Study duration: 12 y		
Supp	ement use: NR	, , , , , , , , , , , , , , , , , , ,		
Pregr	ant or lactating: NR			
l ertil intake N: NF % Fe Mean Race, Meno Obes Mean kg/m² Incon ≥3,00 Educ: >Coll	3 3 (Women): Protein cut-offs NR Age (SD): 50.6 (8.1) y Ethnicity: NR pausal status: NR ty status: NR BMI (SD): 24.4 (2.9) ne level: 0,000 KRW: 19.5% ation level: arge: 10.1%			
≥Coli Mean (SD): Healt Poor Chror Media Supp	ige: 10.1% physical activity level 21.7 (13.1) METs- h/d 1 status/ Comorbidities: dental health: 40.9% ic disease: 3.0% iation use: NR ement use: NR			
Healt Poor Chror Medio Supp Pregr	i status/ Comorbidities: Jental health: 40.9% ic disease: 3.0% ation use: NR ement use: NR nant or lactating: NR			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
			assessment)	
PMID: 34124824 Wham	Study of: Adults Total sample N: 554	Arm 1: Māori women	Protein Assessment Method: Two times	Muscle Strength - Grip strength
2021 ⁸²		Baseline Protein Amount	multiple pass 24-hour	
Location/Country: New	Arm 1: Māori women	Median (IQR): 0.86 (0.64-	dietary recall.	Measure/Method of
Zealand	N: 116	1.11) g/kg/d	Nutrient intakes were	Assessment: Measured using
HDI: Very high	% Female: 57%	Carbohydrate Median (IQR):	calculated by coding all	handgrip dynamometer
Setting: Community	Mean Age (SD): 83.56 (2.62) y	NR	food and drinks using the	
dwelling	Race/ Ethnicity: NR	Fat Median (IQR): NR	New Zealand Food	
Urban/ Rural: NR	Menopausal status: NR		Composition Database.	
Study design: Prospective	Obesity status: NR	Protein Amount at the end of		
conort study	Mean BMI (SD): 28.86 (6.41)	the study		
Funding source:		Median (IQR): NR		
Government Dick of biog occurs, Uigh				
Risk of blas score: High	Education level: NR	NR Eat Madian (IOR): NR		
	(SD): 96.77 (87.23) PASE	rat median (IQR). NR		
	Health status/ Comorbidities:	Arm 2: Māori men		
	Rheumatoid arthritis: 28.6%			
	Osteoarthritis: 35.7%	Baseline Protein Amount		
	Asthma or chronic lung	Median (IQR): 0.97 (0.73-		
	disease: 34.8%	1.36) g/kg/d		
	Congestive heart failure:	Carbohydrate Median (IQR):		
	29.0%	NR		
	Diabetes: 29.8%	Fat Median (IQR): NR		
	Medication use: NR			
	Supplement use: NR	Protein Amount at the end of		
	Pregnant or lactating: NR	the study		
		Median (IQR): NR		
	Arm 2: Māori men	Carbohydrate Median (IQR):		
	N: 86	NR		
	% Female: 0%	Fat Median (IQR): NR		
	Mean Age (SD): 82.94 (2.65) y			
	Race/ Ethnicity: NR	Arm 3: Non-Maori women		
	Menopausal status: NA	Deseline Drotein Amerunt		
	Moon BML (SD): 28 68 (5.20)	Daseline Protein Amount		
	ka/m ² ka/m ² ka/m ²	1 13) g/kg/d		
	Income level: NR	Carbohydrate Median (IOR)		
	Education level: NR	NR		
	Mean physical activity level	Fat Median (IQR). NR		
	(SD): 111.65 (79.38) PASE			
	Health status/ Comorbidities:			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of	Outcome (Measures and methods of assessment)
	Bhoumataid arthritia: 10.1%	Dratain Amount at the and of	assessment)	
	Optoportbritio: 25.0%	the study		
	Asthma or obrania lung	Modion (IOP): NP		
	Astrina or chronic lung	Median (IQR). NR		
	disease: 38.8%			
	Congestive neart failure:			
	36.1%	Fat Median (IQR): NR		
	Diabetes: 23.3%	· · · · · ·		
	Medication use: NR	Arm 4: Non-Maori men		
	Supplement use: NR			
	Pregnant or lactating: NA	Baseline Protein Amount		
		Median (IQR): 0.97 (0.84-		
	Arm 3: Non-Māori women	1.18) g/kg/d		
	N: 183	Carbohydrate Median (IQR):		
	% Female: 52%	NR		
	Mean Age (SD): 85.55 (0.51) y	Fat Median (IQR): NR		
	Race/ Ethnicity: NR			
	Menopausal status: NR	Protein Amount at the end of		
	Obesity status: NR	the study		
	Mean BMI (SD): 26.81 (4.46)	Median (IQR): NR		
	kg/m ²	Carbohydrate Median (IQR):		
	Income level: NR	NR		
	Education level: NR	Fat Median (IQR): NR		
	Mean physical activity level			
	(SD): 78.55 (53.49) PASE	Protein type/ source: Mixed		
	Health status/ Comorbidities:			
	Rheumatoid arthritis: 13.1%	Energy balance status:		
	Osteoarthritis: 50.3%	Eucaloric		
	Asthma or chronic lung			
	disease: 29.5%	Study duration: 5 y		
	Congestive heart failure:			
	17.5%			
	Diabetes: 13.1%			
	Medication use: NR			
	Supplement use: NR			
	Pregnant or lactating: NR			
	Arm 1: Non-Māori men			
	N: 160			
	% Econolo: NA			
	70 Female. NA Moon Ago (SD): 85 56 (0.51) y			
	Pace/Ethnicity: NP			
	Menongueal status: NA			
	Menopausal status: NA			

Study	Participants	Intervention (s) (Content)	Intervention (s) (Methods (of assessment)	Outcome (Measures and methods of assessment)
	Obesity status: NR Mean BMI (SD): 26.66 (3.67) kg/m ² Income level: NR Education level: NR Mean physical activity level (SD): 94.37 (71.51) PASE Health status/ Comorbidities: Rheumatoid arthritis: 9.5% Osteoarthritis: 37.5% Asthma or chronic lung disease: 25.0% Congestive heart failure: 17.8% Diabetes: 13.6%			
	Medication use: NR Supplement use: NR Pregnant or lactating: NR			

Abbreviations: aBW = adjusted body weight; ALM = Appendicular lean mass; ASM = Appendicular skeletal muscle mass; ASMI = Appendicular skeletal muscle mass; as index; BIA = bioelectrical impedance analysis; BMI = body mass index; COPD = chronic obstructive pulmonary disease; cpm = counts per minute d = days; DXA = Dual-energy x-ray absorptiometry; FFQ = Food frequency questionnaire; g = gram; GS = Grip strength; h = hour; HDI = human development index; IQR = inter quartile range; kg = kilograms; kg/m² = kilograms per meters squared; LC n-3 PUFA = long chain n-3 polyunsaturated fatty acids; m = meters; METs = metabolic equivalents; min = minutes; ml = milligrams; MRI = magnetic resonance imaging; NA = not applicable; NR = not reported; nmol/L = nanomoles per liter; NR = not reported; PASE = Physical Activity Score for the Elderly; PMID = PubMed Identification Number; PUFA = polyunstaturated fatty acids; RCT = randomized controlled trial; RM: Rep maximum; RoB = Risk of Bias; SD = standard deviation; SE = standard error; SPPB = Short Physical Performance Battery; TUG = Timed-Up-and-Go; WHI = Women's Health Initiative; wk = week; w/o = without; y = year

Note: *Studies overlap KQs

Appendix D. Summary of the Basic Characteristics of All Eligible Studies

Key Question 1. What is the association between dietary protein intake and risk of bone disease?

Overview

Studies were mainly non-RCTs, with prospective cohort study design (22 of 31 studies).¹⁰⁻³¹ The remaining studies (N=9) were randomized controlled trials (RCT).¹⁻⁹ We present information on all eligible studies in the evidence tables in Appendix C.

RCT

Table D1 summarizes the characteristics of the RCT literature set. We identified 8 unique studies from 8 unique publications that examined the association between dietary protein intake and risk of bone disease bone in adults.^{1-7, 9} We identified one unique study that examined the association between dietary protein intake and risk of bone disease in children and adolescents.⁸ The earliest study that met the inclusion criteria was published in 2002.⁷ Studies were conducted in various countries, including three from the U.S.,^{2, 5, 6} two from Australia,^{4, 9} two from Denmark,^{7, 8} one from France,³ and one from Japan.¹ Adult study sample sizes ranged from 62² to 323.⁴ A large number of the adult studies (N=5) enrolled post-menopausal women^{1-4, 9}. Overall, five studies had high risk of bias and were not included in the analytic set.^{1, 2, 4, 6, 9} Four studies (3 low risk and 1 moderate risk of bias) were included in the analytic set.^{3, 5, 7, 8} One study had both low and high risk of bias based on the outcomes.⁵ We included that study in our analytic set and provide findings for the outcomes that had low risk of bias. We present information on the summary risk of bias assessments for all eligible studies in Appendix G.

Characteristic	Information (adults)	Information (children and adolescents)
Total studies	8 studies	1 study
U.S studies	3 studies	-
Non-U.S. studies	5 studies	1 study
Settings	Community dwelling: 6 studies Outpatient clinic: 1 study NR: 1 study	Community dwelling: 1 study
Study design	RCT (parallel): 8 studies	RCT (parallel): 1 study
Sex of study participants	Female only: 5 studies Female and Male: 3 studies	Female and Male: 1 study
Age range	31 to 74 years	6 to 8 years
Sample size range	62 to 323	200

Table D1. Basic characteristics of RCT literature set for risk of bone disease

Follow-up duration range	6 weeks – 2 years	24 weeks
Outcomes evaluated:	Bone Turnover Marker (Overall Turnover) – Osteocalcin: 4 studies Bone Formation Marker - BAP: 4 studies Bone Formation Marker - P1NP: 1 study Bone Resorption Marker - CTX: 2 studies Bone Resorption Marker – NTx: 1 study Bone Resorption Marker – TRAP: 1 study Bone Resorption Marker – TRAP: 1 study Bone Resorption Marker - Urinary excretion of deoxypyridinoline: 2 studies BMC of the Appendicular Skeleton (hip, total): 1 study BMC of the Appendicular Skeleton (femoral neck): 4 studies BMD of the Appendicular Skeleton (forearm, total): 2 studies BMD of the Appendicular Skeleton (forearm, total): 2 studies BMD of the Appendicular Skeleton (hip, total): 4 studies BMD of the Appendicular Skeleton (lumbar spine): 2 studies Total Body/Whole Body BMC (total body): 3 studies Total Body/Whole Body BMD (total body): 4 studies Bone Geometry and Strength Indices - Femoral neck cross- sectional area: 1 study Bone Geometry and Strength Indices - Femoral neck polar CCMI (crease acetisened mement of inertic): 1 study	Bone Turnover Marker (Overall Turnover) – Osteocalcin: 1 study BMC of the Axial Skeleton (lumbar spine): 1 study BMD of the Appendicular Skeleton z-score (lumbar spine): 1 study Bone Geometry and Strength Indices - Bone area (lumbar spine): 1 study
Menopausal status	Post-menopausal: 5 studies	N/A
	NR: 3 studies	
Risk of bias of all eligible	Low: 2 studies*	Low: 1 study
stuales	Moderate: 1 study High: 7 studies*	
Analytic set	3 studies	1 study

Abbreviations: BAP = bone specific alkaline phosphatase; BMC = bone mineral content; BMD = bone mineral density; CTX = C-terminal peptide of collagen; NA = not applicable; NR = not reported; NTx = N-teleopeptides of type I collagen; P1NP = procollagen type I N-terminal propertide; RCT = randomized controlled trial; TRAP = 5b, tartrate resistant acid phosphatase, isoform 5; U.S. = United States

*: One study had both low and high risk of bias based on the outcomes.

Non-RCT

Table D2 summarizes the characteristics of the non-RCT literature set for adult studies. We identified 22 unique studies from 22 unique publications that examined the association between dietary protein intake and risk of bone disease in adults.¹⁰⁻³¹ The earliest study that met the inclusion criteria was published in 2000.¹⁶ Studies were conducted in various countries, including thirteen studies from the U.S.,^{10-12, 16, 17, 20, 22, 24, 26, 28-31} three from Australia,^{15, 18, 23} two from China,^{13, 21} one from France,¹⁴ one from Canada,¹⁹ one from Mexico,²⁷ and one from Japan.²⁵ Study adult sample sizes ranged from 560¹⁰ to 144,580.¹¹ A large number of the studies (N=11)

described participants as post-menopausal women.^{11, 14, 15, 19, 23, 25-30} Twenty-one studies had high risk or very high risk of bias and were not included in the analytic set.^{10-26, 28-31} One study with moderate risk of bias was included in the analytic set.²⁷ We present information on the summary of risk of bias assessments for all eligible studies in Appendix G.

Characteristic	Information
Total studies	22 studies
U.S studies	13 studies
Non-U.S. studies	9 studies
Settings	Community dwelling: 13 studies
	NR: 9 studies
Sex of study participants	Female only: 9 studies
	Male only: 2 studies
	Female and Male: 11 studies
Age range	24 to 78 years
Sample size range	560 to 144,580
Follow-up duration range	1-17 years
Outcomes evaluated:	BMD of the Appendicular Skeleton (femoral neck): 7 studies
	BMD of the Appendicular Skeleton (hip, total): 13 studies
	BMD of the Appendicular Skeleton (intertrochanter): 1 study
	BMD of the Appendicular Skeleton (trochanter): 3 studies
	BMD of the Appendicular Skeleton - mean percent bone loss (hip): 1 study
	BMD of the Appendicular Skeleton - mean percent bone loss (radius): 1 study
	BMD of the Axial Skeleton (lumbar spine): 8 studies
	BMD of the Axial Skeleton - mean percent bone loss (spine): 1 study
	Total Body/Whole Body BMC (total body): 1 study
	Total Body/Whole Body BMD (total body): 4 studies
	Osteoporotic Fractures and Fracture Risk - Fragility fracture (osteoporotic and low trauma fracture):
	7 studies
	Osteoporotic Fractures and Fracture Risk - Hip fracture: 6 studies
	Osteoporotic Fractures and Fracture Risk - Spine fracture: 2 studies
	Osteoporotic Fractures and Fracture Risk - Forearm fracture: 1 study
Menopausal status	Pre-menopausal: 1 study
	Post-menopausal: 10 studies
	Pre and post-menopausal: 1 study
	NA: 2 studies
	NR: 8 studies
Risk of bias of all eligible studies	Moderate: 1 study
	High: 20 studies
	Very high: 1 study
Analytic set	1 study

Table D2. Basic Characteristics of non-RCT literature set for risk of bone disease: adults

Abbreviations: BMC = bone mineral content; BMD = bone mineral density; NA = not applicable; non-RCT = non-randomized controlled trial; NR = not reported; U.S. = United States

Key Question 2. What is the association between dietary protein intake and risk of kidney disease?

Overview

Studies were mainly non-RCTs, with prospective cohort study design (17 of 26 studies).³⁹⁻⁵⁵ The remaining studies used parallel (N=8) ^{5, 6, 32-34, 36-38} and crossover RCT (N=1)³⁵ study designs. We present information on all eligible studies in the evidence tables in Appendix C.

RCT

Table D3 summarizes the characteristics of the RCT literature set. We identified 9 unique studies from 9 unique publications that examined the association between dietary protein intake and risk of kidney disease.^{5, 6, 32-38} The earliest study that met the inclusion criteria was published in 2008.³³ Studies were conducted in various countries, including five from the U.S.,^{5, 6, 33-35} one from Australia,³⁸ one from Ireland,³⁶ one from Germany,³² and one from China.³⁷ Studies had sample sizes ranging from 52³⁷ to 378.³⁴ Eight studies had high risk of bias and were not included in the analytic set.^{5, 6, 32-37} One study with moderate risk of bias was included in the analytic set.³⁸ We present information on the summary risk of bias assessments for all eligible studies in Appendix G.

Characteristic	Information
Total studies	9 studies
U.S studies	5 studies
Non-U.S. studies	4 studies
Settings	Community dwelling: 7 studies
	Outpatient clinic: 1 study
	NR: 1 study
Study design	RCT (parallel): 8 studies
	RCT (cross over): 1 study
Sex of study participants	Male only: 1 study
	Female and Male: 8 studies
Age range	22 to >80 years (exact upper limit not reported)
Sample size range	52 to 378
Follow-up duration range	6 – 52 weeks
Outcomes evaluated:	Kidney Function – Serum creatinine: 5 studies
	Kidney Function – Creatinine clearance: 2 studies

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	Kidney Function – eGFR: 4 studies		
	Kidney Function – Blood urea nitrogen: 4 studies		
	Kidney Function – Urinary urea nitrogen: 2 studies		
	Kidney Function – Serum cystatin C: 2 studies		
	Kidney Function – Serum Beta-2-microglobulin: 1 study		
	Kidney Function – Urea clearance: 1 study		
	Kidney stones – Urine calcium: 2 studies		
	Proteinuria – Urinary albumin excretion: 1 study		
Menopausal status	NA: 1 study		
	NR: 8 studies		
Risk of bias of all eligible studies	Moderate: 1 study		
	High: 8 studies		
Analytic set	1 study		

Abbreviations: eGFR = estimated glomerular filtration rate; ESRD = end-stage renal disease; NA = not applicable; NR = not reported; RCT = randomized controlled trial; U.S. = United States

Non-RCT

Table D4 summarizes the characteristics of the non-RCT literature set. We identified 17 unique studies from 17 unique publications that examined the association between dietary protein intake and risk of kidney disease.³⁹⁻⁵⁵ The earliest study that met the inclusion criteria was published in 2003.⁴⁷ Studies were conducted in various countries, including five from the U.S.,^{43, 45, 47, 51, 52} three from Iran,^{39, 41, 55} two from South Korea,^{46, 49} two from Japan,^{48, 53} two from Netherlands,^{42, 44} one from Italy,⁴⁰ one from Singapore,⁵⁰ and one from China.⁵⁴ Studies had sample sizes ranging from 1624⁴⁷ to 127,220.⁵⁴ All seventeen studies had high risk or very high risk of bias and no non-RCT was included in the analytic set.³⁹⁻⁵⁵ We present information on the summary risk of bias assessments for all eligible studies in Appendix G.

Characteristic	Information	
Total studies	17 studies	
U.S studies	5 studies	
Non-U.S. studies	12 studies	
Settings	Community dwelling: 17 studies	
Sex of study participants	Female only: 1 study	
	Female and Male: 16 studies	
Age range	18 to 97 years	
Sample size range	1624 to 127220	
Follow-up duration range	3 – 25 years	
Outcomes evaluated:	Kidney Function – Incident CKD: 6 studies	
	Kidney Function – Incident ESRD: 2 studies	
	Kidney Function – eGFR: 8 studies	
	Kidney stones: 1 study	

Table D4. Basic characteristics of non-RCT literature set for risk of kidney disease

	Proteinuria – Presence of proteinuria: 1 study Hyperfiltration: 1 study
Menopausal status	NR: 17 studies
Risk of bias of all eligible studies	High: 12 studies
	Very high: 5 studies
Analytic set	0 studies

Abbreviations: eGFR = estimated glomerular filtration rate; ESRD = end stage renal disease; NA = not applicable; NR = not reported; non-RCT = non-randomized controlled; U.S. = United States

Key Question 3. What is the association between dietary protein intake and risk of sarcopenia?

Overview

Studies were mainly non-RCTs, with prospective cohort study design (19 of 35 studies).^{22, 23, 65-82} The remaining studies (N=16) used a parallel RCT study design.^{4, 5, 32, 33, 36-38, 56-64} We present information on all eligible studies in the evidence tables in Appendix C.

RCT

Table D5 summarizes the characteristics of the RCT literature set. We identified 16 unique studies from 16 unique publications that examined the association between dietary protein intake and risk of sarcopenia.^{4, 5, 32, 33, 36-38, 56-64} The earliest study that met the inclusion criteria was published in 2008.³³ Studies were conducted in various countries, including four from the U.S.,^{5, 33, 62, 63} three from Australia,^{4, 38, 64} one from New Zealand,⁵⁹ two from Germany,^{32, 57} two from China,^{37, 60} one from Netherlands,⁵⁶ one from Netherlands and Finland,⁶¹ one study from Iran,⁵⁸ and one from Ireland.³⁶ Studies had sample sizes ranging from 52⁶² to 323.⁴ A noticeable number of the studies (N=6) enrolled post-menopausal women.^{4, 56, 57, 62-64} Seven studies had a high risk of bias and were not included in the analytic set.^{4, 32, 33, 36, 37, 59, 63} Nine studies (seven low risk and two moderate risk of bias) were included in the analytic set.^{5, 38, 56-58, 60-62, 64} We present information on the summary risk of bias assessments for all eligible studies in Appendix G.

Table D5. Basic characteristics of RC	T literature set for risk of sarcopenia
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Characteristic	Information
Total studies	16 studies
U.S studies	4 studies
Non-U.S. studies	12 studies
Settings	Community dwelling: 14 studies
	Outpatient clinic: 1 study
	NR: 1 study
Study design	RCT (parallel): 16 studies

Sex of study participants	Female only: 7 studies			
	Male only: 1 study			
	Female and Male: 7 studies			
	NR: 1 study			
Age range	24 to 80 years			
Sample size range	52 to 323			
Follow-up duration range	11 weeks – 2 years			
Outcomes evaluated:	Muscle mass – Appendicular skeletal muscle index (ASMi): 4 studies			
	Muscle mass – Whole skeletal muscle mass estimated by BIA: 2 studies			
	Muscle mass – Total lean body mass estimated by DXA: 6 studies			
	Muscle mass – Total lean body mass estimated by BIA: 1 study			
	Muscle mass – Total lean body mass NR: 1 study			
	Muscle mass – Appendicular lean body mass / skeletal muscle mass estimated by DXA: 3 studies			
	Muscle mass – Fat Free Mass estimated by DXA: 2 studies			
	Muscle mass – Fat Free Mass estimated by BIA: 4 studies			
	Physical performance – Timed Up-and-Go (TUG) [Timed: start in sitting position, get up and walk 3-			
	meters, turn around come back and sit down]: 2 studies			
	Physical performance – 6-meter timed walk or 6-meter walking speed: 1 study			
	Physical performance – 6 min walking distance: 1 study			
	Physical performance – 4 m walk gait speed: 1 study			
	Physical performance – 40 m fast-paced walk test: 1 study			
	Physical performance – 400m walk speed: 3 studies			
	Physical performance – Gait speed assessment NR: 1 study			
	Muscle Strength – Handgrip strength: 8 studies			
	Muscle Strength – Leg/Knee extension (including 1-RM leg extension): 3 studies			
	Muscle Strength – Knee flexion: 1 study			
	Muscle Strength – 1-RM leg press: 1 study			
	Muscle Strength – Sum 1-RM strength: 1 study			
	Muscle Strength – Sum knee extension peak torque: 2 studies			
	Muscle Strength – Sum knee flexion peak torque: 2 studies			
	Muscle Strength – Chair stand test: 2 studies			
	Muscle Strength – 5 times sit-to-stand, 5-time chair rise test: 2 studies			
	Physical performance - SPPB (includes sit-to-stand test; 3- or 4-meter timed walk; balance): 5			
	studies			
Menopausal status	Post-menopausal: 6 studies			
	Pre-menopausal: 1 study			
	NA: 1 study			
	NR: 8 studies			
Risk of bias of all eligible studies	Low: 7 studies			
	Moderate: 2 studies			
	High: 7 studies			
Analytic set	9 studies			

Abbreviations: BIA = bioelectrical impedance analysis; DXA = dual-energy x-ray absorptiometry; m = meter; NA = not applicable; NR = not reported; RCT = randomized controlled trial; RM = repetition maximum; SPPB = Short physical performance battery; U.S. United States

Non-RCT

Table D6 summarizes the characteristics of the non-RCT literature set. We identified 20 articles reporting on 19 unique studies that examined the association between dietary protein intake and risk of sarcopenia.^{22, 23, 65-82} The earliest study that met the inclusion criteria was published in 2008.⁷² Studies were conducted in various countries, including four from the U.S.,^{22, 65, 68, 72} three from Canada,^{69, 71, 79} two from the UK,^{70, 77} two from Korea,^{74, 81} two from Australia,^{23, 80} two from China,^{66, 67} one from Finland,⁷³ one from Japan,⁷⁸ one from New Zealand,⁸² and one from multiple countries.⁷⁶ Studies had sample sizes ranging from 172⁷⁹ to 134,961.⁶⁵ A large number of the studies described participants as post-menopausal women (N=9).^{23, 65, 66, 68, 70, 72, 73, 75, 78} All nineteen studies had a high risk or very high risk of bias and no non-RCT was included in the analytic set.^{22, 23, 65-82} We present information on the summary risk of bias assessments for all eligible studies in Appendix G.

Characteristic	Information	
Total studies	19 studies	
U.S studies	4 studies	
Non-U.S. studies	15 studies	
Settings	Community dwelling: 13 studies	
	Mixed: 1 study	
	NR: 5 studies	
Sex of study participants	Female only: 3 studies	
	Male only: 0 studies	
	Female and Male: 16 studies	
Age range	36 to 86 years	
Sample size range	172 to 134,961	
Follow-up duration range	2 – 16 years	
Outcomes evaluated:	Muscle mass – Appendicular skeletal muscle mass index (ASMI): 1 study	
	Muscle mass – Skeletal muscle index (SMI): 1 study	
	Muscle mass – I otal lean body mass estimated by DXA: 5 studies	
	Muscle mass – I otal lean body mass estimated by BIA: 1 study	
	Nuscie mass – Appendicular lean body mass/ skeletal muscle mass estimated by DXA: 8 studies	
	Physical performance – Timed Up-and-Go (TUG) [Timed: start in sitting position, get up and walk 3-	
	Physical performance 6 meter timed welk or 6 meter welking anode 2 studies	
	Physical performance – Walk a 20 m course at their usual walking speed. 2 studies	
	Physical performance – Narrow walk speed: 1 study	
	Physical performance – Walking speed: 1 study	
	Muscle Strength – Handgrin strength: 9 studies	
	Muscle Strength – Leg/Knee extension (including 1-RM leg extension): 4 studies	
	Muscle Strength – Chair stand test: 4 studies	
Menopausal status	Post-menopausal: 9 studies	
	Pre and post-menopausal: 2 study	

	NR: 8 studies
Risk of bias of all eligible studies	High: 17 studies
	Very high: 2 studies
Analytic set	0 studies

Abbreviations: BIA = bioelectrical impedance analysis; CT = computerized tomography; DXA = dual-energy x-ray absorptiometry; MRI = magnetic resonance imaging; NA = not applicable; non-RCT = non-randomized controlled trial; NR = not reported; RM = repetition maximum; U.S. = United States

Appendix E. Results Tables for All Analyzed Studies

Table E1. Bone Disease RCT: Bone Turnover Marker-Overall Turnover (Adults)

Study	Statistics/Confounders adjusted for	Osteoclacin
PMID: 22357739 Author: Bonjour Study year: 2012 ³	Statistics: Pearson correlation coefficient Confounders adjusted for: None	Intervention: Treated group (test food - 13.8 g protein) Baseline: n analyzed: 36 M (SD): 25.9 (9.7) mg/L Follow-up (6 weeks): n analyzed: 36 Change in Osteocalcin M (SD): -0.39 (3.6) mg/L
		Comparator: Usual diet Baseline: n analyzed: 35 M (SD): 26.9 (9.6) mg/L Follow-up (6 weeks): n analyzed: 35 Change in Osteocalcin M (SD): 0.77 (3.4) Between group comparison and p-value: Not statistically difference from comparator (p>0.05)

Abbreviations: g = gram; M = mean; mg/L = milligrams per liter; n = number analyzed; PMID = PubMed Identification Number; RCT = randomized controlled trial; SD = standard deviation

Table E2. Bone Disease RCT: Bone Resorption Markers Outcome (Adults)

Study	Statistics/Confounders adjusted for	СТХ	TRAP
PMID: 22357739 Author: Bonjour Study year: 2012 ³	Statistics: Pearson correlation coefficient	Intervention: Treated group (test food - 13.8 g protein)	Intervention: Treated group (test food - 13.8 g protein)
	Confounders adjusted for: None	Baseline: n analyzed: 36 M (SD) 3.56 (1.6) nmol/L	Baseline: n analyzed: 36 M (SD) 5.49 (1.42) U/L

Study	Statistics/Confounders adjusted for	СТХ	TRAP
		Follow-up (6 weeks): n analyzed: 36 (Change in CTX): M (SD) -0.18 (0.70) nmol/L	Follow up (6 weeks): n analyzed: 36 (Change in TRAP): M (SD) -0.64 (0.56) U/L
		Comparator: Usual diet	Comparator: Usual diet
		Baseline: n analyzed: 35 M (SD) 3.56 (1.58) nmol/L	Baseline: n analyzed: 35 M (SD) 5.35 (1.38) U/L
		Follow up (6 weeks): n analyzed: 35 (Change in CTX) M (SD): 0.06 (0.85) nmol/L	Follow up (6 weeks): n analyzed: 35 (Change in TRAP): M (SD) -0.34 (0.59) U/L
		Between group comparison and p- value: Not statistically different from comparator (p>0.05) P=0.23	Between group comparison and p- value: Statistically different from comparator (p<0.05) P = 0.011

Abbreviations: CTX = carboxy terminal crosslinked telopeptide of type I collagen; g = gram; M = mean; n = number analyzed; nmol/L = nanomols per liter; PMID = PubMed Identification Number; RCT = randomized controlled trial; SD = standard deviation; TRAP = tartrate resistant acid phosphatase; U/L = Units per Liter;

Study	Statistics/Confounders adjusted for	BAP	P1NP
PMID: 22357739 Author: Bonjour Study year: 2012 ³	Statistics: Pearson correlation coefficient Confounders adjusted for: None	Intervention: Treated group (test food - 13.8 g protein) Baseline n analyzed: 36	Intervention: Treated group (test food - 13.8 g protein) Baseline n analyzed: 36
		M (SD) 11.3 (3.8) mg/L Follow-up (6 weeks): n analyzed: 36 M (SD) -1.2 (1.8) mg/L	M (SD) 52.0 (19.7) mg/L Follow-up (6 weeks): n analyzed: 36 M (SD) 0.25 (9.3) mg/L
		Comparator: Usual diet	Comparator: Usual diet
		Baseline:	Baseline:
		n analyzed: 35 M (SD) 10.8 (3.2) mg/L	n analyzed: 35 M (SD) 54.2 (20.3) mg/L

Study	Statistics/Confounders adjusted for	BAP	P1NP
		Follow-Up (6 weeks): n analyzed: 35 M (SD) -0.9 (1.2) mg/L Between group comparison and p-	Follow-up (6 weeks): n analyzed: 35 M (SD) 2.8 (10.8) mg/L Between group comparison and p-
		comparator (p>0.05)	comparator (p>0.05)

Abbreviations: BAP = bone specific alkaline phosphatase; g = gram; M = mean; mg/L = milligrams per liter; n = number analyzed; P1NP = procollagen type 1 N-terminal; PMID = PubMed Identification Number; RCT = randomized controlled trial; SD = standard deviation

Table L7. Dulle Disease IVT. Divid VI (ile Axial Skeletuli Vutculle (Auuits)
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Study	Statistics/Confounders adjusted for	Lumbar spine BMD
PMID: 25844619 Author: Kerstetter Study year: 2015 *5	Statistics: General linear mixed-models analysis Confounders adjusted for: gender, age, body composition, and baseline BMD, measures of bone turnover, 25(OH)D, eGFR, and 24-hour urinary urea	Intervention: High Protein (45g whey protein supplement isolate) Baseline: n analyzed: 105 M (SD) 1.09 (0.01) g/cm ² Follow-up (18 months): n analyzed: 92 M (SD) 1.10 (0.01) g/cm ² Comparator: Low Protein (carbohydrate (isocaloric maltodextrin control supplement) Baseline: n analyzed: 102 M (SD) 1.10 (0.01) g/cm ² Follow-up (18 months): n analyzed: 79 M (SD) 1.11 (0.02) g/cm ² Between group comparison and p-value: Not statistically different from comparator (p>0.05)
PMID: 12055318	Statistics: Mixed Regression Model [interaction]	Intervention: High protein diet (protein - 25%
Author: SKOV	Confoundary adjusted for: Distance adjust intel/a shanges in	or local energy)
	for moon	Pagalina:
	Tal mass	Baseline:

Study	Statistics/Confounders adjusted for	Lumbar spine BMD
		n analyzed: 25 M (SEM)
		Follow-up (6 months): n analyzed: 25 M (SEM)
		Comparator: Low protein diet (protein - 12% of total energy)
		Baseline: n analyzed: 25 M (SEM) 1.17 (0.01) g/cm ²
		Follow up (6 months): n analyzed: 25 M (SEM) 1.01 (0.03) g/cm ²
		Between group comparison and p-value: Not statistically different from comparator (p>0.05)

Abbreviations: 25(OH)D = 25-hydroxyvitamin D; BMD = bone mineral density; eGFR = estimated glomerular filtration rate; g/cm² = grams per centimeter squared; M = mean; n = number analyzed; PMID = PubMed Identification Number; RCT = randomized controlled trial; SD = standard deviation; SEM = standard error of the mean

Note: *Study overlaps KQs

Table E5. Bone Disease RCT: BMD of the Appendicular Skeleton Outcome (Adults)

Study	Statistics/Confounders adjusted for	Total hip BMD	Femoral neck BMD
PMID: 25844619 Author: Kerstetter Study year: 2015 * ⁵	Statistics: General linear mixed-models analysis	Intervention: High Protein (45g whey protein supplement isolate)	Intervention: High Protein (45g whey protein supplement isolate)
	Confounders adjusted for: gender, age, body composition, and baseline BMD, measures of bone turnover, 25(OH)D, eGFR, and 24-hour urinary urea	Baseline: n analyzed: 106 LSM (SEM) 0.89 (0.01) g/cm²	Baseline: n analyzed: 106 LSM (SEM) 0.81 (0.01) g/cm²
		Follow up (18 months): n analyzed: 92 LSM (SEM) 0.88 (0.01) g/cm ²	Follow up (18 months): n analyzed: 92 LSM (SEM) 0.80 (0.01) g/cm ²

Study	Statistics/Confounders adjusted for	Total hip BMD	Femoral neck BMD
		Comparator: Low Protein (carbohydrate (isocaloric maltodextrin control supplement)	Comparator: Low Protein (carbohydrate (isocaloric maltodextrin control supplement)
		Baseline: n analyzed: 102 LSM (SEM) 0.90 (0.01) g/cm²	Baseline: n analyzed: 102 LSM (SEM) 0.82 (0.01) g/cm²
		Follow up (18 months): n analyzed: 79 LSM (SEM) 0.89 (0.01) g/cm²	Follow up (18 months): n analyzed: 79 LSM (SEM) 0.82 (0.01) g/cm ²
		Between group comparison and p- value: Not statistically different from comparator (p>0.05),	Between group comparison and p- value: Not statistically different from comparator (p>0.05),

Abbreviations: BMD = bone mineral density; CI = confidence interval; DXA = dual x-ray absorptiometry; g/cm^2 = grams per centimeter squared; LSM = least square mean; n = number analyzed; PMID = PubMed Identification Number; SEM = standard error of the mean

Note: *Study overlaps KQs

Table E6. Bone Disease RCT: Total Body BMD and BMC Outcome (Adults)

Study	Statistics /Confounders adjusted for	Total body BMC	Total body BMD
PMID: 12055318	Statistics: Mixed Regression Model	Intervention: High Protein (45g	Intervention: High Protein (45g
Author: Skov		whey protein supplement isolate)	whey protein supplement isolate)
Study year: 2002 ⁷	Confounders adjusted for: Dietary calcium		
	intake, changes in fat mass		
		Baseline:	Baseline:
		n analyzed: 25	n analyzed: 25
		M (SEM) 2828 (71) g	M (SEM)
			1.17 (0.01)
		Follow up (6 months):	g/cm ²
		n analyzed: 25	
		M (SEM) 2713 (75) g	Follow up (6 months):
			n analyzed: 25
		Comparator: Low protein diet	M (SEM) 1.17 (0.01) g/cm ²
		(protein - 12% of total energy)	
			Comparator: Low protein diet
		Baseline:	(protein - 12% of total energy)
		n analyzed: 25	
		M (SEM) 2760 (72) g	Baseline:

Study	Statistics /Confounders adjusted for	Total body BMC	Total body BMD
		Follow up (6 months): n analyzed: 25 M (SEM) 2660 (75) g	n analyzed: 25 M (SEM) 1.18 (0.01) g/cm ²
		Between group comparison and p- value: Statistical difference from comparator(p<0.05)	Follow up (6 months): n analyzed: 25 M (SEM) 1.17 (0.01) g/cm ²
			Between group comparison and p- value: Not statistical different from comparator (p>0.05)

Abbreviations: BMC = bone mineral content; BMD = bone mineral density; DXA = dual x-ray absorptiometry; g = grams; $g/cm^2 = grams$ per centimeter squared; M = mean; n = number analyzed; PMID = PubMed Identification Number; RCT = randomized controlled trial; SEM = standard error of the mean

Table E7. Bone Disease Non-RCT: BMD of the Axial Skeleton Outcome (Ac	dults)
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Study	Statistics/ Confounders adjusted for	Lumbar spine BMD
PMID: 33847345 Author: Rivera-Paredez Study year: 2021 ²⁷	Statistics: Hybrid mixed-effects regression models Confounders adjusted for: energy intake (nutrients adjusted by the residual method) adjusted for: age (years), body mass index (kg/m ²), alcohol consumption (g/day), smoking status (non-smoker, smoker, ex-smoker) and leisure time physical activity (min/day)	Arm: Whole cohort Baseline: n Analyzed: NR* Mean (SD): 1.035 (0.171) g/cm²Follow-up (6.4 years): n Analyzed: 317 Mean (SD): 0.999 (0.893) g/cm²Comparator: NANot statistically different between subject associations (β, beta coefficient): $0.065 (95\%$ CI -0.063,0.194) (p>0.05) P = 0.32

Abbreviations: BMD = bone mineral density; $g/cm^2 = grams per square centimeter$; HR = hazard ratio; n = number analyzed; non-RCT = non-randomized controlled trial; NR = not reported; OR = odds ratio; PMID = PubMed Identification Number; RoB = Risk of Bias; RR = relative risk; SD = standard deviation

Note: *42% of the total postmenopausal women evaluated in the second wave of the study

Study	Statistics/Confounders adjusted for	Total hip BMD	Femoral neck BMD
PMID: 33847345 Author: Rivera-Paredez Study year: 2021 ²⁷	Statistics: Hybrid mixed-effects regression models Confounders adjusted for: energy intake (nutrients adjusted by the residual method) adjusted for: age (years), body mass index (kg/m2), alcohol consumption (g/day), smoking status (non-smoker,	Arm: Whole cohort Baseline: n Analyzed: NR* Mean (SD): 0.959 (0.140) g/cm ² Follow-up (6.4 years): n Analyzed: 317 Mean (SD): 0.917 (0.137) g/cm ²	Arm: Whole cohort Baseline: n Analyzed: NR* Mean (SD): 0.921 (0.135) g/cm ² Follow-up (6.4 years): n Analyzed: 317 Mean (SD): 0.873 (0.127) g/cm ²
	smoker, ex-smoker) and leisure time physical activity (min/day)	Comparator: NA Not statistically different between subject associations (β, beta coefficient): 0.101 (95% CI -0.017,0.219) (p>0.05) P =0.09	Comparator: NA Statistical difference between subject associations (β , beta coefficient): 0.124 (95% CI 0.010, 0.237). (p<0.05) P = 0.03

Table E8. Bone Disease Non-RCT: BMD of the Appendicular Skeleton Outcome (Adults)

Abbreviations: BMD = bone mineral density; $CI = confidence interval; g/cm^2 = grams per square centimeter; HR = hazard ratio; n = number analyzed; NA = not applicable; non-RCT = non-randomized controlled trial; NR = not reported; OR = odds ratio; PMID = PubMed Identification Number; RoB = Risk of Bias; RR = relative risk; SD = standard deviation$

Note: *42% of the total postmenopausal women evaluated in the second wave of the study

Study	Statistics /Confounders adjusted for	Osteocalcin
PMID: 34581765 Author: Stounbjerg Study year: 2021 ⁸	Statistics: 2-way ANCOVA Confounders adjusted for: gender, age, puberty, BMI and Vitamin D tablet group	Intervention 1: Placebo-HP (placebo plus drained low-fat yogurt with a high protein content of 9-11 g protein/100 g) Baseline: n analyzed: 33-34 M (SD): 38.3 (9.1) μg/L Follow up (24 weeks): n analyzed: 33-34 M (SD): 38.3 (9.1) μg/L

Table E9. Bone Disease RCT: Bone Turnover Marker-Overall Turnover Outcome (Children and Adolescents)

Study	Statistics /Confounders adjusted for	Osteocalcin
		Intervention 2: Vitamin D-HP (vitamin D plus drained low-fat yogurt with a high protein content of 9-11 g protein/100 g)
		Baseline: n analyzed: 39-41 Μ (SD): 37.1 (10.8) μg/L
		Follow up (24 weeks): n analyzed: 39-41 M (SD): 38.2 (10.0) µg/L
		Comparator 1: Placebo-NP (placebo plus regular yogurt with a normal protein content of 3.0-3.9 g protein/100 g)
		Baseline: n analyzed: 36 Μ (SD): 38.1 (11.9) μg/L
		Follow up (24 weeks): n analyzed: 36 Μ (SD): 5.3 (8.5) μg/L
		Comparator 2: Vitamin D-NP (vitamin D plus regular yogurt with a normal protein content of 3.0-3.9 g protein/100 g)
		Baseline: n analyzed: 38-41 Μ (SD) 37.1 (9.5) μg/L
		Follow up (24 weeks): n analyzed: 38-41 M (SD): 39.8 (9.8) µg/L

Study	adjusted for	Osteocalcin
		Between group comparison and p-value: Statistically different from comparator P = 0.017

Abbreviations: ANCOVA = analysis of covariance; g = gram; HP = normal protein; M = mean; n = number analyzed; NP = normal protein; PMID = PubMed Identification Number; RCT = randomized controlled trial; SD = standard deviation; $\mu g/L$ = micro grams per liter

Note: The 2 high protein intake arms were combined by the study authors for the analyses of their study findings; and the 2 normal protein intake arms findings reports were also combined by the study authors for the analyses of their study findings

Study	Statistics/Confounders adjusted	Lumbar spine (L1–L4)	Lumbar spine (L1–L4)	Lumbar spine (L1–L4)
PMID: 34581765 Author: Stounbjerg Study year: 2021 ⁸	Statistics: 2-way ANCOVA Confounders adjusted for: gender, age, puberty, BMI and Vitamin D tablet group	Intervention 1: Placebo-HP (placebo plus drained low- fat yogurt with a high protein content of 9-11 g protein/100 g)	Intervention 1: Placebo-HP (placebo plus drained low- fat yogurt with a high protein content of 9-11 g protein/100 g)	Intervention 1: Placebo-HP (placebo plus drained low- fat yogurt with a high protein content of 9-11 g protein/100 g)
		Baseline: n analyzed: 45 M (SD): 0.681 (0.074) g/cm²	Baseline: n analyzed: 45 M (SD): 0.056 (0.807)	Baseline: N analyzed: 45 M (SD): 21.5 (4.4) g
		Follow up (24 weeks): n analyzed: 45 M (SD): 0.681 (0.074) g/cm²	Follow up (24 weeks): n analyzed: 45 M (SD): 0.056 (0.807)	Follow up (24 weeks): n analyzed: 45 M (SD): 21.5 (4.4) g
		Intervention 2: Vitamin D- HP (vitamin D plus drained low-fat yogurt with a high protein content of 9-11 g protein/100 g)	Intervention 2: Vitamin D- HP (vitamin D plus drained low-fat yogurt with a high protein content of 9-11 g protein/100 g)	Intervention 2: Vitamin D- HP (vitamin D plus drained low-fat yogurt with a high protein content of 9-11 g protein/100 g)
		Baseline: n analyzed: 49 M (SD): 0.682 (0.084) g/cm ²	Baseline: n analyzed: 49 M (SD): 0.077 (0.955)	Baseline: n analyzed: 49 M (SD): 21.8 (4.2) g
		Follow up (24 weeks): n analyzed: 49 M (SD): 0.692 (0.082) g/cm ²	Follow up (24 weeks): n analyzed: 49 M (SD): 0.066 (0.908)	Follow up (24 weeks): n analyzed: 49 M (SD): 23.2 (4.3) g
		Comparator 1: Placebo-NP (placebo plus regular yogurt with a normal protein	Comparator 1: Placebo-NP (placebo plus regular yogurt with a normal protein	Comparator 1: Placebo-NP (placebo plus regular yogurt with a normal protein

Table E10. Bone Disease RCT: BMD and BMC of the Axial Skeleton Outcome (Children and Adolescents)

Study	Statistics/Confounders adjusted for	Lumbar spine (L1–L4) BMD	Lumbar spine (L1–L4) zscore BMD	Lumbar spine (L1–L4) BMC
		content of 3.0-3.9 g	content of 3.0-3.9 g	content of 3.0-3.9 g
		protein/100 g)	protein/100 g)	protein/100 g)
		Baseline:	Baseline:	Baseline:
		n analyzed: 44 M (SD): 0.691 (0.078) g/cm²	n analyzed: 44 M (SD): 0.152 (0.918)	n analyzed: 44 M (SD): 22.4 (4.6) g
		Follow up (24 weeks): n analyzed: 44 M (SD): 0.702 (0.086) g/cm²	Follow up (24 weeks): n analyzed: 44 M (SD): 0.145 (0.980)	Follow up (24 weeks): n analyzed: 44 M (SD): 23.8 (5.2) g
		Comparator 2 : Vitamin D- NP (vitamin D plus regular yogurt with a normal protein content of 3.0-3.9 g protein/100 g)	Comparator 2: Vitamin D- NP (vitamin D plus regular yogurt with a normal protein content of 3.0-3.9 g protein/100 g)	Comparator 2: Vitamin D- NP (vitamin D plus regular yogurt with a normal protein content of 3.0-3.9 g protein/100 g)
		Baseline: n analyzed: 46 M (SD): 0.679 (0.074) g/cm²	Baseline: n analyzed: 46 M (SD): 0.022 (0.836)	Baseline: n analyzed: 46 M (SD): 22.3 (4.1) g
		Follow up (24 weeks): n analyzed: 46 M (SD): 0.695 (0.078) g/cm²	Follow up (24 weeks): n analyzed: 46 M (SD): 0.073 (0.852)	Follow up (24 weeks): n analyzed: 46 M (SD): 23.6 (4.5) g
		Between group comparison and p-value: Statistically different from comparator P = 0.027	Between group comparison and p-value: Statistically different from comparator P = 0.026	Between group comparison and p-value: Not statistically different from comparator P = 0.944

Abbreviations: ANCOVA = analysis of covariance; BMC = bone mineral content; BMD = bone mineral density; g = grams; $g/cm^2 = grams$ per centimeter squared; HP = high protein; M = mean; n = number analyzed; NP = normal protein; PMID = PubMed Identification Number; RCT = randomized controlled trial; SD = standard deviation

Note: The 2 high protein intake arms were combined by the study authors for the analyses of their study findings; and the 2 normal protein intake arms findings reports were also combined by the study authors for the analyses of their study findings.

Table E11. Bone Disease RCT: Bone Geome	v and Strength Indices Outcome	(Children and Adolescents)
	J	

Study	Statistics /Confounders adjusted for	BA lumbar spine (L1–L4)
PMID: 34581765	Statistics 2-way ANCOVA	Intervention 1: Placebo-HP (placebo plus
Author: Stounbjerg		drained low-fat yogurt with a high protein
Study year: 2021 ⁸		content of 9-11 g protein/100 g)

Study Statistics /Confounders adjusted for		BA lumbar spine (L1–L4)
	Confounders adjusted for: gender, age, puberty, BMI and Vitamin D tablet group	Baseline: n analyzed: 45 M (SD): 1.3 (4.2) cm ²
		Follow up (24 weeks): n analyzed: 45 M (SD): 1.3 (4.2) cm ²
		Intervention 2: Vitamin D-HP (vitamin D plus drained low-fat yogurt with a high protein content of 9-11 g protein/100 g) Baseline: n analyzed: 49 M (SD): 31.9 (3.7) cm ²
		Follow up (24 weeks): n analyzed: 49 M (SD): 33.3 (3.8) cm ²
		Comparator 1: Placebo-NP (placebo plus regular yogurt with a normal protein content of 3.0-3.9 g protein/100 g) Baseline: n analyzed: 44 Mean (SD): 32.2 (3.8) cm ²
		Follow up (24 weeks): n analyzed: 44 M (SD): 33.8 (4.3) cm²
		Comparator 2 : Vitamin D-NP (vitamin D plus regular yogurt with a normal protein content of 3.0-3.9 g protein/100 g) Baseline: n analyzed: 46 M (SD): 32.7 (3.4) cm ²
		Follow up (24 weeks): n analyzed: 46 M (SD): 33.8 (3.6) cm ²
		Between group comparison and p-value: Not statistically different from comparator $P = 0.133$

Abbreviations: BA = bone area; BMI = body mass index; n = number analyzed; ANCOVA = analysis of covariance; cm² = centimeter squared; g = gram; HP = high protein; M = mean; NP = normal protein; PMID = PubMed Identification Number; SD = standard deviation

Note: The 2 high protein intake arms were combined by the study authors for the analyses of their study findings; and the 2 normal protein intake arms findings reports were also combined by the study authors for the analyses of their study findings.

Study	Statistics/Confounders adjusted for	Creatinine clearance
PMID: 22406907 Author Wycherley	Statistics: Intention-to-treat - maximal likelihood mixed model analysis with fixed and random effects	Intervention: High Protein (35% energy from protein) Baseline:
Study Year 2012 * ³⁸	Confounders adjusted for: NR	n Analyzed: 58** Mean (SD): NR
		Follow up: n Analyzed: 58** Mean (SD): NR
		Comparator: Low protein (high carbohydrate - 17% energy from protein) Baseline: n Analyzed: 62** Mean (SD): NR
		Follow up: n Analyzed: 62** Mean (SD): NR
		Between group comparison and p-value Not statistically different from comparator P = 0.55

Tahlo E12 K	idnov Disoaso	RCT. Kid	nev Function	Outcome
I able E 12. R	lulley Disease		ley Function	Outcome

Abbreviations: n = number analyzed; NR = not reported; PMID = PubMed Identification Number; SD = standard deviation

Note: *Study overlaps KQs; ** Baseline characteristics were presented for participants who completed the 52-week intervention; but intention-to-treat evaluation was conducted for the full sample.

Table E13. Sarcopenia RCT: Muscle mass Outcome

Study	Statistics/ Confounders adjusted for	Total body lean mass	Appendicular lean mass/ skeletal muscle mass	Appendicular skeletal muscle index (ASMi)	Whole skeletal Muscle Mass	Fat free mass (FFM)
PMID: 26471344 Author: Backx Year: 2016 ⁵⁶	Statistics: ANCOVA Cofounders	Intervention: High protein diet (contain 1.7 g of protein/kg/day) Baseline:	Intervention: High protein diet (contain 1.7 g of protein/kg/day) Baseline:	-	-	-

Study	Statistics/ Confounders adjusted for	Total body lean mass	Appendicular lean mass/ skeletal muscle mass	Appendicular skeletal muscle index (ASMi)	Whole skeletal Muscle Mass	Fat free mass (FFM)
	BMI, gender, age, fasting glucose	Mean (SD): 54.8 (12.2) kg	Mean (SD): 23.8 (5.5) kg			
	giuceee	Follow-up (12 weeks): N Analyzed: NR Mean (SD): 53.1 (11.4) kg	Follow-up (12 weeks): N Analyzed: NR Mean (SD): 23.1 (5.4) kg			
		Comparator : Normal Protein diet (contain 0.9 g protein/kg/day) Baseline: n Analyzed: 30 Mean (SD): 54.5 (9.3) kg	Comparator : Normal Protein diet (contain 0.9 g protein/kg/day) Baseline: n Analyzed: 30 Mean (SD): 23.8 (4.8) kg			
		Follow-up (12 weeks): n Analyzed: NR Mean (SD): 52.4 (9.1) kg	Follow-up (12 weeks): n Analyzed: NR Mean (SD): 22.8 (4.6) kg			
		Between group comparison and p-value: Not statistically different from comparator P = 0.219	Between group comparison and p-value: Not statistically different from comparator P = 0.122			
PMID: 33975325 Author: Englert Year: 2021 ⁵⁷	Statistics: T- test Confounders adjusted for: NR	-	-	-	-	Intervention: High Protein (1.5 g/kg body weight/day) Baseline: n Analyzed: 27 Mean (SD): 46.8 (6.9) kg
						Follow-up (12 weeks): n Analyzed: 27 Mean (SD) (Change at 12 weeks): -0.9 (1.1) kg

Study	Statistics/ Confounders adjusted for	Total body lean mass	Appendicular lean mass/ skeletal muscle mass	Appendicular skeletal muscle index (ASMi)	Whole skeletal Muscle Mass	Fat free mass (FFM)
						Comparator: Normal Protein (0.8 g/kg body weight/day) Baseline: n Analyzed: 27 Mean (SD): 46.7 (5.0) kg Follow-up (12 weeks) n Analyzed: 27 Mean (SD) (Change at 12 weeks): -1.0 (1.3) kg Between group comparison and p- value: Not statistically different from comparator P =
PMID: 34208986 Author: Haghighat Year: 2021 ⁵⁸	Statistics: ANCOVA Confounders adjusted for: NR	-	-	-	Intervention: High protein (high protein snack (50g of soybeans, protein: 18.2 g)) Baseline: n Analyzed: 60 NR Follow-up (6 months): n Analyzed: 52 Mean increase 1.2 kg (95% Cl=1.5 to 1)	-

Study	Statistics/ Confounders	Total body lean mass	Appendicular lean mass/ skeletal muscle	Appendicular skeletal muscle index (ASMi)	Whole skeletal	Fat free mass (FFM)
	adjusted for		mass		Muscle Mass	()
					Comparator: Low protein (~3.5 servings of fruit, protein: <2 g) Baseline: n Analyzed: NR NR	
					Follow-up (6 months): n Analyzed: 55 Mean increase 0.3 kg (95% CI=0.7 to 0.02)	
					Between group comparison and p-value: Statistically different from comparator (p<0.001)	
PMID: 25844619 Author: Kerstetter Year: 2015 *5	Statistics: General linear mixed-models analysis Confounders adjusted for: gender, age, body composition, and baseline BMD, measures of bone turnover, 25(OH)D, eGER, and 24	Intervention: High Protein (45g whey protein supplement isolate: 40 g of protein) Baseline: n Analyzed: 105 Mean (SEM): 42.6 (0.8) kg Follow-up (18 months): n Analyzed: 105 Mean (SEM): 42.6 (0.8) kg	_			-

Study	Statistics/ Confounders adjusted for	Total body lean mass	Appendicular lean mass/ skeletal muscle mass	Appendicular skeletal muscle index (ASMi)	Whole skeletal Muscle Mass	Fat free mass (FFM)
	hour urinary urea	Comparator : Low Protein (carbohydrate - isocaloric maltodextrin control supplement) Baseline: n Analyzed: 102 Mean (SEM): 42.0 (0.8) kg				
		Follow-up (18 months): n Analyzed: 102 Mean (SEM): 41.5 (0.8) kg				
		Between group comparison and p-value: Not statistically different from comparator P = 0.069)				
PMID: 33612439 Author: Li Year: 2021 ⁶⁰	Statistics: ANCOVA Confounders adjusted for: Sex, age, height, physical activity level, total dietary energy intake	Intervention 1: Whey Protein (whey protein blended supplement twice daily: 7.98 g protein per supplement) Baseline: n Analyzed: 31 Mean (SD): 34.96 (6.75) kg Follow-up (6 months): n Analyzed: 31 Mean (SD): 35.13 (6.4) kg	Intervention 1: Whey Protein (whey protein blended supplement twice daily: 7.98 g protein per supplement) Baseline: n Analyzed: 31 Mean (SD): 14.47 (3.34) kg Follow-up (6 months): n Analyzed: 31 Mean (SD): 14.62 (3.10) kg	Intervention 1: Whey Protein (whey protein blended supplement twice daily: 7.98 g protein per supplement) Baseline: n Analyzed: 31 Mean (SD): 5.70 (0.92) kg/m ² Follow-up (6 months): n Analyzed: 31 Mean (SD): 5.76 (0.81)	-	-
		Intervention 2: Soy protein (soy protein blended supplement twice daily: 8.80 g protein per supplement) Baseline: n Analyzed: 31	Intervention 2: Soy protein (soy protein blended supplement twice daily: 8.80 g protein per supplement) Baseline: n Analyzed: 31	kg/m ² Intervention 2: Soy protein (soy protein blended supplement twice daily: 8.80 g protein per supplement) Baseline:		

Study	Statistics/ Confounders adjusted for	Total body lean mass	Appendicular lean mass/ skeletal muscle mass	Appendicular skeletal muscle index (ASMi)	Whole skeletal Muscle Mass	Fat free mass (FFM)
		Mean (SD): 34 66 (6.83)	Mean (SD): 14 46 (3 27)	n Analyzed: 31	macore maco	
		kg	kg	Mean (SD): 5.62 (0.83) kg/m ²		
		Follow-up (6 months): n Analyzed: 31 Mean (SD): 34.84 (6.78) kg	Follow-up (6 months): n Analyzed: 31 Mean (SD): 14.54 (3.27) kg	Follow-up (6 months): n Analyzed: 31 Mean (SD): 5.65 (0.84) kg/m ²		
		Intervention 3: Whey- Soy protein group (1:1 ratio of whey and soy blended supplement: 8.39 g protein per supplement) Baseline: n Analyzed: 31 Mean (SD): 35.49 (6.49) kg	Intervention 3: Whey- Soy protein group (1:1 ratio of whey and soy blended supplement: 8.39 g protein per supplement) Baseline: n Analyzed: 31 Mean (SD): 15.07 (3.33) kg	Intervention 3: Whey- Soy protein group (1:1 ratio of whey and soy blended supplement: 8.39 g protein per supplement) Baseline n Analyzed: 31 Mean (SD): 5.68 (0.81) kg/m ²		
		n Analyzed: 31 Mean (SD): 35.77 (6.57) kg	n Analyzed: 31 Mean (SD): 15.26 (3.38) kg	Follow-up (6 months): n Analyzed: 31 Mean (SD): 5.75 (0.80) kg/m ²		
		Comparator 1: Control (no supplementation) Baseline: n Analyzed: 30 Mean (SD): 33.79 (6.17) kg	Comparator 1: Control (no supplementation) Baseline: n Analyzed: 30 Mean (SD): 14.13 (3.03) kg	Comparator 1: Control (no supplementation) Baseline: n Analyzed: 30 Mean (SD): 5.65 (0.84) kg/m ²		
		Follow-up (6 months): n Analyzed: 30 Mean (SD): 33.32 (6.0) kg	Follow-up (6 months): n Analyzed: 30 Mean (SD): 13.76 (2.98) kg	Follow-up (6 months): n Analyzed: 30 Mean (SD): 5.50 (0.81) kg/m ²		
		Between group comparison and p-value: Statistically different from comparator (p<0.05)	Between group comparison and p-value: Statistically different from comparator (p<0.05)	Between group comparison and p-value: Statistically different from comparator (p<0.001)		

Study	Statistics/ Confounders	Total body lean mass	Appendicular lean	Appendicular skeletal muscle index (ASMi)	Whole skeletal	Fat free mass (FFM)
	adjusted for		mass		Muscle Mass	(,
PMID: 34609621 Author: Reinders Year: 2022 ⁶¹	Statistics: Linear regression model Confounders adjusted for: Residual confounding checked for baseline 400 m walk time, baseline protein intake, sex, and study site	-	-	-	-	Intervention: Protein advice (advised to increase protein intake to ≥1.2 g/kg aBW/d) Baseline: n Analyzed: 96 Mean (SE): 52.0 (1.06) kg Follow-up (6 months): n Analyzed: 96 Mean (SE): 52.6 (1.15) kg
						Comparator: Control (no advice to increase protein consumption) Baseline: n Analyzed: 91 Mean (SE): 51.8 (0.97) kg
						Follow-up (6 months): n Analyzed: 91 Mean (SE): 52.1 (0.99) kg
						Between group comparison and p- value: Not statistically different from comparator (p>0.05)
PMID: 29687650 Author: Smith Year: 2018 ⁶²	Statistics: Linear mixed model	Intervention: Weight loss plus whey protein supplement (hypocaloric	-	-	-	Intervention: Weight loss plus whey protein

Study	Statistics/ Confounders adjusted for	Total body lean mass	Appendicular lean mass/ skeletal muscle mass	Appendicular skeletal muscle index (ASMi)	Whole skeletal Muscle Mass	Fat free mass (FFM)
	Confounders adjusted for: NR	diet with increased protein intake 1.2 g/kg/d) Baseline: n Analyzed: 25 Mean (SEM): 44.4 (1.0) kg Follow-up (6 months): n Analyzed: 25 Mean (SEM): 43.3 (1.0) kg Comparator : Weight loss plus recommended protein Baseline: n Analyzed: 27 Mean (SEM): 45.7 (0.9) kg Follow-up (6 months): n Analyzed: 27 Mean (SEM): 44.2 (1.0) kg Between group comparison and p-value: Not statistically different from comparator (p>0.05)				supplement (hypocaloric diet with increased protein intake 1.2 g/kg/d) Baseline: n Analyzed: 25 Mean (SEM): 46.9 (1.0) kg Follow-up (6 months): n Analyzed: 25 Mean (SEM): 45.8 (1.0) kg Comparator: Weight loss plus recommended protein (hypocaloric diet with 0.8 g/kg/d protein) Baseline: n Analyzed: 27 Mean (SEM): 48.2 (1.0) kg Follow-up (6 months): n Analyzed: 27 Mean (SEM): 48.7 (1.0) kg Between group
						comparison and p- value: Not statistically different from comparator (p>0.05)

Study	Statistics/ Confounders	Total body lean mass	Appendicular lean mass/ skeletal muscle	Appendicular skeletal muscle index (ASMi)	Whole skeletal	Fat free mass (FFM)
	adjusted for		mass		Muscle Mass	
PMID: 22406907 Author: Wycherley Year: 2012 * ³⁸	Statistics: Intention-to- treat - maximal likelihood mixed model analysis with fixed and random effects Confounders	-	-	-	-	Intervention: High Protein (35% energy from protein) Baseline: n Analyzed: 58** Mean (SD): NR Follow-up (52 weeks):
	NR					Mean (SD): NR
						Comparator: Low Protein (high carbohydrate - 17% energy from protein) Baseline: n Analyzed: 62** Mean (SD): NR
						Follow-up (52 weeks): n Analyzed: 62** Mean (SD): NR
						Between group comparison and p- value: Not statistically different from comparator P = 0.17
PMID: 26400966 Author: Zhu Year: 2015 ⁶⁴	Statistics: Linear mixed- effects model analysis Confounders adjusted for: NR	-	Intervention: High Protein (supplement drink - 30 g of protein per day) Baseline: n Analyzed: 101 Mean (SD): 16.2 (2.4) kg	Intervention: High Protein (supplement drink - 30 g of protein per day) Baseline: n Analyzed: 101 Mean (SD): 6.3 (0.7) kg/m ²	-	-
Study	Statistics/ Confounders adjusted for	Total body lean mass	Appendicular lean mass/ skeletal muscle mass	Appendicular skeletal muscle index (ASMi)	Whole skeletal Muscle Mass	Fat free mass (FFM)
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			Follow-up (2 years): n Analyzed: 93 Mean (SEM) (Change at 2 y): -0.03 (0.07) kg	Follow-up (2 years): n Analyzed: 93 Mean (SEM) (Change at 2 y): 0.02 (0.03) kg/m ²		
			Comparator: Placebo supplement (high- carbohydrate drink supplement drink - 2.1 g of protein per day) Baseline: n Analyzed: 95 Mean (SD): 16.6 (2.4) kg	Comparator: Placebo supplement (high- carbohydrate drink supplement drink - 2.1 g of protein per day) Baseline: n Analyzed: 95 Mean (SD): 6.5 (0.8) kg/m ²		
			Follow-up (2 years): n Analyzed: 88 Mean (SEM) (Change at 2 y): 0.03 (0.08) kg	Follow-up (2 years): n Analyzed: 88 Mean (SEM) (Change at 2 y): 0.05 (0.03) kg/m ²		
			Between group comparison and p-value: Not statistically different from comparator (p>0.05)	Between group comparison and p-value: Not statistically different from comparator (p>0.05)		

Abbreviations: aBW = adjusted body weight; ANCOVA = analysis of covariance; ASMi = appendicular skeletal muscle index; BMI = body mass index; d = day; FFM = fat free mass; g = gram; kg = kilogram; kg/m² = kilograms per square meter; M = meter; n = number analyzed; NR = not reported; PMID = PubMed identification number; SD = standard deviation; SE = standard error; SEM = standard error of the mean

Note: *Study overlaps KQs; ** Baseline characteristics were presented for participants who completed the 52-week intervention; but intention-to-treat evaluation was conducted for the full sample.

 Table E14. Sarcopenia RCT: Muscle strength Outcome

Study	Statistics/ Confounder	Handgrip strength	1-RM leg press	Knee flexor strength	Leg extensor	Sum 1-RM strength	Sum knee extension	Sum knee flexion peak	Chair Stand
	s adjusted for				strength	(sum of leg press. knee	peak torque	torque	
						extension,			
						and knee flexion)			
PMID:	Statistics:	Intervention:	Intervention:	-	1-RM leg	-	-	-	-
2647134 1	ANCOVA	High protein	High protein		extension				
Author:	Cofounders	g of	1.7 g of		Intervention:				
Backx	adjusted for:	protein/kg/day)	protein/kg/da		High protein				
Year:	BMI, gender,	Baseline:	y) Deceline:		diet (contain				
2010	age, lasting dlucose	Mean (SD): 40	n Analvzed:		protein/kg/da				
	9.00000	(11) kg	28		y)				
			Mean (SD):		Baseline:				
		Follow-up:	152 (44) kg		n Analyzed:				
		Mean (SD): 37	Follow-up:		Mean (SD):				
		(9) kg `´´	n Analyzed:		93 (31) kǵ				
		Comparatory	28 Moon (SD):		Follow				
		Normal Protein	143 (39) kg		n Analyzed:				
		diet (contain 0.9			27				
		g	Comparator:		Mean (SD):				
		protein/kg/day) Baseline:	Normal Protein diet		91 (29 kg				
		n Analyzed: 30	(contain 0.9 g		Comparator:				
		Mean (SD): 41	protein/kg/da		Normal				
		(10) kg	y) diet		Protein diet				
		Follow-up:	n Analvzed:		protein/kg/da				
		n Analyzed: 30	25		y)				
		Mean (SD): 40	Mean (SD):		Baseline:				
		(тт) кд	157 (33) Kg		n Analyzed: 26				
		Between group	Follow-up:		Mean (SD):				
		comparison and	n Analyzed:		98 (25) kg				
		p-value: Not	25 Mean (SD):		Follow-up:				
		different from	148 (30) ka		n Analvzed:				
					26				

Study	Statistics/ Confounder s adjusted for	Handgrip strength	1-RM leg press	Knee flexor strength	Leg extensor strength	Sum 1-RM strength (sum of leg press, knee extension, and knee flexion)	Sum knee extension peak torque	Sum knee flexion peak torque	Chair Stand
		comparator P = 0.210)	Between group comparison and p-value: Not statistically different from comparator P = 0.689		Mean (SD): 94 (25) kg Between group comparison and p-value: Not statistically different from comparator P = 0.296				
PMID: 3397532 5 Author: Englert Year: 2021 ⁵⁷	Statistics: T- test Confounders adjusted for: NR	Intervention: High Protein (1.5 g/kg body weight/day) Baseline: n Analyzed: 27 Mean (SD): 28.7 (7.2) kg Follow-up (12 weeks): n Analyzed: 27 Mean (SD) (Change at 12 weeks): +0.01 (2.6) kg Comparator: Normal Protein (0.8 g/kg body weight/day) Baseline: n Analyzed: 27	-	-	-		_	-	-

Study	Statistics/ Confounder s adjusted for	Handgrip strength	1-RM leg press	Knee flexor strength	Leg extensor strength	Sum 1-RM strength (sum of leg press, knee extension, and knee flexion)	Sum knee extension peak torque	Sum knee flexion peak torque	Chair Stand
		Mean (SD): 29.0 (4.9) kg Follow-up (12 weeks): n Analyzed: 27 Mean (SD) (Change at 12 weeks): -1.6 (3.3) kg Between group comparison and p-value: Statistically different from comparator P = 0.041							
PMID: 3361243 9 Author: Li Year: 2021 ⁶⁰	Statistics: ANCOVA Confounders adjusted for: Sex, age, height, physical activity level, total dietary energy intake	Intervention 1: Whey Protein (whey protein blended supplement twice daily: 7.98 g protein per supplement) Baseline: n Analyzed: 31 Mean (SD): 27.06 (7.78) kg Follow-up: n Analyzed: 31 Mean (SD): 26.78 (7.93) kg Intervention 2:	-	-	-		-	-	Intervention 1: Whey Protein (whey protein blended supplement twice daily: 7.98 g protein per supplement Baseline: n Analyzed: 31 Mean (SD): 8.95 (1.54) s Follow-up (6 months): n Analyzed: 31 Mean (SD): 8.22 (1.48) s

Iter Protein (soy protein blended Interventi Soy protein blended Soy protein blended Interventi twice daily: 8.80 g protein per supplement) Baseline: Soy protein blended Baseline: Nalyzet: 31 Mean (SD): Baseline: Follow-up: n Analyzet: 31 Mean (SD): Protein g protein per supplement) Baseline: Soy protein blended Follow-up: n Analyzet: 31 Mean (SD): 27.48 (7.03) kg Network and g protein group Intervention 3: Whey-Soy whey and soy blended whey and soy blended Soy protein g protein g per Soy protein g per Soy protein g per Nalyzet: 31 Mean (SD): Intervention 3: Whey-Soy protein group (1:1 ratio of whey and soy blended Soy protein g supplement: Soy protein g per Soy protein g supplement: Baseline: Soy protein g supplement: Baseline: Baseline: Mean (SD): Baseline: Baseline: Baseline: Baseline: Baseline: Baseline: Baseline:	Study	Statistics/ Confounder s adjusted for	Handgrip strength	1-RM leg press	Knee flexor strength	Leg extensor strength	Sum 1-RM strength (sum of leg	Sum knee extension peak torque	Sum knee flexion peak torque	Chair Stand
Soy protein (soy protein blended supplement twice daily: 8.80 g protein per supplement) Baseline: n Analyzed: 31 Mean (SD): 27.48 (7.03) kg Intervent Soy protein (soy protein g protein supplement) Baseline: n Analyzed: 31 Mean (SD): 27.48 (7.03) kg Follow-up: n Analyzed: 31 Mean (SD): 27.48 (7.03) kg Follow-up: n Analyzed: 31 Mean (SD): 27.48 (7.03) kg Intervention 3: Whey-Soy protein group (1:1 ratio of whey and soy blended supplement: 8.39 g protein per supplement: 8.39 g protein per Intervention Soy Protein group (1:1 ratio of whey and soy blended supplement: 8.39 g protein per							extension, and knee flexion)			
28.42 (8.81) kg n Analyze Follow-up: 8.68 (1.37 n Analyzed: 31 8.68 (1.37 Mean (SD): 28.45 (8.17) kg			Soy protein (soy protein blended supplement twice daily: 8.80 g protein per supplement) Baseline: n Analyzed: 31 Mean (SD): 26.88 (6.93) kg Follow-up: n Analyzed: 31 Mean (SD): 27.48 (7.03) kg Intervention 3: Whey-Soy protein group (1:1 ratio of whey and soy blended supplement: 8.39 g protein per supplement) Baseline: n Analyzed: 31 Mean (SD): 28.42 (8.81) kg Follow-up: n Analyzed: 31 Mean (SD): 28.45 (8.17) kg							Intervention 2: Soy protein (soy protein blended supplement twice daily: 8.80 g protein per supplement) Baseline: n Analyzed: 31 Mean (SD): 8.43 (1.63) s Follow-up (6 months): n Analyzed: 31 Mean (SD): 7.60 (1.71) s Intervention 3: Whey-Soy protein group (1:1 ratio of whey and soy blended supplement: 8.39 g protein per supplement) Baseline: n Analyzed: 31 Mean (SD): 8.68 (1.37) s Follow-up (6 months): n Analyzed: 31

Study	Statistics/ Confounder s adjusted for	Handgrip strength	1-RM leg press	Knee flexor strength	Leg extensor strength	Sum 1-RM strength (sum of leg press, knee extension, and knee flexion)	Sum knee extension peak torque	Sum knee flexion peak torque	Chair Stand
		Comparator: Control (no supplementatio n) Baseline: n Analyzed: 30 Mean (SD): 24.90 (7.33) kg Follow-up: n Analyzed: 30 Mean (SD): 25.33 (6.63) kg Between group comparison and p-value: Not statistically different from comparator (p>0.05)							Mean (SD): 8.25 (1.36) s Comparator: Control (no supplementatio n) Baseline: n Analyzed: 30 Mean (SD): 8.32 (1.32) s Follow-up (6 months): n Analyzed: 30 Mean (SD): 9.72 (1.89) s Between group comparison and p-value: Statistically different from comparator (p<0.001)
PMID: 3460962 1 Author: Reinder s Year: 2022 ⁶¹	Statistics: Linear regression model Confounders adjusted for: Residual confounding checked for baseline 400 m walk time,	Intervention: Protein advice (advised to increase protein intake to ≥1.2 g/kg aBW/d) Baseline: n Analyzed: 96 Mean (SE): 30.2 (1.04) kg	-	-	Leg extension strength Intervention: Protein advice (advised to increase protein intake to ≥1.2 g/kg aBW/d)				-

Study	Statistics/ Confounder s adjusted for	Handgrip strength	1-RM leg press	Knee flexor strength	Leg extensor strength	Sum 1-RM strength (sum of leg	Sum knee extension peak torque	Sum knee flexion peak torque	Chair Stand
						extension, and knee flexion)			
	baseline protein intake, sex, and study site	Follow-up (6 months): n Analyzed: 96 Mean (SE): 29.3 (1.05) kg Comparator: Control (no advice to increase protein consumption) Baseline: n Analyzed: 91 Mean (SE): 29.2 (0.96) kg Follow-up (6 months): n Analyzed: 91 Mean (SE): 27.8 (0.93) kg Between group comparison and p-value: Not statistically different from comparator (p>0.05)			Baseline: n Analyzed: 96 Mean (SE): 309.4 (14.5) N Follow-up (6 months): n Analyzed: 96 Mean (SE): 326.1 (14.2) N Comparator: Control (no advice to increase protein consumption) Baseline: n Analyzed: 91 Mean (SE): 311.4 (12.9) N Follow-up (6 months): n Analyzed: 91 Mean (SE): 295.5 (12.4) N Between group				

Study	Statistics/ Confounder s adjusted for	Handgrip strength	1-RM leg press	Knee flexor strength	Leg extensor strength	Sum 1-RM strength (sum of leg press, knee extension, and knee flexion)	Sum knee extension peak torque	Sum knee flexion peak torque	Chair Stand
					comparison and p-value: Statistically different from comparator (p<0.05)				
PMID: 2968765 0 Author: Smith Year: 2018 ⁶²	Statistics: Linear mixed model Confounders adjusted for: NR					Intervention : Weight loss plus whey protein supplement (hypocaloric diet with increased protein intake 1.2 g/kg/d) Baseline: n Analyzed: 25 Mean (SEM): 170 (6) kg Follow-up (6 months): n Analyzed: 25 Mean (SEM): 173 (6) kg Comparator : Weight loss plus recommende d protein (hypocaloric diet with 0.8	Intervention : Weight loss plus whey protein supplement (hypocaloric diet with increased protein intake 1.2 g/kg/d) Baseline: n Analyzed: 25 Mean (SEM): 326 (14) Nm Follow-up (6 months): n Analyzed: 25 Mean (SEM): 309 (13) Nm Comparator : Weight loss plus recommende d protein (hypocaloric diet with 0.8	Intervention : Weight loss plus whey protein supplement (hypocaloric diet with increased protein intake 1.2 g/kg/d) Baseline: n Analyzed: 25 Mean (SEM): 188 (7) Nm Follow-up (6 months): n Analyzed: 25 Mean (SEM): 183 (6) Nm Comparator : Weight loss plus recommende d protein (hypocaloric diet with 0.8	

Study	Statistics/ Confounder s adjusted	Handgrip strength	1-RM leg press	Knee flexor strength	Leg extensor strength	Sum 1-RM strength (sum of leg	Sum knee extension peak torque	Sum knee flexion peak torque	Chair Stand
	for					press, knee extension, and knee flexion)			
						g/kg/d protein) Baseline: n Analyzed: 27 Mean (SEM): 163 (6) kg	g/kg/d protein) Baseline: n Analyzed: 27 Mean (SEM): 305 (13) Nm	g/kg/d protein) Baseline: n Analyzed: 27 Mean (SEM): 178 (7) Nm	
						Follow-up (6 months): n Analyzed: 27 Mean (SEM): 164 (6) kg	Follow-up (6 months): n Analyzed: 27 Mean (SEM): 303 (13) Nm	Follow-up (6 months): n Analyzed: 27 Mean (SE): 177 (7) Nm	
						Between group comparison and p-value: Not statistically different from comparator (p>0.05)	Between group comparison and p-value: Not statistically different from comparator (p>0.05)	Between group comparison and p-value: Not statistically different from comparator (p>0.05)	
PMID: 2640096 6 Author: Zhu Year: 2015 ⁶⁴	Statistics: Linear mixed- effects model analysis Confounders adjusted for: NR	Intervention: High Protein (supplement drink - 30 g of protein per day) Baseline: n Analyzed: 99 Mean (SD): 21.7 (5.2) kg Follow-up (2 years):	-	Interventio n: High Protein (supplement drink - 30 g of protein per day) Baseline: n Analyzed: 99 Mean (SD): 9.1 (3.6) kg	Knee extensor strength – strain gauge Intervention: High Protein (supplement drink - 30 g of protein per day) Baseline:	_	-	-	-

Study	Statistics/	Handgrip	1-RM leg	Knee flexor	Leg	Sum 1-RM	Sum knee	Sum knee	Chair Stand
-	Confounder	strength	press	strength	extensor	strength	extension	flexion peak	
	s adjusted				strength	(sum of leg	peak torque	torque	
	for					press, knee			
						extension,			
						and knee			
						flexion)			
		n Analyzed: 93		/-	n Analyzed:				
		Mean (SEM)		Follow-up (2	99				
		(Change at 2		years):	Mean (SD):				
		y): -1.09 (0.41)		n Analyzed:	15.4 (5.3) kg				
		кд		93 Maria (OEM)	F - II				
		Compository		Mean (SEM)	Follow-up (2				
		Disselse			years).				
		supplement		(0.38) kg	n Analyzeu.				
		/high-		(0.30) kg	95 Mean (SEM)				
		(nigh-		Comparato	(Change at 2				
		drink		r: Placebo	v): 3 36				
		supplement		supplement	(0.68) ka				
		drink - 2.1 a of		(high-	(0.00)				
		protein per day)		carbohydrat	Comparator:				
		Baseline:		e drink	Placebo				
		n Analyzed: 94		supplement	supplement				
		Mean (SD):		drink - 2.1 g	(high-				
		21.7 (5.5) kg		of protein	carbohydrate				
				per day)	drink				
		Follow-up (2		Baseline:	supplement				
		years):		n Analyzed:	drink - 2.1 g				
		n Analyzed: 88		94	of protein per				
		Mean (SEM)		Mean (SD):	day)				
		(Change at 2		9.7 (3.7) kg	Baseline:				
		y): -1.53 (0.42)			n Analyzed:				
		кд		Follow-up (2	94 Maan (SD):				
				years).	16 1 (7 2) ka				
		Botwoon group		n Analyzeu.	10.1 (7.2) kg				
		comparison and		Mean (SEM)	Follow-up (2				
		n-value. Not		(Change at	vears).				
		statistically		(2 v): 2.36	n Analyzed				
		different from		(0.49) ka	88				
		comparator		(Mean (SEM)				
		(p>0.05)			(Change at 2				
		NI /		Between	ý): 3.17				
				group	(0.80) kg				

Study	Statistics/ Confounder s adjusted for	Handgrip strength	1-RM leg press	Knee flexor strength	Leg extensor strength	Sum 1-RM strength (sum of leg press, knee extension, and knee flexion)	Sum knee extension peak torque	Sum knee flexion peak torque	Chair Stand
				comparison and p-value: Not statistically different from comparator (p>0.05)	Between group comparison and p-value: Not statistically different from comparator (p>0.05)				

Abbreviations: aBW = adjusted body weight; ANCOVA = analysis of covariance; BMI = body mass index; d = day; g = gram; kg = kilogram; n = number analyzed; N = newtons; Nm = newton meter; NR = not reported; PMID = PubMed identification number; RM = repitition maximum; SD = standard deviation; SE = standard error; SEM = standard error of the mean; y = years

Study	Statistics/ Confounders adjusted for	Timed Up-and-Go (TUG)	4m walk gait speed	400m walk speed	SPPB
PMID: 26471344 Author: Backx Year: 2016 ⁵⁶	Statistics: ANCOVA Cofounders adjusted for: BMI, gender, age, fasting glucose	-	-	Intervention: High protein diet (contain 1.7 g of protein/kg/day) Baseline: n Analyzed: 30 Mean (SD): 1.46 (0.19) m/s Follow-up: n Analyzed: 30 Mean (SD): 1.5 (0.2) m/s Comparator: Normal Protein diet (contain 0.9 g protein/kg/day) Baseline: n Analyzed: 29 Mean (SD): 1.45 (0.19) m/s	Intervention: High protein diet (contain 1.7 g of protein/kg/day) Baseline: n Analyzed: 31 Mean (SD): 11.6 (0.7) Follow-up: n Analyzed: 30 Mean (SD): 11.7 (0.5) Comparator: Normal Protein diet (contain 0.9 g protein/kg/day) Baseline: n Analyzed: 30 Mean (SD): 11.4 (0.9)

Table E15. Sarcopenia RCT: Physical Performance Outcome

Study	Statistics/ Confounders adjusted for	Timed Up-and-Go (TUG)	4m walk gait speed	400m walk speed	SPPB
				Follow-up: n Analyzed: 29 Mean (SD): 1.47 (0.22) m/s Between group comparison and p-value: Not statistically different from comparator P	Follow-up: n Analyzed: 30 Mean (SD): 11.6 (0.6) Between group comparison and p-value: Not statistically different from comparator P= 0.483
PMID: 33975325 Author: Englert Year: 2021 ⁵⁷	Statistics: T-test Confounders adjusted for: NR			Intervention: High Protein (1.5 g/kg body weight/day) Baseline: n Analyzed: 27 Mean (SD): 4:10 (0:33) min:sec Follow-up (12 weeks): N Analyzed: 27 Mean (SD) (Change at 12 weeks): -0:00 (0:07) min:sec Comparator: Normal Protein (0.8 g/kg body weight/day) Baseline: n Analyzed: 27 Mean (SD): 4:11 (0:31) min:sec Follow-up (12 weeks): N Analyzed: 27 Mean (SD) (Change at 12 weeks): -0:05 (0:12) min:sec Between group comparison and p-value: Not statistically different from comparator P= 0.281	Intervention: High Protein (1.5 g/kg body weight/day) Baseline: n Analyzed: 27 Mean (SD): 9.4 (1.1) Follow-up (12 weeks): n Analyzed: 27 Mean (SD) (Change at 12 weeks): +0.4 (0.09) Comparator: Normal Protein (0.8 g/kg body weight/day) Baseline: n Analyzed: 27 Mean (SD): 9.9 (1.0) Follow-up (12 weeks): n Analyzed: 27 Mean (SD) (Change at 12 weeks): +0.6 (0.8) Between group comparison and p-value: Not statistically different from comparator P= 0.463
PMID: 33612439	Statistics: ANCOVA	-	Intervention 1:	-	Intervention 1: Whey Protein (whey protein

Study	Statistics/	Timed Up-and-Go	4m walk gait speed	400m walk speed	SPPB
	for	(100)			
Author: Li	Confounders adjusted		Whey Protein (whey		blended supplement twice
2021 ⁶⁰	physical activity level.		supplement twice daily:		supplement)
	total dietary energy		7.98 g protein per		Baseline:
	intake		supplement) Baseline:		n Analyzed: 31
			n Analyzed: 31		Mean (SD): 11.23 (0.8)
			Mean (SD):1.12 (0.2) m/s		Follow up (6 montho):
			Follow-up (6 months):		n Analyzed: 31
			n Analyzed: 31		Mean (SD): 11.65 (0.61)
			Mean (SD): 1.14 (0.12)		
			m/s		Intervention 2: Soy protein
					(soy protein blended
			Intervention 2:		supplement twice daily:
			Soy protein (soy protein		8.80 g protein per
			daily: 8 80 g protein per		Baseline:
			supplement) Baseline		n Analyzed: 31
			n Analyzed: 31		Mean (SD): 11.58 (0.56)
			Mean (SD): 1.17 (0.16)		
			m/s		Follow-up (6 months):
					n Analyzed: 31
			Follow-up (6 months):		Mean (SD): 11.52 (0.63)
			n Analyzed: 31 Mean (SD): 1 15 (0 14)		Intervention 3: Whey-Sov
			m/s		protein group (1.1 ratio of
					whey and soy blended
			Intervention 3: Whey-Soy		supplement: 8.39 g protein
			protein group (1:1 ratio of		per supplement)
			whey and soy blended		Baseline:
			supplement: 8.39 g protein		n Analyzed: 31
			n Analyzed: 31		wear (3D). 11.39 (0.00)
			Mean (SD): 1 15 (0 20)		Follow-up (6 months):
			m/s		n Analyzed: 31
					Mean (SD): 11.71 (0.78)
			Follow-up (6 months):		
			n Analyzed: 31		Comparator 1: Control (no
			Mean (SD): 1.13 (0.17)		supplementation)
			111/5		n Analyzed: 30
			Comparator 1:		Mean (SD): 11.51 (0.62)

Study	Statistics/ Confounders adjusted for	Timed Up-and-Go (TUG)	4m walk gait speed	400m walk speed	SPPB
			Control (no supplementation) Baseline: n Analyzed: 30 Mean (SD): 1.12 (0.1) m/s Follow-up (6 months): n Analyzed: 30 Mean (SD): 0.96 (0.16) m/s Between group comparison and p-value: Statistically different from comparator (p<0.05)		Follow-up (6 months): n Analyzed: 30 Mean (SD): 10.61 (1.28) Between group comparison and p-value: Statistically different from comparator (p<0.01)
PMID: 34609621 Author: Reinders Year: 2022 ⁶¹	Statistics: Linear regression model Confounders adjusted for: Residual confounding checked for baseline 400 m walk time, baseline protein intake, sex, and study site	-	-	Intervention: Protein advice (advised to increase protein intake to ≥1.2 g/kg aBW/d) Baseline: n Analyzed: 96 Mean (SE): 311.3 (7.2) s Follow-up (6 months): n Analyzed: 96 Mean (SE): 306.0 (6.85) s Comparator: Control (no advice to increase protein consumption) Baseline: n Analyzed: 91 Mean (SE): 311.1 (9.3) s Follow-up (6 months): n Analyzed: 91 Mean (SE): 318.2 (11.0) s Between group comparison and p-value: Statistically	Intervention: Protein advice (advised to increase protein intake to ≥ 1.2 g/kg aBW/d) Baseline: n Analyzed: 96 Mean (SE): 9.8 (0.14) Follow-up (6 months): n Analyzed: 96 Mean (SE): 10.0 (0.14) Comparator: Control (no advice to increase protein consumption) Baseline: n Analyzed: 91 Mean (SE): 9.7 (0.17) Follow-up (6 months): n Analyzed: 91 Mean (SE): 10.0 (0.17) Between group comparison and p-value: Not statistically different from comparator

Study	Statistics/ Confounders adjusted for	Timed Up-and-Go (TUG)	4m walk gait speed	400m walk speed	SPPB
				different from comparator (p<0.05)	
PMID: 26400966 Author: Zhu Year: 2015 ⁶⁴	Statistics: Linear mixed- effects model analysis Confounders adjusted for: NR	Intervention: High Protein (supplement drink - 30 g of protein per day) Baseline: n Analyzed: 99 Mean (SD): 7.9 (1.3) s Follow-up (2 years): n Analyzed: 93 Mean (SEM) (Change at 2 y): 0.46 (0.12) s Comparator: Placebo supplement (high-carbohydrate drink supplement drink - 2.1 g of protein per day) Baseline: n Analyzed: 94 Mean (SD): 8.0 (1.5) s Follow-up (2 years): n Analyzed: 88 Mean (SEM) (Change at 2 y): -0.55 (0.12) s Between group comparison and p-value: Not statistically different from comparator (p			

Abbreviations: aBW = adjusted body weight; ACOVA = analysis of covariance; BMI = body mass index; <math>d = day; g = grams; kg = kilograms; m = meter; n = number analyzed; NR = not reported; PMID = PubMed identification number; s = second; SD = standard deviation; SE = standard error; SEM = standard error of the mean; SPBB = Short Physical Performance Battery

Appendix F. Chronic Condition Clinical Endpoints in Studies Not in the Analytic Set

Author (year)	Outcome	Population	Protein	Mean protein	Outcome Findings	Direction of	Risk of bias
	Arms	n analyzed	assessment	intake	_	Effect	
		Age	methods				
		Sex					
		Study Duration					
Beasley, 2014 ¹¹	Fragility fracture	Country: U.S.	FFQ	*Tertile 1: <13.3% of	Fragility fracture (osteoporotic	No	High
	(osteoporotic and			energy	and low-trauma fracture)	difference	
	low-trauma fracture)	Study Design:			Highest protein intake tertile		
		Prospective		*Tertile 2: 14.2-	versus lowest tertile: HR: 0.99		
	Hip fracture	cohort study		14.8% of energy	(0.97, 1.02) per 20% increase in		
					calibrated protein intake		
	Spine fracture	n analyzed:		* Lertile 3: ≥15.6% of			
		n=144,580		energy	Hip fracture:		
	Forearm fracture				Highest protein intake tertile		
		Mean age (SD):			versus lowest tertile: HR: 0.91		
	l ertile 1: Protein intake	Tertile 1: 66 (7.2)			(0.84, 1.00)) per 20% increase		
	<13.3% of energy	y Tautila 0, 00 7			in calibrated protein intake		
	Tautila O: Duatain intelsa	1 ertile 2: 63.7			Crains freshtung		
	14.2.14.0% of energy	(0.9) y			Spine fracture:		
	14.2-14.8% of energy	(6 4) v			Hignest protein intake tertile		
	Tartila 2: Drotain intaka	(0.4) y			(0.09, 1.12) per 20% increase in		
	515 6% of operav	Sov: 100%			(0.90, 1.13) per 20% increase in		
	≥ 15.0% of energy	fomalo			calibrated protein intake		
		lemale			Forearm fracture:		
		6 vears			Highest protein intake tertile		
		o years			versus lowest tertile: HR: 0.93		
					(0.88, 0.98) per 20% increase		
					in calibrated protein intake		
Cauley 2016 ¹²	Hip fracture	Country: U.S	FFQ	*Arm 1· 16 13 (2 91)	For each SD increase in total	Found	Very High
oddioy, 2010		oouning: o.o.		% of energy	energy from protein: HR: 0.76	benefit	v or y r ngri
	Arm 1: No hip fracture	Study Design:		/* c: c	(0.64, 0.89)		
		Prospective		*Arm 2: 15.3 (2.55)	()		
	Arm 2: Hip fracture	cohort study		% of energy			
	'	, , , , , , , , , , , , , , , , , , ,					
		n analyzed:					
		Arm 1: n=5,698					
		Arm 2: n=178					

Table F1. Summary of findings for clinical endpoint outcomes for risk of bone disease: adults

Author (year)	Outcome	Population	Protein	Mean protein	Outcome Findings	Direction of	Risk of bias
	Arms	n analyzed	assessment	intake	_	Effect	
		Age	methods				
		Sex					
		Study Duration					
		Mean age (SD):					
		Arm 1: 73.48					
		(5.81) v					
		Arm 2: 77.81					
		(6.08) v					
		(/)					
		Sex: 0% female					
		8.6 years					
Dargent-Molina, 2008 ¹⁴	Fragility fracture	Country: France	Dietary	*Arm 1: 45.7 (7.3)	Highest protein intake quartile	No	High
	(osteoporotic and		questionnaire	g/1000 kcal/d	versus lowest quartile:	difference	
	low-trauma fracture)	Study Design:			RR: 1.06 (0.94,1.19)		
		Prospective		*Arm 2: 46.0 (7.6)			
	Arm 1: No fractures	cohort study		g/1000 kcal/d			
				-			
	Arm 2: Fractures	n analyzed:					
		Arm 1: n=33,809					
		Arm 2: n=2,408					
		Mean (SD) age:					
		Arm 1: 56.1 (5.5)					
		у					
		Arm 2: 57.1 (5.6)					
		у					
		Sex: 100%					
		female					
		15 years					
Key, 2007 ¹⁸	Fragility fracture	Country:	FFQ	*Arm 1: 73.1 (21.6)	Highest protein intake quintile	No	High
	(osteoporotic and	Australia		g/d	versus lowest quintile:	difference	
	low-trauma fracture)			*Arm 2: 77.8 (22.6)			
	Arm 1: Women	Study design:		g/d	Arm 1: Women		
		Prospective			RR: 0.97 (0.74,1.27)		
	Arm 2: Men	cohort study					
					Arm 2: Men:		
		n analyzed:			RR: 1.29 (0.72,2.31)		
		Arm 1: n=26,749					

Author (year)	Outcome	Population	Protein	Mean protein	Outcome Findings	Direction of	Risk of bias
	Arms	n analyzed	assessment	intake		Effect	
		Age	methods				
		Sex					
		Study Duration					
		Arm 2: n=7,947					
		Mean (SD) age:					
		Arm 1: 45.8					
		(13.1) y					
		Arm 2: 49.5					
		(13.5) y					
		Sex:					
		Arm 1: 100%					
		female					
		Arm 2: 0%					
		female					
		6 years					
Langsetmo, 2015 ¹⁹	Fragility fracture	Country: Canada	FFQ	*Arm 1: 13.6 (12.0-	Fragility fracture:	No	High
	(osteoporotic and			15.1) % of energy	Highest protein intake quartile	difference	-
	low-trauma fracture)	Study Design:		,	vs lowest quartile:		
		Prospective		*Arm 2: 14.3 (12.8-			
	Arm 1: Men	cohort study		15.9) % of energy	Arm 1:		
		Prospective			HR: 0.66 (0.35,1.24)		
	Arm 2: Women	cohort study					
					Arm 2:		
		n analyzed:			HR: 0.85 (0.64,1.09)		
		Arm 1: n=1,919					
		Arm 2: n=4,591					
		Mean (SD) age:					
		NR					
		Sex: Arm 1: 0%					
		female					
		Arm 2: 100%					
		female					
		5 vears					
Langsetmo 201720	Fragility fracture	Country: 11 S	FEO	*Ouartile 1:60	Fragility fracture (osteoporosis	Found	High
	(osteonorotic	0.00. 0.0.		14 1% of energy	fracture) Highest protein intake	henefit	i iigi i
	fracture)				quartile vs lowest quartile.	Solion	
					gaaraio to iottoor quaralo.		

Author (year)	Outcome	Population	Protein	Mean protein	Outcome Findings	Direction of	Risk of bias
	Arms	n analyzed	assessment	intake		Effect	
		Age	methods				
		Sex					
		Study Duration					
		Study Design:		*Quartile 2: 14.2-	HR: 0.92 (0.84,1.00)		
	Fragility fracture (low	-Prospective		15.8% of energy			
	trauma)	cohort study			Fragility fracture (low trauma)		
				*Quartile 3: 15.9-	Highest protein intake quartile		
	Hip fracture	n analyzed:		17.7% of energy	vs lowest quartile:		
		Quartile 1:			HR: 0.92 (0.85–0.99)		
	Spine fracture	n=1,469		*Quartile 4: 17.8-			
		Quartile 2:		29.3% of energy	Hip fracture		
	Quartile 1: Protein	n=1,469			Highest protein intake quartile		
	intake 6.0-14.1% of	Quartile 3:			vs lowest quartile:		
	energy	n=1,469			HR: 0.84 (0.73, 0.95)		
		Quartile 4:					
	Quartile 2: Protein	n=1,468			Spine fracture		
	intake 14.2-15.8% of				Highest protein intake quartile		
	energy	Mean (SD) age:			vs lowest quartile:		
		Quartile 1: 73.6			HR: 1.06 (0.92–1.22)		
	Quartile 3: Protein	(5.9) y					
	intake 15.9-17.7% of	Quartile 2: 74.0					
	energy	(5.8) y					
		Quartile 3: 73.6					
	Quartile 4: Protein	(5.9) y					
	intake 17.8-29.3% of	Quartile 4: 73.4					
	energy	(5.9) y					
		Sex: 0% female					
		15 years					
Misra, 2011 ²⁴	Hip fracture	Country: U.S.	FFQ	*Arm 1: 64.2 g/d	Upper three protein intake	Found	High
					quartiles vs lowest quartile:	benefit	
	Arm 1: No hip fracture	Study Design:		*Arm 2: 63.6 g/d	HR: 0.63 (0.41, 0.97)		
		Prospective					
	Arm 2: Hip fracture	cohort study					
		n analyzed:					
		Arm 1: n=846					
		Arm 2: n=100					
		Mean (SD) age:					
		Arm 1: 75 (5.0) y					

Author (year)	Outcome	Population	Protein	Mean protein	Outcome Findings	Direction of	Risk of bias
	Arms	n analyzed	assessment	intake		Effect	
		Age	methods				
		Sex					
		Study Duration					
		Arm 2: 76 (5.2) y					
		Sex: Arm 1:					
		58.6% female					
		Arm 2: 80.0%					
		female					
		16-17 years					
Nakano, 2023 ²⁵	Fragility fracture	Country: U.S.	FFQ	*73.4 (15.1) g/d	HR: 1.07 (0.90, 1.27) higher	No	High
	(osteoporotic			. , .	protein/energy intake ratio	difference	C C
	fracture)	Study Design:					
		Prospective					
	Arm 1: whole cohort	cohort study					
		n analyzed:					
		1,070					
		Mean (SD) age:					
		69.3 (10.9) y					
		0 1000/					
		Sex: 100%					
		lemale					
		5.8 years					
Sahni, 2010 ²⁸	Hip fracture	Country: U.S.	FFQ	*Arm 1: 79.0 (27) g/d	Total calcium intake < 800 mg/d	No difference	High
	Arm 1 [.] Men	Study Design		g/u	Highest protein intake tertile	amerenee	
		Prospective		*Arm 2 [.] 75 7 (27)	versus lowest tertile: HR: 2 20		
	Arm 2: Women	cohort study		g/d	(0.88, 5.54)		
				-			
		n analyzed:			I otal calcium intake \geq 800 mg/d		
		Arm 1: n=1,725					
		Arm 2: n=1,931			Highest protein intake tertile versus lowest tertile: HR: 0.54		
		Mean age (SD):			(0.12, 1.30)		
		Arm 1: 55.3 (9.9)					
		у					
		Arm 2: 54.9 (9.8)					
		У					

Author (year)	Outcome Arms	Population n analyzed Age Sex	Protein assessment methods	Mean protein intake	Outcome Findings	Direction of Effect	Risk of bias
		Study Duration					
		Sex: Arm 1: 0% female Arm 2: 100% female					
		7-10 years					
Sellmeyer, 2001 ³⁰	Hip fracture Tertile 1: Low ratio of	Country: U.S. Study design:	FFQ	*Tertile 1: 42.0 (15.9) g	Highest versus lowest tertile (high ratio of animal to vegetable protein intake vs low	Found harm	High
	animal to vegetable	Prospective		*Tertile 2: 49.2	ratio):		
	protein	cohort study		(16.9) g	RR: 3.7, P=0.04		
	Tertile 2: Medium ratio of animal to vegetable protein	n analyzed: n=1,035		*Tertile 3: 58.3 (20.0) g			
	' Tertile 3: High ratio of animal to vegetable protein	Mean (SD) age: Tertile 1: 74.3 (5.4) y Tertile 2: 73.2 (4.9) y Tertile 3: 72.5 (4.5) y					
		Sex: 100% female					
Maayar 202131		7 years		*Tautila 4: 40 (4) 0(l linkest protein intelse textile ve	No	Llinda
Weaver, 2021 ³¹	Fragility fracture (low trauma)	-Country: U.S. Study Design:	FFQ	of energy	Highest protein intake tertile vs lowest tertile: HR: 0.71 (0.45, 1.11)	No difference	High
	Tertile 1: Protein intake	Prospective		*Tertile 2: 14 (1) %			
	<13% of energy	cohort study		of energy			
	Tertile 2: Protein intake 13-15% of energy Tertile 3: Protein intake	n analyzed: Tertile 1: n=718 Tertile 2: n=703 Tertile 3: n=739		*Tertile 3: 18 (2) % of energy			
	>15% of energy						

Author (year)	Outcome Arms	Population n analyzed Age Sex Study Duration	Protein assessment methods	Mean protein intake	Outcome Findings	Direction of Risk of bias Effect
		Mean (SD) age: Tertile 1: 73.5 (2.9) y Tertle 2: 73.4 (2.8) y Tertile 3: 73.7 (2.9) y				
		5 years				

Abbreviations: d = day; FFQ = food frequency questionnaire; g = gram; HR = hazard ratio; IRR = incidence rate ratio; mg = miligram; n = number; NR = not reported; RR = relative risk; U.S. = United States; y = years

*: Reported baseline Protein intake. Follow up protein intake was not reported.

Note: Outcome findings were pulled from the adjusted models, and when reported, included the highest protein intake quartile/tertile versus the reference group.

Author (year)	Outcome Arms	Population n analyzed Age Sex	Protein assessment method	Mean protein intake*	Outcomes Findings	Direction of Effect	Risk of bias
		Study Duration					
Alvirdizadeh, 2020 ³⁹	Incident CKD	Country: Iran Study design:	FFQ	Tertile 1: Lower protein intake: 50.36 (9.83) ɑ/day	Highest protein intake tertile versus lowest	No difference	High
	protein intake	Prospective cohort study		Tertile 2: Moderate	tertile: OR: 0.59		
	Tertile 2: Moderate protein intake	n=1,630		protein intake: 74.23 (6.43) g/day	(95%CI: 0.32 to 1.08)		
	Tertile 3: Higher protein intake	Mean (SD)age: Tertile 1: Lower protein intake: 43.3 (11.3) y Tertile 2: Moderate protein intake: 42.8(10.9) y		Tertile 3: Higher protein intake: 114.44 (29.42) g/day			

Table F2. Summary of findings for clinical endpoint outcomes for risk of kidney disease

Author	Outcome	Population	Protein	Mean protein	Outcomes	Direction of	Risk of bias
(year)	Arms	n analyzed	assessment	intake*	Findings	Effect	
		Age	method		· ·		
		Sex					
		Study Duration					
		Tertile 3: Higher					
		protein intake: 42.4					
		(11.4) y					
		Sex:					
		Tertile 1: Lower protein					
		intake: 55.7% female					
		Tertile 2: Moderate					
		protein					
		intake: 52.8% female					
		Tertile 3: Higher					
		protein intake: 43%					
		remale					
		C 1 years					
F a sila a des a la al		6.1 years	550			F a constal la consta	l l'ada
	Inclaent CKD	Country: Iran	FFQ	Tertile 1: Lower	Hignest protein	Found narm	High
20191	Tautila de Lauran			LOW-			
		Sludy design: Broopportivo cohort		Carbonydrate High-	versus iowest		
	Low- Carbobydrato High	etudy		Diot Score: 12.0	OD: 1 /8 (05%		
	Drotoin	study		(1.7) % energy	CI: 1.03 to 2.15)		
	Diet Score	n=1 707		(1.7) Menergy	C1. 1.05 (0 2.15)		
		11-1,737		Tertile 2 [.] Moderate			
	Tertile 2 [.] Moderate	Mean (SD) age:					
	l ow-	Tertile 1 [·] Lower Low-		Carbohydrate High-			
	Carbohvdrate High-	Carbohvdrate High-		Protein			
	Protein	Protein		Diet Score: 13.0			
	Diet Score	Diet Score: 39.0 (12.5)		(2.2) %energy			
		y Č		() ()			
	Tertile 3: Higher			Tertile 3: Higher			
	Low-Carbohydrate	Tertile 2: Moderate		Low-Carbohydrate			
	High-Protein	Low-		High-Protein			
	Diet Score	Carbohydrate High-		Diet Score: 15.8			
		Protein		(2.1) %energy			
		Diet Score: 37.1 (12.1)					
		У					
		Tertile 3: Higher Low-					

Author	Outcome	Population	Protein	Mean protein	Outcomes	Direction of	Risk of bias
(year)	Arms	n analyzed	assessment	intake*	Findings	Effect	
-		Age	method		_		
		Sex					
		Study Duration					
		Carbohydrate High-					
		Protein					
		Diet Score: 36.6 (12.3)					
		у					
		Sex:					
		Tertile 1: Lower Low-					
		Carbonydrate High-					
		Protein Dist Secret 41, 49/					
		fomalo:					
		Tortilo 2: Modorato					
		Carbohydrate High-					
		Protein					
		Diet Score: 56%					
		female:					
		Tertile 3: Higher Low-					
		Carbohydrate High-					
		Protein					
		Diet Score: 63.4%					
		female					
		6.1 years	550	Ossinatila da Ductain			l li ada
Haring,	Incident CKD	Country: U.S.	FFQ	Quintile 1: Protein	Hignest protein	No difference	High
2017	Quintile 1: Protein	Study design:		a/d			
	intako	Prospective cohort		y/u	quintile:		
	41.1(7.3) d/d	study		Quintile 2 [.] Protein	HR \cdot 0.89		
	11.1 (1.0) g/d	olddy		intake: 57 2 (3 6)	(95%CI		
	Quintile 2: Protein	n=11.952		a/d	0.76 to 1.05)		
	intake 57.2 (3.6)	,		5.	,		
	g/d	Mean (SD) age:		Quintile 3: Protein			
	-	Quintile 1: Protein		intake: 69.0			
	Quintile 3: Protein	intake: 53.8 (5.8) y		(3.3) g/d			
	intake 69.0			-			
	(3.3) g/d	Quintile 2: Protein		Quintile 4: Protein			
		intake: 53.8 (5.7) y		intake: 82.3			
				(4.5) g/d			

Armsn analyzed Age Sex Study Durationassessment methodintake*FindingsEffectQuintile 4: Protein intake 82.3 (4.5) g/dQuintile 3: Protein intake 69.0 (3.3) g/d: 53.8 (5.7) yQuintile 5: Protein intake: 100 5 (d. 2) p/dQuintile 5: Protein intake: 100 5 (d. 2) p/d	
Age Sex Study Duration method Quintile 4: Protein intake 82.3 (4.5) g/d Quintile 3: Protein intake 69.0 (3.3) g/d: 53.8 (5.7) y Quintile 5: Protein intake: 100 5 (d. 2) c/d	i
Sex Study Duration Quintile 4: Protein intake 82.3 (4.5) g/d Quintile 3: Protein intake 69.0 (3.3) g/d: 53.8 (5.7) y	
Study DurationQuintile 4: Protein intake 82.3 (4.5) g/dQuintile 3: Protein intake 69.0 (3.3) g/d: 53.8 (5.7) yQuintile 5: Protein intake: (4.0) 5 (40.2) c/d	ł
Quintile 4: Protein intake 82.3 (4.5) g/dQuintile 3: Protein intake 69.0 (3.3) g/d: 53.8 (5.7) yQuintile 5: Protein intake: 100.5 (40.2) c/d	
intake 82.3 intake 69.0 Quintile 5: Protein (4.5) g/d (3.3) g/d: 53.8 (5.7) y intake:	1
(4.5) g/d (3.3) g/d: 53.8 (5.7) y intake:	ľ
	ł
109.5 (18.3) g/d	ľ
Quintile 5: Protein Quintile 4: Protein	ł
intake intake 82.3	ľ
109.5 (18.3) g/d (4.5) g/d: 53.8 (5.7) y	ľ
Quintile 5: Protein	ľ
intake	ł
109.5 (18.3) g/d: 53.7	ł
(5.6) y	l
Sex:	l
Quintile 1: Protein	ł
intake 41.1 (7.3) g/d:	ł
64.2% female	l
Quintile 2: Protein	l
intake 57.2 (3.6) g/d:	ł
56.9% female	ľ
Quintile 2: Protoin	l
intake 69.0	ł
(3 3) q/d: 57 8%	ł
female	ľ
	ľ
Quintile 4: Protein	ł
	ł
(4.5) g/d: 55.4%	ľ
	ľ
Quintile 5: Protein	
intake	
109.5 (18.3) g/d:	ł
47.0% female	
25 vears	ſ

Author	Outcome	Population	Protein	Mean protein	Outcomes	Direction of	Risk of bias
(year)	Arms	n analyzed	assessment	intake*	Findings	Effect	
		Age	method				
		Sex					
		Study Duration					
Kubo, 2023 ⁴⁸	Incident CKD	Country: Japan	brief-type self- administered diet	Quartile 1: Protein intake:	Highest protein intake quartile	Found benefit	High
	intake	Prospective cohort	questionnaire	12 (1.2) %energy	quartile:		
	12% of energy	study		Quartile 2: Protein intake:14.2 (0.5) %	HR: 0.72 (95%CI:		
	Quartile 2: Protein intake	n=3,277		energy	0.52 to 0.99)		
	14.2% of energy	Mean (SD) age: Quartile 1: Protein		Quartile 3: Protein intake			
	Quartile 3: Protein intake	intake 12% of energy: 58.8		15.9 (0.6) %energy			
	15.9% of energy	(7.4) y		Quartile 4: Protein intake: 18.9 (2.0)			
	Quartile 4: Protein intake 18.9% of energy	Quartile 2: Protein intake 14.2% of energy: 59.0 (8.5) v		%energy			
		Quartile 3: Protein intake 15.9% of energy: 58.6 (8.5) y					
		Quartile 4: Protein intake 18.9% of energy: 58.9 (8.5) y					
		Sex: Quartile 1: Protein intake 12% of energy: 66.4% female					
		Quartile 2: Protein intake 14.2% of energy: 63.9% female					

Author	Outcome	Population	Protein	Mean protein	Outcomes	Direction of	Risk of bias
(year)	Arms	n analyzed	assessment	intake*	Findings	Effect	
		Age	method		-		
		Sex					
		Study Duration					
		Quartile 3: Protein					
		intake					
		15.9% of energy					
		Quartile 3: Protein					
		intake					
		15.9% of energy: 65%					
		female					
		Quartile 4: Protein					
		intake					
		18.9% of energy:					
		64.4% female					
		10					
Kuran		12 years		Tartila 1. Dratain	l link oct nuctoin	Found honofit	Link
rwon, 202249	Incident CKD	Country: Korea	FFQ	intako <0.8 g/kg/d:	Highest protein	Found benefit	High
2022	Tertile 1. Protein	Study design:		$0.6 (0.1) \alpha/k\alpha/day$			
	intake <0.8 g/kg/d	Prospective cohort		0.0 (0.1) g/kg/day	tertile.		
		study		Tertile 2 [.] Protein	HR: 0.63		
	Tertile 2: Protein	otady		intake 0.8–1.3	(95%CI:		
	intake 0.8–1.3	n=7339		a/ka/d: 1.0 (0.1)	0.44 to 0.89)		
	g/kg/d			g/kg/day	,		
	0 0	Mean (SD) age:					
	Tertile 3: Protein	Tertile 1: Protein intake		Tertile 3: Protein			
	intake >1.3 g/kg/d	<0.8 g/kg/d: 53.1 (8.8)		intake >1.3 g/kg/d:			
		У		1.7 (0.4) g/kg/day			
		Tertile 2 [.] Protein intake					
		$0.8-1.3 \text{ g/kg/d} \cdot 51.4$					
		(8.5) v					
		Tertile 3: Protein intake					
		>1.3 g/kg/d: 51.1 (8.6)					
		У					
		Sex:					

Author	Outcome	Population	Protein	Mean protein	Outcomes	Direction of	Risk of bias
(year)	Arms	n analyzed	assessment	intake*	Findings	Effect	
-		Age	method		_		
		Sex					
		Study Duration					
		Tertile 1: Protein intake					
		<0.8 g/kg/d: 52.9%					
		female					
		Tertile 2: Protein intake					
		0.8–1.3 g/kg/d: 50.6%					
		remale					
		Tertile 3 [.] Protein intake					
		$>1.3 \text{ a/ka/d} \cdot 57.1\%$					
		female					
		lonidio					
		16 years					
Lew, 2017 ⁵⁰	Incident ESRD	Country: Singapore	FFQ	Quartile 1: 12.5 g/d	Highest median	No difference	High
				median red meat	red meat intake		-
	Quartile 1: 12.5 g/d	Study design:		intake: 53.1 (10.3)	quartile versus		
	median red meat	Prospective cohort		g/d	lowest quartile:		
	intake	study			HR: 1.19		
				Quartile 2: 24.2 g/d	(95%CI:		
	Quartile 2: 24.2 g/d	n=60,198		median red meat	0.98 to 1.44)		
	median red meat			intake: 57.6 (7.9)			
	intake	Mean (SD) age:		g/d			
		Quartile 1: 12.5 g/d					
	Quartile 3: 33.4 g/d	median red meat		Quartile 3: 33.4 g/d			
	median red meat	Intake: 56.5 (7.8) y		median red meat			
	Intake	Quartila 2: 24 2 a/d		Intake: 60.5 (7.6)			
	Quartila 1: 19 9 a/d	Qualitie Z. Z4.Z g/u		g/u			
	Qual life 4. 40.0 g/u	integral fed fileat		Quartilo 4: 48.8 g/d			
	intako	intake. 50.9 (0.1) y		median red meat			
	Intake	Quartile 3: 33 4 d/d		intake: 65.3 (9.0)			
		median red meat		a/d			
		intake: 56.5 (8.1) v		g, u			
		Quartile 4: 48.8 g/d					
		median red meat					
		intake: 55.7 (7.9) y					
		Sex:					

Author	Outcome	Population	Protein	Mean protein	Outcomes	Direction of	Risk of bias
(year)	Arms	n analyzed	assessment	intake*	Findings	Effect	
		Age	method				
		Sex					
		Study Duration					
		Quartile 1: 12.5 g/d					
		median red meat					
		intake: 50% female					
		Quartile 2: 24.2 g/d					
		median red meat					
		intake: 46% female					
		Quartile 3: 33.4 g/d					
		median red meat					
		intake: 56% female					
		Quartile 4: 48.8 g/d					
		median red meat					
		intake: 55% female					
		5 years					
Malhotra,	Incident ESRD	Country: U.S.	FFQ and 24 h	Incident end-stage	Incident end-	Found harm	Very high
201651	Incident and stage	Study designs Case	dietary recalls		stage renai		
	ropal disease	Sludy design. Case-		Cases. $15.7 (5.5)$	uisease cases		
		control study		/oenergy	Group:		
	Cases	n=1 255		Control Group: 15.1	OR=1 76		
	versus	11-4,200		(3.1) %energy	(95% CI · 1 17 to		
		Mean (SD) age:		(o.r) /conorgy	2.65)		
	Control Group	Incident end-stage					
	•	renal disease cases:					
		54.5 (9.1) y					
		Control Group: 54.6					
		(8.8) y					
		Sex:					
		Incident end-stage					
		renal disease cases:					
		54.4% female					
		Control Group: 55.2%					
		female					

Author (year)	Outcome Arms	Population n analyzed Age Sex Study Duration	Protein assessment method	Mean protein intake*	Outcomes Findings	Direction of Effect	Risk of bias
					1		
		7 years					
Teymoori, 2022 ⁵⁵	Incident CKD Tertile 1: Protein score (8.2 ± 2.8) Tertile 2: Protein score (9.6 ± 2.8) Tertile 3: Protein score (12.0 ± 3.1)	Country: Iran Study design: Prospective cohort study n=6,044 Mean (SD) age: Tertile 1: Protein score (8.2 \pm 2.8): 36.1(12.1) y Tertile 2: Protein score (9.6 \pm 2.8): 37.8 (12.8) y Tertile 3: Protein score (12.0 \pm 3.1): 40.4 (13.3) y Sex: Tertile 1: Protein score (8.2 \pm 2.8): 57.7% female; Tertile 2: Protein score (9.6 \pm 2.8): 57.7% female; Tertile 3: Protein score (9.6 \pm 2.8): 54.9% female; Tertile 3: Protein score (12.0 \pm 3.1): 48.8% female 19 years	FFQ	Tertile 1: Protein score (8.2 ± 2.8) : 13.1 (1.8) %energy Tertile 2: Protein score (9.6 ± 2.8) : 14.8 (3.2) %energy Tertile 3: Protein score (12.0 \pm 3.1): 16.1 (9.8) %energy	Highest protein score tertile versus lowest tertile: HR=0.91 (95% CI: 0.78 to 1.05)	No difference	High

Abbreviations: CI = confidence interval; CKD = chronic kidney disease; d = day; ESRD = end stage renal disease; FFQ = food frequency questionnaire; g = gram; h = hour; HR = hazard ratio; kg = kilo grams; OR = odds ratio; U.S. = United States; y = years

*: Reported baseline Protein intake. Follow up protein intake was not reported.

Note: Outcome findings were pulled from the adjusted models, and when reported, included the highest protein intake quintile/quartile/tertile versus the reference group.

Appendix G. Risk of Bias Assessments of All Eligible Studies

Table G1. Risk of Bias Assessments of Randomized Controlled Trials (Parallel Design) with RoB-2

Author, Year	Bias from	Bias from	Bias from missing	Bias in	Bias in selection	Overall risk of
PMID	process	intended interventions (assignment)	outcome data	outcome	of reported result	Low, Moderate, High)
Aoyagi, 2010 ¹ PMID: NR	Low	High	High	Low	Some concerns	High
Arjmandi, 2005 ² PMID: 15727682	Low	High	High	Low	Some concerns	High
Backx, 2016 ⁵⁶ PMID: 26471344	Low	Low	Low	Low	Low	Low
Bonjour, 2012 ³ PMID: 22357739	Moderate	Low	Low	Low	Low	Moderate
Englert, 2021 ⁵⁷ PMID: 33975325	Low	Low	Low	Low	Low	Low
Flechtner-Mors, 2010* ³² PMID: 20578205	Moderate	High	High	Low	Low	High
Frestedt, 2008* ³³ PMID: 18371214	Moderate	High	High	Low	Low	High
Haghighat, 2021 ⁵⁸ PMID: 34208986	Low	Moderate	Low	Low	Low	Moderate
Jacobs, 2010 ³⁴ PMID: 19167797	Low	Low	Low	Low	High	High
Jesudason, 2013*4 PMID: 24047916	Moderate	High	Low	Low	Low	High
Kerstetter, 2015* ⁵ PMID: 25844619	Low	#	Low	Low	Low	#
Kruger, 2023 PMID: 37739678	Low	High	High	Low	Low	High
Li, 2010*6 PMID: 21194471	Low	High	Some concerns	Low	Some concerns	High
Li, 2021 ⁶⁰ PMID: 33612439	Low	Low	Low	Low	Low	Low
Murphy, 2021* ³⁶ PMID: 33871558	Low	High	High	Low	Low	High
Peng, 2021* ³⁷ PMID: 34098214	Low	High	High	Low	Low	High
Reinders, 2022 ⁶¹	Low	Low	Low	Low	Low	Low

Author, Year PMID	Bias from randomization process	Bias from deviation from intended interventions (assignment)	Bias from missing outcome data	Bias in measurement of outcome	Bias in selection of reported result	Overall risk of bias (Low, Moderate, High)
PMID: 34609621						
Skov, 2002 ⁷ PMID: 12055318	Low	Low	Low	Low	Low	Low
Smith, 2018 ⁶² PMID: 29687650	Low	Low	Low	Low	Low	Low
Stojkovic, 2017 ⁶³ PMID: 28492492	High	High	High	Low	Low	High
Stounbjerg, 2021 ⁸ PMID: 34581765	Low	Low	Low	Low	Low	Low
Wycherley, 2012* ³⁸ PMID: 22406907	Low	Low	Moderate	Low	Low	Moderate
Zhu, 2011 ⁹ PMID: 21590739	Low	High	High	Low	Low	High
Zhu, 2015 ⁶⁴ PMID: 26400966	Low	Low	Low	Low	Low	Low

Abbreviations: PMID = PubMed Identification Number; RoB-2 = risk of bias tool for randomized trials

Note: When at least one domain is as a high risk of bias, we determined that a study had an overall risk of bias judgement of high risk of bias (based on the RoB-2 algorithm for reaching overall risk of bias judgement), *: Studies overlap KQs, #: Kerstetter, 2015 reported on KQ1, KQ2, and KQ3 outcomes: KQ1 outcomes were assessed as both low (including BMD lumbar, hip and femoral outcomes) and high risk of bias (including all other reported outcomes); KQ2 outcomes were assessed as high risk of bias; and KQ3 outcomes were assessed as low risk of bias.

Table G2. Risk of Bias Assessments of Randomized Controlled Trials (Crossover Design) with RoB-2

Author, Year PMID	Bias from randomization process	Bias from period and carryover effects	Bias from deviation from intended interventions (assignment)	Bias from missing outcome data	Bias in measurement of outcome	Bias in selection of reported result	Overall risk of bias (Low, Moderate, High)
Juraschek, 2013 ³⁵ PMID: 23219108	Low	Low	Low	Low	Low	Low	High

Abbreviations: PMID = PubMed Identification Number; RoB-2 = risk of bias tool for randomized trials

Note: When at least one domain is as a high risk of bias, we determined that a study had an overall risk of bias judgement of high risk of bias (based on the RoB-2 algorithm for reaching overall risk of bias judgement)

Author, Year PMID	Bias in selection of participants into the study (or into the analysis)	Bias due to post-exposure interventions	Bias due to missing data	Bias from measurement of the outcome	Bias in selection of the reported result	Bias due to confounding	Bias from measurement of the exposure	Overall risk of bias (Low, Moderate, High, Very high)
Alvirdizadeh, 2020 ³⁹ PMID: 33203389	Low	Low	High	Low	Low	-	-	High
Beasley, 2010 ¹⁰ PMID: 20219968	Low	Low	High	Low	Low	-	-	High
Beasley, 2013 ⁶⁵ PMID: 24219187	Low	Low	High	Low	Low	-	-	High
Beasley, 2014 ¹¹ PMID: 24552750	Low	Low	High	Low	Low	-	-	High
Cauley, 2016 ^{**12} PMID: 26988112	-	-	-	-	-	-	-	Very high
Chan, 2011 ¹³ PMID: 21437561	Low	Low	High	Low	Low	-	-	High
Chan, 2014 ⁶⁶ PMID: 24522470	Low	Low	High	Low	Low	-	-	High
Chen, 2023 ⁶⁷ PMID: 37922694	Low	Low	High	Low	Low	-	-	High
Cirillo, 2018 ⁴⁰ PMID: 29439930	Low	Low	High	Low	Low	-	-	High
Dargent- Molina, 2008 ¹⁴ PMID: 18665794	Low	Low	High	Low	Low	-	-	High
Devine, 2005 ¹⁵ PMID: 15941897	Low	Low	High	Low	Low	-	-	High

Table G3. Risk of Bias Assessments of Non-randomized Controlled Trials with ROBINS-E

Author, Year PMID	Bias in selection of participants into the study (or into the analysis)	Bias due to post-exposure interventions	Bias due to missing data	Bias from measurement of the outcome	Bias in selection of the reported result	Bias due to confounding	Bias from measurement of the exposure	Overall risk of bias (Low, Moderate, High, Very high)
Elstgeest, 2020 ⁶⁸ PMID: 32520344	Low	Low	High	Low	Low	-	-	High
Farhadnejad, 2019 ^{**41} PMID: 30579675	Low	Low	High	Low	Low	-	-	High
Farsijani, 2016 ⁶⁹ PMID: 27465379	Low	Low	High	Low	Low	-	-	High
Granic, 2018 ⁷⁰ PMID: 29191494	Low	Low	High	Low	Low	-	-	High
Halbesma, 2009 ⁴² PMID: 19443643	Low	Low	Very high	Low	Low	-	-	Very high
Hannan, 2000 ¹⁶ PMID: 11127216	Low	Low	High	Low	Low	-	-	High
Haring, 2017 ⁴³ PMID: 28065493	Low	Low	High	Low	Low	-	-	High
Hengeveld, 2021 ⁷¹ PMID: 33515002	Low	Low	High	Low	Low	-	-	High
Herber-Gast, 2016 ⁴⁴ PMID: 27935525	Low	Low	High	Low	Low	-	-	High
Houston, 2008 ⁷² PMID: 18175749	Low	Low	High	Low	Low	-	-	High
Hruby, 2018 ⁴⁵	Low	Low	High	Low	Low	-	-	High

Author, Year PMID	Bias in selection of participants into the study (or into the analysis)	Bias due to post-exposure interventions	Bias due to missing data	Bias from measurement of the outcome	Bias in selection of the reported result	Bias due to confounding	Bias from measurement of the exposure	Overall risk of bias (Low, Moderate, High, Very high)
PMID: 30115136								
Hu, 2014 ¹⁷ PMID: 25192416	Low	Low	High	Low	Low	-	-	High
Isanejad, 2016** ⁷³ PMID: 26857389	Low	Low	High	Low	Low	-	-	Very high
Jhee, 2020** ⁴⁶ PMID: 31172186	Low	Low	High	Low	Low	-	-	Very high
Key, 2007 ¹⁸ PMID: 17381900	Low	Low	High	Low	Low	-	-	High
Kim, 2021 ⁷⁴ PMID: 33740517	Low	Low	High	Low	Low	-	-	High
Knight, 2003 ⁴⁷ PMID: 12639078	Low	Low	High	Low	Low	-	-	Very high
Kubo, 2023** ⁴⁸ PMID: 37211392	Low	Low	High	Low	Low	-	-	High
Kwon, 2022** ⁴⁹ PMID: 35947164	Low	Low	High	Low	Low	-	-	High
Langsetmo, 2015 ¹⁹ PMID: 26412291	Low	Low	High	Low	Low	-	-	High
Langsetmo, 2017 ²⁰ PMID: 27943394	Low	Low	High	Low	Low	-	-	High
Lew, 2017** ⁵⁰ PMID: 27416946	Low	Low	High	Low	Low	-	-	High
Author, Year PMID	Bias in selection of participants into the study (or into the analysis)	Bias due to post-exposure interventions	Bias due to missing data	Bias from measurement of the outcome	Bias in selection of the reported result	Bias due to confounding	Bias from measurement of the exposure	Overall risk of bias (Low, Moderate, High, Very high)
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Liu, 2023 ²¹ PMID: 36986162	Low	Low	High	Low	Low	-	-	High
Malhotra, 2016** ⁵¹ PMID: 27562875	Low	Low	High	Low	Low	-	-	Very high
Malhotra, 2018 ⁵² PMID: 29452887	Low	Low	Very high	Low	Low	-	-	Very high
Mangano, 2017* ²² PMID: 28179224	Low	Low	High	Low	Low	-	-	High
Mendonca, 2021 ⁷⁵ PMID: 33829238	Low	Low	High	High	Low	-	-	Very high
Mendonca, 2023 ⁷⁶ PMID: 35791789	Low	Low	High	High	Low	-	-	Very high
Meng, 2009* ²³ PMID: 19419320	Low	Low	High	Moderate	Low	-	-	High
Misra, 2011 ²⁴ PMID: 20442986	Low	Low	High	Low	Low	-	-	High
Mulla, 2013 ⁷⁷ PMID: 22923606	Low	Low	High	Low	Low	-	-	High
Nakano, 2023 ²⁵ PMID: 36715763	Low	Low	High	Low	Low	-	-	High
Otsuka, 2020 ⁷⁸ PMID: 31608843	Low	Low	High	Low	Low	-	-	High

Author, Year PMID	Bias in selection of participants into the study (or into the analysis)	Bias due to post-exposure interventions	Bias due to missing data	Bias from measurement of the outcome	Bias in selection of the reported result	Bias due to confounding	Bias from measurement of the exposure	Overall risk of bias (Low, Moderate, High, Very high)
Promislow, 2002 ²⁶ PMID: 11914191	Low	Low	High	Low	Low	-	-	High
Rahi, 2016 ⁷⁹ PMID: 26179475	Low	Low	High	Low	Low	-	-	High
Rivera- Paredez, 2021 ²⁷ PMID: 33847345	Low	Low	Some concerns	Low	Low	Some concerns	Low	Moderate
Sahni, 2010 ²⁸ PMID: 20662074	Low	Low	High	Low	Low	-	-	High
Sahni, 2014 ²⁹ PMID: 24168918	Low	Low	High	Low	Low	-	-	High
Scott, 2010 ⁸⁰ PMID: 21054294	Low	Low	High	Low	Low	-	-	High
Sekiguchi, 2022 ⁵³ PMID: 35142012	Low	Low	High	Low	Low	-	-	High
Sellmeyer, 2001 ³⁰ PMID: 11124760	Low	Low	High	Low	Low	-	-	High
Shu, 2019 ⁵⁴ PMID: 31430246	Low	Low	Low	High	Low	-	-	High
So, 2020 ⁸¹ PMID: 32825743	Low	Low	High	Low	Low	-	-	High
Teymoori, 2022** ⁵⁵	Low	Low	High	Low	Low	-	-	High

Author, Year PMID	Bias in selection of participants into the study (or into the analysis)	Bias due to post-exposure interventions	Bias due to missing data	Bias from measurement of the outcome	Bias in selection of the reported result	Bias due to confounding	Bias from measurement of the exposure	Overall risk of bias (Low, Moderate, High, Very high)
PMID: 36532536								
Weaver, 2021 ³¹ PMID: 33677533	Low	Low	High	Low	Low	-	-	High
Wham, 2021 ⁸² PMID: 34124824	Low	Low	High	Low	Low	-	-	High

Abbreviations: PMID = PubMed Identification Number; ROBINS-E = risk of bias in non-randomized studies of exposures

Note: When at least one domain is as a high risk or very high risk of bias, we determined that a study had an overall risk of bias judgement of high risk or very high risk of bias (based on the ROBINS-E algorithm for reaching overall risk of bias judgement), *: Studies overlap KQs, **: Study risk of bias assessment did not progress beyond the preliminary questions in section B of the ROBINS-E tool used to decide whether to proceed with a risk-of-bias assessment, thus detailed risk-of-bias assessment was unnecessary

Appendix H. Strength of Evidence for All Analyzed Studies

Table H1. Strength of Evidence for Bone Disease (Adults)

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
Osteocalcii	n									
Bonjour, 2012 ³	OC Treated group (test food - 13.8 g protein) vs usual diet	Individuals recruited from France	1 no difference n=71 6 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion
CTX and T	RAP									
2012 ³	Treated group (test food - 13.8 g protein) vs usual diet)	recruited from France	1 no difference n=71 6 weeks	Low risk: 1	Direct	(single study)	Imprecise	NA	Insufficient	on which to draw a conclusion
Bonjour, 2012 ³	TRAP Treated group (test food - 13.8 g protein) vs usual diet)	Individuals recruited from France	1 found benefit n=71 6 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Precise	NA	Insufficient	Insufficient evidence on which to draw a conclusion
BAP and P	1NP									
Bonjour, 2012 ³	BAP Treated group (test food - 13.8 g protein) vs usual diet)	Individuals recruited from France	1 no difference n=71 6 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion
Bonjour, 2012 ³	P1NP Treated group (test food -	Individuals recruited from France	1 no difference n=71 6 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
	13.8 g protein) vs usual diet)									conclusion
Lumbar spir	ne BMD									
Kerstetter, 2015 ^{**5}	Lumbar spine BMD High protein (45g whey protein supplement isolate) vs low protein (carbohydrate -isocaloric maltodextrin control supplement)	Individuals recruited from U.S.	1 no difference n=171 18 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion
Skov, 2002 ⁷	Lumbar spine BMD High protein diet (protein - 25% of total energy) vs low protein diet (protein - 12% of total energy)	Individuals recruited from Denmark	1 no difference n=50 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion
Rivera- Paredez, 2021 ²⁷ Hip and fem	Lumbar spine (L1-L4) BMD No comparison arm poral neck BMD	Individuals recruited from Mexico	1 no difference n=317 6.4 years	1 non-RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion

Kerstetter, 2015**5Total hip BMD High protein (45g whey protein supplement isolate) vs low protein carbohydrate -isocaloric maltodextrin (Afs whey protein (carbohydrate -isocaloric maltodextrin (Afs whey protein supplement)Individuals recruited from U.S.1 RCT Low risk: 1 NADirectUnknown (single study)ImpreciseNAKerstetter, 2015**5Femoral neck BMDIndividuals recruited from U.S.1 no difference n=171 18 months1 RCT Low risk: 1DirectUnknown (single study)Imprecise NANAKerstetter, 2015**5Femoral neck BMDIndividuals recruited from U.S.1 no difference n=171 18 months1 RCT Low risk: 1DirectUnknown (single study)Imprecise NAKerstetter, 2015**5Femoral neck BMDIndividuals recruited from U.S.1 no difference n=171 18 months1 RCT Low risk: 1Direct Unknown (single study)Imprecise NA	Author, Year	Outcome Comparisons	Population	Findings (n	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
Kerstetter, 2015**5Total hip BMD High protein (45g whey protein supplement isolate) vs low protein (carbohydrate -isocaloric maltodextrin (45g whey proteinIndividuals recruited from U.S.1 RCT Low risk: 1DirectUnknown (single study)ImpreciseNAKerstetter, 2015**5Femoral neck BMDIndividuals 				Timing							
Kerstetter, 2015**5Femoral neck BMDIndividuals recruited from U.S.1 no difference n=171 18 months1 RCT Low risk: 1DirectUnknown (single study)ImpreciseNAHigh protein (45g whey protein supplement isolate) vs low protein (carbohydrate -isocaloric maltodextrin controlIndividuals recruited from U.S.1 no difference n=171 18 months1 RCT Low risk: 1DirectUnknown (single study)Imprecise NA	Kerstetter, 2015 ^{**5}	Total hip BMD High protein (45g whey protein supplement isolate) vs low protein (carbohydrate -isocaloric maltodextrin control supplement)	Individuals recruited from U.S.	1 no difference n=171 18 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion
supplement)	Kerstetter, 2015** ⁵	Femoral neck BMD High protein (45g whey protein supplement isolate) vs low protein (carbohydrate -isocaloric maltodextrin control supplement)	Individuals recruited from U.S.	1 no difference n=171 18 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion
Rivera- Paredez, 202127Total hip BMD Paredez, 202127Individuals recruited from Mexico1 no difference n=317 6.4 years1 non-RCT Low risk: 1DirectUnknown (single study)ImpreciseNA	Rivera- Paredez, 2021 ²⁷	Total hip BMD No comparison arm	Individuals recruited from Mexico	1 no difference n=317 6.4 years	1 non-RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion
Rivera- Paredez, 202127 Femoral neck BMD Individuals recruited from Mexico 1 found benefit n=317 1 non-RCT Low risk: 1 Direct Unknown (single study) Imprecise NA No comparison arm No 6.4 years -	Rivera- Paredez, 2021 ²⁷	Femoral neck BMD No comparison arm BMD and BMC	Individuals recruited from Mexico	1 found benefit n=317 6.4 years	1 non-RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
Skov, 2002 ⁷	Total body BMD High protein diet (protein - 25% of total energy) vs low protein diet (protein - 12% of total energy)	Individuals recruited from Denmark	1 no difference n=50 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion
Skov, 2002 ⁷	Total body BMC High protein diet (protein - 25% of total energy) vs low protein diet (protein - 12% of total energy)	Individuals recruited from Denmark	1 found benefit n=50 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Precise	NA	Insufficient	Insufficient evidence on which to draw a conclusion

Abbreviations: BAP = bone specific alkaline phosphatase; BMC = bone mineral content; BMD = bone mineral density; CTX = carboxy terminal crosslinked telopeptide of type I collagen; n = number analyzed; NA = not applicable; OC = osteocalcin; P1NP = amino-terminal propeptide of type I procollagen; RCT = randomized control trial; SoE = strength of evidence; TRAP = tartrate resistant acid phosphatase; U.S. = United States

Note: *Includes study design and RoB score, **: Study overlaps KQs

Table H2. Strength of Evidence for Bone Disease (Children and Adolescents)

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
Osteocalcin										
Stounbjerg, 2021 ⁸	Osteocalcin	Individuals recruited	1 found benefit n=184	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
	High protein (9-11 g protein/100 g) vs normal protein (3.0- 3.9 g protein/100 g)	from Denmark	24 weeks							on which to draw a conclusion
BMD and BM	AC of the lumbar	spine								
Stounbjerg, 2021 ⁸	BMD lumbar spine, L1- L4	Individuals recruited from Denmark	1 found benefit n=184 24 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a
	(9-11 g protein/100 g) vs normal protein (3.0- 3.9 g protein/100 g)									conclusion
Stounbjerg, 2021 ⁸	BMD lumbar spine, L1- L4 zscore High protein (9-11 g protein/100 g)	Individuals recruited from Denmark	1 found benefit n=184 24 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion
	vs normal protein (3.0- 3.9 g protein/100 g)									
Stounbjerg, 2021 ⁸	BMC lumbar spine, L1- L4 High protein	Individuals recruited from Denmark	1 no difference n=184 24 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion
	(9-11 g protein/100 g) vs normal protein (3.0-									

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
	3.9 g protein/100 g)									
BA lumbar s	pine									
Stounbjerg, 2021 ⁸	BA lumbar spine, L1-L4 High protein (9-11 g protein/100 g) vs normal protein (3.0- 3.9 g protein/100 g)	Individuals recruited from Denmark	1 no difference n=184 24 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insufficient	Insufficient evidence on which to draw a conclusion

Abbreviations: BA = bone area; BMC = bone mineral content; BMD = bone mineral density; n = number analyzed; NA = Not applicable; RCT = randomized controlled trial; SoE = strength of evidence; U.S. = United States

Note: *Includes study design and RoB score

Table H3. Strength of Evidence for Kidney Disease

Author, Year	Outcome Comparisons	Populatio n	Findings (n analyzed) Timing	Limitations *	Directness	Study Consistency	Precision Reportin g	Reportin g Bias	Grad e	Conclusion
Kidney Fun	iction									
Wycherle y, 2012** ³⁸	Creatinine clearance High protein (35% energy from protein) vs low protein (high carbohydrate - 17% energy from protein)	Individuals recruited from Australia	1 no difference (n=120)** *	1 RCT Moderate risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Abbreviations: n = number analyzed; NA = Not applicable; RCT = randomized controlled trial; U.S. = United States

Note: *Includes study design and RoB score; **: Study overlaps KQs; *** Baseline characteristics were presented for participants who completed the 52-week intervention; but intention-to-treat evaluation was conducted for the full sample.

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
Muscle Ma	SS									
Backx, 2016 ⁵⁶	Total body lean mass by DXA High protein diet (contain 1.7g of protein/kg/day) vs normal protein diet (contain 0.9 g protein/kg/day)	Individuals recruited from the Netherland s	1 no difference (n=NR) 12 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Kerstetter , 2015** ⁵	Total body lean mass by DXA High protein (45g whey protein supplement isolate) vs low protein (carbohydrate - isocaloric maltodextrin control supplement)	Individuals recruited from U.S.	1 no difference (n=207) 18 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Precise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Smith, 2018 ⁶²	Total body lean mass by DXA Weight loss plus whey protein supplement (hypocaloric diet with increased protein intake 1.2 g/kg/d) vs weight loss plus	Individuals recruited from U.S.	1 no difference (n=52) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
	recommended protein (hypocaloric diet with 0.8 g/kg/d protein)									
Li, 2021 ⁶⁰	Total body lean mass by DXA Whey Protein (whey protein blended supplement), soy protein blended supplement), whey-Soy protein group (1:1 ratio of whey and soy blended supplement) vs control (no supplementation)	Individuals recruited from China	1 found benefit (n=123) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Precise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Li, 2021 ⁶⁰	Appendicular lean mass/ skeletal muscle mass by DXA Whey Protein (whey protein blended supplement), soy protein (soy protein blended supplement), whey-Soy protein group (1:1 ratio of whey and soy blended supplement) vs	Individuals recruited from China	1 found benefit (n=123) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Precise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Author, Year	Outcome Comparisons	Population	Findings (n analyzed)	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
			Timing							
	control (no supplementation)									
Backx, 2016 ⁵⁶	Appendicular lean mass / skeletal muscle mass by DXA High protein diet	Individuals recruited from the Netherland s	1 no difference (n=NR) 6 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
	protein/Kg/day) vs normal protein diet (contain 0.9 g protein/Kg/day)									
Zhu, 2015 ⁶⁴	Appendicular lean mass/ skeletal muscle mass by DXA High Protein (supplement drink - 30 g of protein per day) vs placebo supplement (high- carbohydrate drink supplement drink - 2.1 g of protein per day)	Individuals recruited from Australia	1 no difference (n=181) 2 years	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Li, 2021 ⁶⁰	Appendicular skeletal muscle mass index Whey Protein (whey protein blended supplement), soy protein (soy protein blended	Individuals recruited from China	1 found benefit (n=123) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Precise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
	supplement), whey-Soy protein group (1:1 ratio of whey and soy blended supplement) vs control (no supplementation)									
Zhu, 2015 ⁶⁴	Appendicular skeletal muscle mass index High Protein (supplement drink - 30 g of protein per day) vs placebo supplement (high- carbohydrate drink supplement drink - 2.1 g of protein per day)	Individuals recruited from Australia	1 no difference (n=181) 2 years	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Haghighat , 2021 ⁵⁸	Whole skeletal muscle mass by BIA High protein (high protein snack (50g of soybeans, protein: 18.2 g)) vs low protein (~3.5 servings of fruit, protein: <2 g)	Individuals recruited from Iran	1 found benefit (n=107) 6 months	1 RCT Moderate risk: 1	Direct	Unknown (single study)	Precise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Englert, 2021 ⁵⁷	FFM by BIA	Individuals recruited	1 no difference (n=54)	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence

Author, Year	Outcome Comparisons	Population	Findings (n analyzed)	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
			Timing							
	High Protein (1.5 g/kg body weight) vs normal protein (0.8 g/kg body weight)	trom Germany	12 Weeks							on which to draw a conclusion
Reinders, 2022 ⁶¹	FFM by BIA Protein advice (advised to increase protein intake to≥1.2 g/kg aBW/d) vs control (no advice to increase protein consumption)	Individuals recruited from Finland and the Netherland s	1 no difference (n=187) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Smith, 2018 ⁶²	FFM by DXA Weight loss plus whey protein supplement (hypocaloric diet with increased protein intake 1.2 g/kg/d) vs weight loss plus recommended protein (hypocaloric diet with 0.8 g/kg/d protein)	Individuals recruited from U.S.	1 no difference (n=52) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Wycherle y, 2012** ³⁸	FFM by DXA High protein (35% energy from protein) vs low protein (high carbohydrate -	Individuals recruited from Australia	1 no difference (n=120)** * 52 weeks	1 RCT Moderate risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
	17% energy from protein)									
Physical pe	erformance									
Zhu, 2015 ⁶⁴	TUG High Protein (supplement drink - 30 g of protein per day) vs placebo supplement (high- carbohydrate drink supplement drink - 2.1 g of protein per day)	Individuals recruited from Australia	1 no difference (n=181) 2 years	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Li, 2021 ⁶⁰	4 m gait speed Whey Protein (whey protein blended supplement), soy protein blended supplement), whey-Soy protein group (1:1 ratio of whey and soy blended supplement) vs control (no supplementation)	Individuals recruited from China	1 found benefit (n=123) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Precise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Backx, 2016 ⁵⁶	400m walk speed High protein diet (contain 1.7g of protein/Kg/day) vs normal protein	Individuals recruited from the Netherland s	1 no difference (n=59) 12 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
	diet (contain 0.9 g protein/Kg/day)									
Englert, 2021 ⁵⁷	400m walk speed High Protein (1.5 g/kg body weight) vs normal protein (0.8 g/kg body weight)	Individuals recruited from Germany	1 no difference (n=54) 12 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Reinders, 2022 ⁶¹	400m walk speed Protein advice (advised to increase protein intake to≥1.2 g/kg aBW/d) vs control (no advice to increase protein consumption)	Individuals recruited from Finland and the Netherland s	1 found benefit (n=187) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Precise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Backx, 2016 ⁵⁶	SPPB High protein diet (contain 1.7g of protein/Kg/day) vs normal protein diet (contain 0.9 g protein/Kg/day)	Individuals recruited from the Netherland s	1 no difference (n=60) 12 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Englert, 2021 ⁵⁷	SPPB High Protein (1.5 g/kg body weight) vs normal protein (0.8 g/kg body weight)	Individuals recruited from Germany	1 no difference (n=54) 12 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
Reinders, 2022 ⁶¹	SPPB Protein advice (advised to increase protein intake to≥1.2 g/kg aBW/d) vs control (no advice to increase protein consumption)	Individuals recruited from Finland and the Netherland s	1 no difference (n=187) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Li, 2021 ⁶⁰	SPPB Whey Protein (whey protein blended supplement), soy protein (soy protein blended supplement), whey-Soy protein group (1:1 ratio of whey and soy blended supplement) vs control (no supplementation)	Individuals recruited from China	1 found benefit (n=123) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Precise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Muscle Stre	ength									
Backx, 2016 ⁵⁶	Handgrip strength High protein diet (contain 1.7g of protein/Kg/day) vs normal protein diet (contain 0.9 g protein/Kg/day)	Individuals recruited from the Netherland s	1 no difference (n=60) 12 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Author, Year	Outcome Comparisons	Population	Findings (n analyzed)	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
			riming							
Li, 2021 ⁶⁰	Handgrip strength Whey Protein (whey protein blended supplement), soy protein (soy protein blended supplement), whey-Soy protein group (1:1 ratio of whey and soy blended supplement) vs control (no supplementation)	Individuals recruited from China	1 no difference (n=123) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Precise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Reinders, 2022 ⁶¹	Handgrip strength Protein advice (advised to increase protein intake to≥1.2 g/kg aBW/d) vs control (no advice to increase protein consumption)	Individuals recruited from Finland and the Netherland s	1 no difference (n=187) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Zhu, 2015 ⁶⁴	Handgrip strength High Protein (supplement drink - 30 g of protein per day) vs placebo supplement (high-	Individuals recruited from Australia	1 no difference (n=181) 2 years	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
	carbohydrate drink supplement drink - 2.1 g of protein per day)									
Englert, 2021 ⁵⁷	Handgrip strength High Protein (1.5 g/kg body weight) vs normal protein (0.8 g/kg body weight)	Individuals recruited from Germany	1 found benefit (n=54) 12 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Backx, 2016 ⁵⁶	1-RM leg press High protein diet (contain 1.7g of protein/Kg/day) vs normal protein diet (contain 0.9 g protein/Kg/day)	Individuals recruited from the Netherland s	1 no difference (n=53) 12 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Zhu, 2015 ⁶⁴	Knee flexor strength High Protein (supplement drink - 30 g of protein per day) vs placebo supplement (high- carbohydrate drink supplement drink - 2.1 g of protein per day)	Individuals recruited from Australia	1 no difference (n=181) 2 years	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Backx, 2016 ⁵⁶	Leg extensor strength (1-RM leg extension)	Individuals recruited from the	1 no difference (n=53) 12 weeks	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
	High protein diet (contain 1.7g of protein/Kg/day) vs normal protein diet (contain 0.9 g protein/Kg/day)	Netherland s								conclusion
Zhu, 2015 ⁶⁴	Leg extensor strength (knee extensor strength) High Protein (supplement drink - 30 g of protein per day) vs placebo supplement (high- carbohydrate drink supplement drink - 2.1 g of protein per day)	Individuals recruited from Australia	1 no difference (n=181) 2 years	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Reinders, 2022 ⁶¹	Leg extensor strength Protein advice (advised to increase protein intake to≥1.2 g/kg aBW/d) vs control (no advice to increase protein consumption)	Individuals recruited from Finland and the Netherland s	1 found benefit (n=187) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Smith, 2018 ⁶²	Sum 1-RM strength Weight loss plus whey protein	Individuals recruited from U.S.	1 no difference (n=52) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
	supplement (hypocaloric diet with increased protein intake 1.2 g/kg/d) vs weight loss plus recommended protein (hypocaloric diet with 0.8 g/kg/d protein)									
Smith, 2018 ⁶²	Sum knee extension peak torque Weight loss plus whey protein supplement (hypocaloric diet with increased protein intake 1.2 g/kg/d) vs weight loss plus recommended protein (hypocaloric diet with 0.8 g/kg/d protein)	Individuals recruited from U.S.	1 no difference (n=52) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion
Smith, 2018 ⁶²	Sum knee flexion peak torque Weight loss plus whey protein supplement (hypocaloric diet with increased protein intake 1.2 g/kg/d) vs weight loss plus	Individuals recruited from U.S.	1 no difference (n=52) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Imprecise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Author, Year	Outcome Comparisons	Population	Findings (n analyzed) Timing	Limitations*	Directness	Study Consistency	Precision Reporting	Reporting Bias	Grade	Conclusion
	recommended protein (hypocaloric diet with 0.8 g/kg/d protein)									
Li, 2021 ⁶⁰	Chair stand Whey Protein (whey protein blended supplement), soy protein (soy protein blended supplement), whey-Soy protein group (1:1 ratio of whey and soy blended supplement) vs control (no supplementation	Individuals recruited from China	1 found benefit (n=123) 6 months	1 RCT Low risk: 1	Direct	Unknown (single study)	Precise	NA	Insuffi cient	Insufficient evidence on which to draw a conclusion

Abbreviations: aBW = adjusted body weight; BIA = bioelectrical impedance analysis; d = day; DXA = dual-energy X-ray absorptiometry; g = gram(s); kg = kilogram(s); n = number analyzed; NA = not applicable; NR = not reported; RCT = randomized controlled trial; RM = repetition maximum; SoE = strength of evidence; SPPB = Short physical performance battery; TUG = Timed Up-and-Go; FFM = fat free mass; U.S. = United States

Note: *Includes study design and RoB score, **: Studies overlap KQs, *** Baseline characteristics were presented for participants who completed the 52-week intervention; but intention-to-treat evaluation was conducted for the full sample.

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