Nutritional Recommendations to Prevent Osteoporosis

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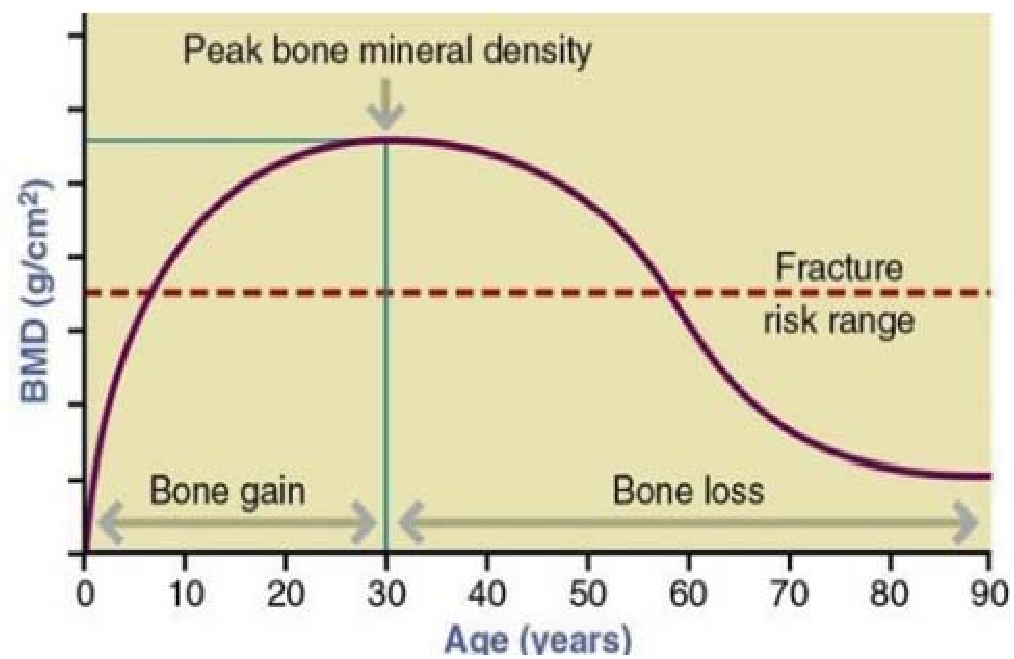
Outline

- Introduction
- Macronutrients
- Main micronutrients
- Dairy products, coffee, sugar sweetened beverages
- Dietary indices & dietary patterns
- The role of BMI in bone health
- Integrative approach and its advantages
- Conclusion

Introduction

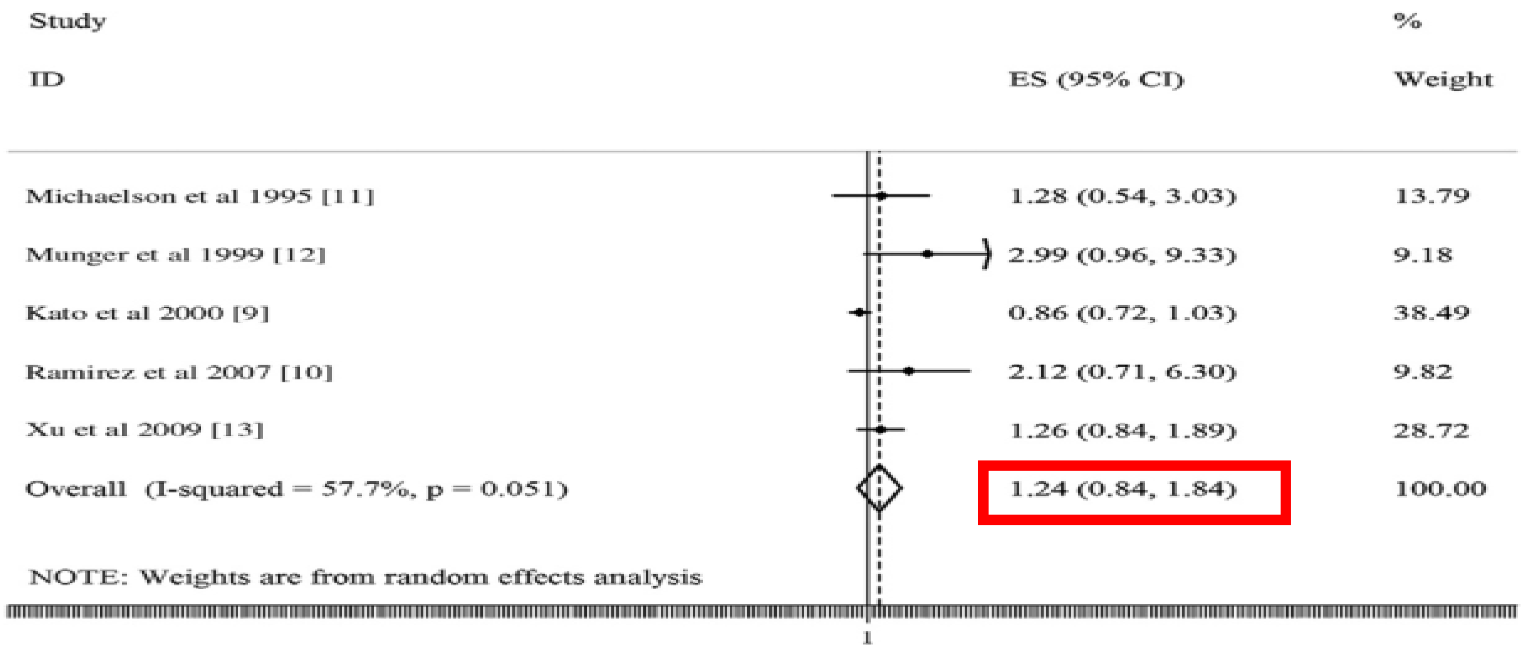
- Adequate nutrition is essential for the development and maintenance of the skeleton.



Janice Raymond Kelly Morrow. Krause and Mahan's Food & the Nutrition Care Process;15th Edition

Macronutrients & Bone health

Carbohydrate & Fracture



Mozaffari, H., et al (2020). Dietary carbohydrate intake and risk of bone fracture: a systematic review and meta-analysis of observational studies. *Public health*, *181*, 102-109.

GI, GL, & Fracture

- A cohort study on subjects aged 55-80 y (n=870):

  At high cardiovascular disease risk

  Follow up: 9 years

- New cases of osteoporotic-related fractures: 114

✓ Association with Glycemic Index: HR: (1.80; 95% CI: 1.03, 3.15)

✓ Association with Glycemic Load: HR: (3.20; 95% CI: 1.25, 8.18)

García-Gavilán, J. F., et al. (2018). Higher dietary glycemic index and glycemic load values increase the risk of osteoporotic fracture in the PREvención con DIeta MEDiterránea (PREDIMED)-Reus trial. *The American journal of clinical nutrition*, *107*(6), 1035-1042.

Possible mechanisms of sugar to induce osteoporosis

↑Ca and Mg urinary excretion

↓Ca absorption and transport in the intestine

↑Osteoclasic & decrease in osteoblastic activities

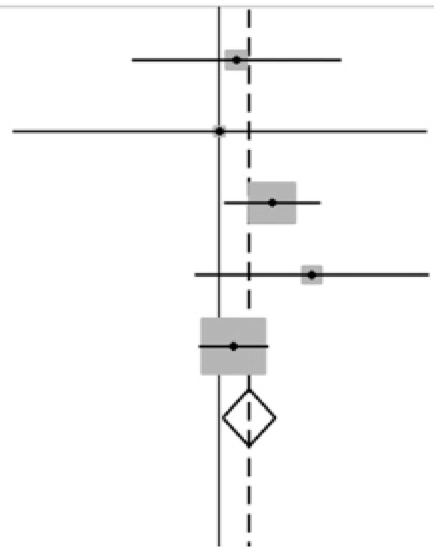
↓Vitamin D activation

↑ Inflammation, hyperinsulinemia, increased renal acid load

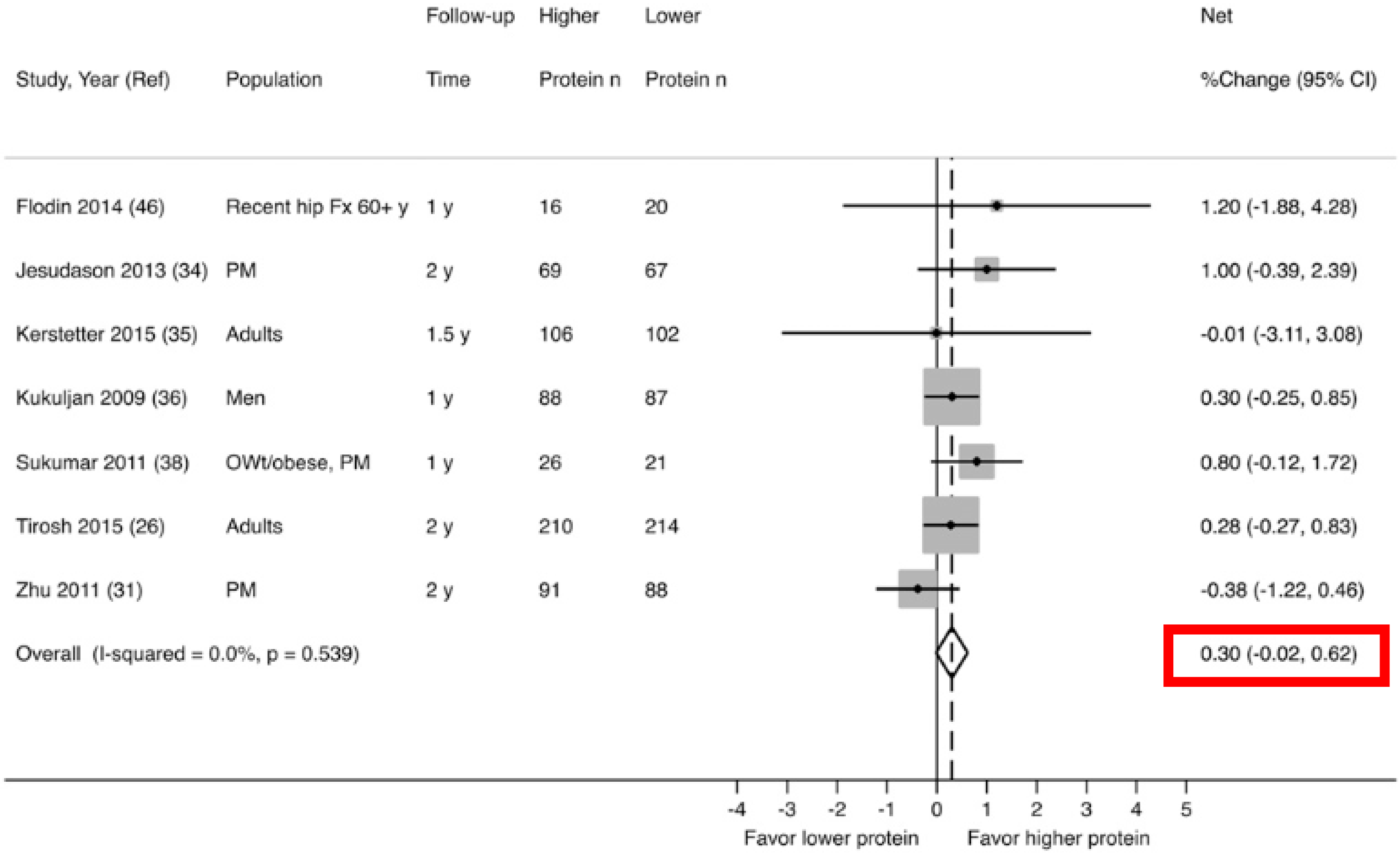
DiNicolantonio, J. J., et al. (2018). Not salt but sugar as aetiological in osteoporosis: A review. *Missouri medicine*, *115*(3), 247.

Protein intake & BMD (lumbar spine)

Study, Year (Ref)	Population	Follow-up Time	Higher Protein n	Lower Protein n	Net %Change (95% CI)
Jesudason 2013 (34)	PM	2 y	69	67	0.30 (-1.51, 2.11)
Kerstetter 2015 (35)	Adults	1.5 y	105	102	0.01 (-3.56, 3.58)
Kukuljan 2009 (36)	Men	1 y	88	87	0.92 (0.08, 1.75)
Sukumar 2011 (38)	OWt/obese, PM	1 y	26	21	1.60 (-0.42, 3.62)
Tirosh 2015 (26)	Adults	2 y	210	214	0.25 (-0.35, 0.85)
Overall (I-squared = 0.0%, p = 0.579)					0.52 (0.06, 0.97)



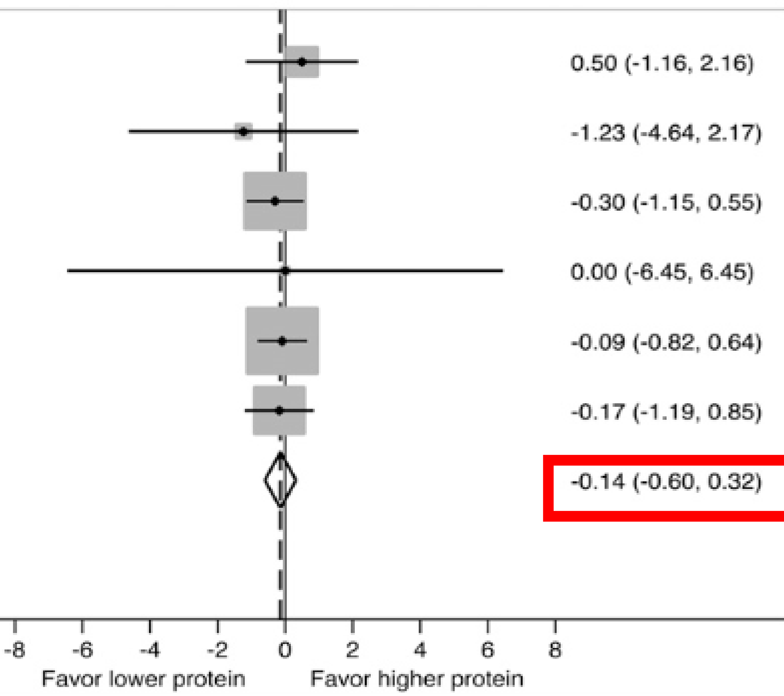
Protein intake & BMD (hip bone)



Shams-White, M. M., et al. (2018). Dietary protein and bone health: a systematic review and meta-analysis from the National Osteoporosis Foundation. *The American journal of clinical nutrition*, *105*(6), 1528-1543.

Protein intake & BMD (femoral neck)

Study, Year (Ref)	Population	Follow-up Time	Higher Protein n	Lower Protein n	Net %Change (95% CI)
Jesudason 2013 (34)	PM	2 y	69	67	0.50 (-1.16, 2.16)
Kerstetter 2015 (35)	Adults	1.5 y	106	102	-1.23 (-4.64, 2.17)
Kukuljan 2009 (36)	Men	1 y	88	87	-0.30 (-1.15, 0.55)
Sukumar 2011 (38)	OWt/obese, PM	1 y	26	21	0.00 (-6.45, 6.45)
Tirosh 2015 (26)	Adults	2 y	210	214	-0.09 (-0.82, 0.64)
Zhu 2011 (31)	PM	2 y	91	88	-0.17 (-1.19, 0.85)
Overall (I-squared = 0.0%, p = 0.952)					-0.14 (-0.60, 0.32)



Shams-White, M. M., et al. (2018). Dietary protein and bone health: a systematic review and meta-analysis from the National Osteoporosis Foundation. *The American journal of clinical nutrition*, *105*(6), 1528-1543.

Animal vs. plant protein

- Systematic reviews and meta-analysis on cohort studies (n=10):

Follow-up: 3-13 years

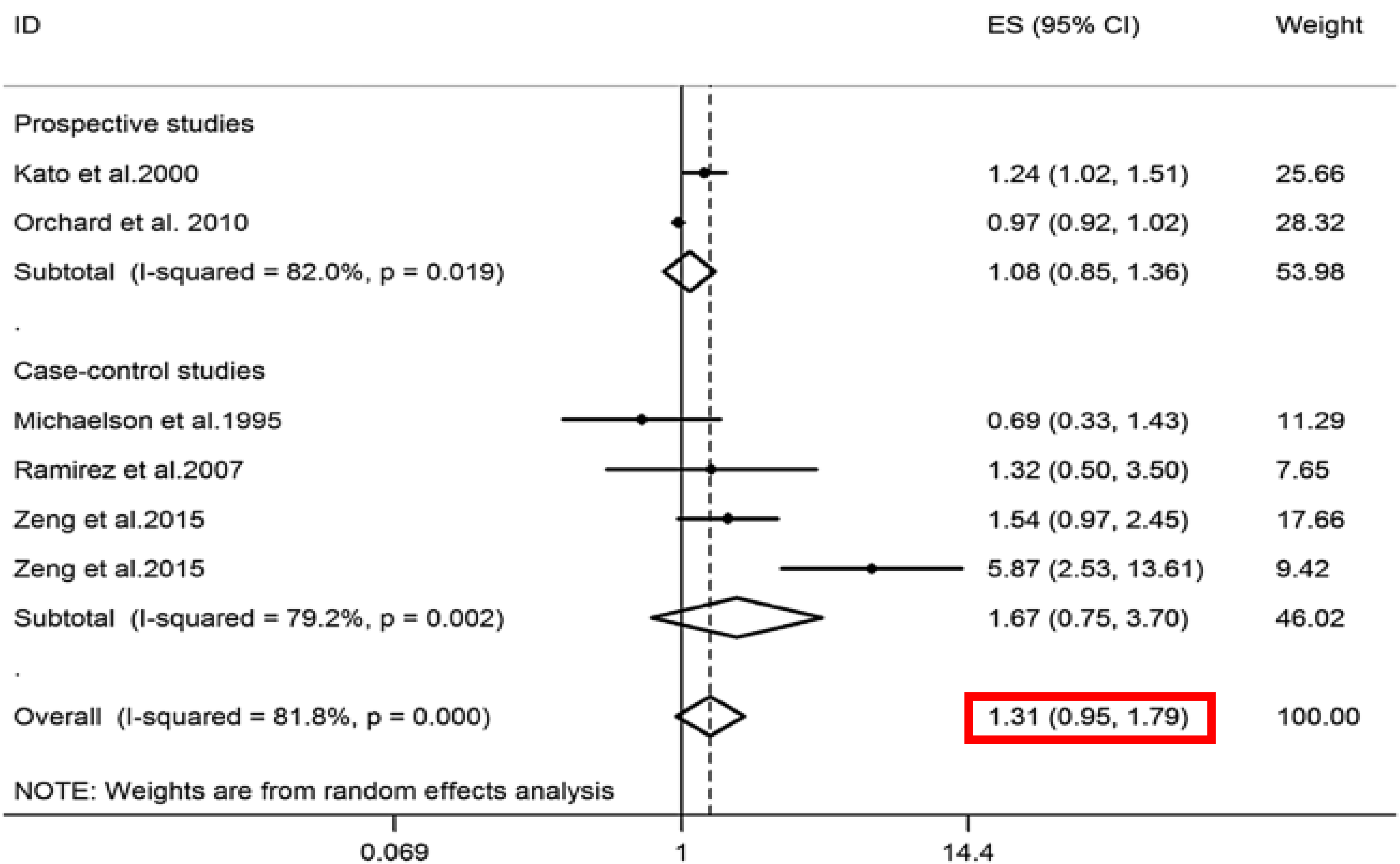
Findings: No significant dose-response relationships

between levels of plant or animal protein intake and bone loss (changes in BMD)

No significant difference between isoflavone-rich, isoflavone-poor, or animal protein at several but not all BMD sites

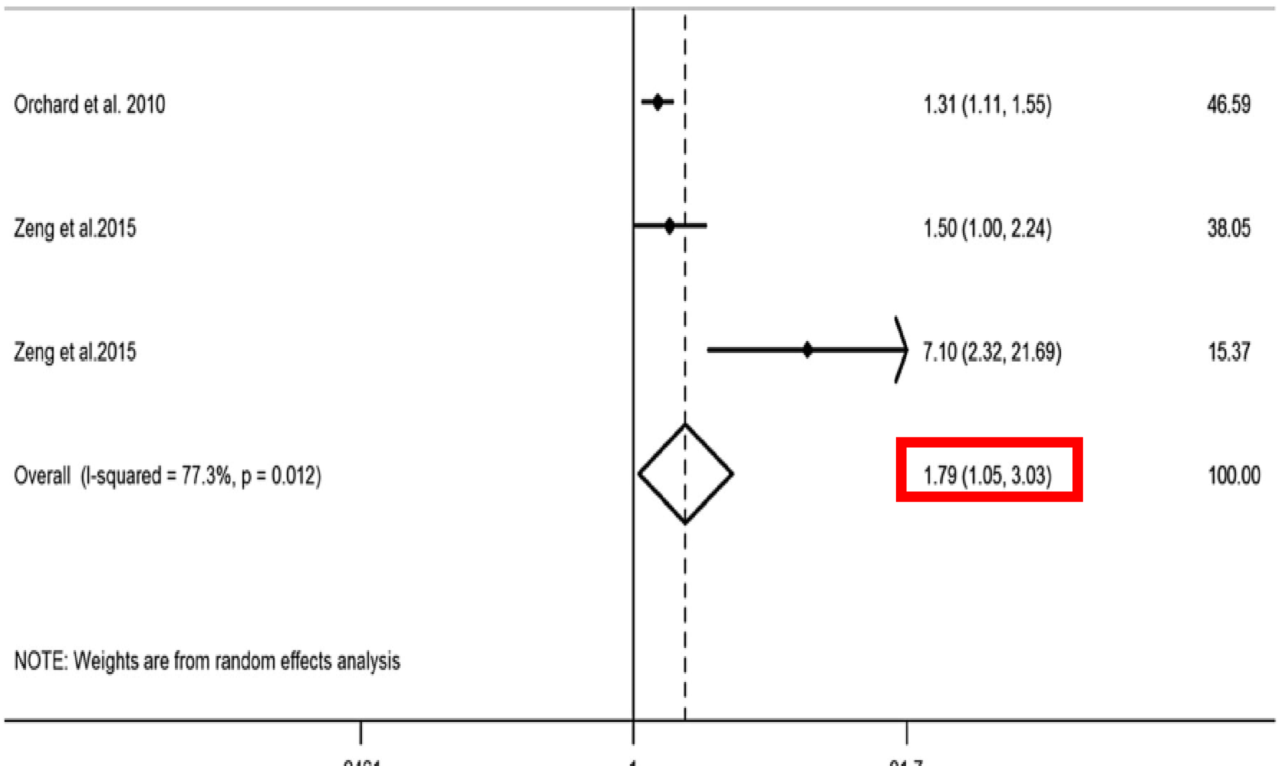
Consumption of soy protein is not more advantageous as compared to animal proteins, or vice versa

Dietary fat & fracture



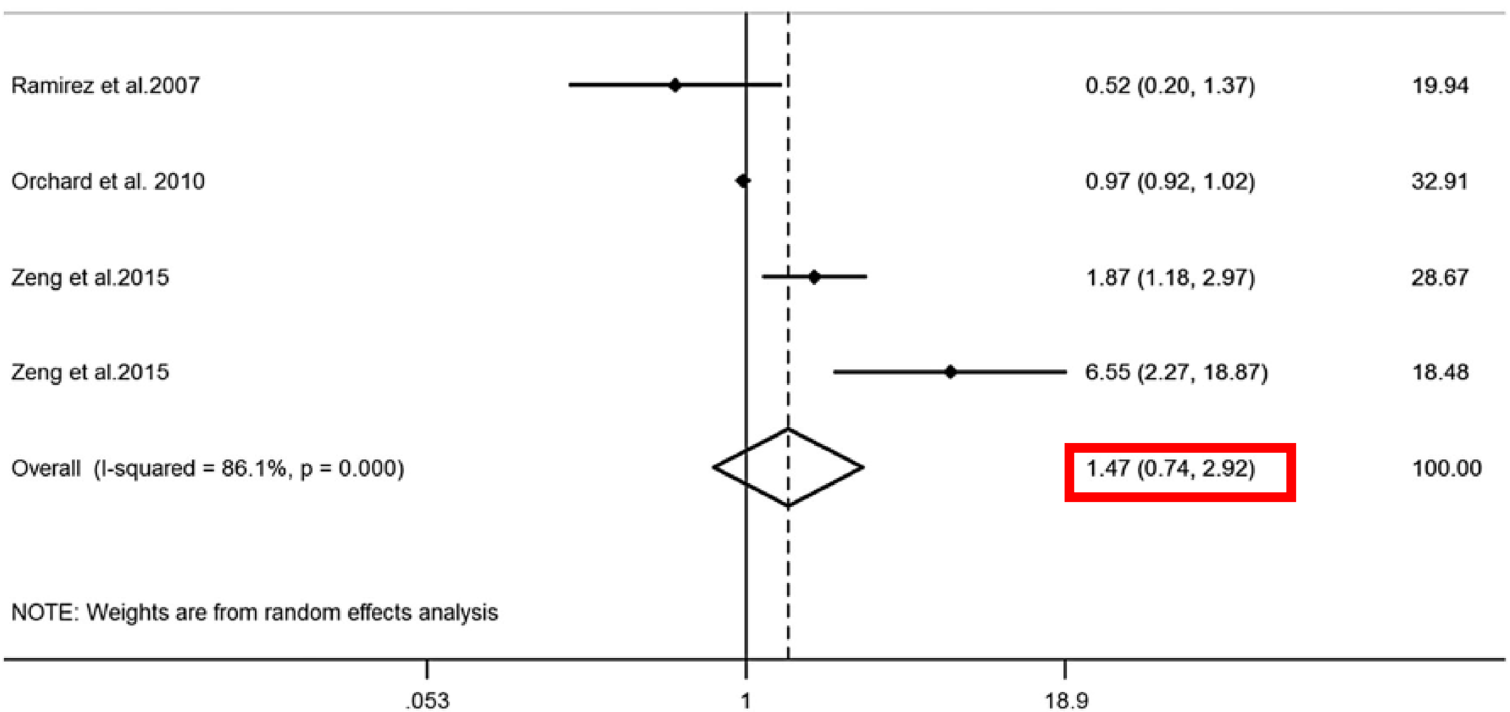
Mozaffari, H., et al. (2018). Dietary fat, saturated fatty acid, and monounsaturated fatty acid intakes and risk of bone fracture: a systematic review and meta-analysis of observational studies. *Osteoporosis International*, *29*(9), 1949-1961.

Saturated fatty acids & hip fracture



Mozaffari, H., et al. (2018). Dietary fat, saturated fatty acid, and monounsaturated fatty acid intakes and risk of bone fracture: a systematic review and meta-analysis of observational studies. *Osteoporosis International*, *29*(9), 1949-1961.

Monounsaturated fatty acids & fracture



Mozaffari, H., et al. (2018). Dietary fat, saturated fatty acid, and monounsaturated fatty acid intakes and risk of bone fracture: a systematic review and meta-analysis of observational studies. *Osteoporosis International*, *29*(9), 1949-1961.

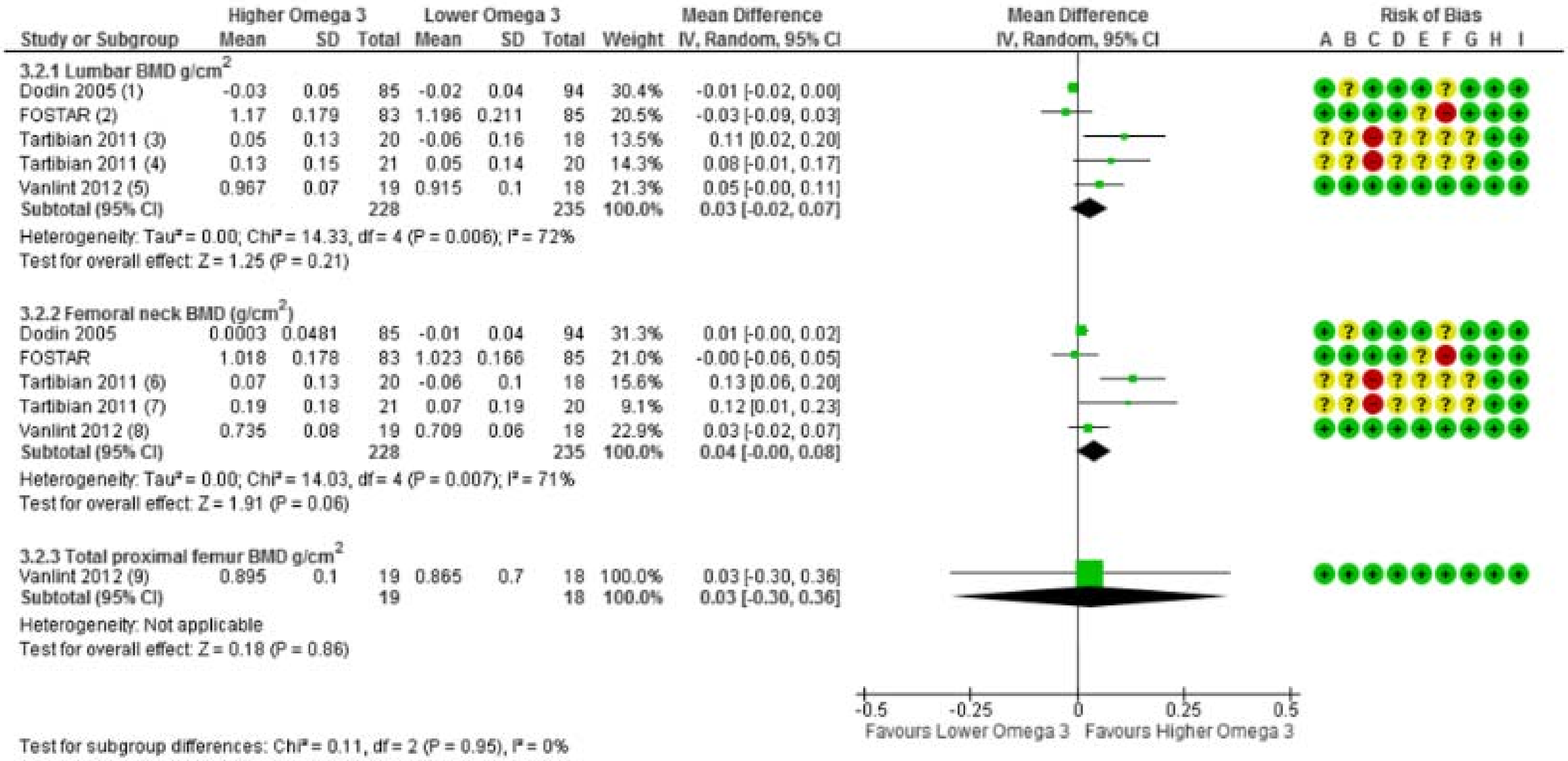
Possible mechanisms

Diet with high SFA:

- ✓Increases urinary excretion of calcium and magnesium
- ✓Reduces efficacy of calcium absorption due to formation of soaps with calcium
- ✓is highly correlated with serum retinol level and retinoic acid induces osteoclast formation and inhibits osteoblast activity

Mozaffari, H., et al. (2018). Dietary fat, saturated fatty acid, and monounsaturated fatty acid intakes and risk of bone fracture: a systematic review and meta-analysis of observational studies. *Osteoporosis International*, *29*(9), 1949-1961.

Omega-3 & BMD



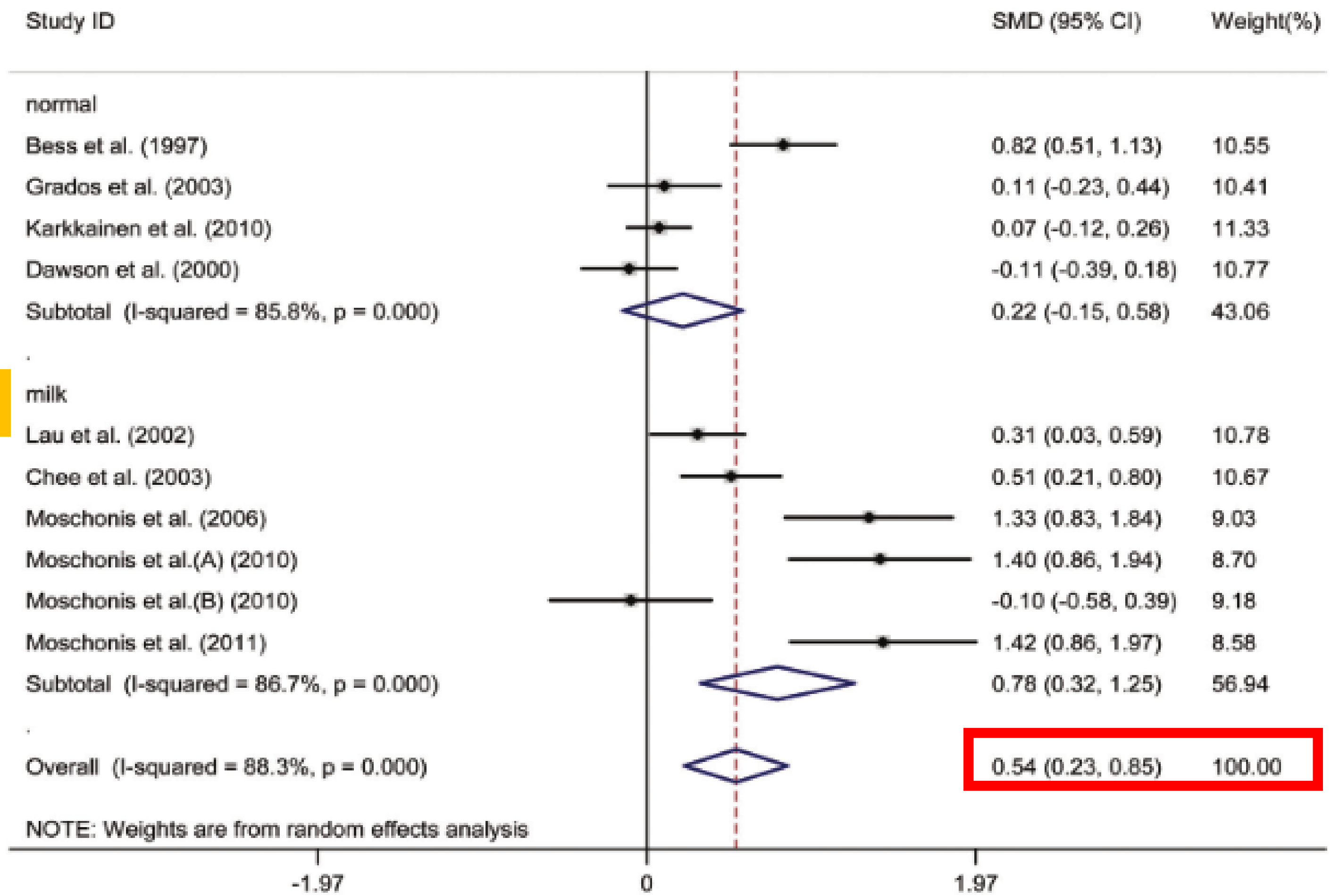
Study or Subgroup	Higher Omega 3 Mean	Higher Omega 3 SD	Higher Omega 3 Total	Lower Omega 3 Mean	Lower Omega 3 SD	Lower Omega 3 Total	Weight	Mean Difference IV, Random, 95% CI
3.2.1 Lumbar BMD g/cm^2								
Dodin 2005 (1)	-0.03	0.05	85	-0.02	0.04	94	30.4%	-0.01 [-0.02, 0.00]
FOSTAR (2)	1.17	0.179	83	1.196	0.211	85	20.5%	-0.03 [-0.09, 0.03]
Tartibian 2011 (3)	0.05	0.13	20	-0.06	0.16	18	13.5%	0.11 [0.02, 0.20]
Tartibian 2011 (4)	0.13	0.15	21	0.05	0.14	20	14.3%	0.08 [-0.01, 0.17]
Vanlint 2012 (5)	0.967	0.07	19	0.915	0.1	18	21.3%	0.05 [-0.00, 0.11]
Subtotal (95% CI)			**228**			**235**	**100.0%**	**0.03 [-0.02, 0.07]**
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 14.33$, df = 4 (P = 0.006); $I^2 = 72\%$								
Test for overall effect: Z = 1.25 (P = 0.21)								
3.2.2 Femoral neck BMD (g/cm^2)								
Dodin 2005	0.0003	0.0481	85	-0.01	0.04	94	31.3%	0.01 [-0.00, 0.02]
FOSTAR	1.018	0.178	83	1.023	0.166	85	21.0%	-0.00 [-0.06, 0.05]
Tartibian 2011 (6)	0.07	0.13	20	-0.06	0.1	18	15.6%	0.13 [0.06, 0.20]
Tartibian 2011 (7)	0.19	0.18	21	0.07	0.19	20	9.1%	0.12 [0.01, 0.23]
Vanlint 2012 (8)	0.735	0.08	19	0.709	0.06	18	22.9%	0.03 [-0.02, 0.07]
Subtotal (95% CI)			**228**			**235**	**100.0%**	**0.04 [-0.00, 0.08]**
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 14.03$, df = 4 (P = 0.007); $I^2 = 71\%$								
Test for overall effect: Z = 1.91 (P = 0.06)								
3.2.3 Total proximal femur BMD g/cm^2								
Vanlint 2012 (9)	0.895	0.1	19	0.865	0.7	18	100.0%	0.03 [-0.30, 0.36]
Subtotal (95% CI)			**19**			**18**	**100.0%**	**0.03 [-0.30, 0.36]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.18 (P = 0.86)								
Test for subgroup differences: $Chi^2 = 0.11$, df = 2 (P = 0.95), $I^2 = 0\%$								

Abdelhamid, A., et al. (2019). The relationship between omega-3, omega-6 and total polyunsaturated fat and musculoskeletal health and functional status in adults: a systematic review and meta-analysis of RCTs. *Calcified tissue international*, *105*(4), 353-372.

Micronutrients & Bone Health

Calcium+Vitamin D & total BMD

Enriched



Liu, C., et al. (2020). Effects of combined calcium and vitamin D supplementation on osteoporosis in postmenopausal women: a systematic review and meta-analysis of randomized controlled trials. *Food & Function*, *11*(12), 10817-10827.

Recommended daily calcium intake

Recommended daily calcium intakes (IOM, NAM)		
	Age	Calcium Recommended daily Intake (mg/day)
Infancy to Adolescence	0-6 months	200
	6-12 months	260
	1-3 years	700
	4-8 years	1000
	9-13 years	1300
	14-18 years	1300
Adulthood	19-50 years	1000
	51-70 years	Females 1200 Males 1000
	Over 70 years	1200

IOF. Available at: https://www.osteoporosis.foundation/educational-hub/topic/calcium/calcium-recommendations

Calcium content of dietary products

Products.	Portion	Calcium Content (mg)
Whole milk	200 mL	236
Semi-skimmed milk	200 mL	240
Skimmed milk	200 mL	244
Sheep milk	200 mL	380
Soy dring (non-enriched)	200 mL	26
Soy drink (calcium-enriched)	200 mL	240
Rice drink	200 mL	22
Almond milk	200 mL	90
Flavoured yoghurt	150 g	197
Natural yoghurt	150 g	207
Hard cheese (e.g., Parmesan, Cheddar)	30 g	240
Fresh cheese (e.g., Ricotta, cottage cheese)	200	138
Mozzarella	60	242

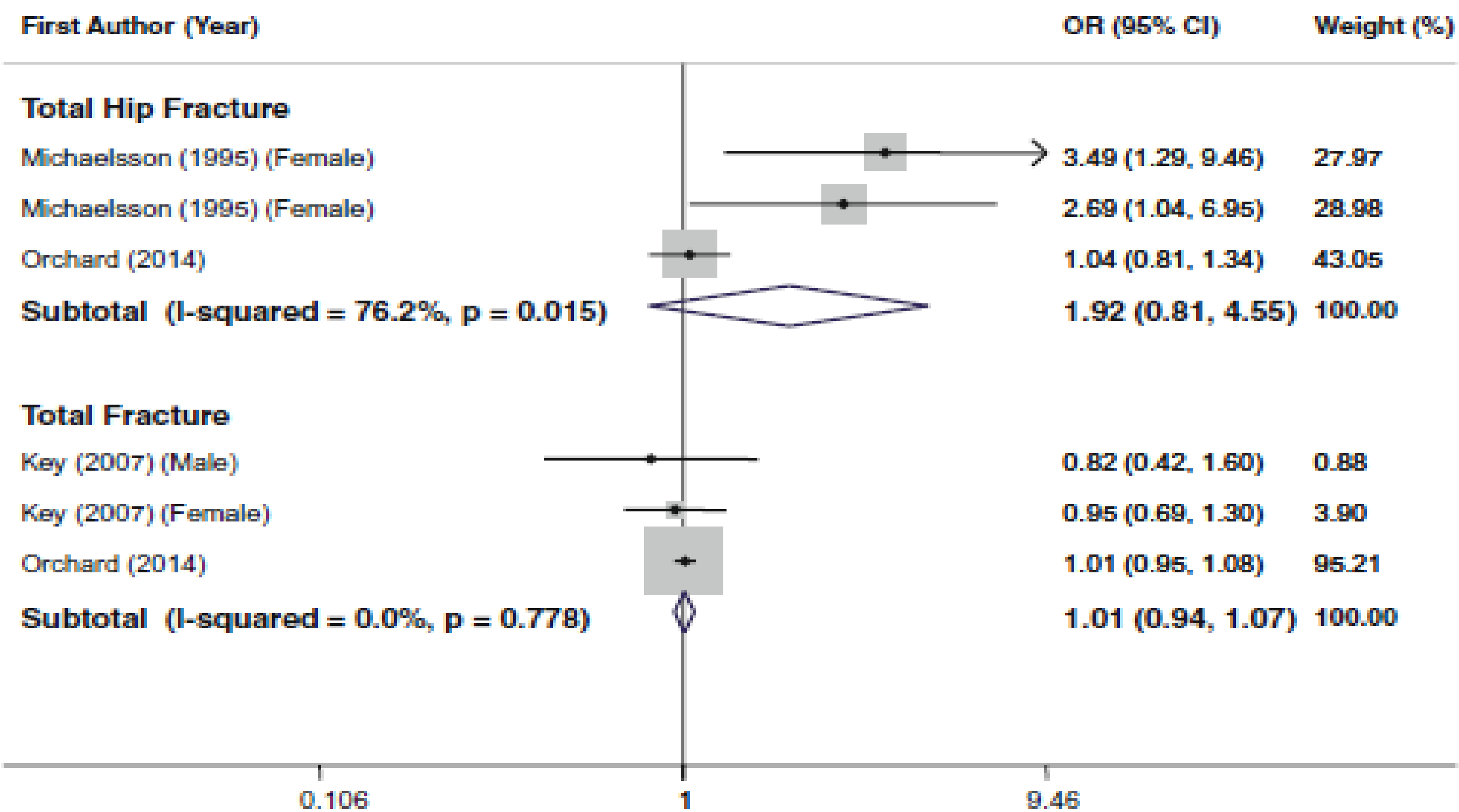
Ratajczak, A. E., et al. (2021). Milk and Dairy Products: Good or Bad for Human Bone? Practical Dietary Recommendations for the Prevention and Management of Osteoporosis. *Nutrients*, *13*(4), 1329.

Dietary sources of vitamin D

Food	Vitamin D content (IU) *
Wild Salmon	600-1000
Farmed Salmon	100-250
Sardines, canned	300-600
Tuna, canned	236
Shitake mushrooms, fresh	100
Shitake mushrooms, sun-dried	1600
Egg Yolk	20 per yolk
*per 100 mg unless otherwise stated IU: International Unit	

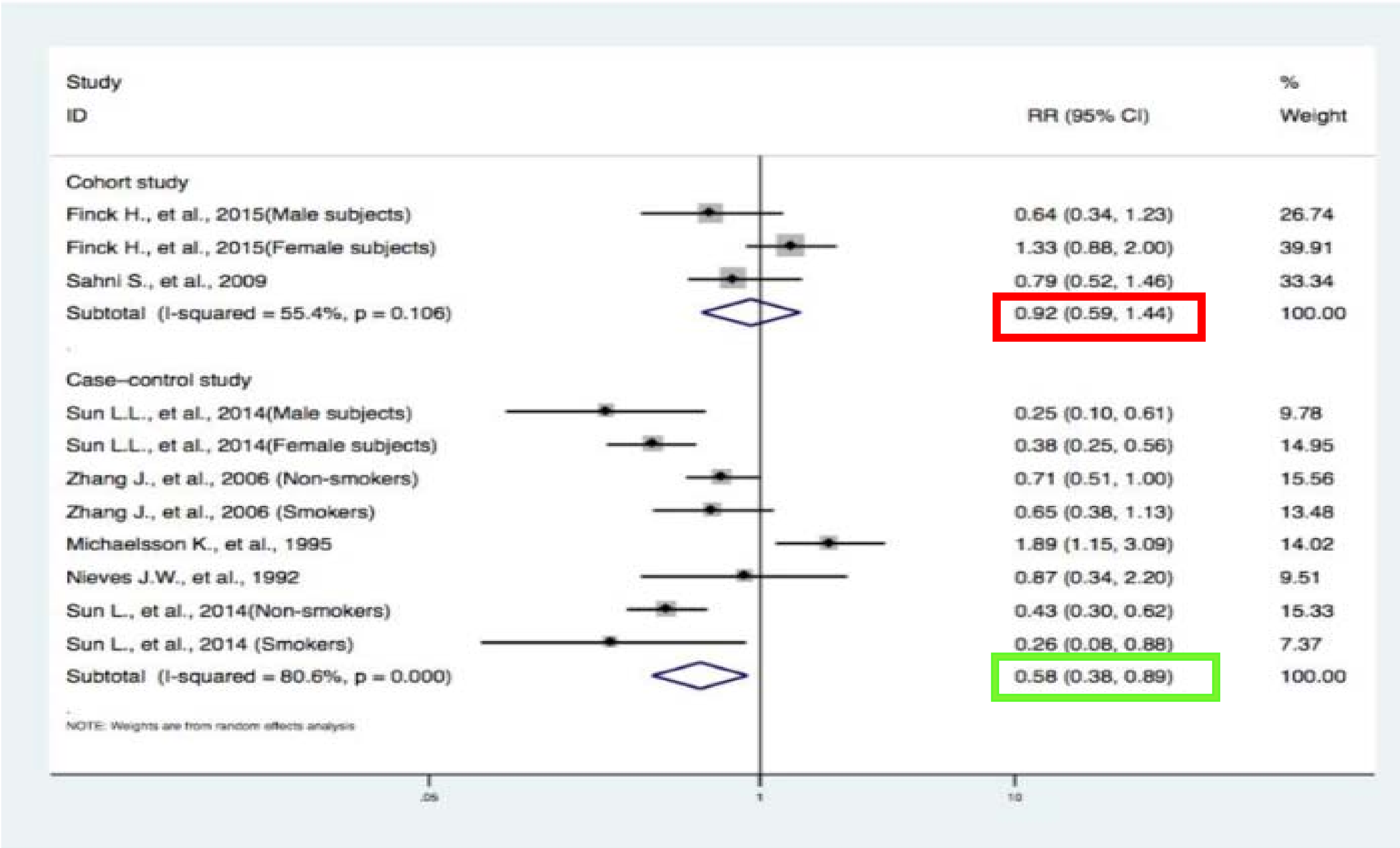
IOF. Available at: https://www.osteoporosis.foundation/patients/prevention/vitamin-d

Magnesium & Fracture



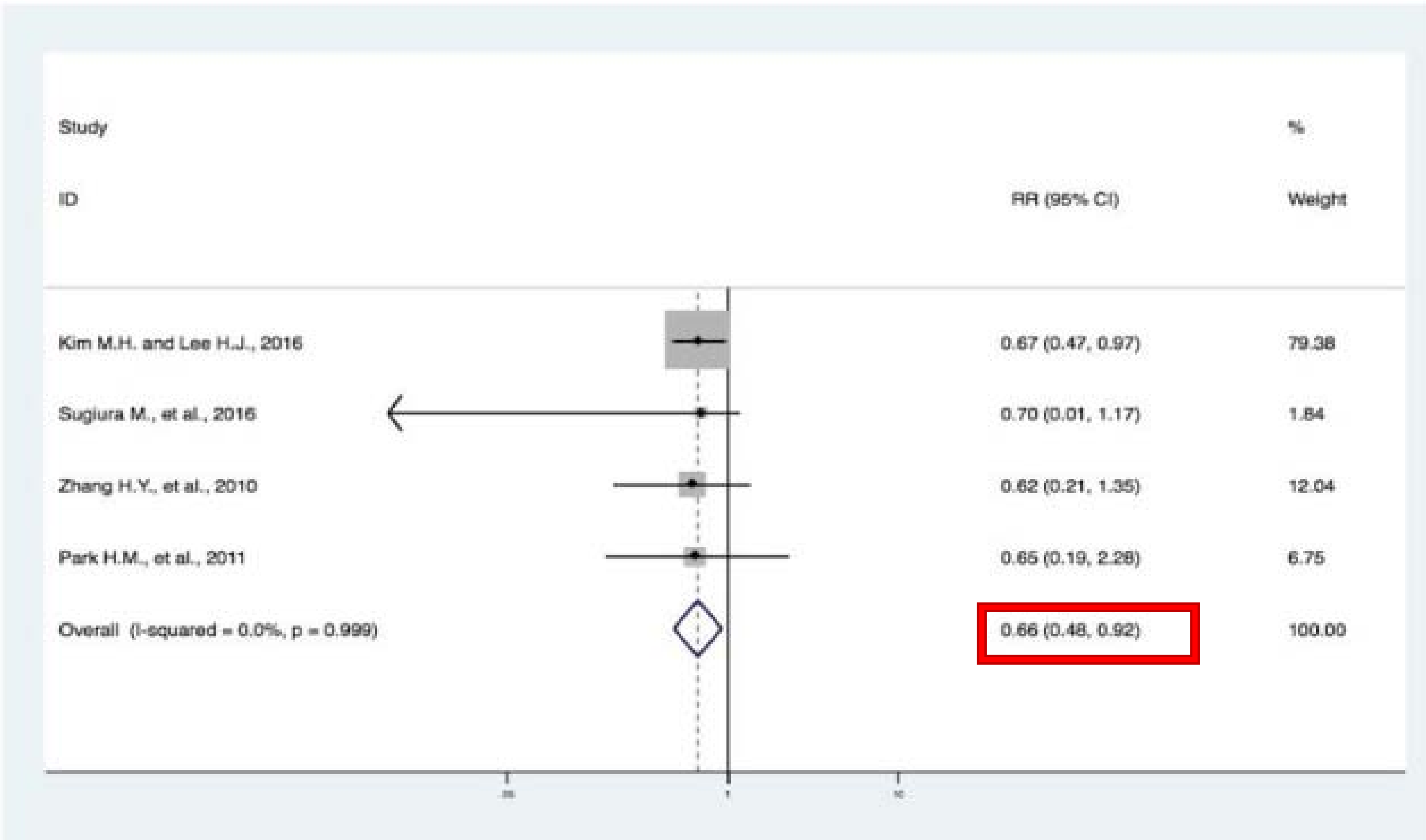
Farsinejad-Marj, et al. (2016). Dietary magnesium intake, bone mineral density and risk of fracture: a systematic review and meta-analysis. *Osteoporosis International*, *27*(4), 1389-1399.

Vitamin C oriented foods & hip fracture



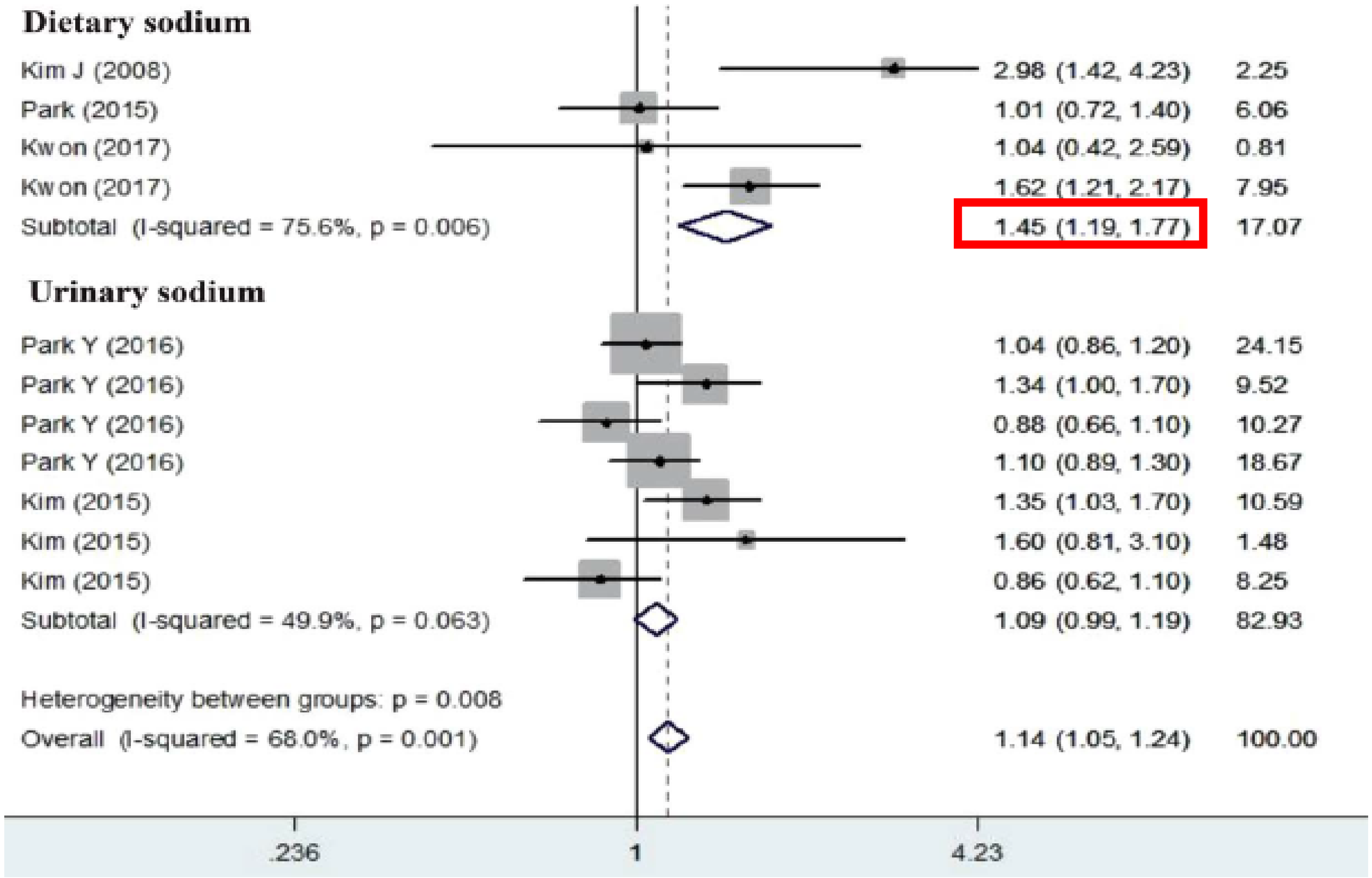
Zeng, L. F., et al. (2020). Can dietary intake of vitamin C-oriented foods reduce the risk of osteoporosis, fracture, and BMD loss? Systematic review with meta-analyses of recent studies. *Frontiers in endocrinology*, *10*, 844.

Vitamin C oriented foods & osteoporosis



Zeng, L. F., et al. (2020). Can dietary intake of vitamin C-oriented foods reduce the risk of osteoporosis, fracture, and BMD loss? Systematic review with meta-analyses of recent studies. *Frontiers in endocrinology*, *10*, 844.

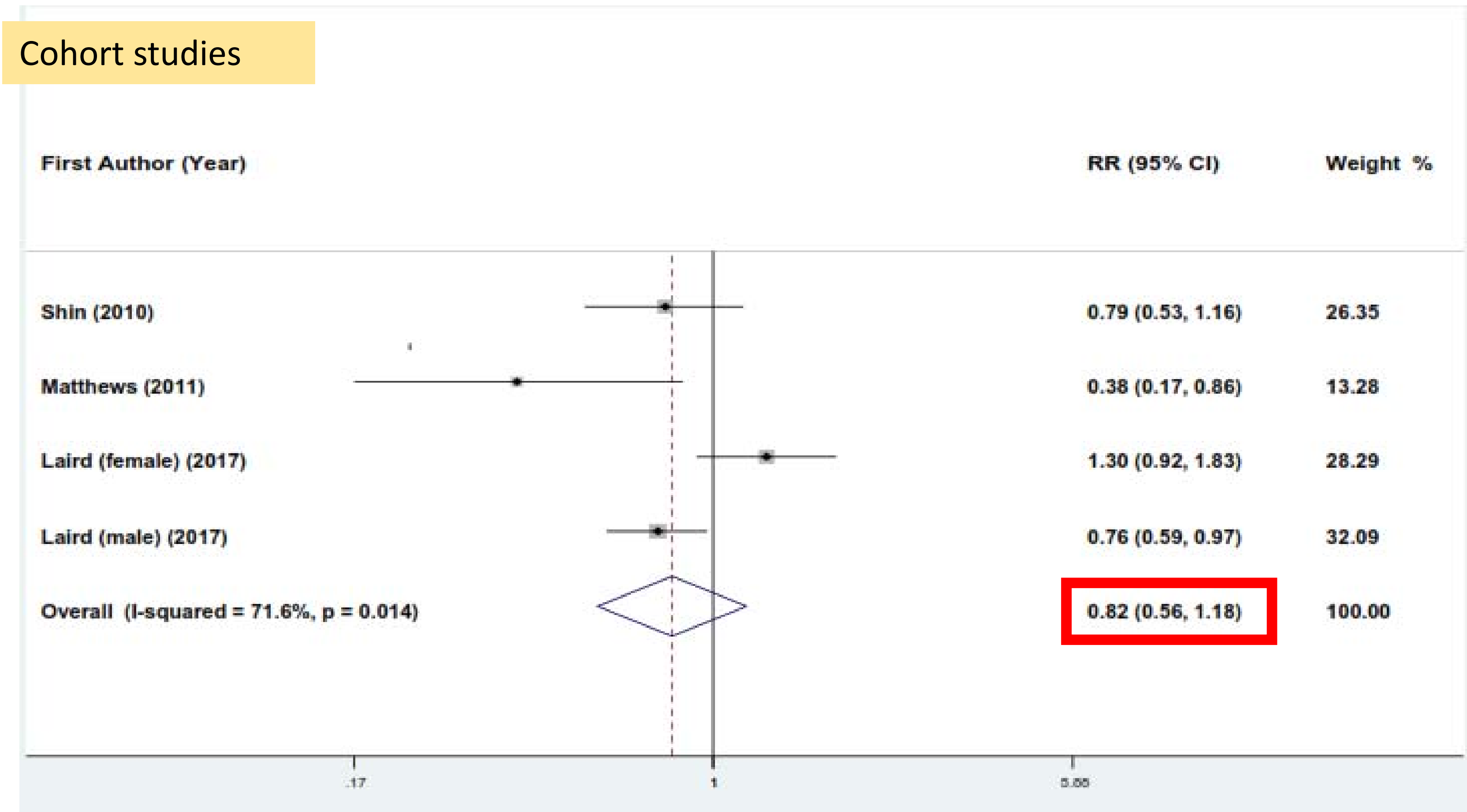
Sodium & risk of osteoporosis



Fatahi, S., et al. (2018). The association of dietary and urinary sodium with bone mineral density and risk of osteoporosis: a systematic review and meta-analysis. *Journal of the American College of Nutrition*, *37*(6), 522-532.

Dairy Products & Bone Health

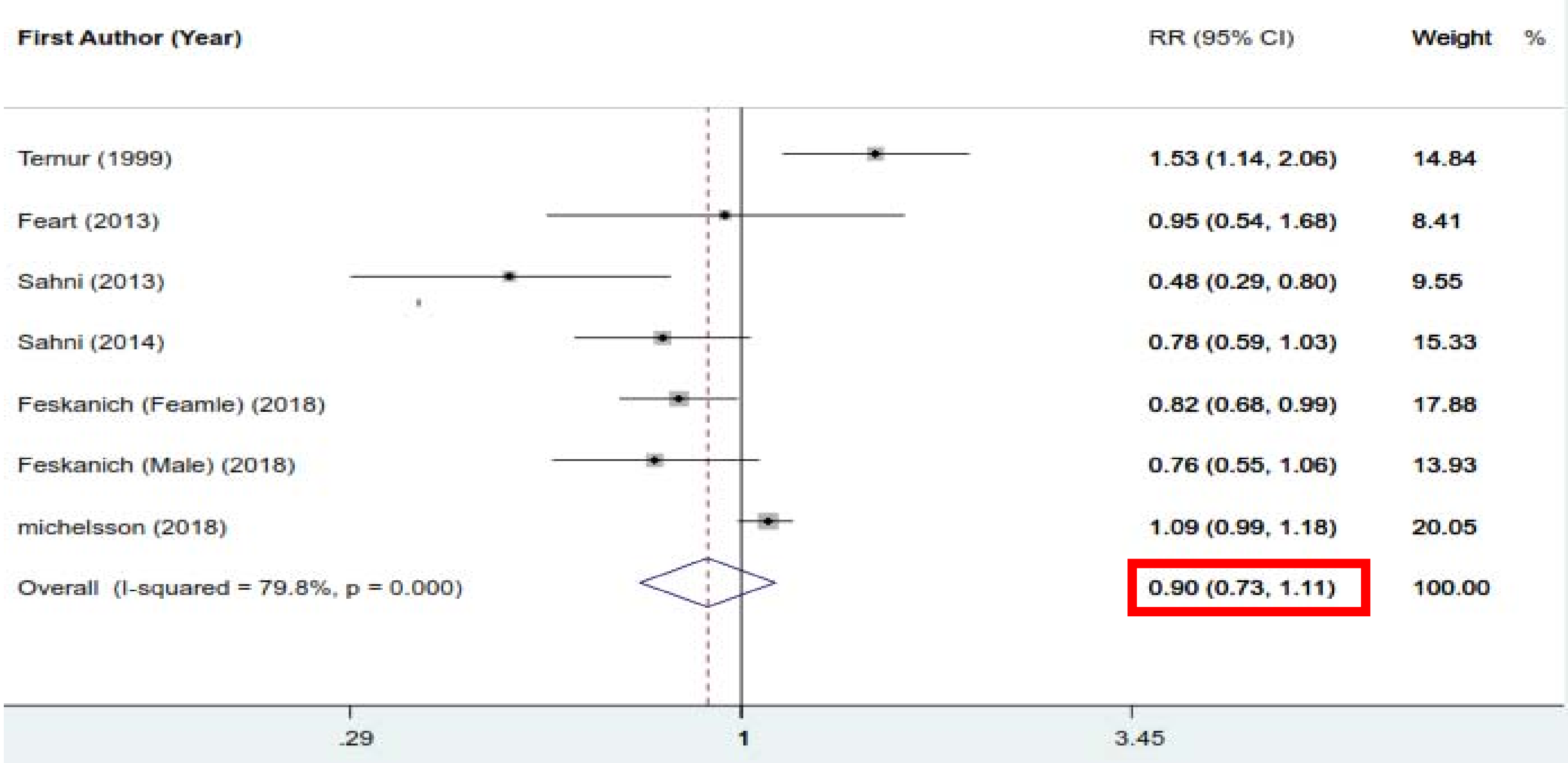
Consumption of total dairy products and risk of Osteoporosis



Malmir, H., Larijani, B., & Esmaillzadeh, A. (2020). Consumption of milk and dairy products and risk of osteoporosis and hip fracture: a systematic review and Meta-analysis. *Critical reviews in food science and nutrition*, *60*(10), 1722-1737.

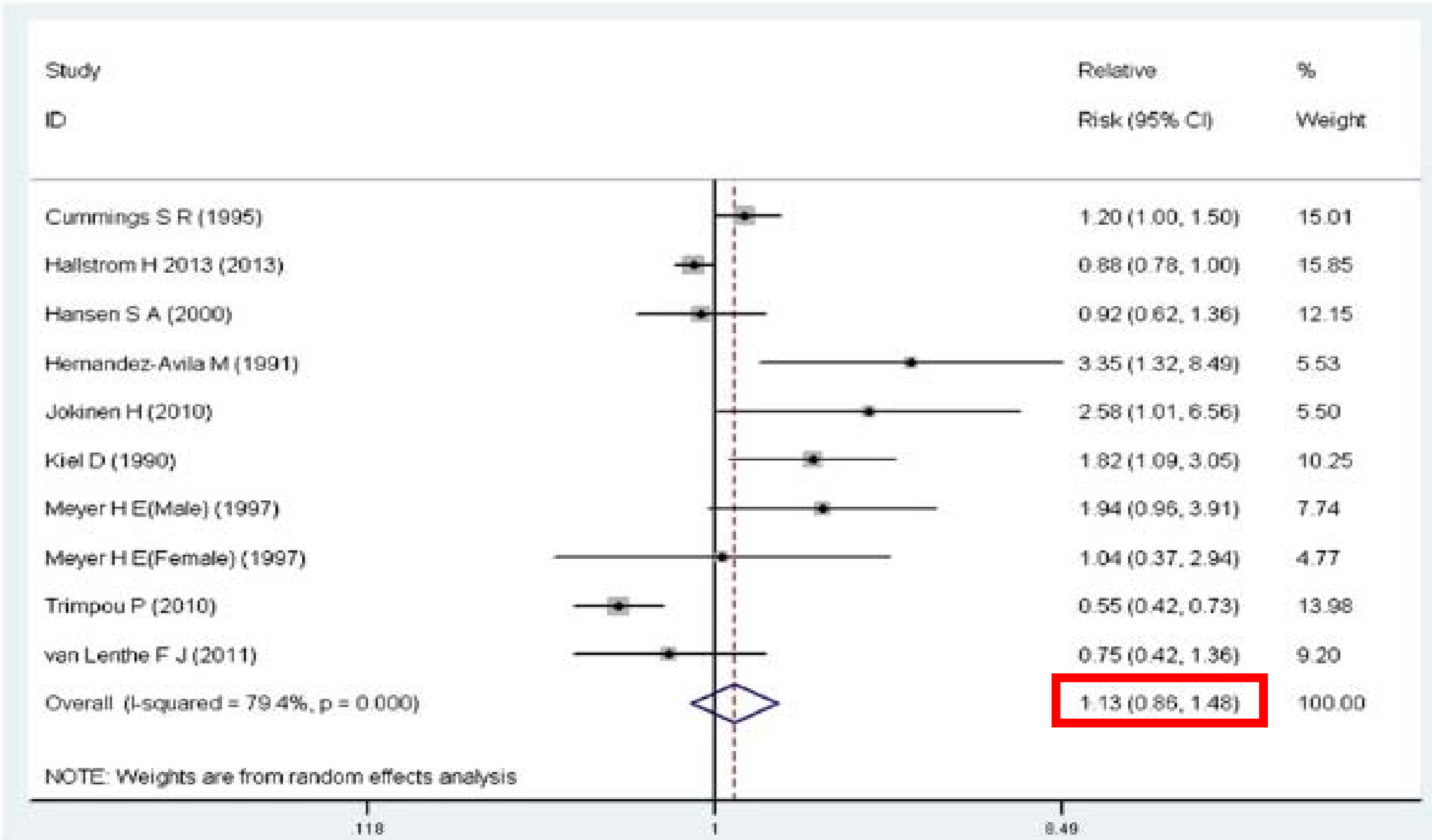
Consumption of total dairy products and hip fracture

Cohort studies



Malmir, H., Larijani, B., & Esmaillzadeh, A. (2020). Consumption of milk and dairy products and risk of osteoporosis and hip fracture: a systematic review and Meta-analysis. *Critical reviews in food science and nutrition*, *60*(10), 1722-1737.

Coffee & hip fracture

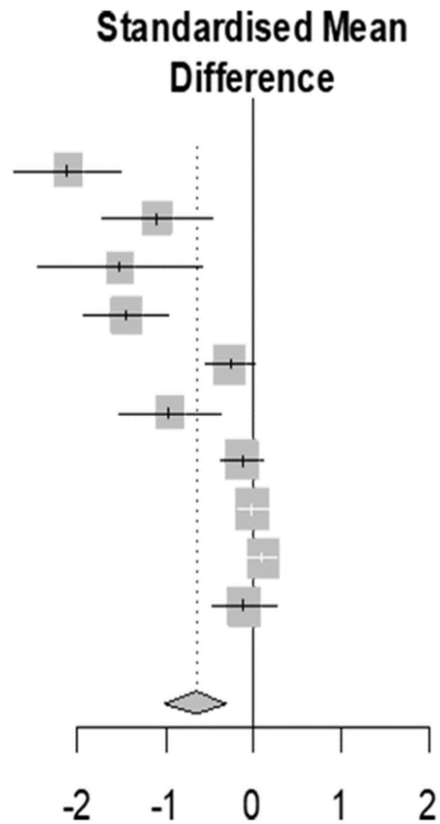


Li, S., et al. (2015). Effect of coffee intake on hip fracture: a meta-analysis of prospective cohort studies. *Nutrition journal*, *14*(1), 1-7.

Sugar sweetened beverages & BMD

Study	TE	seTE	SMD	95%-CI	Weight
Alghadir, 2015, young men (37)	-2.13	0.3162	-2.13	[-2.75; -1.51]	8.8%
Alghadir, 2015, young women (37)	-1.11	0.3302	-1.11	[-1.75; -0.46]	8.6%
Alghadir, 2015, old men (37)	-1.53	0.4817	-1.53	[-2.47; -0.58]	6.5%
Alghadir, 2015, old women (37)	-1.46	0.2530	-1.46	[-1.95; -0.96]	9.8%
Cho, 2008 (38)	-0.27	0.1483	-0.27	[-0.56; 0.02]	11.3%
Hammad, 2017 (39)	-0.96	0.3033	-0.96	[-1.56; -0.37]	9.0%
Kim, 1997 (42)	-0.13	0.1301	-0.13	[-0.38; 0.13]	11.5%
Kim, 2020, men (43)	-0.02	0.0909	-0.02	[-0.20; 0.16]	11.8%
Kim, 2020, women (43)	0.10	0.0836	0.10	[-0.06; 0.27]	11.9%
Yeon, 2009 (48)	-0.11	0.1949	-0.11	[-0.50; 0.27]	10.7%
Random effects model			**-0.66**	**[-1.01; -0.31]**	**100.0%**

Heterogeneity: $I^2 = 91\%$, $\tau^2 = 0.2616$, $p < 0.01$



Ahn, H., & Park, Y. K. (2021). Sugar-sweetened beverage consumption and bone health: a systematic review and meta-analysis. *Nutrition journal*, *20*(1), 1-16.

Dietary indices,

Dietary patterns,

&

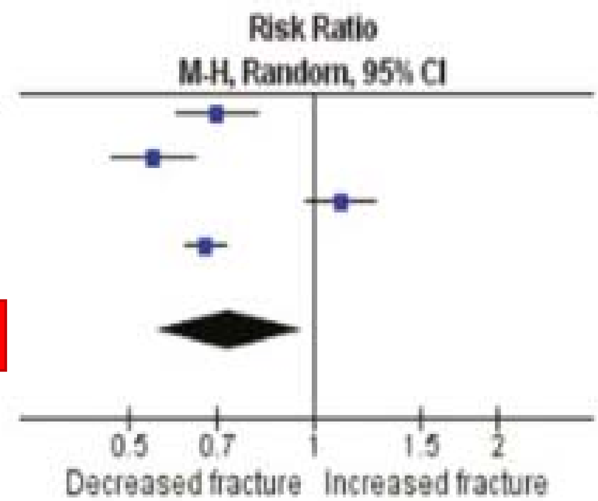
Bone health

Healthy dietary patterns and fracture

	Highest level		Lowest level			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% CI
Zeng 2013	132	326	266	459	24.5%	0.70 [0.60, 0.81]
Dai 2014	240	12631	438	12631	24.4%	0.55 [0.47, 0.64]
Fung 2015	480	22569	433	22569	25.1%	1.11 [0.97, 1.26]
Warensjo 2017	1002	14184	1501	14184	26.0%	0.67 [0.62, 0.72]
Total (95% CI)		**49710**		**49843**	**100.0%**	**0.73 [0.56, 0.96]**
Total events	1854		2638			

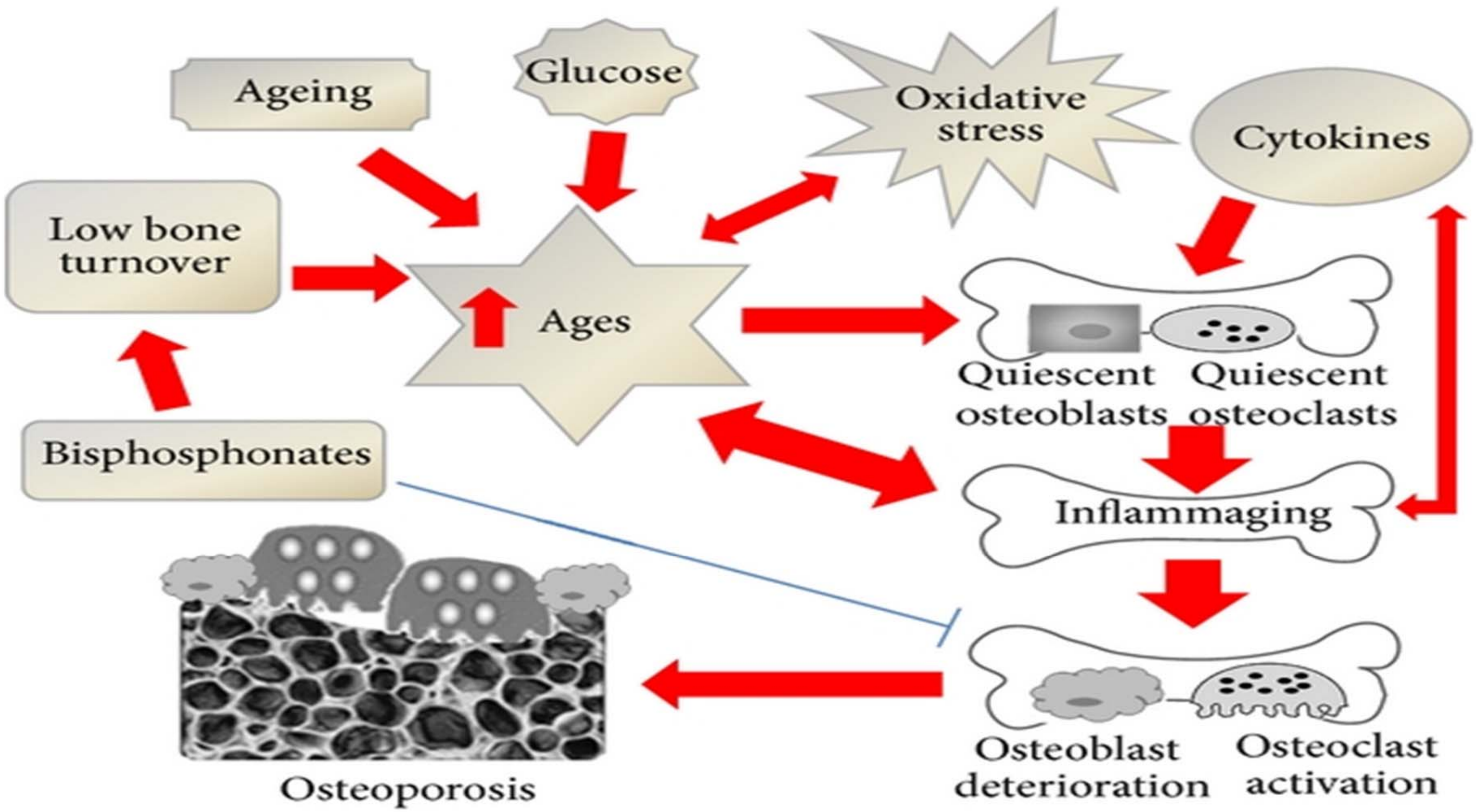
Heterogeneity: $Tau^2 = 0.07$; $Chi^2 = 59.03$, df = 3 ($P < 0.00001$); $I^2 = 95\%$

Test for overall effect: Z = 2.26 (P = 0.02)



Nguyen, H. H., et al. (2021). Associations of dietary patterns with bone density and fractures in adults: A systematic review and meta-analysis. *Australian Journal of General Practice*, *50*(6), 394-401.

Inflammation & Osteoporosis



Sanguineti, R., et al. (2014). Advanced glycation end products play adverse proinflammatory activities in osteoporosis. Mediators of inflammation, 2014.

Diet and inflammation

- Evidence on pro-inflammatory and anti-inflammatory effects of some certain nutrients and foodstuffs

- Dietary Inflammatory Index (DII):
- Designed based on a comprehensive literature review (n=1943 papers; 1950-2010)

- Specifically reflect the inflammatory potential of dietary factors and classify the individual's diet into most pro-inflammatory and anti-inflammatory ones.
- Reporting the effect of 45 dietary parameters on 6 inflammatory biomarkers (IL-1β, IL-6, TNF-α, CRP, IL-4 or IL-10)

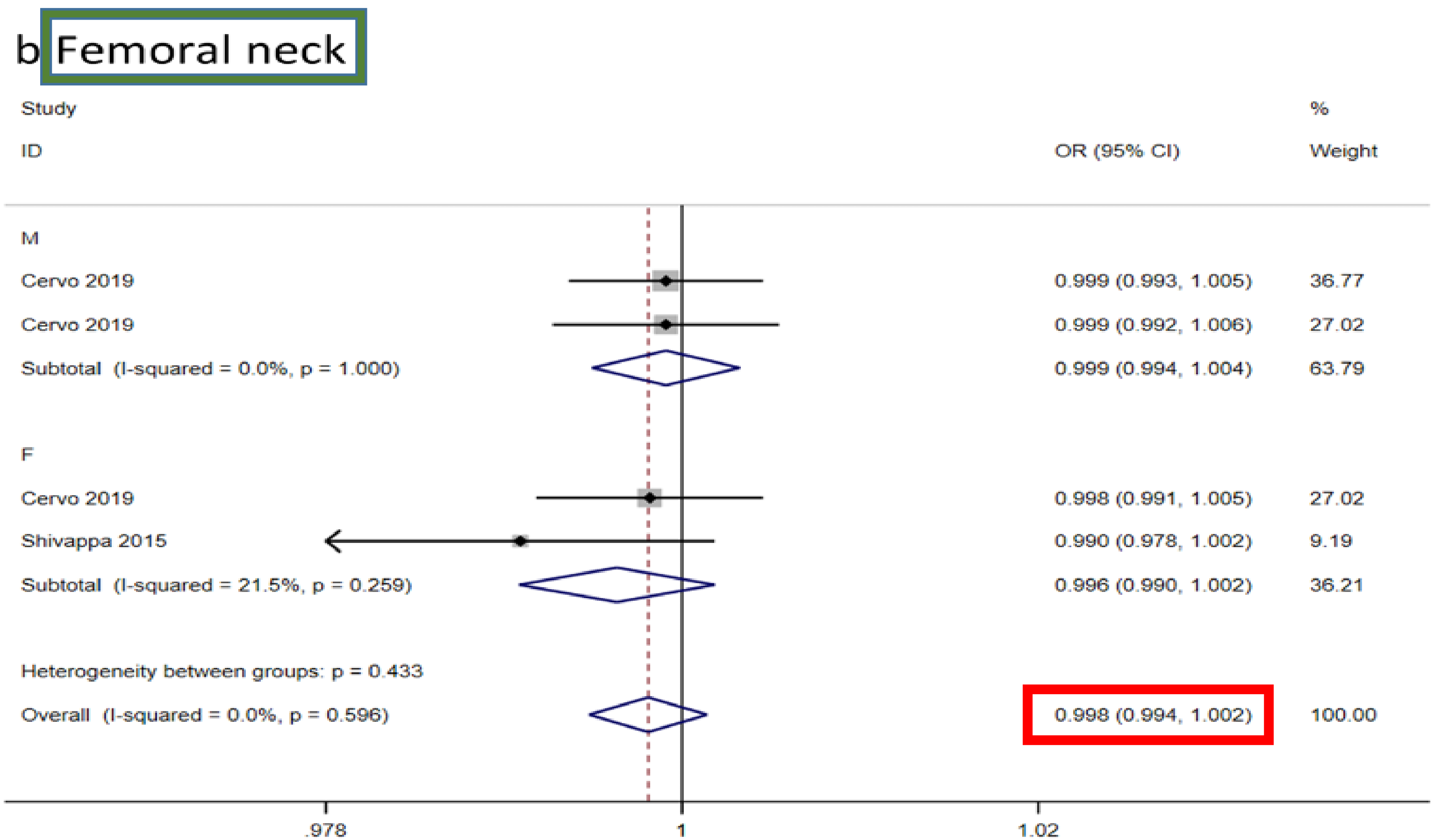
Ruiz-Canela, M., et al. (2016). The role of dietary inflammatory index in cardiovascular disease, metabolic syndrome and mortality. *International journal of molecular sciences*, *17*(8), 1265.

List of pro- and anti-inflammatory items (for DII calculation)

Energy	Ginger	Alcohol	Riboflavin
Protein	Saffron	Carbohydrate	Niacin
SFA	Turmeric	Fiber	Vitamin B-6
Trans fatty acids	Green/black tea	(n-3) Fatty acids	Folic Acid
Vitamin A	Caffeine	MUFA	Vitamin B-12
Vitamin E	Total fat	Cholesterol	Vitamin C
(n-6) Fatty acids	Fiber	Thiamin	Vitamin D
Garlic	Onion	Pepper	*β*-carotene
Magnesium	Zinc	Iron	Selenium
Rosemary	Thyme/oregano	Flavonones	Isoflavones
Anthocyanidins	Flavan-3-ol/Flavones	Anthocyanidins	Flavonols

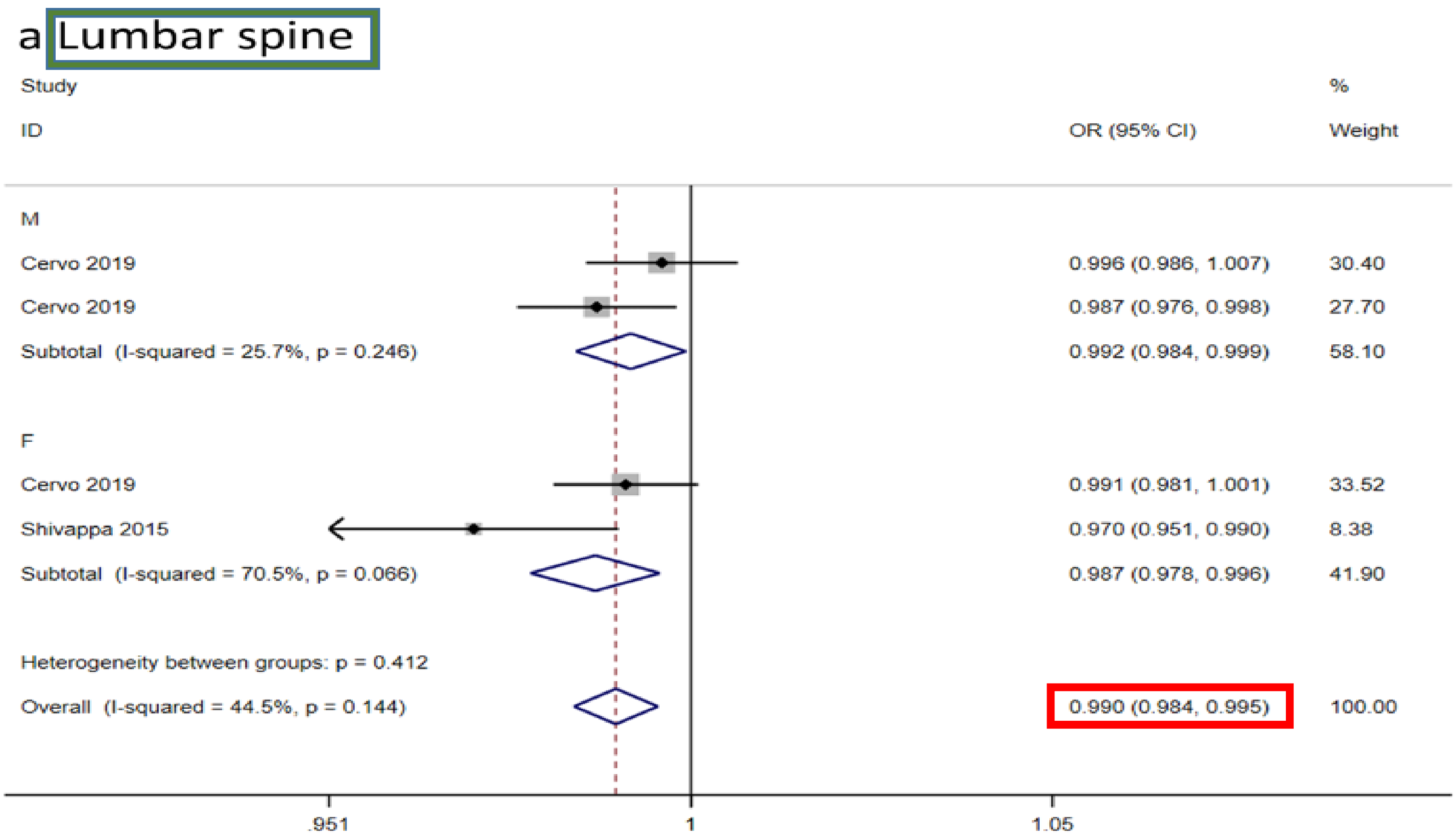
Shivappa, N., Steck, S. E., Hurley, T. G., Hussey, J. R., & Hébert, J. R. (2014). Designing and developing a literature-derived, population-based dietary inflammatory index. *Public health nutrition*, *17*(8), 1689-1696.

Dietary Inflammatory index & BMD



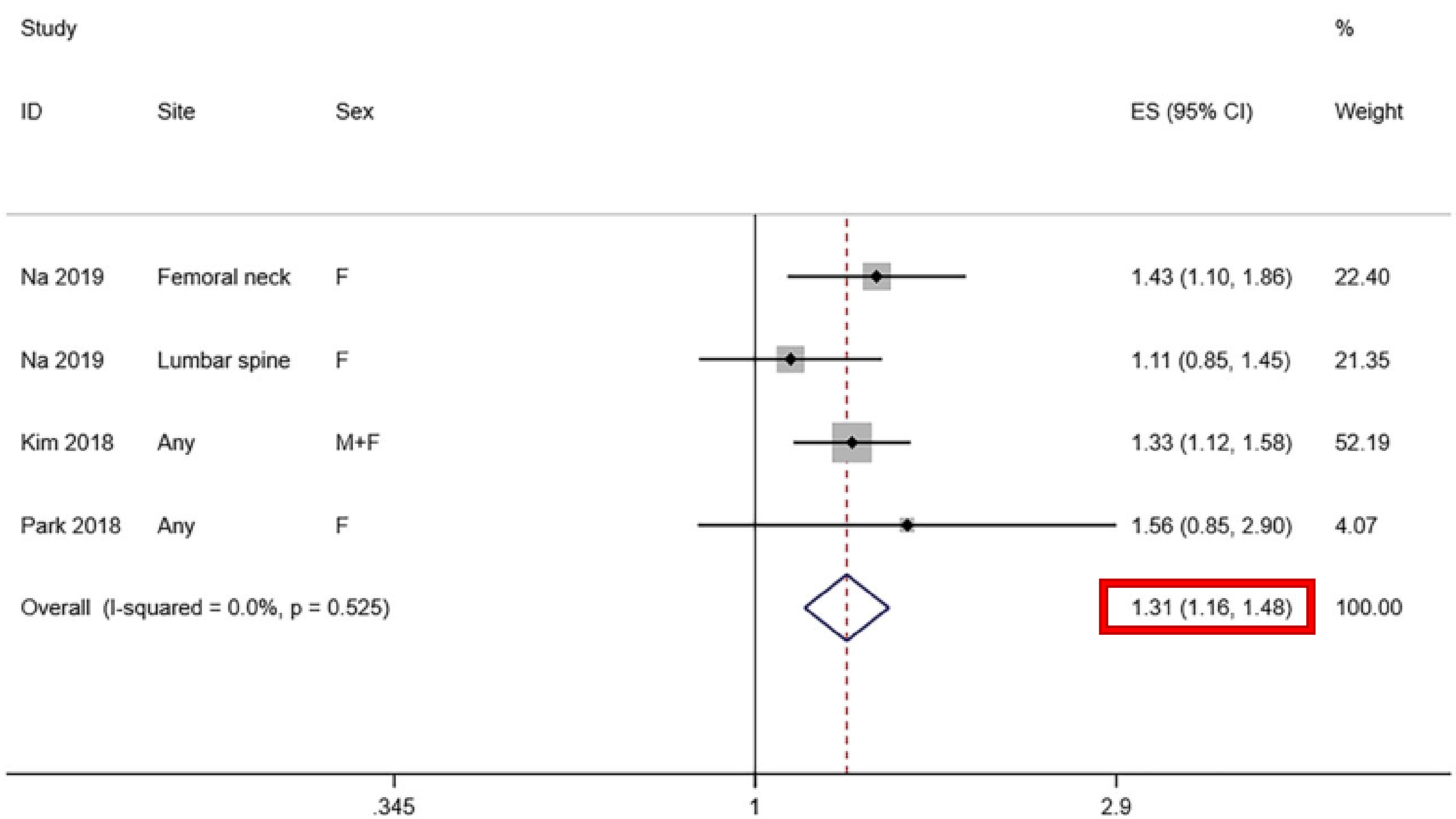
Fang, Y., Zhu, et al. (2021). Dietary Inflammatory Index in relation to bone mineral density, osteoporosis risk and fracture risk: a systematic review and meta-analysis. *Osteoporosis International*, *32*(4), 633-643.

Dietary Inflammatory index & BMD



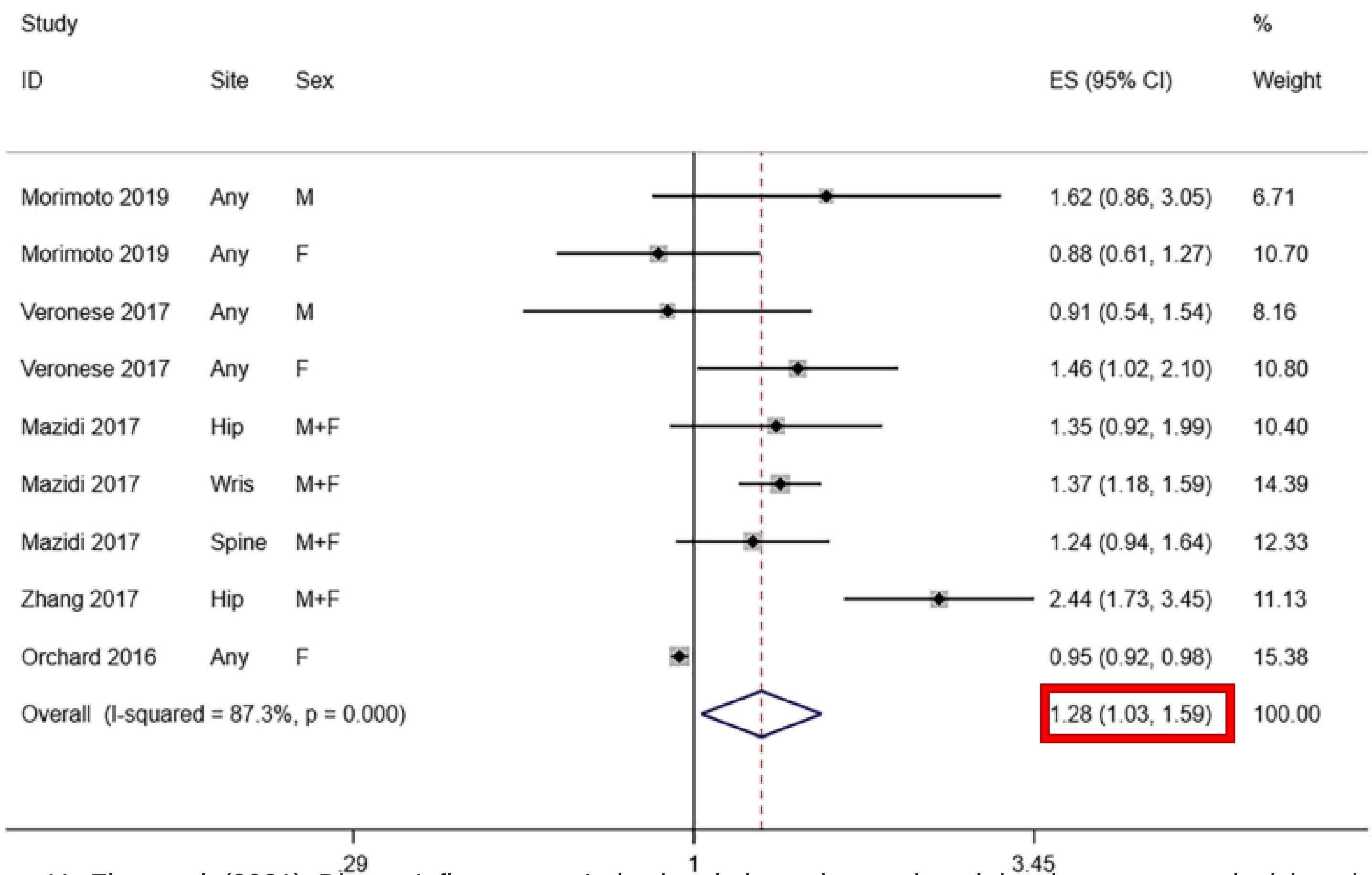
Fang, Y., Zhu, et al. (2021). Dietary Inflammatory Index in relation to bone mineral density, osteoporosis risk and fracture risk: a systematic review and meta-analysis. *Osteoporosis International*, *32*(4), 633-643.

Dietary Inflammatory index & Osteoporosis



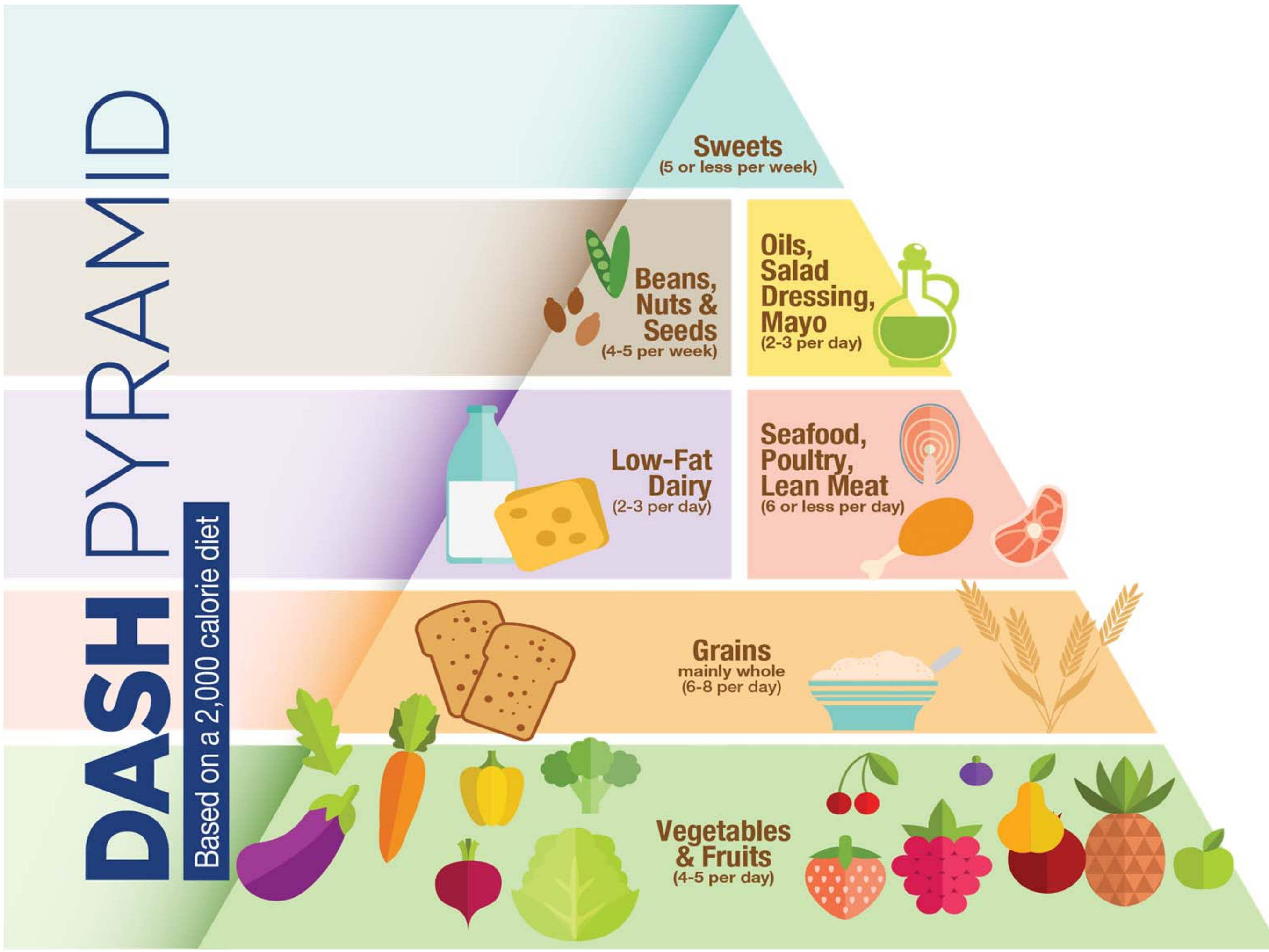
Fang, Y., Zhu, et al. (2021). Dietary Inflammatory Index in relation to bone mineral density, osteoporosis risk and fracture risk: a systematic review and meta-analysis. *Osteoporosis International*, *32*(4), 633-643.

Dietary Inflammatory index & fracture



Fang, Y., Zhu, et al. (2021). Dietary Inflammatory Index in relation to bone mineral density, osteoporosis risk and fracture risk: a systematic review and meta-analysis. *Osteoporosis International*, *32*(4), 633-643.

DASH diet (Dietary Approaches to Stop Hypertension)



DASH & risk of osteoporosis

A cross- sectional study

- Postmenopausal Iranian women aged 50–85 years

Findings:

- Inverse link between DASH score and risk of osteoporosis at lumbar spine (OR= 0.28; 95% CI, 0.09–0.88).
- No significant association between DASH score and risk of osteoporosis at femoral neck

Shahriarpour, Z., et al. (2020). Adherence to the dietary approaches to stop hypertension (DASH) dietary pattern and osteoporosis risk in postmenopausal Iranian women. *Osteoporosis International*, *31*(11), 2179-2188.

Dietary acid load

- Hypothesis: higher acid diets increase calcium excretion and have a detrimental effect on bone.

Meta-analysis of effects of acidic diet on bone metabolism markers and BMD

Outcome type and indicators	Studies, *n*	*P*	SMD (95% CI)	I^2, %
Markers of mineral metabolism				
NAE	5	0.003	2.99 (1.01, 4.96)	94
Calcium excretion	11	<0.00001	0.47 (0.30, 0.64)	47
Hormone-regulating mineral metabolism				
IGF-I	4	0.21	0.14 (−0.08, 0.35)	0
PTH	8	0.35	− 0.26 (−0.81, 0.29)	85
Bone resorption marker				
NTX	6	0.30	0.15 (−0.13, 0.43)	27
TRAP	3	0.95	− 0.01 (−0.34, 0.32)[2]	0
Bone formation marker				
BAP	3	0.38	0.13 (−0.16, 0.42)	35
OC	3	0.31	− 0.15 (−0.44, 0.14)	0
BMD				
Total hip BMD	2	0.95	0.01 (−0.21, 0.22)	0
Femoral neck BMD	2	0.18	− 0.14 (−0.36, 0.07)	0

[1] BAP, bone-specific alkaline phosphatase; BMD, bone mineral density; IGF-I, insulin-like growth factor I; NAE, renal net acid excretion; NTX, aminoterminal cross-linking telopeptide of bone collagen; OC, osteocalcin; PTH, parathyroid hormone; SMD, standardized mean difference; TRAP, tartrate-resistant acid phosphatase.

[2] Values are mean differences.

Han, Y., et al. (2021). Effect of Acid or Base Interventions on Bone Health: A Systematic Review, Meta-Analysis, and Meta-Regression. *Advances in Nutrition*.

Meta-analysis of effects of alkaline diet on bone metabolism markers and BMD

Outcome type and indicators	Studies, *n*	*P*	SMD (95% CI)	I^2, %
Markers of mineral metabolism				
NAE	4	<0.00001	−1.29 (−1.52, −1.07)	37
Calcium excretion	8	0.007	−0.44 (−0.76, −0.12)	63
Hormone-regulating mineral metabolism				
IGF-I	5	0.13	−0.15 (−0.34, 0.04)	0
PTH	6	0.25	−2.29[2] (−6.22, 1.65)	57
Bone resorption marker				
NTX	5	0.003	−0.29 (−0.48, −0.10)	0
CTX	5	0.17	−0.13 (−0.33, 0.06)	0
Bone formation marker				
BAP	5	0.76	−0.03 (−0.24, 0.18)	0
PINP	5	0.13	−0.15 (−0.34, 0.04)	0
OC	4	0.02	−0.23 (−0.42, −0.03)	0
BMD				
Total hip BMD	3	0.02	0.98[2] (0.13,1.83)	99
Femoral neck BMD	2	<0.00001	1.62[2] (1.50,1.74)	0
Lumbar spine BMD	3	<0.00001	1.66[2] (1.33,1.99)	87

[1]BAP, bone-specific alkaline phosphatase; BMD, bone mineral density; CTX, carboxyterminal cross-linking telopeptide; IGF-I, insulin-like growth factor I; NAE, renal net acid excretion; NTX, aminoterminal cross-linking telopeptide of bone collagen; OC, osteocalcin; PINP, serum aminoterminal propeptide of type I procollagen; PTH, parathyroid hormone; SMD, standardized mean difference.

[2]Values are mean differences.

Han, Y., et al. (2021). Effect of Acid or Base Interventions on Bone Health: A Systematic Review, Meta-Analysis, and Meta-Regression. *Advances in Nutrition*.

Other parameters involved in bone health

BMI & Bone health

- BMI >30 kg/m2 increase risk of bone mass loss by 33% vs. normal BMI.

- Excess fat mass

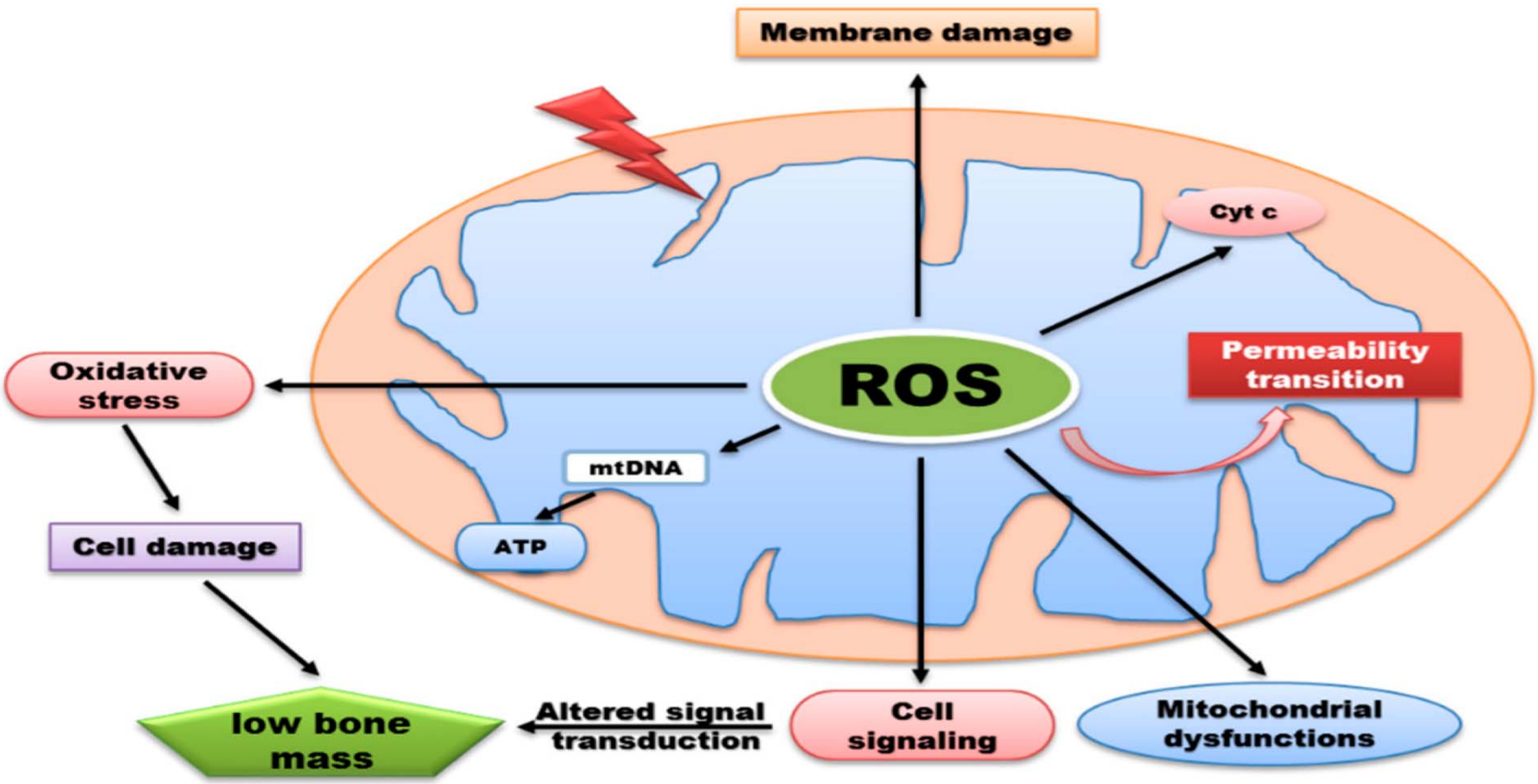
-Imbalances in vitamin D, calcium and phosphorus

- A strong correlation between BMD and BMI.
- BMI<21 kg/m2

✓ Low BMD
✓ Increase the risk for fracture in women

Janice Raymond Kelly Morrow. Krause and Mahan's Food & the Nutrition Care Process;15th Edition.
Hou, J., et al. (2020). Obesity and Bone Health: A Complex Link. Frontiers in Cell and Developmental Biology, 8, 1620.

Oxidative status & bone health



Agidigbi, T. S., & Kim, C. (2019). Reactive oxygen species in osteoclast differentiation and possible pharmaceutical targets of ROS-mediated osteoclast diseases. *International journal of molecular sciences*, *20*(14), 3576.

Oxidative- balanced score

Dietary factors	Biomarkers	Lifestyle Factors	Medication
Pro-oxidants Total Fat Poly unsaturated fatty acids Saturated fatty acids Iron Red Meat	***Pro-oxidants*** Ferritin	***Pro-oxidants*** Alcohol Smoking Obesity (High BMI)	***Anti-oxidant*** Aspirin Non-Steroidal Anti-Inflammatories (NSAIDs)
Anti-oxidants Vitamin C Vitamin E Total Carotenoids Lutein, α,β-carotene Lycopene β-cryptoxantin Zeaxantin Flavonoids Glucosinolates Selenium Zinc	***Anti-oxidants*** α,β-carotene Lycopene β-cryptoxantin Zeaxantin α-tocopherol gama- tocopherol	***Anti-oxidants*** Physical Activity	

Hernández-Ruiz, et al(2019). "A review of a priori defined oxidative balance scores relative to their components and impact on health outcomes." Nutrients **11**(4): 774.

Oxidative- balanced score

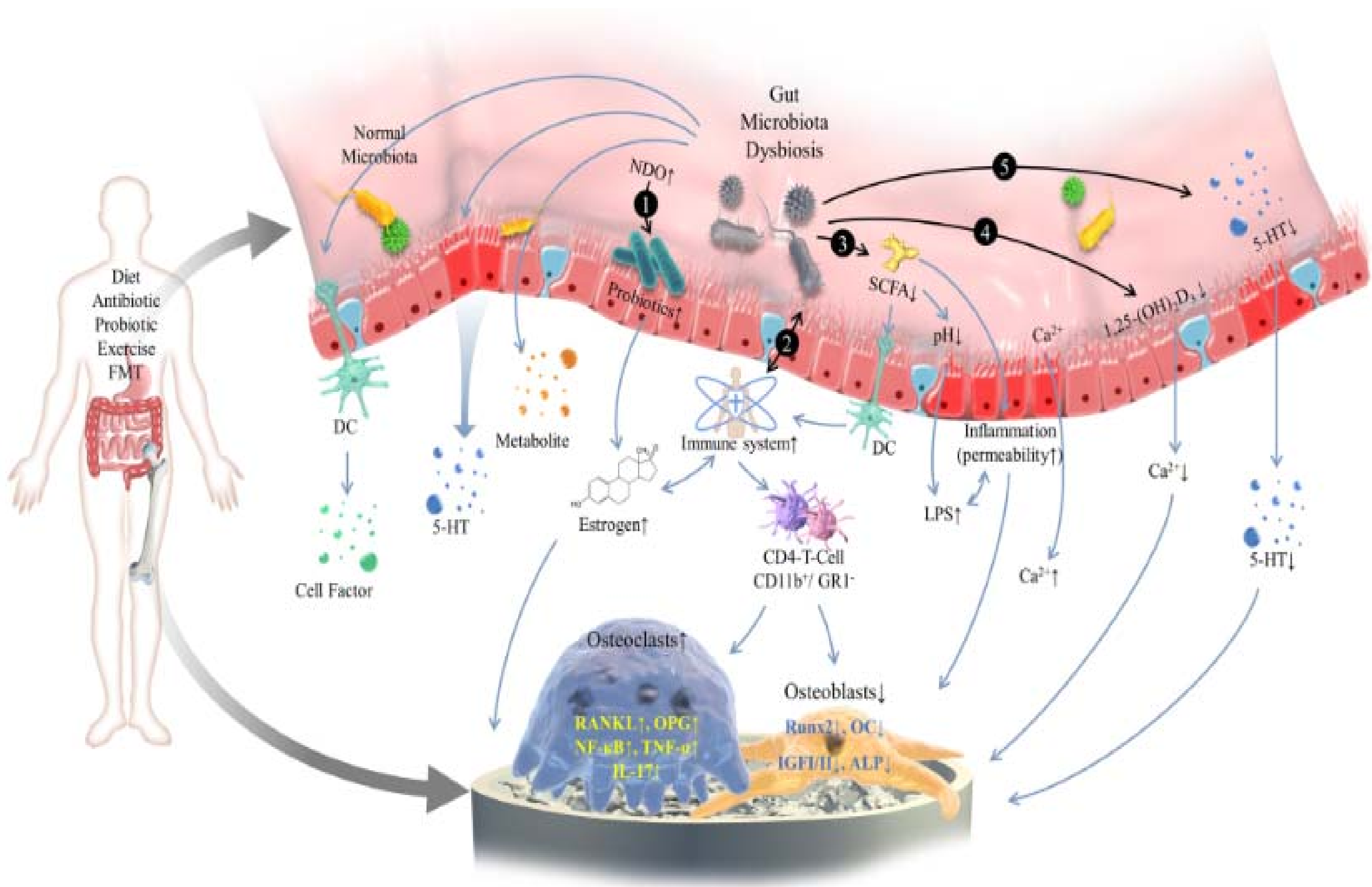
- A cross-sectional study
- Postmenopausal Iranian women aged 50–85 y (n=151)

Findings:

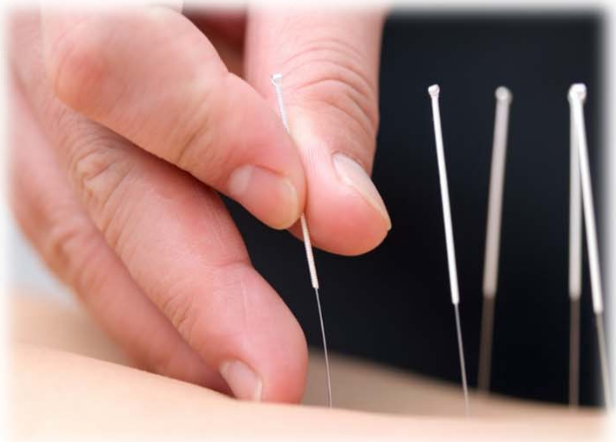
- Positive link between OBS and risk of lumbar spine osteoporosis (OR= 0.14; 95% CI, 0.04–0.45; $p = 0.001$).
- No association between OBS & risk of femoral neck osteoporosis.

Shahriarpour, Z., et al. (2021). Oxidative balance score and risk of osteoporosis among postmenopausal Iranian women. *Archives of Osteoporosis*, *16*(1), 1-10.

Gut microbiota & Osteoporosis



Ding, K., et al. (2020). Gut microbiome and osteoporosis. *Aging and disease*, *11*(2), 438.

Integrative approach to prevent osteoporosis



Complementary and integrative approach

- WHO Traditional Medicine Strategy 2014–2023:

✓To promote the safety, quality and effectiveness of T&CM.

✓Take steps for the appropriate integration of T&CM into health systems (particularly health services) by:

- Developing national policies
- Regulatory frameworks and strategic plans for T&CM products, practices and practitioners.

WHO global report on traditional and complementary medicine. Available at:https://www.who.int/traditional-complementary-integrative-medicine/WhoGlobalReportOnTraditionalAndComplementaryMedicine2019.pdf

Benefits of an Integrative approach

- ✓ Cover both types of recommendations
- ✓ A solution to those who are confused about discrepancies in accumulating evidence on traditional and modern dietary recommendations
- ✓ Maybe more effective than relying on only conventional science

Integrative approach

- ✓Anti-inflammatory diet
- ✓Calcium and bone supportive micronutrients
- ✓ Nutritive herbs such as nettle (*Urtica dioica*).

Anti-inflammatory herb

Rich source of calcium:

- ✓ 1400 mg /100 grams dried herb or 430 mg cooked fresh herb
- ✓ Side effects: diarrhea and skin rash
- ✓ Not recommended in pregnancy or lactation

Janice Raymond Kelly Morrow. Krause and Mahan's Food & the Nutrition Care Process;15th Edition

Conclusion

- Positive effects of healthy dietary patterns with bone health

- High dietary GI& GL, SFA → ↑ fracture
- Enriched dairy products → ↑BMD
- Sugar sweetened beverages → ↓BMD
- Dietary Na → ↑Osteoporosis
- Vitamin C oriented foods → ↓osteoporosis

Conclusion

Negative effects of:

- Pro-inflammatory diets
- Obesity, high fat mass, and underweight
- Possible negative effects of acidic diets on bone health

- Possible positive effects of integrative medicine to prevent osteoporosis

Thank you for your attention