**Supplementary Appendix**

This appendix has been supplied by the authors to provide reviewers/readers with additional information on the work under consideration.

**Supplement to: editors.** Role of Diet in Osteoporosis Incidence: Umbrella Review of Meta-analyses of Prospective Observational Studies

**Contents**

**Part A: Supplemental Table 1: Search strategy**

**Part B: Supplemental Table 2 Study characteristics.**

**Part C: Supplemental Table 3 Detailed evaluation of the methodological quality with AMSTAR 2.**

**Part D: Supplemental Table 4 GRADE classification.**

**Part E: Supplemental Table 5 List of excluded studies**

**Supplemental Table 1: Search strategy**

(diet OR nutrition OR food OR beverage OR bread OR cereal OR grain OR corn OR wholegrain OR soy OR wheat OR potatoes OR granary OR tuber OR pulses OR legumes OR lentils OR beans OR chickpeas OR rice OR pasta OR quinoa OR vegetable OR fruit OR milk OR dairy OR yoghurt OR cheese OR egg OR meat OR pork OR lamb OR chicken OR beef OR turkey OR duck OR fish OR seafood OR shellfish OR oil OR butter OR margarine OR nut OR desert OR sweets OR candy OR sugar OR alcohol OR coffee OR caffeine OR tea OR juice OR beer OR lemonade OR drinks OR wine OR liquor) AND (bone mineral density OR osteoporosis OR fracture) AND (systematic review OR meta-analysis)

**Supplemental Table 2 Study characteristics.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Outcome** | **Category** | **Study** | **Case** | **MA**  **metric** | **Estimates** | **95%CI** | **Cohort/ RCT** | **Case- control** | **Cross- sectional** | **Model** | **I2** | **P-value** |
| **Osteoporotic fracture** | | | | | | | | | | | | |
| Fracture | Milk | 2020 Malmir, H. | 616,420 | RR | 0.84 | 0.7-0.99 | 15 | 11 | 2 | Random | 32.40% | 0.224 |
| Fracture | Milk | 2020 Hidayt, K. | 363,383 | RR | 0.86 | 0.73-1.02 | 14 | 0 | 0 | Random | 60.10% | 0.01 |
| Fracture | Milk | 2020 Malmir, H. | 21,068 | RR | 0.79 | 0.57-1.08 | 4 | 3 | 8 | Random | 63.30% | 0.008 |
| Fracture | Dairy | 2020 Malmir, H. | 21,068 | RR | 0.89 | 0.72-1.07 | 6 | 0 | 3 | Random | 0.00% | 0.886 |
| Fracture | Milk/dairy | 2019 Fabiani, R. | 19,650 | OR | 0.59 | 0.5-0.68 | 1 | 0 | 9 | Random | 22% | <0.0001 |
| Fracture | Milk | 2018 B,H.K.M. | 4,280 | HR | 1 | 0.99-1.01 | 3 | 0 | 0 | Random | 97.30% | 0.8 |
| Fracture | Milk | 2011 B-F,H.A. | 270,251 | RR | 0.97 | 0.89-1.04 | 7 | 0 | 0 | Random | 29.10% | 0.235 |
| Fracture | Milk | 2005 Kanis,J.A. | 5,073 | RR | 1.17 | 0.91-1.5 | 6 | 0 | 0 | Random | 13% | >0.3 |
| Fracture | Yogurt | 2020 Hidayt, K. | 234,654 | RR | 0.78 | 0.68-0.9 | 4 | 0 | 0 | Random | 14.30% | 0.321 |
| Fracture | Cheese | 2020 Hidayt, K. | 305,157 | RR | 0.85 | 0.66-1.08 | 4 | 0 | 0 | Random | 76.90% | 0.005 |
| Fracture | Dairy | 2019 M-M, P. | 382,239 | HR | 0.97 | 0.94-1 | 9 | 0 | 0 | Random | 31.70% | 0.231 |
| Fracture | Dairy | 2018 Bian, S. | 381,987 | RR | 0.82 | 0.73-0.91 | 10 | 0 | 0 | Random | 38.50% | 0.202 |
| Fracture | Alcohol | 2021 Asoudeh,F. | 5,053,117 | RR | 1.24 | 1.11-1.38 | 38 | 0 | 0 | Random | 99.10% | <0.001 |
| Fracture | Alcohol | 2019 Cheraghi, Z. | NA | RR | 1.37 | 1.14-1.59 | 2 | 3 | 1 | Random | 0.00% | 0.803 |
| Fracture | Tea | 2017 Sun, K. | 106,897 | OR | 0.62 | 0.46-0.83 | 2 | 4 | 11 | Random | 94% | 0.002 |
| Fracture | Tea | 2017 Guo, M. | 9,622 | OR | 0.86 | 0.74-1.01 | 3 | 6 | 0 | Random | 88% | 0.07 |
| Fracture | Tea | 2014 Sheng, J. | 147,288 | RR | 0.84 | 0.66-1.02 | 6 | 8 | 0 | Random | 45.30% | 0.05 |
| Fracture | Tea | 2014 Chen,B. | 147,950 | OR | 0.9 | 0.77-1.06 | 6 | 3 | 0 | Random | 75.60% | 0 |
| Fracture | Coffee | 2015 Li, S. | 205,930 | RR | 1.13 | 0.86-1.48 | 10 | 0 | 0 | Random | 79.40% | 0 |
| Fracture | Coffee | 2014 Sheng, J. | 188,297 | RR | 0.94 | 0.71-1.17 | 6 | 8 | 0 | Random | 56.30% | 0.005 |
| Fracture | Coffee | 2013 Li,X.L. | 162,477 | OR | 1.3 | 0.96-1.75 | 6 | 6 | 0 | Random | 84.50% | 0 |
| Fracture | Calcium+ Vitamin D | 2020 Liu, C. | 78,206 | RR | 0.86 | 0.76-0.98 | 15 | 0 | 0 | Random | 42.30% | 0.096 |
| Fracture | Calcium+Vitamin D | 2019 P. Yao | 49,282 | RR | 0.91 | 0.81-1 | 6 | 0 | 0 | Random | 52.80% | 0.145 |
| Fracture | Calcium+Vitamin D | 2017 J. G. Zhao | 51,145 | RR | 1.09 | 0.85-1.39 | 13 | 0 | 0 | Random | NA | NA |
| Fracture | Calcium+ vitamin D | 2016 Weaver, C.M. | 30,970 | RR | 0.79 | 0.69-0.89 | 8 | 0 | 0 | Random | 54.10% | 0.14 |
| Fracture | Vitamin D | 2019 P. Yao | 34,243 | RR | 0.87 | 0.74-0.99 | 17 | 0 | 0 | Random | 93.50% | 0 |
| Fracture | Vitamin D | 2017 J. G. Zhao | 51,145 | RR | 1.21 | 0.99-1.47 | 33 | 0 | 0 | Random | NA | NA |
| Fracture | Vitamin D | 2005 H.A.B-F, W. | 9,048 | RR | 0.76 | 0.68-0.84 | 7 | 0 | 0 | random | 0.00% | 0.722 |
| Fracture | Vitamin D | 2002 P, E. | 7,245 | RR | 0.7 | 0.54-0.86 | 25 | 0 | 0 | Random | 76.50% | 0.014 |
| Fracture | Vitamin C | 2018 Malmir, H. | 65,250 | RR | 0.74 | 0.51-1.08 | 6 | 6 | 10 | Random | 79.10% | 0 |
| Fracture | Vitamin C | 2018 Malmir, H. | 3,378 | RR | 0.67 | 0.47-0.94 | 1 | 1 | 1 | Random | 0.00% | 0.999 |
| Fracture | Calcium | 2015 Wang, D. | 267,759 | RR | 0.97 | 0.88-1.06 | 8 | 0 | 0 | Random | 0.00% | 0.581 |
| Fracture | Calcium | 2017 J. G. Zhao | 51,145 | RR | 1.53 | 0.97-2.42 | 33 | 0 | 0 | Random | 0 | 0 |
| Fracture | Calcium | 2007 B-F,H.A. | 239,597 | RR | 1 | 0.96-1.04 | 5 | 0 | 0 | Random | 59.40% | 0.116 |
| Fracture | Calcium | 2002 Shea,B. | 798 | RR | 0.78 | 0.53-1.04 | 5 | 0 | 0 | Random | 0.00% | 0.801 |
| Fracture | n-3 PUFAs | 2019 Sadeghi, O | 265,151 | OR | 0.89 | 0.8-0.99 | 7 | 3 | 0 | Fixed | 17.30% | 0.298 |
| Fracture | Urinary sodium | 2018 Fatahi, S. | 28,363 | OR | 1.09 | 0.99-1.19 | 2 | 0 | 13 | Random | 49.90% | 0.063 |
| Fracture | Dietary sodium | 2018 Fatahi, S. | 9,507 | OR | 1.45 | 1.19-1.77 | 0 | 0 | 4 | Random | 75.60% | 0.006 |
| Fracture | Vitamin C foods | 2019 Zeng, L. F. | 16,428 | RR | 0.66 | 0.47-0.94 | 3 | 5 | 0 | Random | 79.50% | 0 |
| Fracture | Vitamin C foods | 2019 Zeng, L. F. | 3,537 | RR | 0.66 | 0.48-0.92 | 1 | 2 | 1 | Random | 0.00% | 0.999 |
| Fracture | Dietary vitamin C | 2018 Sun, Y. | 7,908 | OR | 0.73 | 0.55-0.97 | 3 | 3 | 0 | Random | 69.10% | 0.002 |
| Fracture | Dietary magnesium | 2016 F-M, M. | 90,149 | OR | 1.01 | 0.95-1.08 | 8 | 0 | 9 | Random | 0.00% | 0.34 |
| Fracture | Vegetarianism | 2019 Iguacel, I. | 33,131 | RR | 1.32 | 1.04-1.67 | 5 | 0 | 0 | Random | 87.80% | <0.001 |
| Fracture | Healthy | 2019 Fabiani, R. | 19,650 | OR | 0.79 | 0.66-0.93 | 1 | 0 | 9 | Random | 66.40% | 0.028 |
| Fracture | Meat/western | 2019 Fabiani, R. | 19,650 | OR | 1.11 | 1.05-1.17 | 1 | 0 | 9 | Random | 32.50% | 0.028 |
| Fracture | Mediteranean diet | 2018 Malmir, H. | 353,076 | RR | 0.79 | 0.72-0.87 | 6 | 1 | 6 | Random | 0.00% | 0.77 |
| Fracture | Healthy | 2018 D-G, E. | 175,060 | OR | 0.86 | 0.75-0.96 | 18 | 1 | 12 | Random | 20.20% | 0.263 |
| Fracture | Unhealthy | 2018 D-G, E. | 175,060 | OR | 1.09 | 1.03-1.15 | 18 | 1 | 12 | Random | 0.00% | 0.744 |
| Fracture | Fish | 2019 Sadeghi,O. | 182,688 | OR | 0.88 | 0.79-0.98 | 7 | 3 | 0 | Fixed | 57.90% | 0.02 |
| Fracture | Vegetables+ fruits | 2016 Luo, Sy. | 330,417 | HR | 0.83 | 0.7-0.98 | 4 | 1 | 0 | Random | 84.70% | 0 |
| Fracture | Fruits | 2016 Luo, Sy. | 330,417 | HR | 0.87 | 0.74-1.04 | 4 | 1 | 0 | Random | 73.00% | 0.002 |
| Fracture | Vegetables | 2020 Zeng, L. F. | 14,247 | OR | 0.73 | 0.57-0.95 | 0 | 4 | 8 | Random | 65.50% | 0.001 |
| Fracture | Fruits | 2018 Hu, D. | 10,034 | OR | 0.68 | 0.56-0.83 | 0 | 3 | 6 | Random | 57.30% | 0.016 |
| Fracture | Vegetables | 2016 Luo, Sy. | 330,417 | HR | 0.75 | 0.61-0.92 | 4 | 1 | 0 | Random | 79.60% | 0 |
| Fracture | Vegetables | 2018 Hu, D. | 9,948 | OR | 0.87 | 0.65-1.16 | 0 | 2 | 7 | Random | 68.90% | 0.001 |

**Supplemental Table 2 continued...**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Outcome** | **Category** | **Study** | **Case** | **MA**  **metric** | **Estimates** | **95%CI** | **Cohort/ RCT** | **Case- control** | **Cross- sectional** | **Model** | **I2** | **P-value** |
| **Bone mineral density** | | | | | | | | | | | | |
| BMD | Milk | 2018 B,H.K.M. | 7,445 | SMD | 0.1 | 0.02-0.18 | 2 | 0 | 0 | Random | 0.00% | 0 |
| BMD | Tea | 2017 Zhang, Z,F. | 12,635 | SMD | 0.02 | 0.01-0.03 | 4 | 1 | 8 | Random | 75.10% | 0.001 |
| BMD | Tea | 2017 Guo, M. | 134,425 | MD | 0.04 | 0.01-0.08 | 3 | 0 | 4 | Random | 88% | 0.02 |
| BMD | Calcium+ Vitamin D | 2020 Liu, C. | 78,206 | SMD | 0.54 | 0.23-0.85 | 15 | 0 | 0 | Random | 88.30% | 0 |
| BMD | Vitamin D | 2014 Reid,I.R. | 4,082 | WMD | -0.03 | -0.21-0.14 | 23 | 0 | 0 | Random | 64.70% | 0.023 |
| BMD | Vitamin C | 2018 Malmir, H. | 36,420 | RR | 0.15 | 0.09-0.22 | 1 | 1 | 10 | Random | 0.00% | 0.587 |
| BMD | Protein | 2018 S-W, M. M. | 803 | SMD | -0.08 | -0.54-0.37 | 7 | 0 | 0 | Random | 0.00% | 0.666 |
| BMD | Calcium | 2015 Tai, V. | 13,790 | MD | 0.75 | 0.63-0.87 | 59 | 0 | 0 | Random | 68.70% | 0 |
| BMD | Calcium | 2015 Silk, L,N. | 867 | ES | 0.41 | 0.32-0.49 | 6 | 0 | 0 | Random | 53.30% | 0.093 |
| BMD | Calcium | 2002 Shea,B. | 845 | WMD | 1.63 | 1.15-2.11 | 11 | 0 | 0 | Random | 0.00% | 0.917 |
| BMD | Urinary sodium | 2018 Fatahi, S. | 28,363 | OR | -0.12 | -1-0.76 | 2 | 0 | 13 | Random | 98.10% | 0 |
| BMD | Dietary sodium | 2018 Fatahi, S. | 21,538 | OR | -0.06 | -0.38-0.25 | 2 | 0 | 10 | Random | 76.20% | 0 |
| BMD | Soy isoflavones | 2012 Wei,P. | 793 | SMD | 0.54 | 0.13-0.94 | 7 | 0 | 0 | Random | 91% | 0.009 |
| BMD | Soy isoflavones | 2010 Taku,K. | 2,108 | MD | 2.4 | 1.11-3.68 | 11 | 0 | 0 | Random | 0.00% | 0.965 |
| BMD | Soy isoflavones | 2010 Ricci,E. | 1,261 | MD | 0.73 | -2.79-4.25 | 12 | 0 | 0 | Random | 17% | 0.68 |
| BMD | Soy isoflavones | 2009 Liu,J. | 896 | NET | 2.09 | -0.29-4.48 | 10 | 0 | 0 | Random | 2.40% | 0.359 |
| BMD | Soy isoflavones | 2008 Ma,D.F. | 608 | WMD | 1.06 | -0.24-2.36 | 10 | 0 | 0 | Random | 82.60% | 0.017 |
| BMD | Vitamin D foods | 2020 Tangestani, H. | 1,786 | WMD | 0.03 | 0.02-0.05 | 20 | 0 | 0 | Random | 58.80% | 0.002 |
| BMD | Vitamin C foods | 2019 Zeng, L. F. | 6,546 | RR | 0.16 | 0.1-0.22 | 1 | 2 | 2 | Random | 0.00% | 0.467 |
| BMD | Vegetarianism | 2019 Iguacel, I. | 4,003 | MD | -0.032 | -0.048—0.015 | 15 | 0 | 0 | Random | 41.04% | 0.04 |
| BMD | Mediteranean diet | 2018 Malmir, H. | 14,654 | MD | 0.11 | 0.09-0.13 | 6 | 1 | 6 | Random | 0.00% | 0.814 |
| BMD | Healthy | 2019 Fabiani, R. | 19,650 | OR | 0.82 | 0.69-0.98 | 1 | 0 | 9 | Random | 66.36% | <0.0001 |
| BMD | Meat/Western | 2019 Fabiani, R. | 19,650 | OR | 1.22 | 1.02-1.45 | 1 | 0 | 9 | Random | NA | 0.015 |
| BMD | Healthy | 2018 D-G, E. | 175,060 | OR | 0.57 | 0.43-0.71 | 18 | 1 | 12 | Random | 0.00% | 0.864 |
| BMD | Unhealthy | 2018 D-G, E. | 175,060 | OR | 1.59 | 1.24-1.95 | 18 | 1 | 12 | Random | 0.00% | 0.483 |
| BMD | Dietary protein | 2017 S-W, M.M. | 1,204 | NET | 0.22 | 0.01-0.43 | 36 | 0 | 0 | Random | 34.80% | 0.189 |
| BMD | Dietary magnesium | 2016 F-M, M. | 1,721 | OR | 0.13 | 0.06-0.2 | 1 | 0 | 5 | Random | 0.00% | 0.552 |
| BMD | Dietary sources | 2015 V.Tai,W. | 1533 | WMD | 0.92 | 0.37-1.47 | 15 | 0 | 0 | Random | 83.20% | 0 |

\*MA, meta-analysis; CI, confidence interval; RR, relative risk, OR, odds ratio; SMD, standard mean difference; NA, not available; WMD, weighted mean difference; MD, mean difference; HR, hazard ratio; NET, net change.

**Supplemental Table 3 Detailed evaluation of the methodological quality with AMSTAR 2.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Category** | | **Reference** | | | **Comparison** | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** | **Q6** | **Q7** | **Q8** | **Q9** | **Q10** | **Q11** | **Q12** | **Q13** | **Q14** | **Q15** | **Q16** | **All** |
| **Osteoporotic fracture** | | | | | | | | | | | | | | | | | | | | | | |
| Milk | | 2020 Malmir, H. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | No | Yes | No | No | Yes | 12 |
| Milk | | 2020 Hidayt, K. | | | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | No | Yes | No | No | Yes | 11 |
| Milk | | 2020 Malmir, H. | | High v low | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | No | Yes | No | No | Yes | 12 |
| Dairy | | 2020 Malmir, H. | | High v low | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | No | Yes | No | No | Yes | 12 |
| Milk/dairy | | 2019 Fabiani, R. | | | High v low | Yes | Yes | Yes | Yes | No | No | Yes | Yes | No | Yes | Yes | Yes | Yes | No | No | No | 10 |
| Milk | | 2018 B,H.K.M. | | | Dose-response | Yes | Yes | Yes | Yes | No | No | No | No | No | No | Yes | Yes | No | Yes | Yes | Yes | 9 |
| Milk | | 2011 B-F,H.A. | | | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | No | Yes | No | No | Yes | 12 |
| Milk | | 2005 Kanis,J.A. | | | Dose-response | Yes | Yes | Yes | No | No | No | No | Yes | No | No | Yes | Yes | No | No | Yes | No | 7 |
| Yogurt | | 2020 Hidayt, K. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | No | Yes | Yes | 14 |
| Cheese | | 2020 Hidayt, K. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | No | Yes | Yes | 14 |
| Dairy | | 2019 M-M, P. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | No | 14 |
| Dairy | | 2018 Bian, S. | | | High v low | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | No | No | No | Yes | Yes | 11 |
| Alcohol | | 2021 Asoudeh, F. | | | Dose-response | yes | yes | yes | yes | yes | yes | Yes | Yes | No | No | Yes | No | Yes | Yes | Yes | Yes | 13 |
| Alcohol | 2019 Cheraghi, Z. | | High v low | | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Tea | | 2017 Sun, K. | | High v low | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | No | 14 |
| Tea | | 2017 Guo, M. | | High v low | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | No | 14 |
| Tea | | 2014 Sheng, J. | | | High v low | Yes | Yes | Yes | No | No | No | Yes | Yes | No | No | Yes | Yes | No | Yes | Yes | Yes | 10 |
| Tea | | 2014 Chen,B. | | | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Coffee | | 2015 Li, S. | | | High v low | Yes | Yes | Yes | No | No | No | Yes | Yes | No | No | Yes | Yes | No | Yes | No | Yes | 9 |
| Coffee | | 2014 Sheng, J. | | | High v low | Yes | Yes | Yes | No | No | No | Yes | Yes | No | No | Yes | Yes | No | Yes | Yes | Yes | 10 |
| Coffee | | 2013 Li,X.L. | | | High v low | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | No | Yes | No | Yes | Yes | Yes | Yes | 13 |
| Calcium+Vitamin D | | 2020 Liu, C. | | | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | No | 14 |
| Calcium+Vitamin D | | 2019 P. Yao | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Ys | 15 |
| Calcium+Vitamin D | | 2017 J. G. Zhao | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Ys | 15 |
| Calcium+vitamin D | | 2016 Weaver, C.M. | | | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | 15 |
| Vitamin D | | 2019 P. Yao | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Ys | 15 |
| Vitamin D | | 2017 J. G. Zhao | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Ys | 15 |
| Vitamin D | | 2005 H.A.B-F, W. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Ys | 15 |
| Vitamin D | | 2002 P, E. | | | High v low | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | No | 12 |
| Vitamin C | | 2018 Malmir, H. | | | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 16 |
| Vitamin C | | 2018 Malmir, H. | | | High v low | Yes | Yes | Yes | Yes | yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Calcium | | 2017 J. G. Zhao | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Ys | 15 |
| Calcium | | 2015 Wang, D. | | | High v low | Yes | Yes | Yes | Yes | No | No | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 12 |
| Calcium | | 2007 B-F,H.A. | | | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Calcium | | 2002 Shea,B. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 14 |
| n-3 PUFAs | | 2019 Sadeghi, O | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Urinary sodium | | 2018 Fatahi, S. | | | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Dietary sodium | | 2018 Fatahi, S. | | | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Vitamin C foods | | 2019 Zeng, L. F. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 14 |
| Vitamin C foods | | 2019 Zeng, L. F. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 14 |
| Dietary vitamin C | | 2018 Sun, Y. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | No | Yes | Yes | Yes | Yes | 13 |
| Dietary magnesium | | 2016 F-M, M. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 14 |
| Vegetarianism | | 2019 Iguacel, I. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 14 |
| Healthy | | 2019 Fabiani, R. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | 14 |
| Meat/western | | 2019 Fabiani, R. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | 14 |
| Mediteranean diet | | 2018 Malmir, H. | | | High v low | Yes | Yes | Yes | Yes | yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Healthy | | 2018 D-G, E. | | | High v low | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 13 |
| Unhealthy | | 2018 D-G, E. | | | High v low | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 13 |
| Fish | | 2019 Sadeghi, O. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Ye | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Vegetables+fruits | | 2016 Luo, Sy. | | | High v low | Yes | Yes | Yes | No | No | No | Yes | Yes | Yes | No | Yes | Yes | No | No | Yes | Yes | 10 |
| Fruits | | 2016 Luo, Sy. | | | High v low | Yes | Yes | Yes | No | No | No | Yes | Yes | Yes | No | Yes | Yes | No | No | Yes | Yes | 10 |
| Vegetables | | 2020 Zeng, L. F. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 14 |
| Fruits | | 2018 Hu, D. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Vegetables | | 2018 Hu, D. | | | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Vegetables | | 2016 Luo, Sy. | | | High v low | Yes | Yes | Yes | No | No | No | Yes | Yes | Yes | No | Yes | Yes | No | No | Yes | Yes | 10 |

**Supplemental Table 3 continued...**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Category** | **Reference** | **Comparison** | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** | **Q6** | **Q7** | **Q8** | **Q9** | **Q10** | **Q11** | **Q12** | **Q13** | **Q14** | **Q15** | **Q16** | **All** |
| **Bone mineral density** | | | | | | | | | | | | | | | | | | | |
| Milk | 2018 B,H.K.M. | Dose-response | Yes | Yes | Yes | Yes | No | No | No | No | No | No | Yes | Yes | No | Yes | Yes | Yes | 9 |
| Tea | 2017 Zhang, Z,F. | High v low | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | No | 13 |
| Tea | 2017 Guo, M. | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | No | 14 |
| Calcium+Vitamin D | 2020 Liu, C. | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | No | 14 |
| Vitamin D | 2014 Reid,I.R. | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Vitamin C | 2018 Malmir, H. | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 16 |
| Protein | 2018 S-W, M. M. | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | No | Yes | Yes | Yes | Yes | 14 |
| Calcium | 2015 Tai, V. | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Calcium | 2015 Silk, L,N. | Dose-response | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Calcium | 2002 Shea,B. | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 14 |
| Urinary sodium | 2018 Fatahi, S. | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | No | Yes | Yes | Yes | Yes | 13 |
| Dietary sodium | 2018 Fatahi, S. | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | No | Yes | Yes | Yes | Yes | 13 |
| Soy isoflavones | 2012 Wei,P. | Dose-response | Yes | Yes | Yes | No | No | No | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 11 |
| Soy isoflavones | 2010 Taku,K. | Dose-response | Yes | Yes | Yes | No | No | No | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 12 |
| Soy isoflavones | 2010 Ricci,E. | High v low | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 13 |
| Soy isoflavones | 2009 Liu,J. | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Soy isoflavones | 2008 Ma,D.F. | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 14 |
| Vitamin D foods | 2020 Tangestani, H. | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Vitamin C foods | 2019 Zeng, L. F. | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 14 |
| Vegetarianism | 2019 Iguacel, I. | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 14 |
| Mediteranean diet | 2018 Malmir, H. | High v low | Yes | Yes | Yes | Yes | yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Healthy | 2019 Fabiani, R. | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | 14 |
| Meat/Western | 2019 Fabiani, R. | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | 14 |
| Healthy | 2018 D-G, E. | High v low | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 13 |
| Unhealthy | 2018 D-G, E. | High v low | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 13 |
| Dietary protein | 2017 S-W, M.M. | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |
| Dietary magnesium | 2016 F-M, M. | High v low | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | Yes | Yes | Yes | Yes | 14 |
| Dietary sources | 2015 V.Tai,W. | Dose-response | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | 15 |

\*Q = Question; Q1: Did the research questions and inclusion criteria for the review include the components of PICO? Q2: Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol? Q3: Did the review authors explain their selection of the study designs for inclusion in the review? Q4: Did the review authors use a comprehensive literature search strategy? Q5: Did the review authors perform study selection in duplicate? Q6: Did the review authors perform data extraction in duplicate? Q7: Did the review authors provide a list of excluded studies and justify the exclusions? Q8: Did the review authors describe the included studies in adequate detail? Q9: Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review? Q10: Did the review authors report on the sources of funding for the studies included in the review? Q11: If meta-analysis was performed did the review authors use appropriate methods for statistical combination of results? Q12: If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis? Q13: Did the review authors account for RoB in individual studies when interpreting/ discussing the results of the review? Q14: Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review? Q15: If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review? Q16: Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?

**Supplemental Table 4 GRADE classification.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Outcome** | **Category** | **Year** | **Author** | **AMSTAR** | **GRADE** |
| **Osteoporotic fracture** | | | | | |
| Fracture | Milk | 2020 | Malmir, H. | 12 | Moderate |
| Fracture | Milk | 2020 | Hidayt, K. | 11 | Moderate |
| Fracture | Milk | 2020 | Malmir, H. | 12 | Moderate |
| Fracture | Dairy | 2020 | Malmir, H. | 12 | Moderate |
| Fracture | Milk/dairy | 2019 | Fabiani, R. | 10 | Moderate |
| Fracture | Milk | 2018 | B,H.K.M. | 9 | low |
| Fracture | Milk | 2011 | B-F,H.A. | 12 | High |
| Fracture | Milk | 2005 | Kanis,J.A. | 7 | low |
| Fracture | Yogurt | 2020 | Hidayt, K. | 14 | Moderate |
| Fracture | Cheese | 2020 | Hidayt, K. | 14 | Moderate |
| Fracture | Dairy | 2019 | M-M, P. | 14 | Moderate |
| Fracture | Dairy | 2018 | Bian, S. | 11 | High |
| Fracture | Alcohol | 2021 | Asoudeh, F. | 13 | High |
| Fracture | Alcohol | 2019 | Cheraghi, Z. | 15 | High |
| Fracture | Tea | 2017 | Sun, K. | 14 | low |
| Fracture | Tea | 2017 | Guo, M. | 14 | Very low |
| Fracture | Tea | 2014 | Sheng, J. | 10 | High |
| Fracture | Tea | 2014 | Chen,B. | 15 | low |
| Fracture | Coffee | 2015 | Li, S. | 9 | Moderate |
| Fracture | Coffee | 2014 | Sheng, J. | 10 | High |
| Fracture | Coffee | 2013 | Li,X.L. | 13 | low |
| Fracture | Calcium+Vitamin D | 2020 | Liu, C. | 14 | High |
| Fracture | Calcium+Vitamin D | 2019 | P. Yao | 15 | low |
| Fracture | Calcium+Vitamin D | 2017 | J. G. Zhao | 15 | High |
| Fracture | Calcium+vitamin D | 2016 | Weaver, C.M. | 15 | High |
| Fracture | Vitamin D | 2019 | P. Yao | 15 | low |
| Fracture | Vitamin D | 2017 | J. G. Zhao | 15 | High |
| Fracture | Vitamin D | 2005 | H.A.B-F, W. | 15 | Moderate |
| Fracture | Vitamin D | 2002 | P, E. | 12 | Very low |
| Fracture | Vitamin C | 2018 | Malmir, H. | 16 | Moderate |
| Fracture | Vitamin C | 2018 | Malmir, H. | 15 | low |
| Fracture | Calcium | 2017 | J. G. Zhao | 15 | High |
| Fracture | Calcium | 2015 | Wang, D. | 12 | low |
| Fracture | Calcium | 2007 | B-F,H.A. | 15 | High |
| Fracture | Calcium | 2002 | Shea,B. | 14 | Moderate |
| Fracture | n-3 PUFAs | 2019 | Sadeghi, O | 15 | Moderate |
| Fracture | Urinary sodium | 2018 | Fatahi, S. | 15 | Moderate |
| Fracture | Dietary sodium | 2018 | Fatahi, S. | 15 | Moderate |
| Fracture | Vitamin C foods | 2019 | Zeng, L. F. | 14 | High |
| Fracture | Vitamin C foods | 2019 | Zeng, L. F. | 14 | High |
| Fracture | Dietary vitamin C | 2018 | Sun, Y. | 13 | Moderate |
| Fracture | Dietary magnesium | 2016 | F-M, M. | 14 | High |
| Fracture | Vegetarianism | 2019 | Iguacel, I. | 14 | High |
| Fracture | Healthy | 2019 | Fabiani, R. | 14 | Moderate |
| Fracture | Meat/western | 2019 | Fabiani, R. | 14 | Moderate |
| Fracture | Mediteranean diet | 2018 | Malmir, H. | 15 | low |
| Fracture | Healthy | 2018 | D-G, E. | 13 | Moderate |
| Fracture | Unhealthy | 2018 | D-G, E. | 13 | Moderate |
| Fracture | Fish | 2019 | Sadeghi, O. | 15 | Moderate |
| Fracture | Vegetables+fruits | 2016 | Luo, Sy. | 10 | Very low |
| Fracture | Fruits | 2016 | Luo, Sy. | 10 | Very low |
| Fracture | Fruits | 2016 | Luo, Sy. | 10 | Very low |
| Fracture | Vegetables | 2020 | Zeng, L. F. | 14 | High |
| Fracture | Fruits | 2018 | Hu, D. | 15 | low |
| Fracture | Vegetables | 2018 | Hu, D. | 15 | low |

**Supplemental Table 4 continued...**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Outcome** | **Category** | **Year** | **Author** | **AMSTAR** | **GRADE** |
| **Bone mineral density** | | | | | |
| BMD | Milk | 2018 | B,H.K.M. | 9 | Very low |
| BMD | Tea | 2017 | Zhang, Z,F. | 13 | Very low |
| BMD | Tea | 2017 | Guo, M. | 14 | Very low |
| BMD | Calcium+Vitamin D | 2020 | Liu, C. | 14 | High |
| BMD | Vitamin D | 2014 | Reid,I.R. | 15 | High |
| BMD | Vitamin C | 2018 | Malmir, H. | 16 | Moderate |
| BMD | Protein | 2018 | S-W, M. M. | 14 | low |
| BMD | Calcium | 2015 | Tai, V. | 15 | Moderate |
| BMD | Calcium | 2015 | Silk, L,N. | 15 | low |
| BMD | Calcium | 2002 | Shea,B. | 14 | Moderate |
| BMD | Urinary sodium | 2018 | Fatahi, S. | 13 | Moderate |
| BMD | Dietary sodium | 2018 | Fatahi, S. | 13 | Moderate |
| BMD | Soy isoflavones | 2012 | Wei,P. | 11 | low |
| BMD | Soy isoflavones | 2010 | Taku,K. | 12 | Moderate |
| BMD | Soy isoflavones | 2010 | Ricci,E. | 13 | Moderate |
| BMD | Soy isoflavones | 2009 | Liu,J. | 15 | low |
| BMD | Soy isoflavones | 2008 | Ma,D.F. | 14 | low |
| BMD | Vitamin D foods | 2020 | Tangestani, H. | 15 | High |
| BMD | Vitamin C foods | 2019 | Zeng, L. F. | 14 | High |
| BMD | Vitamin C foods | 2019 | Zeng, L. F. | 14 | High |
| BMD | Vegetarianism | 2019 | Iguacel, I. | 14 | High |
| BMD | Mediteranean diet | 2018 | Malmir, H. | 15 | low |
| BMD | Healthy | 2019 | Fabiani, R. | 14 | Moderate |
| BMD | Meat/Western | 2019 | Fabiani, R. | 14 | Moderate |
| BMD | Healthy | 2018 | D-G, E. | 13 | Moderate |
| BMD | Unhealthy | 2018 | D-G, E. | 13 | Moderate |
| BMD | Dietary protein | 2017 | S-W, M.M. | 15 | Moderate |
| BMD | Dietary magnesium | 2016 | F-M, M. | 14 | High |
| BMD | Dietary sources | 2015 | 2015 V.Tai,W | 15 | Moderate |

\*AMSTAR, a measurement tool to assess systematic; GRADE, Grading of Recommendations Assessment, Development, and Evaluation.

**Supplemental Table 5 List of excluded studies**

|  |  |  |
| --- | --- | --- |
| **Reference Title** | | **Reason for Exclusion** |
| 1. | Cardoso, I., et al., Lack of Transparency in the Meta-Analyses of Dietary and Urinary Sodium and Bone Mineral Density or Risk of Osteoporosis: A Letter to the Journal. J Am Coll Nutr, 2019. 38(8): p. 746-747. | A letter to the journal. |
| 2. | Appleby, P.N. and T.J.A. Key, Letter: Veganism, vegetarianism, bone mineral density, and fracture risk: a systematic review and meta-analysis. Nutr Rev, 2019. 77(6): p. 451. | A letter to the journal. |
| 3. | Avenell, A., et al., Further major uncorrected errors in National Osteoporosis Foundation meta-analyses of calcium and vitamin D supplementation in fracture prevention. Osteoporos Int, 2017. 28(2): p. 733-734. | Based on further corrected results, the original study was finally included. |
| 4. | Weaver, C.M., et al., Erratum and additional analyses re: Calcium plus vitamin D supplementation and the risk of fractures: an updated meta-analysis from the National Osteoporosis Foundation. Osteoporos Int, 2016. 27(8): p. 2643-2646. | Based on further supplements, the original study was finally included. |
| 5. | Zhang, H., X. Tao, and J. Wu, Association of homocysteine, vitamin B12, and folate with bone mineral density in postmenopausal women: a meta-analysis. Arch Gynecol Obstet, 2014. 289(5): p. 1003-9. | Intervention measures belong to drug intervention. |
| 6. | Fang, Y., et al., Effect of vitamin K on bone mineral density: a meta-analysis of randomized controlled trials. J Bone Miner Metab, 2012. 30(1): p. 60-8 | Intervention measures belong to drug intervention. |
| 7. | Iwamoto, J., H. Matsumoto, and T. Takeda, Efficacy of menatetrenone (vitamin K2) against non-vertebral and hip fractures in patients with neurological diseases: meta-analysis of three randomized, controlled trials. Clin Drug Investig, 2009. 29(7): p. 471-479. | The intervention measures belong to drug intervention, and the object of intervention does not belong to osteoporosis. |
| 8. | Ho-Pham, L.T., N.D. Nguyen, and T.V. Nguyen, Effect of vegetarian diets on bone mineral density: a Bayesian meta-analysis. Am J Clin Nutr, 2009. 90(4): p. 943-50. | The research method does not meet the inclusion conditions of this study. |
| 9. | Fenton, T.R., et al., Phosphate decreases urine calcium and increases calcium balance: a meta-analysis of the osteoporosis acid-ash diet hypothesis. Nutr J, 2009. 8: p. 41. | Intervention measures belong to drug intervention. |
| 10. | Chen, B., et al., Association between vitamin D receptor BsmI, FokI, and Cdx2 polymorphisms and osteoporosis risk: an updated meta-analysis. Biosci Rep, 2020. 40(7). | The intervention method did not conform to this study. |