Table 1 Study and Participants Characteristics

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| Study, year  Country/region | Arms | Participants, health status，sex, N, Year (mean±SD / median (Q1–Q3)) | Vitamin D/calcium Supplementation | | | | Exercise | | | During  (weeks) | Outcome |
| types | strategies | dosage | calcium | intervention | Frequence per week | Methods/intensity |
| Agergaard (1) 2015  Denmark | 2  Experiment group (EG)  Control group (CON) | Healthy  Men17/women0  EG: n=7，67.1 ± 2.9  CON: n=10, 66.6 ± 4.2 | Vitamin D3 | daily | EG:1920IU  CON: placebo | EG: 800mg  CON:800mg | EG: progressive-RT  Con: progressive-RT RT | 3 sessions | progressive-RT: 36 sessions, progressive loading levels, 65-85% | 12 | △CSA of quadriceps muscle：EG↑;CON↑  △Isometric muscle strength: EG↑; CON↑ |
| Aoki (2) 2018  Janpan | 3  The exercise group (EX)  The vitamin D group (VitD)  The exercise and vitamin D (EX+VitD) | Healthy  men28/women102  EX: n=45, 71.2± 6.79  VitD: n=42, 71.3± 5.80  EX+VitD: n=43, 68.8±5.25 | vitamin D3 | daily | EX: 0IU/day  VitD: 1000IU/day vitamin D3  EX+VitD: 1000IU/day vitamin D3 | - | EX：RT  VitD：-  EX+VitD：RT | 7 sessions | RT: single-leg standing and squatting | 24 | Strength of knee extension, Strength of hip ﬂexion, Lower limb muscle mass and Two-Step Test：EX↑, VitD↑; EX+VitD↑  SLS test: EX－, VitD－, EX+VitD↓  FTSTS test: EX↓, VitD↓, EX+VitD↓  FRT: EX－, VitD↑, EX+VitD－ |
| Aschauer (3)2021  Austria | 3  Control group (CON)  Vitamin D daily group (VDD)  Vitamin D monthly group (VDM) | Healthy  Men67/women33  CON: n=33, 68.9 (67.0–72.9)  VDD: n=30, 68.7 (66.9–74.8)  VDM: n=37, 69.9 (67.0–74.3) | vitamin D3 | Daily; monthly | CON: -  VDD: 800IU/day  VDM: 50000IU month | CON: 400mg calcium/day  VDD: 400mg calcium/day  VDM: 400mg calcium/day | CON: Progressive-RT  VDD: Progressive-RT  VDM: Progressive-RT | 2 sessions | Progressive-RT: duration from 60 to 90 min, 60-80% RM | 10 | 30s chair stand test, 30s Arm Curl Test, TUG, Gait Speed and 6MW: CON－, VDD－, VDM－ |
| Brech (4) 2021  Brazil | Experimental group (EG)：  Control group (CG) | With low bone mineral density  Men0/Women46  EG：n=23, 65.8±4.6  CG：n=23, 65.3±3.9 | vitamin D3 | weekly | EG: 50000IU  CG: placebo | - | EG: multimodal training  CG: multimodal training | 2 sessions | RT and balance exercise  RT: leg press, leg press calf raise, squat, leg flexion, chest press in the chair, hip abduction straight leg raise, glute bridge exercise  Balance exercise: stable and un stable surface | 12 | 15 steps, Chair raise test, HG (no domain) and Dynamometry isokinetic test: EG↑, CG↑  HG (Domain): EG－, CG－ |
| Bunout (5) 2006  chile | 4  Training+Calciu(EX+Ca+):  Training+Calcium+Vitamin D (EX+Ca+vitD+)  No Training+Calcium (EX-Ca+)  No Training+Calcium+vitamin D(EX-Ca+vitD+) | Healthy  Men10/women86  EX+Ca+: n=24, 76 ± 4  EX+Ca+vitD+: n=24, 78 ± 4  EX-Ca+: n=24, 77 ± 4  EX-Ca+vitD+: n=24, 77 ± 5 | vitamin D3 | daily | EX+Ca+: placebo  EX+Ca+vitD+: 400IU/day vitamin D3  EX-Ca+: placebo  EX-Ca+vitD+: 400IU/day vitamin D3 | EX+Ca+: 800mg/day calcium  EX+Ca+vitD+: 800mg/day calcium  EX-Ca+: 800mg/day calcium  EX-Ca+vitD+: 800mg/day calcium | EX+Ca+：RT  EX+Ca+vitD+: RT  EX-Ca+：-  EX-Ca+vitD+: - | 2 sessions | RT: 1.5 h, strength, balance and aerobic workout | 36 | Quadriceps strength(right, left and %) and SPPB: compared with EX-Ca+and EX-Ca+vitD+, EX+Ca+－↑, EX+Ca+vitD+ ↑.  HG(right, left and %)：－  12MW: compared with EX-Ca+, EX-Ca+vitD+↑.  TUG：compared with EX-Ca+, EX+Ca+vitD+↓. |
| Draxler (6) 2023  Austria | 3  Control(CON)  Vitamin D low(VDD)  Vitamin D high(VDM) | Healthy  Men67/women33  CON：n=33  VDD：n=30  VDM：n=37  70.6 ±4.5 | vitamin D3 | Daily; monthly | CON: -  VDD: 800IU/day vitamin D3  VDM: 50000IU/month vitamin D3 | CON: 400mg/day  VDD: 400mg/day  VDM: 400mg/day | CON：RT  VDD: RT  VDM：RT | 2 sessions | RT: duration 55–75 min, | 10 | Lean body mass：CON－, VDD－, VDM↑ |
| Uusi-Rasi (7) 2015  Finland | 4  Vitamin D and exercise(VitD+EX+)  Placebo and exercise(Pla+EX+)  Vitamin D without exercise(VitD+EX-)  Placebo without exercise(Pla+EX-) | Healthy  Men0/women409  VitD+EX+: n=102, 74.1±2.9  Pla+EX+: n=103, 74.8±2.9  VitD+EX-: n=102, 74.1±3.0  Pla+EX-: n=102, 73.8±3.1 | vitamin D3 | daily | VitD+EX+：800IU/day  Pla+EX+：-  VitD+EX-:800IU/day  Pla+EX-：- | - | VitD+EX+ and Pla+EX+： multimodal exercise training  VitD+EX- and Pla+EX-：- | 2 sessions | Multimodal exercise training: balance challenging, weight bearing, strengthening, agility, and functional exercises  30-75%RM | 96 | %Normal Walking Speed and %TUG: compared with Pla+EX-，Pla+EX+↑，VitD+EX+－，VitD+EX-－  %Chair Stand Time: compared with Pla+EX-，Pla+EX+↓，VitD+EX+－，VitD+EX-－  %Backward Walking: compared with Pla+EX-，Pla+EX+↑，VitD+EX+↑,VitD+EX-－. |
| Verschueren (8) 2011  Belgium | 4  WBV conventional dose group (WBV+CON)  WBV high dose group(WBV+High)  CON conventional dose group(CON+CON)  CON high dose group(CON+High) | Healthy  Men0/women113  WBV+CON: n=25，79.8± 5.3  WBV+High: n=25，80.3± 5.3  CON+CON: n=26，79.6±5.2  CON+High: n=27, 78.7±5.6 | vitamin D3 | daily | WBV+CON: 800IU/day  WBV+High: 1600IU/day  CON+CON: 800IU/day  CON+High: 1600IU/day | WBV+CON: 1000mg/day  WBV+High: 1000mg/day  CON+CON: 1000mg/day  CON+High: 1000mg/day | WBV+CON and WBV+High：whole-body vibration training(WBV)  CON+CON and CON+High：- | 3 sessions | WBV: static and dynamic exercises on a vibration platform, involving squat, deep squat, wide-stance squat, toe stance, and one-legged squats, 30-60Hz | 24 | Isometric muscle strength, Dynamic muscle strength, Muscle mass: WBV+CON－, WBV+High－, CON+CON－, CON+High－ |
| Jessup (9)  2003  America | 2  Exercise group(EG)  Sedentary group(CG) | Healthy  Men0/women18  EG: n=9, 69.1 ± 2.8  CG: n=9, 69.4 ± 4.2 | vitamin D3 | daily | EG: 400IU/day  CG: 400IU/day | EG: 1000mg/day  CG: 1000mg/day | EG：multimodal exercise training  CG：- | 3 sessions | Multimodal exercise training: 60-90 min/session, strength exercise, 50-75% RM and balance exercise | 32 | HG:EG↑, CG－ |
| Gianoudis (10)  2014  Australia | 2  Oste-ocise  Control(CON) | with risk factors for falls and/or low bone mineral density  men43/women119  Oste-ocise：n=81, 67.7 ± 6.5  Control(CON)：n=81, 67.2 ± 5.5 | vitamin D3 | daily | Oste-ocise: 1000IU/day  CON: 1000IU/day | Oste-ocise: 700mg/day  CON: 700mg/day | Oste-ocise：Multimodal exercise programs  CON：- | 3 sessions | Multimodal exercise programs: HV-PRT(40-60%RM) combined diverse-loading, moderate-impact, weight-bearing exercises and high‐challenge balance/functional exercises | 48 | %Lean mass:12 months: Oste-ocise－, CON－  %Leg strength, %Back strength, %Sit to stand, %Timed stair climb : 6 and 12 months: Oste-ocise↑, CON－  %Four square step: 6 and 12 months: Oste-ocise↓, CON－  %TUG: 6 and 12 months: Oste-ocise－, CON－ |
| Drey (11)  2012  Germany | 3  Strength training(ST)  Power training(PT)  Control(CON) | Prefrail older adults  Men21/women48  ST：n=23, 77 (72–80)  PT：n=24, 77 (73–84)  CON：n=22, 76 (70–82) | Vitamin D3 | daily | ST: 1000IU/day or 2000IU/day  PT: 1000IU/day or 2000IU/day  CON: 1000IU/day or 2000IU/day | - | ST: Strength training  PT: Power training  CON: - | 2 sessions | Strength training: 1h, followed the same routine as PT group, which performed concentric and eccentric contractions with an ‘average’ velocity  Power training: 1h, explosive resistance training.  RPE: 10-16 | 12 | %SPPB: Compared with CON, ST↑, PT↑  %Power,% Appendicular lean mass, %SF-LLFDI: Compared with CON, ST－, PT－ |
| Hornikx (12)  2012  Belgium | 2  Vitamin D group  Placebo group | patients with COPD  men38/women12  Vitamin D group: n=25, 67 ± 8  Placebo group: n=25, 69 ± 6 | vitamin D3 | monthly | Vitamin D group: 100000IU/month  Placebo group: － | － | Vitamin D group and Placebo group: rehabilitation | 3 sessions | Rehabilitation: Cycling, walking on the treadmill, stair climbing, strength exercises for the upper and lower extremities and arm cranking  60-85% of the baseline Wmax;75%-110% of the walking speed;70-121%RM | 12 | Quadriceps Strength,△Quadriceps Strength, Expiratory Muscle Strength, △Expiratory Muscle Strength, 6 MW, △6 MW: post *vs* pre, vitamin D group－, placebo group－; after intervention, compared with placebo group, vitamin D group－  Inspiratory Muscle Strength: post *vs* pre, vitamin D group↑, placebo group－; after intervention, compared with placebo group, vitamin D group↑ |
| Stemmle (13)  2018  Switzerland | 4  800IU/day without SHEP（800 IU D3/-SHEP）  800IU/day plus SHEP（800 IU D3/+SHEP）  2000IU/day without SHEP（2000 IU D3/-SHEP）  2000IU/day plus SHEP（2000 IU D3/+SHEP） | Acute hip fracture patients  Men36/women137  800 IU D3/-SHEP:  n=44, 85.5±6.0  800 IU D3/+SHEP  n=43, 83.2±7.4  2000 IU D3/-SHEP  n=42, 84.6±6.9  2000 IU D3/+SHEP  n=44, 83.5±7.1 | Vitamin D3 | daily | 800 IU D3/-SHEP: 800IU  800 IU D3/+SHEP: 800IU  2000 IU D3/-SHEP: 2000IU  2000 IU D3/+SHEP: 2000IU | 800 IU D3/-SHEP: 1000mg  800 IU D3/+SHEP: 1000mg  2000 IU D3/-SHEP: 1000mg  2000 IU D3/+SHEP: 1000mg | 800 IU D3/-SHEP, 2000 IU D3/-SHEP: -  800 IU D3/+SHEP, 2000 IU D3/+SHEP: simple home exercise program | 7 sessions | simple home exercise program: standing on both legs and then standing on one leg while holding on to a handrail, pulling a rubber band while sitting for arm and shoulder strength training, and getting in and out of a chair and going up and down stairs | 48 | TUG: compared with 800 IU D3/-SHEP,800 IU D3/+SHEP↑, 2000 IU D3/+SHEP-,2000 IU D3/-SHEP-  Knee flexor strength: 800 IU D3/-SHEP-,800 IU D3/+SHEP-, 2000 IU D3/+SHEP-,2000 IU D3/-SHEP-  Knee extensor strength: 800 IU D3/-SHEP-,800 IU D3/+SHEP-, 2000 IU D3/+SHEP-,2000 IU D3/-SHEP- |

Note: TUG: Timed up and Go Test; 6MW: 6-Minute Walk Test; 12MW: 12-Minute Walk Test; HG: Hand grip strength; SPPB: the Short Physical Performance Battery. RT: resistance training; COPD: Chronic Obstructive Pulmonary Disease, 1RM: the one-repetition maximum, RPE: Borg’s Rate of Perceived Exertion, Wmax: maximal workload. ↑: increase, ↓: decrease; -: no change.

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