Table 1 Study and Participants Characteristics

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| --- | --- | --- | --- | --- | --- | --- |
| Study, yearCountry/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) 2015Denmark | 2Experiment group (EG)Control group (CON) | HealthyMen17/women0EG: n=7，67.1 ± 2.9CON: n=10, 66.6 ± 4.2 | Vitamin D3 | daily | EG:1920IUCON: 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) 2018Janpan | 3The exercise group (EX)The vitamin D group (VitD)The exercise and vitamin D (EX+VitD) | Healthymen28/women102EX: n=45, 71.2± 6.79VitD: n=42, 71.3± 5.80EX+VitD: n=43, 68.8±5.25 | vitamin D3 | daily | EX: 0IU/day VitD: 1000IU/day vitamin D3EX+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)2021Austria | 3Control group (CON)Vitamin D daily group (VDD)Vitamin D monthly group (VDM) | HealthyMen67/women33CON: 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/dayVDD: 400mg calcium/dayVDM: 400mg calcium/day | CON: Progressive-RTVDD: Progressive-RTVDM: 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) 2021Brazil | Experimental group (EG)：Control group (CG) | With low bone mineral densityMen0/Women46EG：n=23, 65.8±4.6CG：n=23, 65.3±3.9 | vitamin D3 | weekly | EG: 50000IUCG: placebo | - | EG: multimodal trainingCG: multimodal training | 2 sessions | RT and balance exerciseRT: leg press, leg press calf raise, squat, leg flexion, chest press in the chair, hip abduction straight leg raise, glute bridge exerciseBalance 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) 2006chile | 4Training+Calciu(EX+Ca+): Training+Calcium+Vitamin D (EX+Ca+vitD+)No Training+Calcium (EX-Ca+)No Training+Calcium+vitamin D(EX-Ca+vitD+) | HealthyMen10/women86EX+Ca+: n=24, 76 ± 4EX+Ca+vitD+: n=24, 78 ± 4EX-Ca+: n=24, 77 ± 4EX-Ca+vitD+: n=24, 77 ± 5 | vitamin D3 | daily | EX+Ca+: placeboEX+Ca+vitD+: 400IU/day vitamin D3EX-Ca+: placeboEX-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+：RTEX+Ca+vitD+: RTEX-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) 2023Austria | 3Control(CON)Vitamin D low(VDD)Vitamin D high(VDM) | HealthyMen67/women33CON：n=33VDD：n=30VDM：n=3770.6 ±4.5 | vitamin D3 | Daily; monthly | CON: -VDD: 800IU/day vitamin D3VDM: 50000IU/month vitamin D3 | CON: 400mg/day VDD: 400mg/day VDM: 400mg/day  | CON：RTVDD: RTVDM：RT | 2 sessions | RT: duration 55–75 min,  | 10  | Lean body mass：CON－, VDD－, VDM↑ |
| Uusi-Rasi (7) 2015Finland | 4Vitamin D and exercise(VitD+EX+)Placebo and exercise(Pla+EX+)Vitamin D without exercise(VitD+EX-)Placebo without exercise(Pla+EX-) | Healthy Men0/women409VitD+EX+: n=102, 74.1±2.9Pla+EX+: n=103, 74.8±2.9VitD+EX-: n=102, 74.1±3.0Pla+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 trainingVitD+EX- and Pla+EX-：-  | 2 sessions | Multimodal exercise training: balance challenging, weight bearing, strengthening, agility, and functional exercises30-75%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) 2011Belgium | 4WBV conventional dose group (WBV+CON)WBV high dose group(WBV+High)CON conventional dose group(CON+CON)CON high dose group(CON+High) | HealthyMen0/women113WBV+CON: n=25，79.8± 5.3WBV+High: n=25，80.3± 5.3CON+CON: n=26，79.6±5.2CON+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)2003America | 2Exercise group(EG) Sedentary group(CG) | HealthyMen0/women18EG: n=9, 69.1 ± 2.8CG: n=9, 69.4 ± 4.2 | vitamin D3 | daily | EG: 400IU/day CG: 400IU/day  | EG: 1000mg/day CG: 1000mg/day  | EG：multimodal exercise trainingCG：- | 3 sessions | Multimodal exercise training: 60-90 min/session, strength exercise, 50-75% RM and balance exercise | 32 | HG:EG↑, CG－ |
| Gianoudis (10) 2014Australia | 2Oste-ociseControl(CON) | with risk factors for falls and/or low bone mineral densitymen43/women119Oste-ocise：n=81, 67.7 ± 6.5Control(CON)：n=81, 67.2 ± 5.5 | vitamin D3 | daily | Oste-ocise: 1000IU/dayCON: 1000IU/day | Oste-ocise: 700mg/dayCON: 700mg/day | Oste-ocise：Multimodal exercise programsCON：- | 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)2012Germany | 3Strength training(ST)Power training(PT)Control(CON) | Prefrail older adultsMen21/women48ST：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 trainingPT: Power trainingCON: - | 2 sessions | Strength training: 1h, followed the same routine as PT group, which performed concentric and eccentric contractions with an ‘average’ velocityPower 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) 2012Belgium | 2Vitamin D groupPlacebo group | patients with COPDmen38/women12Vitamin D group: n=25, 67 ± 8Placebo group: n=25, 69 ± 6 | vitamin D3 | monthly | Vitamin D group: 100000IU/monthPlacebo 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 cranking60-85% 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)2018Switzerland | 4800IU/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 patientsMen36/women137800 IU D3/-SHEP:n=44, 85.5±6.0800 IU D3/+SHEPn=43, 83.2±7.42000 IU D3/-SHEPn=42, 84.6±6.92000 IU D3/+SHEPn=44, 83.5±7.1 | Vitamin D3 | daily | 800 IU D3/-SHEP: 800IU800 IU D3/+SHEP: 800IU2000 IU D3/-SHEP: 2000IU2000 IU D3/+SHEP: 2000IU | 800 IU D3/-SHEP: 1000mg800 IU D3/+SHEP: 1000mg2000 IU D3/-SHEP: 1000mg2000 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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