**Supplementary Table S1.** T-scores, BMD (g/cm2), and serum 25-hydroxyvitamin D concentrations in the control and BPPV groups.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Total | | |  | Women | | |  | Men | | |
|  |  |  | Control | BPPV | P-value |  | Control | BPPV | P-value |  | Control | BPPV | P-value |
| No |  |  | 130 | 130 |  |  | 100 | 100 |  |  | 30 | 30 |  |
| Age, mean ± SD, y | |  | 54.9 ± 12.2 | 54.9 ± 12.2 |  |  | 54.9 ± 12.7 | 54.9 ± 12.7 |  |  | 54.8 ± 10.6 | 54.8 ± 10.6 |  |
| Femur | |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Neck |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.3 ± 1.0 | -0.6 ± 1.2 | 0.098 |  | -0.4 ± 1.0 | -0.8 ± 1.1 | **0.016** |  | 0.0 ± 0.7 | 0.2 ± 1.2 | 0.356 |
|  |  | BMD, g/cm2 | 0.904 ± 0.120 | 0.863 ± 0.212 | 0.053 |  | 0.891 ± 0.125 | 0.829 ± 0.217 | **0.014** |  | 0.951 ± 0.092 | 0.946 ± 0.150 | 0.432 |
|  | Trochanter | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | 0.2 ± 1.0 | 0.0 ± 1.2 | 0.160 |  | 0.1 ± 1.0 | -0.3 ± 1.1 | **0.022** |  | 0.5 ± 0.9 | 0.8 ± 1.1 | 0.223 |
|  |  | BMD, g/cm2 | 0.765 ± 0.116 | 0.737 ± 0.144 | 0.083 |  | 0.746 ± 0.114 | 0.708 ± 0.120 | **0.025** |  | 0.830 ± 0.101 | 0.832 ± 0.177 | 0.945 |
|  | Total |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | 0.0 ± 1.0 | -0.3 ± 1.3 | 0.136 |  | -0.2 ± 1.0 | -0.6 ± 1.1 | **0.021** |  | 0.5 ± 0.8 | 0.8 ± 1.2 | 0.338 |
|  |  | BMD, g/cm2 | 0.955 ± 0.144 | 0.939 ± 0.154 | 0.361 |  | 0.948 ± 0.124 | 0.907 ± 0.139 | **0.027** |  | 0.980 ± 0.199 | 1.045 ± 0.152 | 0.160 |
| Lumbar | |  |  |  |  |  |  |  |  |  |  |  |  |
|  | L1 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.4 ± 1.3 | -0.7 ± 1.7 | **0.043** |  | -0.5 ± 1.4 | -1.0 ± 1.6 | **0.038** |  | -0.1 ± 1.0 | -0.2 ± 1.7 | 0.683 |
|  |  | BMD, g/cm2 | 1.030 ± 0.160 | 0.986 ± 0.204 | 0.055 |  | 1.009 ± 0.166 | 0.957 ± 0.196 | **0.044** |  | 1.099 ± 0.115 | 1.083 ± 0.205 | 0.703 |
|  | L2 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.3 ± 1.4 | -0.8 ± 1.8 | **0.007** |  | -0.3 ± 1.5 | -1.0 ± 1.8 | **0.006** |  | -0.1 ± 1.1 | -0.3 ± 1.9 | 0.634 |
|  |  | BMD, g/cm2 | 1.107 ± 0.177 | 1.038 ± 0.232 | **0.008** |  | 1.086 ± 0.184 | 1.004 ± 0.225 | **0.005** |  | 1.175 ± 0.133 | 1.151 ± 0.223 | 0.624 |
|  | L3 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | 0.0 ± 1.5 | -0.7 ± 1.9 | **0.001** |  | -0.2 ± 1.5 | -0.9 ± 1.8 | **0.002** |  | 0.5 ± 1.3 | 0.0 ± 1.9 | 0.278 |
|  |  | BMD, g/cm2 | 1.185 ± 0.204 | 1.109 ± 0.222 | **0.005** |  | 1.167 ± 0.213 | 1.086 ± 0.216 | **0.008** |  | 1.245 ± 0.160 | 1.188 ± 0.229 | 0.269 |
|  | L4 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | 0.2 ± 1.6 | -0.4 ± 2.0 | **0.003** |  | 0.1 ± 1.6 | -0.6 ± 1.9 | **0.006** |  | 0.7 ± 1.6 | 0.1 ± 2.1 | 0.199 |
|  |  | BMD, g/cm2 | 1.205 ± 0.214 | 1.133 ± 0.237 | **0.010** |  | 1.183 ± 0.217 | 1.111 ± 0.230 | **0.024** |  | 1.279 ± 0.188 | 1.205 ± 0.252 | 0.201 |
|  | L1-L2 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.3 ± 1.3 | -0.8 ± 1.7 | **0.021** |  | -0.4 ± 1.4 | -1.0 ± 1.7 | **0.016** |  | 0.0 ± 1.0 | -0.2 ± 1.8 | 0.636 |
|  |  | BMD, g/cm2 | 1.062 ± 0.182 | 1.006 ± 0.225 | **0.030** |  | 1.049 ± 0.171 | 0.973 ± 0.218 | **0.007** |  | 1.105 ± 0.213 | 1.119 ± 0.213 | 0.806 |
|  | L1-L3 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.3 ± 1.4 | -0.8 ± 1.7 | **0.011** |  | -0.4 ± 1.4 | -0.9 ± 1.7 | **0.011** |  | 0.1 ± 1.1 | -0.1 ± 1.8 | 0.510 |
|  |  | BMD, g/cm2 | 1.112 ± 0.166 | 1.051 ± 0.211 | **0.011** |  | 1.092 ± 0.171 | 1.023 ± 0.202 | **0.010** |  | 1.176 ± 0.131 | 1.143 ± 0.216 | 0.476 |
|  | L1-L4 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | 0.0 ± 1.8 | -0.7 ± 1.8 | **0.002** |  | -0.2 ± 1.4 | -0.9 ± 1.7 | **0.004** |  | 0.6 ± 2.6 | -0.2 ± 1.9 | 0.175 |
|  |  | BMD, g/cm2 | 1.125 ± 0.206 | 1.075 ± 0.212 | 0.054 |  | 1.111 ± 0.192 | 1.049 ± 0.203 | **0.027** |  | 1.171 ± 0.247 | 1.160 ± 0.223 | 0.849 |
|  | L2-L3 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.2 ± 1.4 | -0.8 ± 1.8 | **0.003** |  | -0.3 ± 1.5 | -1.0 ± 1.7 | **0.003** |  | 0.2 ± 1.2 | -0.2 ± 1.9 | 0.409 |
|  |  | BMD, g/cm2 | 1.141 ± 0.190 | 1.078 ± 0.219 | **0.014** |  | 1.120 ± 0.198 | 1.050 ± 0.210 | **0.017** |  | 1.211 ± 0.144 | 1.170 ± 0.224 | 0.403 |
|  | L2-L4 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | 0.0 ± 1.5 | -0.6 ± 1.8 | **0.003** |  | -0.1 ± 1.5 | -0.8 ± 1.7 | **0.004** |  | 0.4 ± 1.3 | -0.1 ± 1.9 | 0.296 |
|  |  | BMD, g/cm2 | 1.173 ± 0.175 | 1.091 ± 0.235 | **0.002** |  | 1.154 ± 0.177 | 1.064 ± 0.230 | **0.002** |  | 1.235 ± 0.154 | 1.182 ± 0.230 | 0.294 |
|  | L3-L4 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | 0.1 ± 1.5 | -0.5± 1.9 | **0.002** |  | 0.0 ± 1.5 | -0.7 ± 1.8 | **0.004** |  | 0.6 ± 1.4 | 0.1 ± 2.0 | 0.241 |
|  |  | BMD, g/cm2 | 1.202 ± 0.180 | 1.124 ± 0.223 | **0.002** |  | 1.183 ± 0.180 | 1.102 ± 0.215 | **0.004** |  | 1.262 ± 0.168 | 1.196 ± 0.237 | 0.215 |
| Lowest T-score | | | -1.0± 1.1 | -1.5± 1.4 | **0.003** |  | -1.1 ± 1.1 | -1.6 ± 1.4 | **0.002** |  | -0.7 ± 0.8 | -0.9 ± 1.4 | 0.464 |
| 25-OH Vitamin D3,  ng/mL | |  | 20.0 ± 8.1 | 18.21 ± 10.3 | 0.122 |  | 18.8 ± 7.3 | 18.8 ± 11.0 | 0.978 |  | 24.2 ± 9.5 | 16.3 ± 7.5 | **0.001** |

*No, number; y, year; BMD, bone mineral density; 25-OH Vitamin D3, 25-hydroxyvitamin D.*

Statistical results (P values) were calculated using a Student's t-test.

Results are reported as the mean ± standard deviation (SD). Bold face indicates P < 0.05.

**Supplementary Table S2.** T-scores, BMD (g/cm2), and serum ionized calcium, intact PTH, and 25-hydroxyvitamin D concentrations in non-recurrent and recurrent BPPV groups.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Total | | |  | Women | | |  | Men | | |
|  |  |  | Non-recurrent BPPV | Recurrent BPPV | P-value |  | Non-recurrent BPPV | Recurrent BPPV | P-value |  | Non-recurrent BPPV | Recurrent BPPV | P-value |
| No | |  | 67 | 63 |  |  | 50 | 50 |  |  | 17 | 13 |  |
| Age, mean ± SD, y | | | 51.2 ± 12.2 | 58.8 ± 11.1 | **0.001** |  | 50.8 ± 12.2 | 59.1 ± 11.9 | **0.002** |  | 52.5 ± 12.3 | 57.7 ± 7.3 | 0.194 |
| Femur | | |  |  |  |  |  |  |  |  |  |  |  |
|  | Neck | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.4 ± 1.1 | -0.7 ± 1.3 | 0.090 |  | -0.5 ± 1.0 | -1.1 ± 1.2 | **0.025** |  | 0.1 ± 1.2 | 0.4 ± 1.3 | 0.464 |
|  |  | BMD, g/cm2 | 0.896 ± 0.129 | 0.827 ± 0.272 | 0.079 |  | 0.876 ± 0.121 | 0.781 ± 0.275 | **0.024** |  | 0.955 ± 0.136 | 1.005 ± 0.168 | 0.363 |
|  | Trochanter | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | 0.1 ± 1.1 | -0.2 ± 1.2 | 0.136 |  | -0.1 ± 1.1 | -0.5 ± 1.1 | 0.058 |  | 0.7 ± 1.2 | 0.9 ± 1.2 | 0.501 |
|  |  | BMD, g/cm2 | 0.762 ± 0.130 | 0.710 ± 0.155 | **0.044** |  | 0.731 ± 0.118 | 0.685 ± 0.119 | 0.060 |  | 0.853 ± 0.125 | 0.805 ± 0.231 | 0.468 |
|  | Total | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.1 ± 1.2 | -0.4 ± 1.4 | 0.111 |  | -0.3 ± 1.1 | -0.8 ± 1.2 | 0.053 |  | 0.7 ± 1.2 | 0.9 ± 1.2 | 0.615 |
|  |  | BMD, g/cm2 | 0.958 ± 0.140 | 0.918 ± 0.166 | 0.145 |  | 0.932 ± 0.126 | 0.881 ± 0.149 | 0.072 |  | 1.033 ± 0.155 | 1.061 ± 0.154 | 0.621 |
| Lumbar | | |  |  |  |  |  |  |  |  |  |  |  |
|  | L1 | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.6 ± 1.4 | -1.0 ± 1.9 | 0.160 |  | -0.6 ± 1.4 | -1.3 ± 1.7 | **0.030** |  | -0.6 ± 1.5 | 0.2 ± 1.9 | 0.223 |
|  |  | BMD, g/cm2 | 1.011 ± 0.174 | 0.960 ± 0.231 | 0.157 |  | 1.000 ± 0.173 | 0.914 ± 0.209 | **0.031** |  | 1.042 ± 0.178 | 1.136 ± 0.233 | 0.222 |
|  | L2 | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.6 ± 1.7 | -1.1 ± 1.9 | 0.090 |  | -0.6 ± 1.7 | -1.4± 1.8 | **0.020** |  | -0.6 ± 1.6 | 0.0 ± 2.1 | 0.367 |
|  |  | BMD, g/cm2 | 1.076 ± 0.202 | 0.998 ± 0.256 | 0.058 |  | 1.061 ± 0.203 | 0.947 ± 0.233 | **0.014** |  | 1.120 ± 0.198 | 1.193 ± 0.255 | 0.370 |
|  | L3 | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.5 ± 1.6 | -1.0 ± 2.1 | 0.113 |  | -0.5 ± 1.6 | -1.3 ± 1.9 | **0.034** |  | -0.2 ± 1.5 | 0.3 ± 2.4 | 0.441 |
|  |  | BMD, g/cm2 | 1.140 ± 0.193 | 1.077 ± 0.247 | 0.113 |  | 1.133 ± 0.198 | 1.039 ± 0.224 | **0.033** |  | 1.159 ± 0.180 | 1.225 ± 0.285 | 0.437 |
|  | L4 | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.3 ± 1.8 | -0.6 ± 2.2 | 0.451 |  | -0.4 ± 1.8 | -0.9 ± 2.0 | 0.217 |  | -0.1± 1.9 | 0.5 ± 2.4 | 0.416 |
|  |  | BMD, g/cm2 | 1.148 ± 0.216 | 1.117 ± 0.259 | 0.459 |  | 1.139 ± 0.215 | 1.082 ± 0.242 | 0.218 |  | 1.171 ± 0.224 | 1.249 ± 0.287 | 0.401 |
|  | L1-L2 | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.5 ± 1.5 | -1.0 ± 1.9 | 0.078 |  | -0.5 ± 1.5 | -1.4± 1.7 | **0.013** |  | -0.5 ± 1.5 | 0.2 ± 2.0 | 0.294 |
|  |  | BMD, g/cm2 | 1.028 ± 0.217 | 0.984 ± 0.233 | 0.269 |  | 1.009 ± 0.225 | 0.937 ± 0.208 | 0.105 |  | 1.083 ± 0.186 | 1.166 ± 0.243 | 0.290 |
|  | L1-L3 | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.5 ± 1.5 | -1.0 ± 1.9 | 0.078 |  | -0.5 ± 1.5 | -1.4 ± 1.8 | **0.015** |  | -0.4 ± 1.5 | 0.2 ± 2.1 | 0.336 |
|  |  | BMD, g/cm2 | 1.083 ± 0.180 | 1.018 ± 0.236 | 0.085 |  | 1.073 ± 0.181 | 0.974 ± 0.212 | **0.018** |  | 1.110 ± 0.180 | 1.187 ± 0.256 | 0.331 |
|  | L1-L4 | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.5 ± 1.6 | -0.9 ± 2.0 | 0.189 |  | -0.5 ± 1.6 | -1.2 ± 1.8 | 0.052 |  | -0.5 ± 1.6 | 0.2 ± 2.2 | 0.340 |
|  |  | BMD, g/cm2 | 1.103 ± 0.179 | 1.045 ± 0.240 | 0.125 |  | 1.095 ± 0.178 | 1.004 ± 0.218 | **0.029** |  | 1.126 ± 0.188 | 1.204 ± 0.263 | 0.340 |
|  | L2-L3 | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.5 ± 1.6 | -1.1 ± 2.0 | 0.061 |  | -0.5 ± 1.6 | -1.4 ± 1.8 | **0.013** |  | -0.4 ± 1.5 | 0.2 ± 2.3 | 0.417 |
|  |  | BMD, g/cm2 | 1.111 ± 0.190 | 1.044 ± 0.241 | 0.084 |  | 1.101 ± 0.193 | 1.001 ± 0.216 | **0.021** |  | 1.140 ± 0.184 | 1.210 ± 0.270 | 0.396 |
|  | L2-L4 | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.4 ± 1.6 | -0.9 ± 2.0 | 0.140 |  | -0.4 ± 1.6 | -1.2 ± 1.8 | **0.038** |  | -0.3 ± 1.6 | 0.3 ± 2.3 | 0.390 |
|  |  | BMD, g/cm2 | 1.113 ± 0.225 | 1.070 ± 0.245 | 0.302 |  | 1.099 ± 0.235 | 1.030 ± 0.222 | 0.141 |  | 1.150 ± 0.194 | 1.223 ± 0.274 | 0.388 |
|  | L3-L4 | |  |  |  |  |  |  |  |  |  |  |  |
|  |  | T-score | -0.3 ± 1.1 | -0.8 ± 2.1 | 0.183 |  | -0.4 ± 1.6 | -1.1 ± 1.9 | 0.063 |  | -0.2 ± 1.7 | 0.4 ± 2.4 | 0.435 |
|  |  | BMD, g/cm2 | 1.150 ± 0.191 | 1.098 ± 0.250 | 0.188 |  | 1.144 ± 0.191 | 1.061 ± 0.230 | 0.061 |  | 1.165 ± 0.197 | 1.237 ± 0.283 | 0.405 |
| Lowest T-score | | | -1.3 ± 1.3 | -1.6 ± 1.6 | 0.181 |  | -1.3 ± 1.3 | -1.9 ± 1.5 | **0.042** |  | -1.2 ± 1.1 | -0.5 ± 1.7 | 0.207 |
| Ionized calcium,  mg/dL | | | 5.0 ± 0.2 | 5.0 ± 0.2 | 0.383 |  | 5.0 ± 0.2 | 5.0 ± 0.2 | 0.948 |  | 4.8 ± 0.1 | 4.9 ± 0.2 | 0.133 |
| Intact PTH, pg/mL | | | 39.1 ± 21.9 | 36.3 ± 14.0 | 0.398 |  | 40.4 ± 24.4 | 37.1 ± 14.0 | 0.415 |  | 35.5 ± 11.7 | 33.6 ± 14.2 | 0.684 |
| 25-OH Vitamin D3, ng/mL | | | 17.2 ± 9.4 | 19.3 ± 11.1 | 0.259 |  | 17.4 ± 10.3 | 20.2 ± 11.5 | 0.203 |  | 16.8 ± 6.8 | 15.8 ± 8.7 | 0.710 |

*No, number; y, year; BMD, bone mineral density; PTH, parathyroid hormone; 25-OH Vitamin D3, 25-hydroxyvitamin D.*

Statistical results (P values) were calculated using univariate logistic regression analyses.

The results are reported as the mean ± standard deviation (SD). Bold face indicates P < 0.05.