**Table S1.** Participant information for the older adult group.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Age** | **Gender** | **Dominant hand** | **Daily physical activity level** | **MRI** | **Exclusion** |
| O1 | 73 | F | Right | 3 | 〇 |  |
| O2 | 70 | F | Right | 3 | 〇 |  |
| O3 | 74 | M | Right | 1 | 〇 |  |
| O4 | 76 | M | Right | 1 | 〇 |  |
| O5 | 75 | M | Right | 0 | 〇 | Yes |
| O6 | 79 | M | Right | 1 | 〇 |  |
| O7 | 97 | F | Right | 0 | × |  |
| O8 | 73 | F | Right | 1 | × |  |
| O9 | 81 | F | Right | 0 | × |  |
| O10 | 79 | F | Right | 1 | 〇 |  |
| O11 | 79 | M | Right | 1 | 〇 |  |
| O12 | 70 | F | Left | 2 | × |  |
| O13 | 85 | M | Right | 2 | × |  |
| O14 | 82 | F | Right | 1 | × |  |
| O15 | 82 | F | Right | 2 | × |  |
| O16 | 75 | F | Right | 1 | × |  |
| O17 | 81 | F | Right | 0 | × |  |
| O18 | 83 | F | Right | 1 | 〇 | Yes |
| O19 | 74 | F | Right | 2 | × |  |
| O20 | 78 | F | Right | 1 | 〇 |  |
| O21 | 71 | F | Right | 1 | × |  |
| O22 | 67 | F | Right | 2 | × |  |
| O23 | 69 | F | Right | 2 | × |  |
| O24 | 74 | F | Right | 1 | × |  |
| O25 | 73 | F | Right | 1 | × |  |
| O26 | 72 | F | Right | 1 | × |  |
| O27 | 74 | M | Right | 1 | × |  |
| O28 | 84 | F | Right | 1 | × |  |
| O29 | 71 | F | Right | 1 | × |  |
| O30 | 77 | M | Right | 1 | 〇 | Yes |
| O31 | 72 | M | Right | 0 | × | Yes |
| O32 | 85 | F | Right | 1 | × |  |
| O33 | 84 | F | Right | 1 | × |  |
| O34 | 72 | M | Right | 3 | 〇 |  |
| O35 | 83 | M | Right | 0 | 〇 |  |
| O36 | 77 | F | Right | 1 | 〇 |  |
| O37 | 71 | M | Right | 2 | 〇 |  |
| O38 | 71 | M | Right | 1 | 〇 |  |
| O39 | 74 | F | Left | 1 | 〇 |  |
| O40 | 74 | M | Right | 1 | 〇 |  |
| O41 | 82 | M | Right | 2 | 〇 |  |

**Table S2.** Participant information for the middle-aged group.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Age** | **Gender** | **Dominant hand** | **Exclusion** |  | **No.** | **Age** | **Gender** | **Dominant hand** | **Exclusion** |
| M1 | 56  | M | Right |  |  | M28 | 26  | F | Right |  |
| M2 | 49  | F | Right |  |  | M29 | 56  | M | Right |  |
| M3 | 55  | F | Left |  |  | M30 | 54  | F | Right |  |
| M4 | 25  | F | Right |  |  | M31 | 39  | F | Both |  |
| M5 | 45  | F | Right |  |  | M32 | 33  | M | Right |  |
| M6 | 57  | F | Left | Yes |  | M33 | 46  | F | Right |  |
| M7 | 46  | F | Right |  |  | M34 | 33  | F | Right |  |
| M8 | 50  | F | Right |  |  | M35 | 38  | F | Right |  |
| M9 | 39  | F | Right | Yes |  | M36 | 32  | M | Right |  |
| M10 | 42  | M | Right |  |  | M37 | 53  | F | Right |  |
| M11 | 30  | M | Right |  |  | M38 | 51  | M | Right |  |
| M12 | 30  | F | Right |  |  | M39 | 49  | F | Right |  |
| M13 | 56  | F | Right |  |  | M40 | 55  | F | Right | Yes |
| M14 | 43  | F | Right | Yes |  | M41 | 54  | M | Left |  |
| M15 | 35  | F | Right |  |  | M42 | 54  | M | Right |  |
| M16 | 53  | F | Right |  |  | M43 | 55  | F | Right |  |
| M17 | 56  | F | Right |  |  | M44 | 41  | F | Right |  |
| M18 | 54  | F | Right |  |  | M45 | 41  | F | Right |  |
| M19 | 51  | F | Right | Yes |  | M46 | 39  | F | Right | Yes |
| M20 | 26  | F | Right |  |  | M47 | 27  | F | Right | Yes |
| M21 | 35  | F | Right |  |  | M48 | 26  | F | Right | Yes |
| M22 | 59  | F | Right |  |  | M49 | 55  | F | Right | Yes |
| M23 | 48  | F | Right |  |  | M50 | 36  | F | Right |  |
| M24 | 46  | M | Right |  |  | M51 | 47  | F | Right |  |
| M25 | 27  | F | Right |  |  | M52 | 26  | F | Right |  |
| M26 | 41  | F | Right |  |  | M53 | 23  | F | Right |  |
| M27 | 39  | F | Right |  |  |  |  |  |  |  |

**Table S3.** Mean gap angle of the VR task for individual participants.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Mean gap angle** |  | **No.** | **Mean gap angle** |  | **No.** | **Mean gap angle** |  | **No.** | **Mean gap angle** |
| O1 | 3.2 |  | O22 | 33.4 |  | M1 | 2.4 |  | M28 | 2.5 |
| O2 | 28.4 |  | O23 | 6.8 |  | M2 | 2.1 |  | M29 | 2.2 |
| O3 | 4.0 |  | O24 | 3.2 |  | M3 | 4.8 |  | M30 | 3.2 |
| O4 | 2.8 |  | O25 | 32.2 |  | M4 | 2.1 |  | M31 | 3.1 |
| O6 | 12.0 |  | O26 | 29.8 |  | M5 | 2.4 |  | M32 | 3.1 |
| O7 | 22.6 |  | O27 | 3.9 |  | M7 | 3.6 |  | M33 | 2.8 |
| O8 | 4.7 |  | O28 | 27.0 |  | M8 | 1.7 |  | M34 | 1.3 |
| O9 | 46.2 |  | O29 | 27.6 |  | M10 | 2.2 |  | M35 | 2.5 |
| O10 | 2.3 |  | O32 | 22.8 |  | M11 | 4.8 |  | M36 | 1.9 |
| O11 | 1.3 |  | O33 | 26.0 |  | M12 | 3.5 |  | M37 | 2.4 |
| O12 | 22.6 |  | O34 | 2.9 |  | M13 | 2.0 |  | M38 | 2.8 |
| O13 | 35.5 |  | O35 | 32.4 |  | M15 | 2.7 |  | M39 | 1.9 |
| O14 | 28.9 |  | O36 | 22.2 |  | M16 | 4.2 |  | M41 | 1.3 |
| O15 | 4.2 |  | O37 | 12.8 |  | M17 | 3.2 |  | M42 | 1.9 |
| O16 | 17.5 |  | O38 | 16.3 |  | M18 | 2.4 |  | M43 | 2.4 |
| O17 | 21.5 |  | O39 | 21.9 |  | M20 | 3.3 |  | M44 | 2.1 |
| O19 | 27.0 |  | O40 | 4.7 |  | M21 | 2.6 |  | M45 | 1.7 |
| O20 | 27.3 |  | O41 | 24.1 |  | M22 | 3.5 |  | M50 | 2.2 |
| O21 | 32.0 |  | Avg. | 18.8 |  | M23 | 2.9 |  | M51 | 1.8 |
|  |  |  |  |  |  | M24 | 1.7 |  | M52 | 1.6 |
|  |  |  |  |  |  | M25 | 1.8 |  | M53 | 3.9 |
|  |  |  |  |  |  | M26 | 2.4 |  | Avg. | 2.6 |
|  |  |  |  |  |  | M27 | 2.1 |  |  |  |

**Table S4.** Results of the two-sample t-test and Mann-Whitney U test for each sex group in the older adult and middle-aged groups. P-values were Bonferroni-corrected. All combinations with significant differences were observed for the different age groups.

|  |  |  |
| --- | --- | --- |
| **Two-sample t-test** | Older adults | Middle-aged adults |
| Male | Female | Male | Female |
| Older adults | Male |  | p = 0.2 | p\*\*\* < 0.001 | p = 0.09 |
| Female |  |  | p\*\*\* < 0.001 | p\*\*\* < 0.001 |
| Middle-aged adults | Male |  |  |  | p = 1.0 |
| Female |  |  |  |  |
|  |  |  |  |  |  |
| **Mann-Whitney U** | Older adults | Middle-aged adults |
| Male | Female | Male | Female |
| Older adults | Male |  | p = 0.3 | p\*\* < 0.01 | p\* = 0.05 |
| Female |  |  | p\*\*\* < 0.001 | p\*\*\* < 0.001 |
| Middle-aged adults | Male |  |  |  | p = 1.0 |
| Female |  |  |  |  |