**T****h****e** **Bone Biomarker Response to an Acute Bout of Exercise:**

**A Systematic Review with Meta-Analysis**

**Supplementary File 8: Primary meta-analyses and moderator analyses for bone formation**

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|  | | **Summary of findings** | | | **Evidence Certainty** | | | | | |
| **Outcome (#/n)** | | **Effect size**  **Median [95% CrI]** | **Between study standard error ()**  **Median [75% CrI]** | **ICC**  **Median [75% CrI]** | **D1**  **Risk of Bias** | **D2**  **Directness** | **D3**  **Inconsistency** | | **D4**  **Imprecision** | **D5**  **Small-study Effects** |
| All biomarkers exercise  516 outcomes / 76  studies | | 0.05 [0.01 to 0.08] | 0.11 [0.10 to 0.12] | 0.23 [0.08 to 0.36] | High | Moderate | | Low | Low | Low |
|  | P1NP  200 outcomes / 31 studies | 0.08 [0.03 to 0.13] | 0.12 [0.10 to 0.13] | 0.06 [0.02 to 0.16] | High | Moderate | | Low | Low | Low |
|  | B-ALP  171 outcomes / 31 studies | 0.05 [-0.01 to 0.10] | 0.13 [0.11 to 0.15] | 0.01 [0.00 to 0.04] | High | Moderate | | Low | Low | Low |
|  | Sclerostin  61 outcomes / 15 studies | 0.13 [0.03 to 0.22] | 0.07 [0.03 to 0.19] | 0.81 [0.52 to 0.94] | High | Moderate | | Moderate | Moderate | Moderate |
|  | PICP  52 outcomes / 14 studies | 0.03 [-0.07 to 0.14] | 0.13 [0.10 to 0.16] | 0.33 [0.12 to 0.54] | Moderate | Low | | Very Low | Very Low | Very Low |
|  | DKK  19 outcomes / 4 studies | 0.22 [-0.50 to 0.64] | 0.28 [0.18 to 0.44] | 0.07 [0.01 to 0.24] | High | Moderate | | Low | Very Low | Very Low |
|  | uOC  13 outcomes / 4 studies | 0.09 [-0.10 to 0.29] | 0.09 [0.04 to 0.17] | 0.50 [0.13 to 0.86] | High | Moderate | | Low | Very Low | Very Low |
| All biomarkers Control  67 outcomes / 17 studies  (β-ALP:27; P1NP:14; Sclerostin: 10; PICP:10; DKK:4; uOC: 2) | | -0.03 [-0.08 to 0.02] | 0.02 [0.01 to 0.04] | 0.45 [0.13 to 0.83] | High | Moderate | | Moderate | Moderate | Moderate |
|  | |  |  |  |  |  | |  |  |  |
| **Moderator Analyses (P1NP only)** | | | | | | | | | | |
| **Timing** | | | | | | | | | | |
| (Immediately - 8 hours post)  122 outcomes / 27 studies | | 0.11 [0.04 to 0.19] | 0.15 [0.13 to 0.18] | 0.05 [0.01 to 0.12] | High | Moderate | | Low | Low | Low |
| (Immediatel­­­­y - 15min post)  51 outcomes / 23 studies | | 0.18 [0.10 to 0.27] | 0.15 [0.12 to 0.19] | 0.04 [0.01 to 0.12] | High | Moderate | | Moderate | Moderate | Moderate |
| (> 15 min, ≤ 2 hours post)  42 outcomes / 18 studies | | 0.03 [-0.08 to 0.14] | 0.18 [0.15 to 0.22] | 0.03 [0.01 to 0.10] | High | Moderate | | Low | Low | Low |
| (> 2 hours, ≤ 8 hours post)  29 outcomes / 9 studies | | 0.11 [-0.04 to 0.27] | 0.12 [0.06 to 0.19] | 0.24 [0.05 to 0.66] | High | Moderate | | Low | Very Low | Very Low |
| 24 hours post  38 outcomes / 16 studies | | 0.02 [-0.07 to 0.12] | 0.08 [0.14 to 0.12] | 0.30 [0.07 to 0.72] | High | Moderate | | Low | Low | Low |
| 48 hours post  19 outcomes / 11 studies | | 0.03 [-0.07 to 0.14] | 0.06 [0.03 to 0.10] | 0.36 [0.08 to 0.78] | High | Moderate | | Low | Low | Low |
| **Exercise Type** | | | | | | | | | | |
| Aerobic  166 outcomes / 23 studies | | 0.10 [0.06 to 0.16] | 0.08 [0.06 to 0.09] | 0.09 [0.02 to 0.23] | High | Moderate | | Moderate | Moderate | Moderate |
| Plyometric  20 outcomes / 4 studies | | -0.03 [-0.51 to 0.41] | 0.31 [0.21 to 0.47] | 0.03 [0.01 to 0.11] | Moderate | Moderate | | Low | Very Low | Very Low |
| **Impact level** | | | | | | | | | | |
| Low impact/repetitive  46 outcomes / 9 studies | | 0.08 [-0.02 to 0.18] | 0.09 [0.06 to 0.12] | 0.34 [0.10 to 0.67] | Low | Very Low | | Very Low | Very Low | Very Low |
| Moderate impact/repetitive  122 outcomes / 18 studies | | 0.10 [0.05 to 0.17] | 0.07 [0.04 to 0.10] | 0.10 [0.02 to 0.32] | High | Moderate | | Moderate | Moderate | Moderate |
| High impact / multi-directional  26 outcomes / 5 studies | | -0.03 [-0.31 to 0.40] | 0.24 [0.17 to 0.35] | 0.07 [0.01 to 0.19] | Moderate | Moderate | | Low | Very Low | Very Low |
| **Modality** | | | | | | | | | | |
| Running  110 outcomes / 15 studies | | 0.09 [0.04 to 0.15] | 0.04 [0.02 to 0.07] | 0.25 [0.05 to 0.66] | High | Moderate | | Moderate | Moderate | Moderate |
| Cycling  44 outcomes / 8 studies | | 0.10 [0.00 to 0.21] | 0.09 [0.06 to 0.13] | 0.34 [0.10 to 0.67] | Low | Very Low | | Very Low | Very Low | Very Low |
| Walking  12 outcomes / 3 studies | | 0.17 [-0.43 to 1.2] | 0.33 [0.18 to 0.61] | 0.03 [0.00 to 0.15] | Moderate | Low | | Very Low | Very Low | Very Low |
| **Exercise Characteristics** | | | | | | | | | | |
| Continuous  131 outcomes / 16 studies | | 0.11 [0.05 to 0.16] | 0.07 [0.04 to 0.85] | 0.12 [0.03 to 0.36] | High | Moderate | | Moderate | Moderate | Moderate |
| Intermittent  37 outcomes / 8 studies | | -0.07 [-0.52 to 0.37] | 0.47 [0.36 to 0.62] | 0.07 [0.02 to 0.23] | High | Moderate | | Low | Very Low | Very Low |
|  | |  |  |  |  |  | |  |  |  |
| Duration (Per 10 Mins)  170 outcomes / 23 studies | | 0.05 [-0.01 to 0.12] | 0.07 [0.05 to 0.10] | 0.12 [0.03 to 0.33] | High | Moderate | | Low | Low | Low |
| Intensity Low  120 outcomes / 16 studies | | 0.07 [0.01 to 0.17] | 0.09 [0.07 to 0.12] | 0.10 [0.02 to 0.28] | High | Moderate | | Low | Low | Low |
| Intensity High  36 outcomes / 6 studies | | 0.13 [-0.05 to 0.37] | 0.16 [0.11 to 0.25] | 0.05 [0.01 to 0.17] | High | Moderate | | Low | Very Low | Very Low |
| Total work done  (Per 1000 units)  159 outcomes / 20 studies | | 0.02 [0.00 to 0.04] | 0.06 [0.05 to 0.08] | 0.14 [0.03 to 0.38] | High | Moderate | | Low | Low | Low |
| **Participant Characteristics** | | | | | | | | | | |
| Male  141 outcomes / 20 studies | | 0.10 [0.06 to 0.13] | 0.02 [0.01 to 0.04] | 0.49 [0.14 to 0.86] | High | Moderate | | Moderate | Moderate | Moderate |
| Female  48 outcomes / 8 studies | | 0.03 [-0.16 to 0.24] | 0.22 [0.18 to 0.29] | 0.12 [0.04 to 0.25] | Moderate | Moderate | | Low | Very Low | Very Low |
| Mixed: male/female  11 outcomes / 4 studies | | 0.01 [-0.47 to 0.39] | 0.22 [0.11 to 0.39] | 0.07 [0.00 to 0.32] | Moderate | Low | | Very Low | Very Low | Very Low |
|  | |  |  |  |  |  | |  |  |  |
| Sedentary  33 outcomes / 5 studies | | 0.09 [-0.08 to 0.27] | 0.08 [0.04 to 0.15] | 0.59 [0.21 to 0.89] | Low | Moderate | | Moderate | Low | Low |
| Recreational  113 outcomes / 13 studies | | 0.07 [0.03 to 0.12] | 0.04 [0.02 to 0.06] | 0.19 [0.04 to 0.51] | High | Moderate | | Moderate | Moderate | Low |
| Athlete  40 outcomes / 11 studies | | 0.13 [-0.06 to 0.28] | 0.13 [0.07 to 0.20] | 0.43 [0.14 to 0.76] | High | Moderate | | Low | Very Low | Very Low |

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| **Moderator Analyses (Sclerostin only)** | | | | | | | | |
| **Timing** | | | | | | | | |
| (Immediately - 8 hours post)  34 outcomes / 12 studies | 0.14 [0.01 to 0.27] | 0.09 [0.04 to 0.14] | 0.76 [0.44 to 0.94] | High | Moderate | Moderate | Moderate | Moderate |
| (Immediatel­­­­y - 15min post)  16 outcomes / 9 studies | 0.21 [-0.03 to 0.46] | 0.15 [0.07 to 0.24] | 0.66 [0.31 to 0.91] | High | Moderate | Moderate | Low | Low |
| (> 15 min, ≤ 2 hours post)  18 outcomes / 10 studies | 0.07 [-0.08 to 0.24] | 0.08 [0.04 to 0.14] | 0.69 [0.32 to 0.92] | High | Moderate | Low | Very Low | Very Low |
| 24 hours post  19 outcomes / 11 studies | 0.15 [-0.04 to 0.36] | 0.17 [0.09 to 0.25] | 0.44 [0.14 to 0.77] | High | Moderate | Low | Very Low | Very Low |
| **Exercise Type** | | | | | | | | |
| Aerobic  19 outcomes / 4 studies | 0.20 [-0.15 to 0.52] | 0.14 [0.06 to 0.27] | 0.49 [0.14 to 0.86] | High | Moderate | Moderate | Low | Low |
| Plyometric  26 outcomes / 6 studies | 0.13 [-0.09 to 0.32] | 0.13 [0.07 to 0.21] | 0.59 [0.26 to 0.86] | High | Moderate | Low | Very Low | Very Low |
| Resistance  10 outcomes / 3 studies | -0.06 [-0.86 to 0.68] | 0.29 [0.12 to 0.61] | 0.48 [0.13 to 0.86] | Moderate | Moderate | Low | Very Low | Very Low |
| **Impact level** | | | | | | | | |
| Low impact / High load  16 outcomes / 6 studies | -0.03 [-0.28 to 0.24] | 0.11 [0.05 to 0.20] | 0.70 [0.31 to 0.93] | High | Moderate | Low | Very Low | Very Low |
| High impact / directional  26 outcomes / 6 studies | -0.17 [-0.02 to 0.37] | 0.11 [0.05 to 0.18] | 0.71 [0.36 to 0.92] | High | Moderate | Moderate | Low | Low |
| **Modality** | | | | | | | | |
| Intermittent  14 outcomes / 2 studies | 0.20 [-0.80 to 0.76] | 0.40 [0.13 to 1.3] | 0.09 [0.01 to 0.53] | High | Moderate | Low | Very Low | Very Low |
| Duration (Per 10 Mins)  20 outcomes / 5 studies | 0.05 [-0.10 to 0.19] | 0.12 [0.05 to 0.24] | 0.50 [0.14 to 0.87] | High | Moderate | Low | Low | Low |
| Intensity High  14 outcomes / 2 studies | 0.20 [-0.80 to 0.76] | 0.40 [0.13 to 1.3] | 0.08 [0.01 to 0.53] | High | Moderate | Low | Very Low | Very Low |
| Total work done  (Per 1000 units)  23 outcomes / 5 studies | 0.06 [-0.35 to 0.50] | 0.17 [0.08 to 0.32] | 0.41 [0.11 to 0.82] | High | Moderate | Low | Very Low | Very Low |
| **Participant Characteristics** | | | | | | | | |
| Male  24 outcomes / 6 studies | 0.11 [-0.15 to 0.36] | 0.22 [0.15 to 0.30] | 0.18 [0.05 to 0.42] | High | Moderate | Low | Very Low | Very Low |
| Female  36 outcomes / 9 studies | 0.13 [-0.03 to 0.27] | 0.09 [0.04 to 0.15] | 0.79 [0.46 to 0.95] | High | Moderate | Moderate | Low | Low |
| Recreational  42 outcomes / 9 studies | 0.13 [0.00 to 0.25] | 0.08 [0.04 to 0.13] | 0.76 [0.40 to 0.94] | High | Moderate | Moderate | Moderate | Moderate |

All variables with sufficient data to analyse are presented.