- Closeness: The mean distance of a node to all others, indicating how effectively a variable is linked to the system.
- Betweenness: How much a node falls on the shortest path from others, indicating its bridging role.
- Expected influence (positive/negative): Capturing whether a node supports or hinders other nodes, enabling interpretation of inhibitory versus facilitative connections.

The resulting network was mapped using color-coded clusters, indicating variables with greater interconnections. Centrality plots were also created to compare relative positions of variables. Interpretation involved identifying those variables with high centrality, which could potentially be key drivers or hubs in adolescent bone health, and those with low or negative influence, which could potentially be peripheral or less influential factors.

**Supplementary Table 1. Network analysis**

**Summary of network**

| | Network |
|---|---|
| Number of nodes | 18 |
| Number of non-zero edges | 37 |
| Sparsity | 0.242 |

**Supplementary Table 2. Weight matrix**

| BQI | CHO | CRP | Energy | Fat mass | Fats | Grip strength | Hb | Osteocalcin | PTH | Protein | Serum Ca | T-score | Urinary Ca | Urinary Na | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -0.02 | 0.02 | 0.37 | -0.07 | 0.23 | -0.15 | 0.08 | 0.20 | 0.00 | -0.05 | 0.04 | 0.03 | 0.06 | 0.01 | 0.00 | 0.03 |
| 0.02 | 0.00 | 0.00 | 0.00 | 0.05 | -0.06 | -0.04 | 0.04 | -0.02 | -0.03 | -0.02 | 0.00 | -0.14 | 0.12 | 0.00 | 0.55 |
| 0.00 | 0.00 | -0.08 | 0.01 | 0.09 | -0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.75 | 0.00 | 0.05 | 0.02 |
| 0.00 | 0.00 | 0.00 | 0.80 | 0.09 | -0.26 | 0.03 | 0.00 | -0.03 | -0.05 | 0.20 | -0.06 | -0.03 | 0.05 | -0.04 | 0.04 |
| -0.08 | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 | -0.21 | -0.02 | 0.04 | -0.02 | -0.02 | -0.01 | -0.01 | -0.10 | 0.01 | 0.05 |
| 0.01 | 0.80 | 0.00 | 0.00 | 0.01 | 0.49 | 0.00 | 0.00 | 0.00 | 0.00 | -0.24 | -0.04 | 0.00 | 0.02 | 0.00 | 0.03 |
| 0.09 | 0.09 | 0.14 | 0.01 | 0.00 | 0.00 | -0.34 | -0.03 | -0.04 | 0.16 | 0.07 | 0.00 | 0.02 | 0.16 | -0.15 | 0.02 |
| -0.08 | -0.26 | 0.00 | 0.49 | 0.00 | 0.00 | -0.13 | 0.10 | 0.12 | 0.00 | 0.56 | 0.16 | 0.23 | -0.06 | 0.30 | 0.05 |
| 0.00 | 0.03 | -0.21 | 0.00 | -0.34 | -0.13 | 0.00 | 0.29 | -0.06 | 0.03 | 0.15 | 0.23 | 0.01 | 0.36 | -0.19 | -0.02 |
| 0.00 | 0.00 | -0.02 | 0.00 | -0.03 | 0.10 | 0.29 | 0.00 | 0.03 | 0.02 | 0.00 | 0.00 | 0.05 | 0.33 | 0.07 | 0.01 |
| 0.00 | -0.03 | 0.04 | 0.00 | -0.04 | 0.12 | -0.06 | 0.03 | 0.00 | -0.01 | -0.22 | 0.04 | 0.03 | -0.08 | 0.36 | -0.01 |
| 0.00 | -0.05 | -0.02 | 0.00 | 0.16 | 0.00 | 0.03 | 0.02 | -0.01 | 0.00 | 0.00 | -0.09 | 0.00 | -0.07 | -0.13 | 0.20 |
| 0.00 | 0.20 | -0.02 | -0.24 | 0.07 | 0.56 | 0.15 | 0.00 | -0.22 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | -0.60 | 0.00 |
| 0.15 | -0.06 | -0.01 | -0.04 | 0.00 | 0.16 | 0.23 | 0.00 | 0.04 | -0.09 | 0.00 | 0.00 | 0.04 | 0.00 | 0.03 | 0.00 |
| 0.75 | -0.03 | -0.01 | 0.00 | 0.02 | 0.23 | 0.01 | 0.05 | 0.03 | 0.00 | 0.05 | 0.04 | 0.00 | 0.00 | 0.00 | -0.11 |
| 0.00 | 0.05 | -0.10 | 0.02 | 0.16 | -0.06 | 0.36 | 0.33 | -0.08 | -0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0.05 | -0.04 | 0.01 | 0.00 | -0.15 | 0.30 | -0.19 | 0.07 | 0.36 | -0.13 | -0.60 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0.02 | 0.04 | 0.05 | 0.03 | 0.02 | 0.05 | -0.02 | 0.01 | -0.01 | 0.20 | 0.00 | 0.00 | -0.11 | 0.00 | 0.00 | 0.00 |

Urinary Na: Urinary sodium, Urinary Ca: Urinary calcium, PTH: Parathyroid hormone, Hb: Hemoglobin, CRP: C-reactive protein, BQI: Bone quality index, BMI: Body mass index, CHO: Carbohydrate.

| Supplementary Table 3. Layout | |
|---|---|
| **x** | **y** |
| Alk phosp=0.6957 | Alk phosp=0.1526 |
| BMI=0.4522 | BMI=0.8319 |
| BQI=-0.9119 | BQI=0.5216 |
| CHO=-1 | CHO=-0.2554 |
| CRP=0.9678 | CRP=0.4056 |
| Energy= 0.8826 | Energy=-0.5149 |
| Fat mass=0.2232 | Fat mass=0.0753 |
| CRP: C-reactive protein, BQI: Bone quality index, BMI: Body mass index, CHO: Carbohydrate. | |

| Supplementary Table 4. Centrality measures per variable | | | |
|---|---|---|---|
| | **Network** | | |
| **Variable** | **Betweenness** | **Closeness** | **Strength** |
| Alk phosp | -0.25 | -0.06 | -0.121 |
| BMI | -0.438 | -1.363 | -0.664 |
| BQI | -0.344 | -0.417 | -0.451 |
| CHO | -0.814 | -0.49 | 0.406 |
| CRP | -0.908 | -0.772 | -0.85 |
| Energy | 0.125 | 0.225 | 0.403 |
| Fat mass | -0.25 | 0.506 | 0.211 |
| Fats | 2.754 | 1.838 | 2.459 |
| Grip strength | 1.722 | 1.436 | 1.361 |
| Hb | -0.814 | -0.263 | -0.653 |
| Osteocalcin | -0.908 | -0.672 | -0.814 |
| PTH | -0.157 | -0.93 | -1.263 |
| Protein | -0.626 | 1.406 | 1.334 |
| Serum Ca | -0.438 | -0.017 | -1.247 |
| T-score | 0.783 | -0.152 | 0.06 |
| Urinary Ca | -0.344 | -0.026 | -0.283 |
| Urinary Na | 1.252 | 1.45 | 0.842 |
| Weight | -0.344 | -1.699 | -0.73 |
| Urinary Na: Urinary sodium, Urinary Ca: Urinary calcium, PTH: Parathyroid hormone, Hb: Hemoglobin, CRP: C-reactive protein, BQI: Bone quality index, BMI: Body mass index, CHO: Carbohydrate. | | | |