**Supplementary Tables and Figures:**

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| **Supplementary Table 1. 25-hydroxyvitamin D levels by region and age group** | | | | | | | | |
| Sex | Region | Age group (years old), ng/ml | | | | | Total | P-values |
| 18–29 | 29–39 | 39–49 | 49–59 | >59 |
| Male |  |  |  |  |  |  |  |  |
| Beijing | 18.3 ± 6.1 | 17.0 ± 5.9 | 19.5 ± 6.9 | 14.7 ± 5.8 | 17.4 ± 6.3 | 17.6 ± 6.3 | .03 |
| Hangzhou | 20.6 ± 5.4 | 19.7 ± 4.8 | 21.75 ± 5.9 | 20.0 ± 7.8 | 21.5 ± 5.7 | 20.6 ± 5.8 | .36 |
| Guangzhou | 21.4 ± 4.1 | 21.2 ± 4.6 | 22.9 ± 5.2 | 24.7 ± 6.0 | 22.0 ± 4.0 | 22.3 ± 5.0 | < .01 |
| Dalian | 23.0 ± 6.6 | 23.3 ± 6.0 | 23.2±5.5 | 23.6±7.3 | 24.8±7.1 | 23.4±6.4 | .79 |
| Urumqi | 18.9 ± 5.3 | 19.0 ± 5.3 | 22.5 ± 7.8 | 22.4 ± 6.8 | 22.4 ± 5.1 | 20.4 ± 6.2 | < .01 |
| Total | 20.7 ± 5.9 | 20.0 ± 5.7 | 22.1 ± 6.2 | 21.6 ± 7.5 | 21.9 ± 6.3 | 21.1 ± 6.3 | < .01 |
| P-values | < .001 | < .001 | < .05 | < .001 | < .01 | < .001 |  |
| Female |  |  |  |  |  |  |  |  |
| Beijing | 15.4 ± 4.9 | 13.5 ± 6.0 | 14.8 ± 5.5 | 16.4 ± 6.5 | 14.6 ± 6.8 | 15.0 ± 5.9 | .16 |
| Hangzhou | 16.5 ± 3.9 | 17.9 ± 5.5 | 15.7 ± 5.0 | 18.9 ± 5.8 | 19.9 ± 5.2 | 17.3 ± 5.2 | < .01 |
| Guangzhou | 18.5 ± 4.0 | 19.9 ± 3.9 | 21.2 ± 4.4 | 22.3 ± 4.8 | 22.9 ± 5.3 | 20.5 ± 4.6 | < .001 |
| Dalian | 17.9 ± 5.3 | 18.6 ± 5.5 | 19.6 ± 6.0 | 22.4 ± 7.0 | 22.8 ± 6.4 | 19.8 ± 6.2 | < .01 |
| Urumqi | 15.2 ± 4.5 | 15.8 ± 5.0 | 16.4 ± 5.8 | 19.2 ± 10.2 | 17.4 ± 6.4 | 16.6 ± 6.6 | < .05 |
| Total | 16.6 ± 4.7 | 17.2 ± 5.6 | 17.6 ± 5.9 | 19.7 ± 7.4 | 19.3 ± 6.8 | 17.8±6.1 | < .001 |
| P-values | < .001 | < .001 | < .001 | < .001 | < .001 | < .001 |  |

P-values were calculated using one way ANOVA.

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| **Supplementary Table 2. Vitamin D status by age group and sex** | | | | | | |
| Sex | Age group | n | Vitamin D status (ng/mL), N (%) | | | |
| <10 | 10–20 | 20–30 | >30 |
| Male |  |  |  |  |  |  |
| 18–29 | 289 | 6 (2.1) | 128 (44.3) | 136 (47.1) | 19 (6.6) |
| 29–39 | 271 | 9 (3.3) | 131 (48.3) | 119 (43.9) | 12 (4.4) |
| 39–49 | 235 | 5 (2.1) | 85 (36.2) | 114 (48.5) | 31 (13.2) |
| 49–59 | 172 | 11 (6.4) | 63 (36.6) | 79 (45.9) | 19 (11.0) |
| >59 | 110 | 5 (4.5) | 45 (40.9) | 50 (45.5) | 10 (9.1) |
| Total | 1,077 | 36 (3.3) | 452 (42.0) | 498 (46.2) | 91 (8.4) |
| Female |  |  |  |  |  |  |
| 18–29 | 269 | 20 (7.4) | 186 (69.1) | 62 (23.0) | 1 (0.4) |
| 29–39 | 268 | 24 (9.0) | 154 (57.5) | 87 (32.5) | 3 (1.1) |
| 39–49 | 260 | 25 (9.6) | 155 (59.6) | 74 (28.5) | 6 (2.3) |
| 49–59 | 211 | 15 (7.1) | 96 (45.3) | 90 (42.5) | 10 (5.2) |
| >59 | 88 | 8 (9.1) | 44 (50.0) | 30 (34.1) | 6 (6.8) |
| Total | 1,096 | 92 (8.4) | 635 (57.9) | 343 (31.3) | 27 (2.5) |

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Supplementary Fig.1. The LC-MS/MS chromatography method used in this study. Representative chromatography of serum 25-hydroxyvitamin D (25OHD2 and 25OHD3) indicate that 3-epi 25OHD cannot be separated with this method.

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Supplementary Fig.2 Representative LC-MS/MS chromatography of serum with added 3-epi 25-hydroxyvitamin D (25OHD3).

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Supplementary Fig.3 Correlation and bias of 25-hydroxyvitamin D (25OHD) results from the LC-MS/MS methods that can and cannot separate 3-epi 25OHD. A. Correlation diagram. Y-axis: 25OHD values from LC-MS/MS method that can separate 3-epi 25OHD. X-axis: 25OHD values from LC-MS/MS method that cannot separate 3-epi 25OHD. Bias of results from the LC-MS/MS method that cannot separate 3-epi 25OHD. Y-axis: bias of the method that cannot separate 3-epi 25OHD compared to the method that can separate 3-epi 25OHD. X-axis: mean 25OHD estimates from the two methods.