**Supplementary Table S1**

Population skin and plasma carotenoids according to select population characteristics

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Population characteristics (n = 103)** | | Adjusted mean(SEM)1 / Regression coefficient (95 % CI)2 | | | | *P* |
| **Sex** | Female (n = 58) | | | Male (n = 45) | |  |
| * Skin carotenoids (a.u.) | 35516 (1414) | | | 30390 (1606) | | 0.02 |
| * Plasma carotenoids (µmol/L) | 2.19 (0.12) | | | 1.92 (0.14) | | 0.12 |
| **Race** | Chinese (n = 90) | | Indian (n = 6) | Caucasian (n = 5) | Malay (n = 2) |  |
| * Skin carotenoids (a.u.) | 34285 (1139) | | 28327 (4417) | 26140 (4832) | 20585 (7638) | 0.08 |
| * Plasma carotenoids (µmol/L) | 2.10 (0.10) | | 2.03 (0.38) | 1.86 (0.66) | 1.67 (0.42) | 0.36 |
| **Cigarette smoking** | Never smoked (n = 89) | | | Current/Past smoker (n = 14) | |  |
| * Skin carotenoids (a.u.) | 34147 (1150) | | | 27747 (2908) | | 0.04 |
| * Plasma carotenoids (µmol/L) | 2.10 (0.10) | | | 1.88 (0.25) | | 0.14 |
| **Prescription medication**3 | No (n = 84) | | | Yes (n = 19) | |  |
| * Skin carotenoids (a.u.) | 34448 (1181) | | | 28098 (2506) | | 0.02 |
| * Plasma carotenoids (µmol/L) | 2.20 (0.10) | | | 1.50 (0.21) | | 0.002 |
| **Age (y)** |  | | | | |  |
| * Skin carotenoids2 (a.u.) | -212 (-576, 151) | | | | | 0.25 |
| * Plasma carotenoids (µmol/L) | -0.036 (-0.067, -0.007) | | | | | 0.02 |
| **Body mass index (kg/m2)** |  | | | | |  |
| * Skin carotenoids2 (a.u.) | -1206 (-1664, -748) | | | | | <0.0001 |
| * Plasma carotenoids (µmol/L) | -0.100 (-0.138, -0.061) | | | | | <0.0001 |
| **Waist circumference (cm)** |  | | | | |  |
| * Skin carotenoids2 (a.u.) | -422 (-583, -260) | | | | | <0.0001 |
| * Plasma carotenoids (µmol/L) | -0.033 (-0.047, -0.019) | | | | | <0.0001 |
|  |  | | | | |  |

**Supplementary Table S2**

1 Analysis of covariance adjusting for corresponding dietary carotenoids between respective population characteristics subgroups

2 Multiple linear regressions analyses adjusting for corresponding dietary carotenoids

3 Yes indicates the use of prescription medication which includes cholesterol lowering, anti-hypertensive and anti-diabetic drugs

a.u.: arbitrary units

Multiple linear regression analysis between skin and plasma carotenoids with select daily nutritional data

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Energy and Macronutrients** | β1 | 95% CI | *P* | **Micronutrients** | β2 | 95% CI | *P* |
| **Energy (kcal/d)** |  |  |  | **Sodium (mg/d)** |  |  |  |
| * Skin carotenoids | -0.13 | -4.24, 3.98 | 0.95 | Skin carotenoids | 0.37 | -1.57, 2.30 | 0.71 |
| * Plasma carotenoids (µmol/L) | -0.15 | -4.05, 0.19 | 0.38 | Plasma carotenoids (µmol/L) | -0.07 | -0.23, 0.09 | 0.38 |
| **Carbohydrate (g/d)** |  |  |  | **Potassium (mg/d)** |  |  |  |
| * Skin carotenoids | -8 | -44, 29 | 0.67 | Skin carotenoids | 1.30 | -1.34, 3.94 | 0.33 |
| * Plasma carotenoids (µmol/L) | -1.00 | -4.05, 2.05 | 0.52 | Plasma carotenoids (µmol/L) | 0.03 | -0.19, 0.25 | 0.78 |
| **Sugar (g/d)** |  |  |  | **Calcium (mg/d)** |  |  |  |
| * Skin carotenoids | 4 | -82, 91 | 0.92 | Skin carotenoids | 0.41 | -6.49, 7.30 | 0.91 |
| * Plasma carotenoids (µmol/L) | 2.98 | -4.25, 10.21 | 0.42 | Plasma carotenoids (µmol/L) | 0.02 | -0.56, 0.59 | 0.96 |
| **Fiber (g/d)** |  |  |  | **Vitamin A (μg/d)** |  |  |  |
| * Skin carotenoids | 199 | -61, 459 | 0.13 | Skin carotenoids | -6 | -12, -1 | 0.03 |
| * Plasma carotenoids (µmol/L) | -3.69 | -25.74, 18.35 | 0.74 | Plasma carotenoids (µmol/L) | -0.32 | -0.82, 0.17 | 0.20 |
| **Protein (g/d)** |  |  |  | **Vitamin B9 (μg/d)** |  |  |  |
| * Skin carotenoids | 27 | -37, 92 | 0.40 | Skin carotenoids | -1 | -21, 19 | 0.93 |
| * Plasma carotenoids (µmol/L) | -3.03 | -8.39, 2.33 | 0.27 | Plasma carotenoids (µmol/L) | -0.28 | -1.98, 1.42 | 0.75 |
| **Total fat (g/d)** |  |  |  | **Vitamin B12 (μg/d)** |  |  |  |
| * Skin carotenoids | 6 | -67, 79 | 0.86 | Skin carotenoids | -391 | -922, 139 | 0.15 |
| * Plasma carotenoids (µmol/L) | -3.01 | -9.11, 3.08 | 0.33 | Plasma carotenoids (µmol/L) | -32.45 | -76.99, 12.10 | 0.15 |
| **Saturated fat (g/d)** |  |  |  | **Vitamin C (mg/d)** |  |  |  |
| * Skin carotenoids | -57 | -277, 163 | 0.61 | Skin carotenoids | 37 | 7, 66 | 0.02 |
| * Plasma carotenoids (µmol/L) | -14.06 | -32.32, 4.19 | 0.13 | Plasma carotenoids (µmol/L) | 2.92 | 0.41, 5.42 | 0.02 |
| **Mono-unsaturated fat (g/d)** |  |  |  | **Vitamin D (μg/d)** |  |  |  |
| * Skin carotenoids | 58 | -131, 247 | 0.55 | Skin carotenoids | 19 | -475, 513 | 0.94 |
| * Plasma carotenoids (µmol/L) | -2.97 | -18.85, 12.90 | 0.71 | Plasma carotenoids (µmol/L) | -10.83 | -52.19, 30.53 | 0.61 |
| **Poly-unsaturated fat (g/d)** |  |  |  | **Vitamin E (μg/d)** |  |  |  |
| * Skin carotenoids | 139 | -158, 435 | 0.36 | Skin carotenoids | -7 | -167, 153 | 0.93 |
| * Plasma carotenoids (µmol/L) | -3.33 | -28.30, 21.64 | 0.79 | Plasma carotenoids (µmol/L) | 5.86 | -7.50, 19.22 | 0.39 |

1 Multiple linear regressions analyses adjusting for corresponding dietary carotenoids

2 Multiple linear regressions analyses adjusting for corresponding dietary carotenoids multiplied by factor of 103

**Supplementary Table S3**

Regression analyses of plasma carotenoids with daily fruits, vegetables and carotenoids intake adjusted for dietary fats

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Dietary factors** | **Total plasma carotenoids (µmol/L)** | | | | | | | | |
| Multiple linear regression | | | | | | | | |
| Model 31 | | | Model 42 | | | Model 53 | | |
| β | 95% CI | *P* | β | 95% CI | *P* | β | 95% CI | *P* |
| Fruits and vegetables (servings/d) | 0.089 | 0.034, 0.145 | 0.002 | 0.100 | 0.039, 0.160 | 0.001 | 0.097 | 0.036, 0.158 | 0.002 |
| Total carotenoids (mg/d) | 0.021 | 0.002, 0.041 | 0.03 | 0.023 | 0.002, 0.043 | 0.03 | 0.024 | 0.003, 0.046 | 0.03 |
| **Individual dietary carotenoids** | **Corresponding individual plasma carotenoids (µmol/L)** | | | | | | | | |
| Multiple linear regression | | | | | | | | |
| Model 31 | | | Model 42 | | | Model 53 | | |
| β | 95% CI | *P* | β | 95% CI | *P* | β | 95% CI | *P* |
| α-carotene (mg/d) | 0.033 | 0.011, 0.056 | 0.004 | 0.038 | 0.015, 0.062 | 0.002 | 0.042 | 0.017, 0.066 | 0.001 |
| β-carotene (mg/d) | 0.006 | -0.007, 0.018 | 0.36 | 0.006 | -0.007, 0.019 | 0.36 | 0.005 | -0.008, 0.018 | 0.42 |
| β-cryptoxanthin (mg/d) | 0.408 | 0.184, 0.631 | < 0.001 | 0.415 | 0.179, 0.651 | 0.001 | 0.401 | 0.175, 0.627 | 0.001 |
| Lycopene (mg/d) | 0.050 | 0.033, 0.066 | < 0.001 | 0.057 | 0.039, 0.075 | < 0.001 | 0.057 | 0.039, 0.075 | < 0.001 |
| Lutein and zeaxanthin (mg/d) | 0.009 | -0.004, 0.021 | 0.17 | 0.009 | -0.003, 0.022 | 0.14 | 0.010 | -0.003, 0.022 | 0.12 |

1 Model 3 was adjusted for age, BMI, prescription medication and saturated fat intake per day

2 Model 4 was adjusted for age, BMI, prescription medication and mono-unsaturated fat intake per day

3 Model 5 was adjusted for age, BMI, prescription medication and poly-unsaturated fat intake per day

β: regression coefficient

**Supplementary Table S4**

Multiple linear regression analyses of plasma carotenoids with daily fruits, vegetables and carotenoids intake adjusted dietary vitamin C and fiber

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Dietary factors** | **Total plasma carotenoids (µmol/L)** | | | | | |
| Adjustment of dietary vitamin C1 | | | Adjustment of dietary fiber2 | | | |
| β | 95% CI | *P* | β | 95% CI | *P* | |
| Fruits and vegetables (servings/d) | 0.050 | -0.031, 0.131 | 0.22 | 0.139 | 0.061, 0.217 | 0.001 | |
| Total carotenoids (mg/d) | 0.011 | -0.012, 0.033 | 0.35 | 0.024 | 0.001, 0.047 | 0.04 | |
| **Individual dietary carotenoids** | **Corresponding individual plasma carotenoids (µmol/L)** | | | | | |
| Adjustment of dietary vitamin C1 | | | Adjustment of dietary fiber2 | | | |
| β | 95% CI | *P* | β | 95% CI | *P* | |
| α-carotene (mg/d) | 0.029 | 0.005, 0.053 | 0.02 | 0.036 | 0.010, 0.062 | 0.007 | |
| β-carotene (mg/d) | 0.001 | -0.012, 0.014 | 0.92 | 0.004 | -0.011, 0.018 | 0.62 | |
| β-cryptoxanthin (mg/d) | 0.270 | 0.021, 0.519 | 0.03 | 0.406 | 0.171, 0.640 | 0.001 | |
| Lycopene (mg/d) | 0.010 | -0.003, 0.022 | < 0.001 | 0.051 | 0.034, 0.068 | < 0.001 | |
| Lutein and zeaxanthin (mg/d) | 0.052 | 0.033, 0.070 | 0.14 | 0.012 | -0.001, 0.025 | 0.07 | |

1 Model was adjusted for age, BMI, prescription medication and vitamin C intake per day

2 Model was adjusted for age, BMI, prescription medication and fiber intake per day

β: regression coefficient

**Supplementary Table S5**

Multiple linear regression analyses of skin carotenoids with daily fruits, vegetables and carotenoids intake adjusted dietary vitamin A, C and fiber

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Dietary factors** | **Skin carotenoids** | | | | | | | | |
| Adjustment of dietary vitamin A1 | | | Adjustment of dietary vitamin C2 | | | Adjustment of dietary fiber2 | | |
| β | 95% CI | *P* | β | 95% CI | *P* | β | 95% CI | *P* |
| Fruits and vegetables (servings/d) | 1054 | 377, 1730 | 0.003 | 648 | -314, 1611 | 0.18 | 880 | -93, 1852 | 0.08 |
| Total carotenoids (mg/d) | 270 | 27, 513 | 0.03 | 130 | -136, 396 | 0.34 | 151 | -128, 430 | 0.29 |
| α-carotene (mg/d) | 176 | -256, 608 | 0.42 | 893 | -987, 2772 | 0.35 | 603 | -1472, 2678 | 0.57 |
| β-carotene (mg/d) | 1522 | -358, 3402 | 0.11 | -41 | -482, 401 | 0.86 | -80 | -552, 392 | 0.74 |
| β-cryptoxanthin (mg/d) | 4525 | -3838, 12889 | 0.29 | -1647 | -10729, 7435 | 0.72 | 1267 | -7290, 9825 | 0.77 |
| Lycopene/ (mg/d) | 773 | 46, 1500 | 0.04 | 544 | -381, 1185 | 0.31 | 580 | -159, 1320 | 0.12 |
| Lutein and zeaxanthin (mg/d) | 799 | 99, 1500 | 0.03 | 402 | -136, 1225 | 0.12 | 543 | -157, 1243 | 0.13 |

1 Model was adjusted for sex, BMI, prescription medication, cigarette smoking and daily vitamin A intake

2 Model was adjusted for sex, BMI, prescription medication, cigarette smoking and daily vitamin C intake

3 Model was adjusted for sex, BMI, prescription medication, cigarette smoking and daily fiber intake

β: Regression coefficient