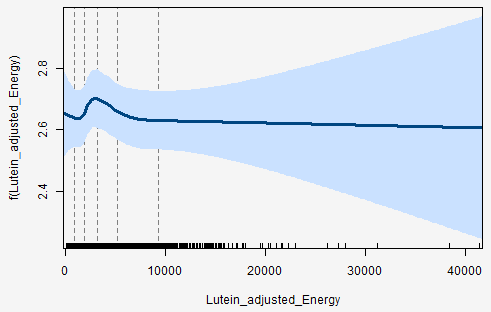
**Online Supporting Material**

**Supplemental Figure 1.**Test non- linear effect of lutein intake

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There is no evidence against a linear effect (Included covariates from Model 2; n of splines4; Chi211·05; p- value 0·05)

**Table 1.** Characteristics of participants in The Rotterdam Study (n= 4402)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | RS I-5 n= 1133 | | RS II-3 n= 1320 | | RS III-2 n= 1949 | |
| Age (y, mean and SD) | 79 | 4 | 72 | 5 | 56 | 6 |
| Female (n,%) | 638 | 56·3 | 731 | 55·4 | 1130 | 58·0 |
| Height (cm, mean and SD) | 166·1 | 9·1 | 168·3 | 9·1 | 171·2 | 9·2 |
| *Missing values* | 0 |  | 1 |  | 0 |  |
| Weight (kg, mean and SD) | 75·9 | 13·4 | 78·0 | 13·6 | 80·5 | 15·4 |
| *Missing values* | 0 |  | 1 |  | 0 |  |
| Caucasian ethnicity (n,%) | 1097 | 96·8 | 1172 | 88·8 | 1832 | 94·0 |
| *Missing values* | 14 | 1·2 | 114 | 8·6 | 21 | 1·1 |
| FEV1(L, mean and SD) | 2·22 | 0·65 | 2·48 | 0·70 | 2·92 | 0·77 |
| FEV1 (%, mean and SD) | 103·5 | 22·9 | 101·81 | 20·7 | 103·6 | 17·7 |
| FVC (L, mean and SD) | 2·96 | 0·82 | 3·26 | 0·88 | 3·82 | 0·99 |
| FEV1/FVC (%, median and IQR) | 76·4 | 71·3, 79·9 | 77·1 | 72·5, 81·0 | 77·5 | 73·0, 81·3 |
| Dietary intake |  | |  | |  | |
| Lutein intake (mg/d, median and  IQR ) | 2·09 | 1·20, 3·57 | 2·50 | 1·41, 4·12 | 3·12 | 1·87, 5·09 |
| Total energy intake (kJ/d, median and   IQR) | 8096 | 6477, 9979 | 8234 | 6573, 9920 | 9301 | 7724, 11343 |
| Total energy intake (kcal/d, median   and IQR) | 1935 | 1548, 2385 | 1968 | 1571, 2371 | 2223 | 1846, 2711 |
| α-carotene intake (mg/d, median and   IQR) | 0·57 | 0·23, 1·06 | 0·61 | 0·25, 1·28 | 0·82 | 0·36, 1·62 |
| β-carotene intake (mg/d, median and   IQR) | 3·10 | 1·66, 5·19 | 3·46 | 1·86, 6·15 | 4·43 | 2·55, 7·38 |
| β-cryptoxanthin intake  mg/d, median and IQR) | 0·30 | 0·11, 0·68 | 0·28 | 0·10, 0·56 | 0·27 | 0·11, 0·50 |
| Lycopene intake (mg/d, median and   IQR) | 0·95 | 0·43, 1·89 | 1·25 | 0·59, 2·38 | 1·73 | 0·90, 2·92 |
| Zeaxanthin intake (mg/d, median and   IQR) | 0·13 | 0·09, 0·18 | 0·13 | 0·09, 0·18 | 0·14 | 0·01, 0·18 |
| Total fat intake (g/d, median and  IQR) | 65·4 | 50·5, 86·4 | 68·1 | 51·4, 86·4 | 77·9 | 60·2, 100·0 |
| Ratio N3:N6 (g/d, median and IQR) | 6·8 | 5·9, 7·7 | 6·8 | 6·0, 7·6 | 7·1 | 6·3, 7·9 |
| Dietary fibre intake (g/d, median and   IQR) | 24·2 | 18·1, 31·6 | 24·3 | 19·0, 31·1 | 28·0 | 21·8, 35·8 |
| Physical activity (MET hours/ per week, median and IQR) | 30·3 | 12·0, 67·8 | 43·7 | 17·9, 83·1 | 46·5 | 19·6, 82·2 |
| *Missing values* | 131 |  | 91 |  | 187 |  |
| Smoking status (n,%) |  | |  | |  | |
| Never | 378 | 33·4 | 441 | 33·4 | 691 | 35·5 |
| Former | 668 | 59·0 | 749 | 56·7 | 1000 | 51·3 |
| Current | 87 | 7·7 | 130 | 9·8 | 258 | 13·2 |
| Education level (n,%) |  | |  | |  | |
| Lower education | 573 | 50·6 | 621 | 47·0 | 815 | 41·8 |
| Higher education | 555 | 49·0 | 658 | 49·9 | 1130 | 58·0 |
| *Missing values* | 5 | 0·4 | 41 | 3·1 | 4 | 0·2 |
| Diabetes Mellitus type 2 (n,%) | 135 | 11·9 | 51 | 3·9 | 97 | 5·0 |
| *Missing values* | 12 | 1·1 | 3 | 0·2 | 5 | 0·3 |
| CVD (n,%) | 60 | 5·3 | 33 | 2·5 | 60 | 3·1 |
| *Missing values* | 14 | 1·2 | 25 | 1·9 | 7 | 0·4 |
| Asthma (n,%) | 61 | 5·4 | 75 | 5·7 | 102 | 5·2 |
| COPD (n,%) | 224 | 19·8 | 211 | 16·0 | 266 | 13·6 |
| Lung cancer (n,%) | 17 | 1·5 | 11 | 0·8 | 1 | 0·1 |

Values are means, SD, numbers with valid percentages (numbers), or medians with interquartile range.   
Abbreviations: n= number of participants; kg= kilogram; cm= centimetres; FEV1= Forced Expiratory volume per second; FVC= Forced Vital Capacity; L= litre; IQR= interquartile range; y=years; kJ= Kilojoules; kcal= kilo calories; mg= milligram; N3:N6-ratio= omega 3: omega 6 fatty acids ratio; MET= Metabolic Equivalent of TASK; COPD= Chronic Obstructive Pulmonary Disease; CVD= cardiovascular diseases (i.e. treatment for narrowed blood vessels, myocardial infarction, stroke, cerebral hemorrhage and cerebro vascular accident).

**Supplemental Table 2.** Specification of the multiple imputation procedure

|  |  |
| --- | --- |
| Software | IBM SPSS Statistics for Windows (Release 21,0,0,1) |
| Imputation method | Fully conditional specification (Markov chain Monte Carlo method) |
| Key settings | Maximum iterations: 20 |
| Imputed data sets | 10 |
| Variables included in the | Lutein intake (ug/d); FEV1 predicted (%); FEV1 (L); FVC (L); Ratio |
|  | FEV1/FVC; ethnicity; gender; age; height (cm); weight (kg); |
| imputation procedure | education; household income; smoking; pack years of smoking; |
| (imputed or used as | physical activity measured in MET (h); energy intake (kcal); |
| predictors of missing | alpha carotene intake (ug/d); zeaxanthin intake (ug/d); |
| data): | betacrypotoxanthin intake (ug/d); beta carotene intake (ug/d); |
|  | lycopene intake (ug/d); total fat intake (g/d); saturated fat intake (g/d) |
|  | mono unsaturated fat intake (g/d); poly unsaturated fat intake (g/d); |
|  | linoleic acid intake (g/d); trans fatty acid intake (g/d); |
|  | alpha linoleinic acid intake (g/d); eicosapentaenoic acid intake (g/d); |
|  | docosahexaenoic acid intake (g/d); fiber intake (g/d); alcohol intake (g/d); |
|  | serum cholesterol (mmol/l); asthma; COPD; diabetes; CVD (treatment for |
|  | narrowed date blood vessels/ CVA); lungfunction test; lung cancer |
|  |  |
|  |  |
| Additionally added | waist circumference (cm) (RS I-3, RS II-1, RS III-1); hip circumference |
| predictive variables to | (cm); (RS I-3, RS II-1, RS III-1); height (cm) (RS I-3, RS II-1, RS III-1); |
| increase plausibility of | weight (kg) (RS I-3, RS II-1, RS III-1); energy intake (kcal) extremes (RS I-5, RS II-1, RS III-1); dietary supplement intake in summer and/ or winter |
| missing at random | (RS I-5, RS II-3, RS III-1); MET/h sport, MET/h walk, MET/h cycling, |
| assumption: | MET/h gardening, MET/h domestic activities (RS I-3, RS II-1) |
|  | Dutch Healthy Diet Index – score (RS I-5, RS II-3, RS III-1); |
|  | protein intake (g/d) (RS I-5, RS II-3, RS III-1); |
|  | vegeterian protein intake (g/d) (RS I-5, RS II-3, RS III-1); |
|  | animal protein intake (g/d) (RS I-5, RS II-3, RS III-1); |
|  | cholesterol intake (g/d) (RS I-5, RS II-3, RS III-1); |
|  | total carbohydrate intake (g/d) (RS I-5, RS II-3, RS III-1); |
|  | mono/disaccharides intake (g/d) (RS I-5, RS II-3, RS III-1); |
|  | polysaccharides intake (g/d) (RS I-5, RS II-3, RS III-1); |
|  | occupational situation (RS I-1, RS II-1, RS III-1); |
|  | last occupational situation (RS I-1, RS II-1, RS III-1); |
|  | highest attained education (RS I-1, RS II-1, RS III-1); |
|  | number of persons living from net income (RS I-1, RS II-1, RS III-1); |
|  | date of retirement/discontinuing occupation (RS I-4, RS II-1, RS III-1) |
|  |  |
| Not normally distributed | Predictive mean matching |
| variables were treated with: |  |
|  |  |
| Binary/categorical | Logistic regression models |
| variables were treated with: |  |