**Online Supporting Material: Supplementary Appendix**

**A Western dietary pattern is prospectively associated with cardio-metabolic traits and incidence of metabolic syndrome**

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**Figure S1.** Flow chart of participants

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**Table S1**. Foods and food groups used as predictor variables for reduced rank regression.

|  |
| --- |
| **FOOD VARIABLES (N=38)1** |
| Vegetables |
| Fruit and berries |
| Fruit juices |
| Potatoes |
| Fried and deep-fried potatoes |
| Eggs |
| Red meat |
| Processed meats |
| Poultry |
| Fish and shellfish |
| Milk (reduced fat) |
| Milk (full fat) |
| Cream |
| Fermented milk |
| Cheese |
| Icecream |
| Cereals, no added sugar |
| Cereals, added sugar |
| Low-fiber bread |
| High-fiber bread |
| Cakes and biscuits |
| Rice and pasta |
| Cooking oils (all) |
| Butter (including milkfat-based spreads) |
| Margarines |
| Dressings |
| Sweets |
| Sugar |
| Nuts and snacks |
| Marmelade |
| Coffee |
| Tea |
| Sugar-sweetened beverages |
| Artifically sweetened-beverages |
| Beer |
| Wine |
| Spirits |
| Industrial powders2 |

1 Excluded food items from Malmö Diet and Cancer food database due to extreme number of zero reporters and/or poor validity: Flour; Ketchup; Mineral water; Tap water; Soy products; Spices; Formula; Gruel; Undefined

2 Industrial powders include ready-to-eat soup and sauce powders mixed with water.

**Table S2**. Pearson correlation coefficients for factor 1 (“Western” dietary pattern) and 12 food items with highest absolute factor loadings (+/-) and cardio-metabolic traits in the Malmö Diet and Cancer Study (n=4,071)1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Pearson correlation with cardio-metabolic traits (responses)2 | | | | | | |  |
|  | Pearson correlation with food pattern score | WC | TG | HDL | LDL | SBP | DBP | FG | FI |
| Food pattern score | 1.00 | 0.23\*\*\* | 0.18\*\*\* | -0.21\*\*\* | 0.06\*\* | 0.09\*\*\* | 0.09\*\*\* | 0.13\*\*\* | 0.18\*\*\* |
| Food groups (predictors)3 |  |  |  |  |  |  |  |  |  |
| Positive loadings |  |  |  |  |  |  |  |  |  |
| Sugar-sweetened beverages | 0.38\*\*\* | 0.07\*\*\* | 0.08\*\*\* | -0.09\*\*\* | 0.03 | 0.05\* | 0.04\* | 0.02 | 0.07\*\*\* |
| Milk (reduced fat) | 0.38\*\*\* | 0.11\*\*\* | 0.05\*\* | -0.07\*\*\* | 0.01 | 0.05\* | 0.05\*\* | 0.04\* | 0.05\*\* |
| Artificially sweetened beverages | 0.28\*\*\* | 0.09\*\*\* | 0.04 | -0.04\* | 0.002 | 0.04 | 0.04 | 0.03 | 0.04 |
| Red meat | 0.23\*\*\* | 0.06\*\* | 0.03 | 0.002 | 0.03 | 0.06\*\* | 0.04 | 0.05\*\* | 0.05\*\* |
| Processed meats | 0.21\*\*\* | 0.07\*\*\* | 0.02 | 0.001 | 0.01 | 0.07\*\*\* | 0.03 | 0.07\*\*\* | 0.02 |
| Sweets | 0.17\*\*\* | 0.02 | 0.03 | -0.05\*\* | 0.05\* | 0.0001 | 0.01 | 0.02 | 0.03 |
| Negative loadings |  |  |  |  |  |  |  |  |  |
| Wine | -0.40\*\*\* | -0.06\*\* | -0.08\*\*\* | 0.19\*\*\* | -0.01 | 0.01 | 0.01 | 0.01 | -0.08\*\*\* |
| Beer | -0.39\*\*\* | -0.06\*\* | -0.08\*\*\* | 0.15\*\*\* | -0.03 | 0.01 | -0.02 | -0.02 | -0.08 |
| Cream | -0.29\*\*\* | -0.07\*\*\* | -0.06\*\*\* | 0.07\*\*\* | 0.04\* | -0.05\*\* | -0.02 | -0.05\* | -0.03 |
| Cheese | -0.27\*\*\* | -0.02 | -0.06\*\*\* | 0.08\*\*\* | -0.02 | -0.04 | -0.03 | -0.03 | -0.04 |
| Tea | -0.26\*\*\* | -0.06\*\* | -0.04 | 0.03 | -0.04\* | -0.06\*\* | -0.03 | -0.07\*\*\* | -0.03 |
| Vegetables | -0.18\*\*\* | 0.01 | -0.04\* | 0.05\*\* | -0.01 | -0.03 | -0.02 | -0.06\*\*\* | -0.03 |

\* P<0.01; \*\* P<0.001; \*\*\* P<0.0001

1 WC, waist circumference; TG, triglycerides; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; FG, fasting glucose; FI, fasting insulin.

2 All cardio-metabolic traits were loge-transformed and adjusted for age and sex.

3 All food groups were loge-transformed and adjusted for total energy intake, age, and sex.

**Table S3**. Pearson correlation coefficients between factor 2 (“Drinker” dietary pattern) and 12 food items with highest absolute factor loadings (+/-) and cardio-metabolic traits in the Malmö Diet and Cancer Study (n=4,071)1

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Pearson correlation with cardio-metabolic traits (responses)2 | | | | | | |  |
|  | Pearson correlation with food pattern score | WC | TG | HDL | LDL | SBP | DBP | FG | FI |
| Food pattern score | 1.00 | 0.07\*\*\* | -0.03 | 0.18\*\*\* | 0.01 | 0.08\*\*\* | 0.06\*\* | 0.10\*\*\* | -0.01 |
| Food groups (predictors)3 |  |  |  |  |  |  |  |  |  |
| Positive loadings |  |  |  |  |  |  |  |  |  |
| Wine | 0.60\*\*\* | 0.06\*\* | -0.07\*\*\* | 0.19\*\*\* | -0.01 | 0.01 | 0.01 | 0.01 | -0.08\*\*\* |
| Beer | 0.37\*\*\* | -0.06\*\*\* | -0.08\*\*\* | 0.15\*\*\* | -0.03 | 0.01 | -0.02 | -0.02 | -0.08\*\*\* |
| Spirits | 0.49\*\*\* | 0.01 | 0.02 | 0.11\*\*\* | 0.01 | 0.04 | 0.04 | 0.03 | -0.04\* |
| Processed meats | 0.33\*\*\* | 0.07\*\*\* | 0.02 | 0.001 | 0.01 | 0.07\*\*\* | 0.03 | 0.07\*\*\* | 0.02 |
| Fish and shellfish | 0.29\*\*\* | 0.01 | -0.04\* | 0.08\*\*\* | 0.03 | 0.0001 | -0.01 | 0.004 | -0.01 |
| Red meat | 0.27\*\*\* | 0.06\*\* | 0.03 | 0.002 | 0.03 | 0.06\*\*\* | 0.04 | 0.05\*\* | 0.05\*\* |
| Negative loadings |  |  |  |  |  |  |  |  |  |
| Sugar | -0.39\*\*\* | -0.06\*\* | 0.03 | -0.08\*\*\* | 0.01 | -0.01 | -0.01 | -0.02 | -0.01 |
| Cakes and biscuits | -0.38\*\*\* | -0.02 | 0.004 | -0.05\*\* | 0.06\*\* | -0.05\* | -0.03 | -0.06\*\*\* | -0.03 |
| Marmelade | -0.22\*\*\* | -0.05\*\* | -0.03 | -0.01 | -0.02 | -0.01 | -0.01 | -0.06\*\* | -0.05\*\* |
| Tea | -0.20\*\*\* | -0.06\*\* | -0.04 | 0.03 | -0.04\* | -0.06\*\* | -0.03 | -0.07\*\*\* | -0.03 |
| Cereals, added sugar | -0.18\*\*\* | -0.03 | -0.04 | 0.01 | -0.05\* | -0.04\* | -0.03 | -0.05\*\* | -0.02 |
| Low-fiber bread | -0.17\*\*\* | -0.03 | 0.01 | -0.03 | -0.01 | 0.01 | -0.03 | -0.02 | -0.03 |

\* P<0.01; \*\* P<0.001; \*\*\* P<0.0001

1 WC, waist circumference; TG, triglycerides; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; FG, fasting glucose; FI, fasting insulin.

2 All cardio-metabolic traits were loge-transformed and adjusted for age and sex.

3 All food groups were loge-transformed and adjusted for total energy intake, age, and sex.

**Table S4**. Age- and sex adjusted means (95% confidence intervals) of cardio-metabolic traits at baseline (1991-1994; N=4,071), after 16-years of follow-up (N=2,704), and percent change (% Δ) in traits (N=2,704) by quartiles of factor 1 (“Western” dietary pattern) among men and women of the Malmö Diet and Cancer cohort.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **“Western” dietary pattern** | | | |  |
| **Response variable** | **Quartile 1** | **Quartile 2** | **Quartile 3** | **Quartile 4** | **P-value\*** |
| Waist circumference |  |  |  |  |  |
| Baseline | 79.8 (79.2-80.3) | 81.2 (80.6-81.8) | 83.1 (82.6-83.7) | 85.4 (84.8-85.9) | <0.0001 |
| Follow-up | 88.7 (87.9-89.5) | 90.2 (89.4-90.9) | 92.4 (91.6-93.2) | 94.4 (93.5-95.2) | <0.0001 |
| %Δ | 11.7 (11.1-12.4) | 12.5 (11.8-13.1) | 13.1 (12.4-13.8) | 13.4 (12.6-14.1) | 0.001 |
| Triglycerides |  |  |  |  |  |
| Baseline | 1.15 (1.12-1.19) | 1.19 (1.15-1.23) | 1.32 (1.29-1.36) | 1.40 (1.36-1.44) | <0.0001 |
| Follow-up | 1.04 (1.00-1.09) | 1.06 (1.02-1.11) | 1.19 (1.15-1.23) | 1.21 (1.16-1.26) | <0.0001 |
| %Δ | -2.4 (-5.2-0.4) | -3.2 (-6.0-(-)0.4) | 1.2 (-1.7-4.1) | 0.8 (-2.3-3.8) | 0.035 |
| HDL cholesterol |  |  |  |  |  |
| Baseline | 1.48 (1.46-1.50) | 1.46 (1.44-1.48) | 1.38 (1.36-1.40) | 1.31 (1.29-1.33) | <0.0001 |
| Follow-up | 1.50 (1.47-1.53) | 1.49 (1.46-1.52) | 1.39 (1.36-1.42) | 1.34 (1.31-1.38) | <0.0001 |
| %Δ | 2.2 (0.7-3.7) | 2.8 (1.3-4.3) | -0.1 (-1.7-1.5) | 0.4 (-1.3-2.1) | 0.022 |
| LDL cholesterol |  |  |  |  |  |
| Baseline | 4.09 (4.03-4.15) | 4.10 (4.04-4.16) | 4.18 (4.12-4.24) | 4.24 (4.18-4.30) | <0.0001 |
| Follow-up | 3.69 (3.63-3.74) | 3.68 (3.62-3.74) | 3.70 (3.64-3.76) | 3.70 (3.64-3.76) | 0.699 |
| %Δ | -7.1 (-8.2-(-)5.9) | -7.4 (-8.6-(-)6.3) | -7.3 (-8.5-(-)6.1) | -8.6 (-9.9-(-7.4) | 0.110 |
| Systolic blood pressure |  |  |  |  |  |
| Baseline | 136.8 (135.7-137.8) | 138.6 (137.5-139.6) | 140.2 (139.1-141.2) | 140.3 (139.3-141.4) | <0.0001 |
| Follow-up | 146.3 (144.8-147.8) | 147.2 (145.8-148.7) | 147.9 (146.4-149.4) | 150.5 (148.9-152.1) | <0.0001 |
| %Δ | 8.5 (7.5-9.4) | 8.3 (7.3-9.3) | 8.4 (7.4-9.4) | 9.5 (8.5-10.6) | 0.166 |
| Diastolic blood pressure |  |  |  |  |  |
| Baseline | 84.8 (84.3-85.4) | 85.4 (84.8-85.9) | 86.4 (85.9-87.0) | 86.7 (86.1-87.2) | <0.0001 |
| Follow-up | 85.4 (84.5-86.2) | 85.9 (85.1-86.8) | 87.1 (86.2-87.9) | 87.7 (86.8-88.5) | <0.0001 |
| %Δ | 1.3 (0.5-2.2) | 1.6 (0.7-2.5) | 2.5 (1.6-3.4) | 2.7 (1.8-3.7) | 0.016 |
| Fasting glucose |  |  |  |  |  |
| Baseline1 | 5.41 (5.36-5.45) | 5.45 (5.40-5.50) | 5.53 (5.48-5.58) | 5.64 (5.59-5.69) | <0.0001 |
| Follow-up | 5.86 (5.78-5.95) | 6.00 (5.92-6.08) | 6.14 (6.05-6.23) | 6.09 (6.00-6.18) | <0.0001 |
| %Δ | 9.1 (7.9-10.4) | 10.9 (9.6-12.1) | 12.5 (11.2-13.9) | 10.8 (9.4-12.2) | 0.017 |
| Fasting insulin |  |  |  |  |  |
| Baseline | 6.36 (5.88-6.83) | 7.15 (6.68-7.63) | 7.41 (6.94-7.89) | 8.75 (8.28-9.23) | <0.0001 |
| Follow-up | 7.60 (7.24-7.96) | 8.32 (7.96-8.68) | 8.94 (8.57-9.32) | 9.79 (9.39-10.2) | <0.0001 |
| %Δ | 2.47 (-1.9-6.8) | 7.3 (3.0-11.6) | 10.3 (5.8-14.9) | 11.9 (7.2-16.7) | 0.002 |

\* P-value represents the linear association between ln transformed response variable or % change (Δ) and quartiles of food pattern score (entered as a continuous variable) from a linear regression model adjusting for age and sex. Percent change in traits (Δ, delta) additionally adjusted for ln-transformed baseline values of the specific traits.

1 Fastingwhole blood glucose converted to plasma glucose using the conversion factor 1.11.

**Table S5**. Age- and sex adjusted means (95% confidence intervals) of cardio-metabolic traits at baseline (1992-1994; N=4,071), after 16-years of follow-up (N=2,704), and percent change (% Δ) in traits (N=2,704) by quartiles of factor 2 (“Drinker” dietary pattern) among men and women of the Malmö Diet and Cancer cohort.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **“Drinker” dietary pattern** | | | |  |
| **Response variable** | **Quartile 1** | **Quartile 2** | **Quartile 3** | **Quartile 4** | **P-value\*** |
| Waist circumference |  |  |  |  |  |
| Baseline | 81.4 (80.8-82.0) | 82.6 (82.0-83.1) | 82.6 (82.0-83.2) | 82.9 (82.3-83.5) | <0.0001 |
| Follow-up | 89.4 (88.6-90.3) | 91.4 (90.6-92.2) | 91.5 (90.7-92.3) | 92.5 (91.7-93.4) | <0.0001 |
| %Δ | 11.5 (10.8-12.2) | 12.7 (12.0-13.4) | 13.0 (12.4-13.7) | 13.2 (12.5-13.9) | 0.001 |
| Triglycerides |  |  |  |  |  |
| Baseline | 1.31 (1.27-1.34) | 1.26 (1.22-1.29) | 1.27 (1.23-1.30) | 1.24 (1.21-1-28) | 0.006 |
| Follow-up | 1.13 (1.08-1.17) | 1.14 (1.10-1.19) | 1.12 (1.08-1.16) | 1.10 (1.05-1.14) | 0.201 |
| %Δ | -1.8 (-4.8-1.1) | 0.4 (-2.5-3.2) | -1.3 (-4.1-1.6) | -1.4 (-4.2-1.5) | 0.953 |
| HDL cholesterol |  |  |  |  |  |
| Baseline | 1.32 (1.30-1.34) | 1.40 (1.38-1.42) | 1.43 (1.41-1.45) | 1.48 (1.46-1.50) | <0.0001 |
| Follow-up | 1.36 (1.33-1.39) | 1.42 (1.39-1.45) | 1.46 (1.43-1.49) | 1.50 (1.47-1.53) | <0.0001 |
| %Δ | 0.9 (-0.7-2.5) | 0.7 (-0.9-2.3) | 1.6 (-0.02-3.1) | 2.3 (0.7-3.9) | 0.158 |
| LDL cholesterol |  |  |  |  |  |
| Baseline | 4.13 (4.07-4.19) | 4.17 (4.11-4.23) | 4.17 (4.11-4.23) | 4.13 (4.07-4.19) | 0.980 |
| Follow-up | 3.66 (3.60-3.71) | 3.72 (3.66-3.77) | 3.73 (3.67-3.79) | 3.66 (3.60-3.72) | 0.786 |
| %Δ | -7.7 (-8.9-(-)6.5) | -7.6 (-8.7-(-)6.4) | -7.1 (-8.3-(-)5.9) | -8.0 (-9.1-(-)6.8) | 0.865 |
| Systolic blood pressure |  |  |  |  |  |
| Baseline | 137.6 (136.6-138.7) | 138.4 (137.3-139.4) | 139.0 (138.0-140.1) | 140.8 (139.8-141.9) | <0.0001 |
| Follow-up | 147.1 (145.6-148.7) | 146.1 (144.6-147.7) | 148.3 (146.8-149.8) | 149.9 (148.4-151.5) | 0.004 |
| %Δ | 8.6 (7.6-9.6) | 7.6 (6.6-8.6) | 9.2 (8.2-10.2) | 9.2 (8.2-10.2) | 0.123 |
| Diastolic blood pressure |  |  |  |  |  |
| Baseline | 85.4 (84.8-85.9) | 85.4 (84.8-85.9) | 85.9 (85.4-86.4) | 86.7 (86.1-87.2) | <0.0001 |
| Follow-up | 85.4 (84.6-86.3) | 86.4 (85.5-87.2) | 86.1 (85.2-86.9) | 87.9 (87.0-88.7) | <0.0001 |
| %Δ | 1.0 (0.1-2.0) | 2.1 (1.2-3.0) | 1.7 (0.8-2.6) | 3.2 (2.2-4.1) | 0.004 |
| Fasting glucose |  |  |  |  |  |
| Baseline1 | 5.42 (5.37-5.46) | 5.48 (5.43-5.53) | 5.53 (5.48-5.58) | 5.60 (5.56-6.65) | <0.0001 |
| Follow-up | 5.92 (5.83-6.01) | 6.00 (5.92-6.09) | 6.02 (5.93-6.10) | 6.13 (6.04-6.21) | 0.001 |
| %Δ | 10.1 (8.7-11.4) | 10.9 (9.6-12.2) | 10.7 (9.4-12.0) | 11.5 (10.2-12.8) | 0.169 |
| Fasting insulin |  |  |  |  |  |
| Baseline | 7.98 (7.50-8.45) | 7.31 (6.83-7.79) | 7.15 (6.67-7.63) | 7.23 (6.75-7.71) | 0.172 |
| Follow-up | 8.47 (8.08-8.85) | 8.78 (8.41-9.16) | 8.72 (8.34-9.09) | 8.45 (8.07-8.82) | 0.807 |
| %Δ | 3.7 (-0.8-8.3) | 10.7 (6.3-15.1) | 10.2 (5.7-14.6) | 6.3 (1.8-10.8) | 0.505 |

\* P-value represents the linear association between ln transformed response variable or % change (Δ) and quartiles of food pattern score (entered as a continuous variable) from a linear regression model adjusting for age and sex. Percent change in traits (Δ, delta) additionally adjusted for ln-transformed baseline values of the specific traits.

1 Fastingwhole blood glucose converted to plasma glucose using the conversion factor 1.11.

**Figure S2**. Sensitivity analysis: Food factor loadings for factor 1 extracted using reduced rank regression in the Malmö Diet and Cancer Study (n=4,071) after exclusion of alcoholic beverages.



**Figure S3**. Food factor loadings for dietary pattern (factor 1) extracted using reduced rank regression in the Malmö Diet and Cancer Study with complete follow-up (n=2,704) and using cardio-metabolic traits measured at 16-year follow-up as response variables. The pattern explained 2.9% of the variation in response variables and 4.7% of the variation in predictor variables.



**Table S6.** Adjusted partial correlation coefficients between dietary pattern predictive of cardio-metabolic traits at follow-up and food groups with the highest absolute factor loadings (+/- 0.20) and cardio-metabolic traits after 16 years of follow-up in the Malmö Diet and Cancer Study (n=2,704).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Correlation coefficient with cardio-metabolic traits at follow-up (responses) | | | | | | | |
|  | Correlation coefficient with dietary pattern score | WC | TG | HDL | LDL | SBP | DBP | FG | FI |
| Dietary pattern score | 1.00 | 0.18\*\*\* | 0.14\*\*\* | -0.12\*\*\* | -0.002 | 0.07\*\* | 0.07\*\* | 0.08\*\*\* | 0.15\*\*\* |
| Food groups (predictors) |  |  |  |  |  |  |  |  |  |
| Positive loadings |  |  |  |  |  |  |  |  |  |
| Red meat | 0.41\*\*\* | 0.04 | 0.04 | -0.04 | 0.0001 | 0.05 | 0.06\* | 0.06\* | 0.05\* |
| Processed meats | 0.38\*\*\* | 0.07\*\* | 0.03 | -0.01 | -0.05 | 0.02 | 0.002 | 0.06\* | 0.05\* |
| Spirits | 0.29\*\*\* | 0.03 | 0.03 | 0.07\*\* | 0.004 | 0.05\* | 0.05 | 0.02 | -0.03 |
| Sugar-sweetened beverages | 0.31\*\*\* | 0.07\*\* | 0.05\* | -0.08\*\*\* | 0.04 | 0.02 | 0.05\* | 0.02 | 0.07\*\* |
| Fried and deep-fried potatoes | 0.23\*\*\* | 0.04 | 0.02 | -0.09 | 0.02 | 0.002 | 0.02 | 0.03 | 0.04 |
| Negative loadings |  |  |  |  |  |  |  |  |  |
| Fruit and berries | -0.31\*\*\* | -0.02 | -0.06\* | 0.01 | -0.02 | -0.01 | -0.03 | -0.03 | -0.04 |

\* P<0.01; \*\* P<0.001; \*\*\* P<0.0001

Abbreviations: WC, waist circumference; TG, triglycerides; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; FG, fasting glucose; FI, fasting insulin

Partial correlation coefficients adjusting for baseline age, sex, and total energy intake. Cardio-metabolic traits and food intakes were loge-transformed.