انواع الگوهای غذایی

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MD, PhD, MPH

Dietary pattern analysis

- Traditional analyses in nutritional epidemiology

Nutrient → Disease

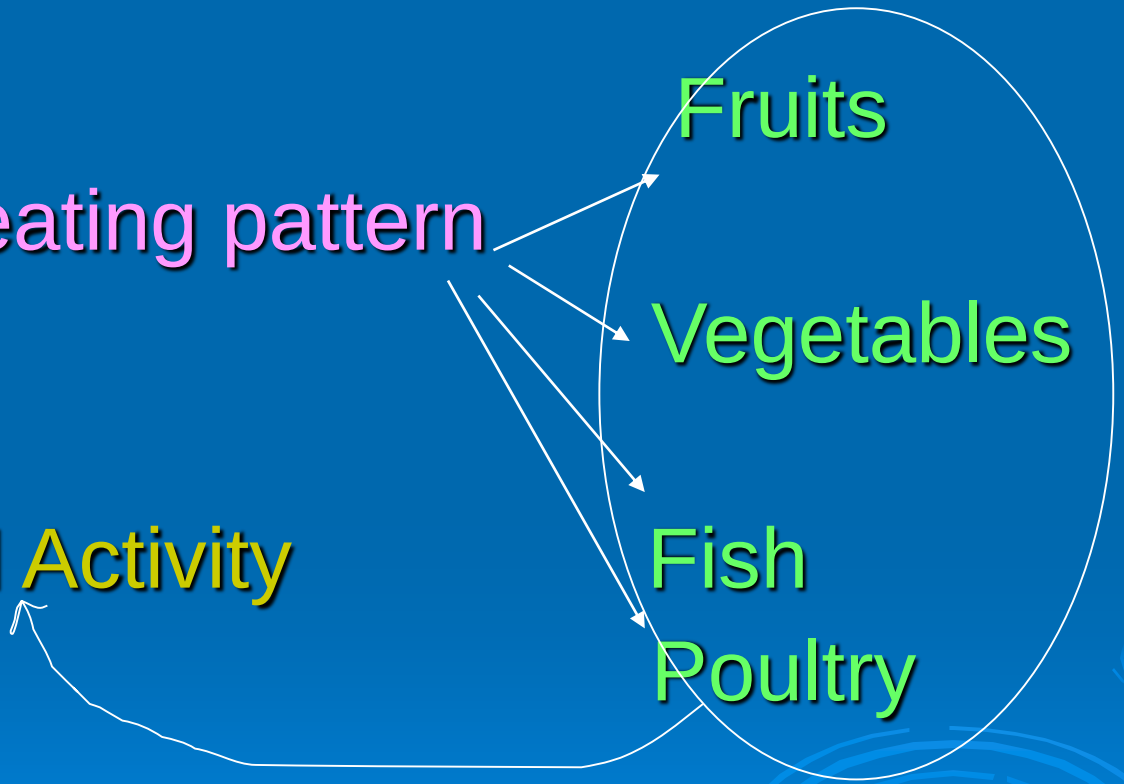
Food → Disease

Health attention

- Behavioral eating pattern

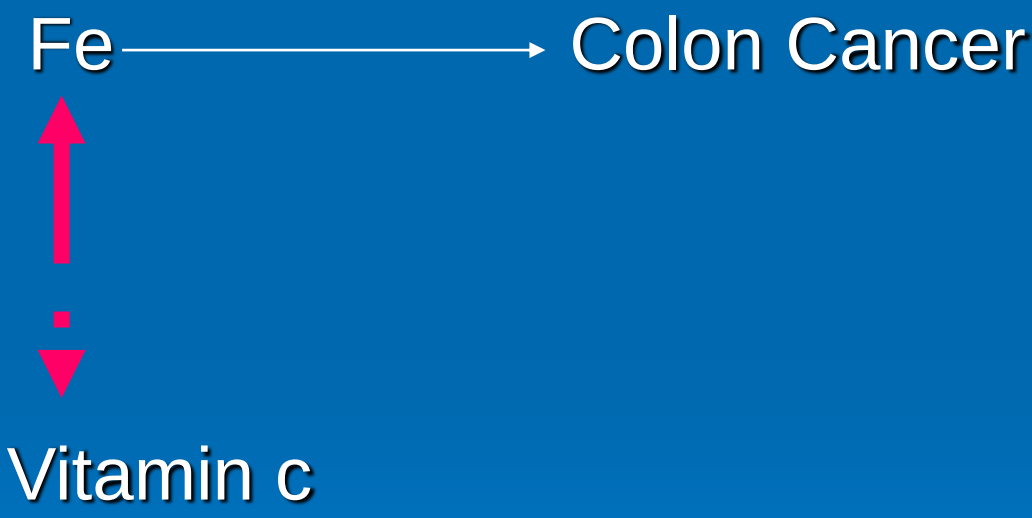
Less smoking

More Physical Activity



Confounding

interactions



Inter-correlations

Refined grains ⟷ - ⟷ Whole grains

Potato chip ⟷ - ⟷ Fruits and vegetable

Why not cumulative effect?

- The effect of a single food or nutrient may be too small to detect, but the cumulative effects of multiple foods or nutrients included in a eating behavior may be sufficiently large to be detectable.

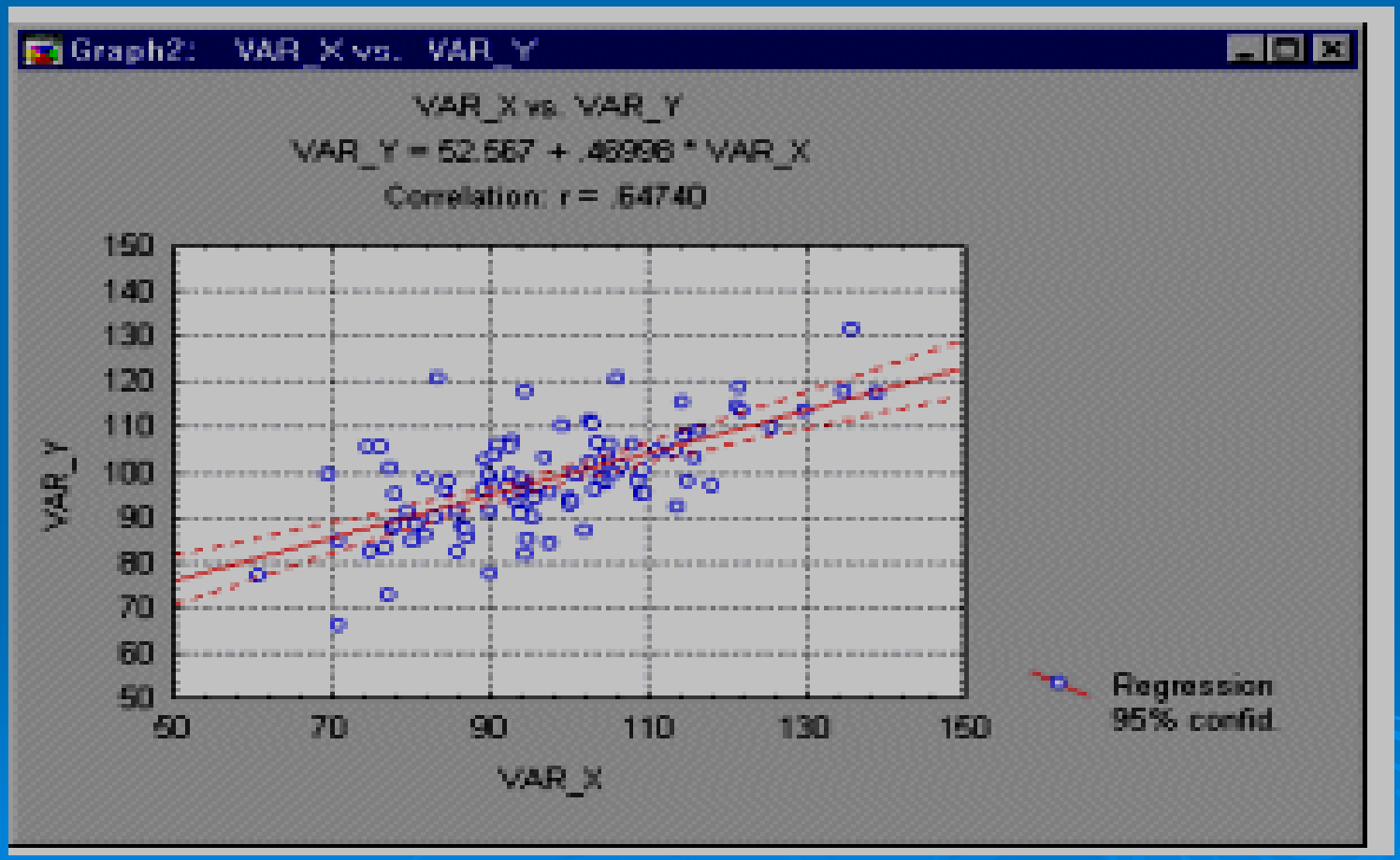
Bias

- Analyses based on a large number of nutrients or food items may produce statistically significant associations simply by chance.

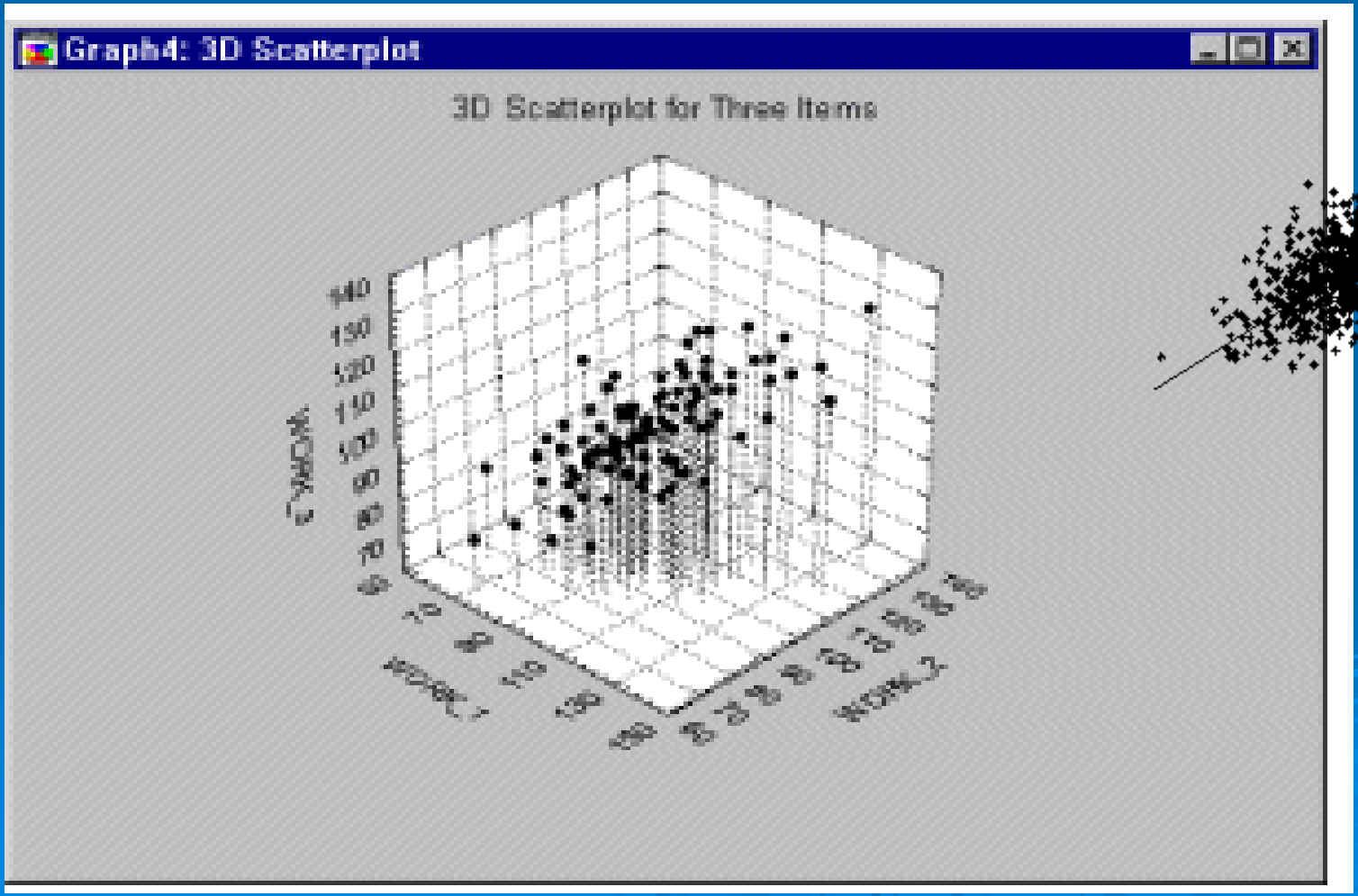
Methods for defining dietary patterns

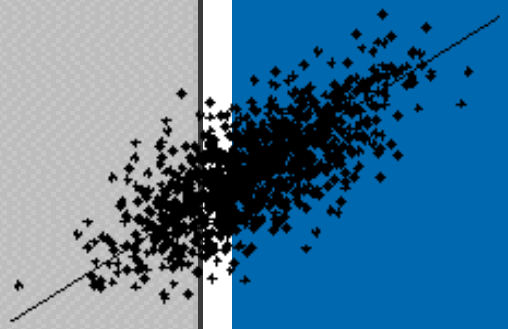
- 1) Factor analysis
- 2) Cluster analysis
- 3) Dietary indices

If we could define a variable that would approximate the regression line in such a plot, then that variable would capture most of the "essence" of the two items



When we have three or more variables, we could plot a three-dimensional scatterplot





Why factor analysis?

(1) to *reduce* the number of variables

(2) to *detect structure* in the relationships between variables, that is to *classify variables*.

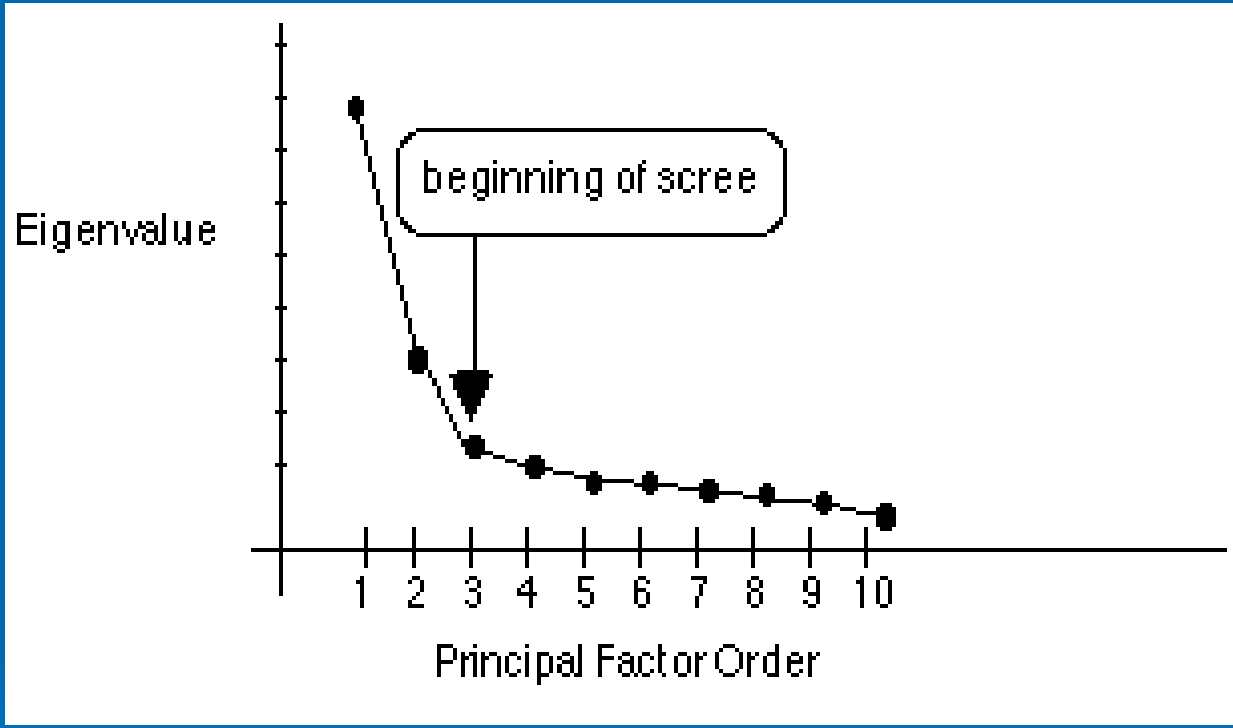
(3) To find a *cumulative effects* of variables

How many factors to retain?

- The Kaiser criterion. We can retain only factors with eigenvalues greater than 1

scree test

- A graphic method for determining the number of factors. The eigenvalues are plotted in the sequence of the principal factors. The number of factors is chosen where the plot levels off to a linear decreasing pattern.


Eigenvalue
beginning of scree
1
2
3
4
5
6
7
8
9
10
Principal Factor Order

Which criterion to use?

- This is an arbitrary decision
- chooses the one that makes the best "sense“!

HPFS 2000

TABLE 2
Factor-loading matrix for the major factors (diet patterns) identified by using food consumption data from the food-frequency questionnaire used in the Health Professionals Follow-up Study in 1986[1]

Food or food group	Factor 1 (prudent diet pattern)	Factor 2 (Western diet pattern)
Other vegetables[2]	0.75	—
Green, leafy vegetables	0.64	—
Dark-yellow vegetables	0.63	—
Cruciferous vegetables	0.63	—
Legumes	0.61	—
Fruit	0.57	—
Tomatoes	0.56	—
Fish	0.51	—
Garlic	0.42	—
Poultry	0.36	—
Whole grains	0.35	—
Red meat	—	0.63
Processed meat	—	0.59
Refined grains	—	0.49
Sweets and desserts	—	0.47
French fries	—	0.46
High-fat dairy products	—	0.45
Eggs	—	0.39
High-sugar drinks	—	0.38
Snacks	—	0.37
Condiments	—	0.36
Margarine	—	0.34
Potatoes	—	0.33
Butter	—	0.31

[1] Absolute values <0.30 were not listed in the table for simplicity. Foods or food groups with factor loadings <0.30 for both factors were excluded.
[2] *See* Table 1 for food groupings.

Taiwan

Table 1 Factor loadings and dietary patterns derived from principal component analysis

Food groups	Western dietary pattern	Prudent dietary pattern
Milk	0.044	0.421[a]
Dairy products	0.227	0.427[a]
Eggs	0.473[a]	0.328[a]
Meat	0.560[a]	0.275
Organ meats	0.510[a]	0.203
Legumes/soy products	0.362[a]	0.459[a]
Seafood	0.322[a]	0.463[a]
Light-colored vegetables	0.035	0.789[a]
Dark-colored vegetables	0.010	0.811[a]
Fruits	0.006	0.640[a]
Vegetables with oil/dressing	0.219	0.575[a]
Rice/flour products	0.346[a]	0.387[a]
Whole grains	0.161	0.381[a]
Root crops	0.262	0.544[a]
Refined dessert	0.441[a]	0.308[a]
Jam/honey	0.464[a]	0.208
Sugar-added beverages	0.601[a]	0.014
Rice/flour cooked in oil	0.513[a]	0.226
Deep-fried food	0.729[a]	0.093
Instant noodles	0.586[a]	0.033
Processed food	0.688[a]	0.117
Sauces	0.653[a]	0.043

[a]The values indicate a factor loading ≥0.30 used in the identification of dietary patterns

Sweden

Factor-loading matrix for 3 major dietary patterns derived from the FFQ at baseline (1987–1990) among 46,572 women in the Swedish Mammography Cohort[1]

Food group	Food item	Pattern 1 (Healthy)	Pattern 2 (Western)	Pattern 3 (Drinker)
Vegetables	Carrots, beets, white cabbage, salad (lettuce or cucumbers), spinach	0.72	—	—
Tomatoes	Tomato	0.61	—	—
Fish	Salmon, mackerel, sardines, herring, tuna, other fish	0.53	—	0.17
Fruit	Apples, pears, citrus fruit, bananas	0.53	—	−0.17
Poultry	Chicken	0.36	—	0.29
Whole grains	Whole-grain soft bread, crisp bread, oatmeal, and other whole-grain, hot cereals	0.36	0.25	−0.46
Breakfast/cereals	Assorted breakfast cereals, muesli	0.32	—	—
Egg	Eggs	0.31	0.2	0.16
Low-fat dairy	Low-fat milk (0.5%), medium-fat milk (1.5%), low-fat yogurt (0.5%)	0.29	—	−0.19
Fruit juice	Juice	0.27	—	—
Tea	Tea	0.19	—	—
Sweets	Assorted candy, caramels, chocolate, cookies, sugar, sweet soups, marmalade or jams	−0.16	0.56	—
Processed meat	Bacon, sausage, blood pudding	—	0.55	—
Refined grains	White bread, rice, spaghetti, pancakes, waffles (refined grains)	—	0.54	0.16
Added fat	Margarine, butter	—	0.51	−0.25
High-fat dairy	Cheese, whole-fat milk (3%), whole yogurt (3%), ice-cream	—	0.49	−0.16
Fried potatoes	Fried potatoes, French fries	—	0.41	0.24
Soft drinks	Carbonated sweetened drinks, uncarbonated sweetened drinks	—	0.4	—
Meat	Beef, chopped meat, minced meat, liver, liver pate	0.32	0.4	0.24
Cooked potatoes	Boiled potatoes	—	0.33	−0.27
Pea soup	Pea soup, bean soup	—	0.27	—
Coffee	Coffee	—	0.17	—
Wine	Wine	—	—	0.61
Liquor	Liquor	—	—	0.55
Snacks	Potato chips, other snack chips, popcorn, fried and salted nuts	—	0.16	0.44
Beer	Beer (3 different alcohol proofs)	—	—	0.42
Proportion of variability, %		9.10	8.70	6.90

[1] Absolute values < 0.15 are not displayed.

Chinese study

Food groups	Alcohol and fish	Traditional	Coarse cereals
Fresh water fish	0.74	—	—
Sea fish	0.73	—	—
Wine	0.68	—	—
Beer	0.65	—	—
Legumes	—	—	0.41
Tea	—	—	—
Poultry	—	—	0.46
Red meat	—	0.50	—
Sugar-sweetened beverage	—	—	—
Potatoes	—	—	—
Vegetables	—	0.73	—
Fruits	—	—	—
Lard oil	—	—	—
Egg	—	—	—
Salted vegetables	—	—	—
Soya-bean oil	——	—	—
Coarse cereals	—	—	0.71
Dairy and its product	—	—	—
Cooked wheaten food	—	0.72	—
Processed meat	—	—	—
Corn oil	—	—	—
Peanut oil	—	—	—
Cooked rice food	—	—	—
Percent of variance explained (%)	10.30%	7.27%	6.88%

Table 2. Principal component analysis of 23 food groups. Factor loading > 0.4 are listed.

Iran

Table 2 Factor-loading matrix for the food groups that represent the two major dietary patterns derived from the FFQ*

Food group	Healthy diet	Western diet
Vegetables	0·834	–
Nuts	0·733	–
Fruit	0·707	–
Tomato	0·622	–
Low-fat dairy	0·558	–
Fish	0·524	–
Juice	0·490	–
Legumes	0·337	–
Whole grains	0·332	−0·279
Red meat	0·322	0·219
Poultry	0·288	–
Liquid oil	0·282	−0·489
Solid oil	−0·268	0·704
Sugar	–	0·631
Sweets	0·490	0·574
Tea	–	0·486
Egg	0·385	0·465
Pickle	0·331	0·427
Processed meat	–	0·411
Refined grains	–	0·393
Soft drinks	–	0·384
Animal butter	–	0·374
Fried potatoes	–	0·353
Snacks	0·225	0·339
Cooked potatoes	–	0·294
High-fat dairy	–	–
Proportion of variability (%)	16	12

*Absolute values of <0·2 are not shown in the table for simplicity.

TLGS

Appendix 2. Factor-loading matrix for major dietary patterns[1]

Food groups	Dietary patterns		
	Healthy	Western	Traditional
Fruits	0.74	−0.29	—
Other vegetables	0.71	−0.31	—
Tomatoes	0.63	—	—
Poultry	0.53	—	—
Legumes	0.52	—	0.26
Cruciferous vegetables	0.47	—	—
Green leafy vegetables	0.41	—	—
Tea	0.39	—	0.42
Fruit juices	0.37	0.21	—
Whole grains	0.34	—	0.40
Butter	−0.31	0.43	—
Potatoes	0.29	0.35	0.46
Low-fat dairy products	0.26	−0.37	—
High-fat dairy products	−0.23	0.39	—
Fish	0.22	−0.29	—
Yellow vegetables	0.21	—	—
Hydrogenated fats	−0.20	0.34	0.28
Refined grains	—	0.66	0.51
Red meats	—	0.56	—
Processed meats	—	0.39	—
Sweets and desserts	—	0.37	—
Pizza	—	0.36	—
Eggs	—	0.35	—
Soft drinks	—	0.33	—
Snacks	—	0.29	—
French fries	—	0.24	—
Coffee	—	0.23	—
Mayonnaise	—	0.22	—
Casserole	—	—	0.23
Nuts	—	—	—
Olive	—	—	—
Sugars	—	—	—
Condiments	—	—	—
Vegetable oils	—	0.20	—
Dough	—	—	—
Organ meats	—	—	—
Margarine	—	—	—
Dried fruits	—	—	—
Salt	—	—	—
Garlic	—	—	—
Pickles	—	—	—
Variance explained, %	0.103	0.086	0.052

Table 2 Component loadings (rotated) for the three major dietary patterns in the Hellenic National Nutrition and Health Survey.

Food groups[c]	Traditional	Western	Prudent
Fruits	+[b]	−[b]	0.32
Fruit juices 100%	+[a]	+[b]	+[b]
Non-starchy vegetables	0.56	−[a]	+[a]
Starchy vegetables	−[a]	+[a]	+[b]
Whole grains	−[a]	+[b]	0.46
Refined grains	+[b]	0.25	−[b]
Legumes	+[b]	−[b]	−[a]
Nuts	+[a]	+[b]	+[b]
Milk	−[a]	+[b]	0.22
Yoghurt	−[a]	−[a]	0.41
Cheese	0.33	0.30	+[a]
Eggs	+[b]	+[b]	+[a]
Seafood	+[a]	−[b]	+[a]
Red meat	+[a]	+[b]	−[b]
White meat	−[b]	+[b]	0.24
Processed meats	−[a]	0.38	−[a]
Olive oil	0.60	+[a]	−[a]
Other vegetable oils	+[a]	+[b]	−[a]
Animal fats	+[a]	0.38	+[a]
Alcohol	+[a]	+[b]	−0.22
SSBs	−[a]	+[b]	−[b]
Beverages with sweeteners	−[b]	+[b]	+[a]
Salty snacks	−[a]	+[b]	−[a]
Sweets	−[a]	0.23	−[a]
Spices/Herbs	−[a]	+[b]	+[a]
Water	+[a]	0.27	0.21
Coffee	−[a]	+[b]	−[b]
Tea	−[a]	+[a]	0.20
Sweeteners	−[a]	+[b]	+[a]
Fast-food	−[b]	+[a]	−0.30
Proportion of variability explained	6.1	5.9	4.5

Absolute values < 0.20 are not listed.
[a] | L Loadings | <0.10.

Table 1. Factor loadings and energy-adjusted intakes of key food groups and nutrients by tertile (T) of the dietary pattern among Kuwaiti adults aged ≥20 years in the 2008-2009 National Nutrition Survey of the State of Kuwait (N=555)

	Vegetable-Rich Pattern			Fast-Food Pattern			Refined-Grains/Poultry Pattern		
Food group/nutrient	Factor loading[a]	T 1	T 3	Factor loading	T1	T3	Factor loading[a]	T1	T3
		mean±standard error[b]			*mean±standard error*[b]			*mean±standard error*[b]	
Fruit (g/d)									
Whole fruit	0.17	48.9±9.7	99.8±17.0**	−0.12	107±16.8	65.1±14.2	−0.33	135±18.1	28.2±5.4***
Dates	−0.09	19.6±5.6	13.2±1.9	−0.38	36.3±6.4	3.8±1.1***	−0.38	39.3±6.5	5.9±1.4***
100% fruit juice	−0.02	34.0±16.4	32.8±9.0	−0.08	44.6±19.2	17.8±6.3	−0.17	68.1±20.8	28.4±16.2
Vegetables (g/d)									
Dark green vegetables	**0.76**	4.8±1.6	79.8±9.3***	−0.03	29.5±4.0	39.0±8.5	−0.20	51.9±7.9	28.2±5.4*
Tomatoes	**0.69**	23.1±3.8	119±7.4***	−0.10	76.7±5.6	56.9±7.0*	0.004	64.0±7.6	74.5±4.6
Other vegetables	**0.76**	26.6±3.7	163±9.4***	−0.17	105±10.8	73.8±9.2*	−0.11	91.8±9.4	84.3±7.1
White potatoes	0.10	7.8±1.6	18.6±2.7***	−0.18	18.5±2.6	9.3±1.9**	0.23	5.5±1.2	20.1±3.0***
Grains (g/d)									
Whole grains	0.09	21.5±4.1	46.3±7.2**	−0.10	40.7±7.7	23.5±5.0	**−0.41**	82.9±11.5	11.4±5.1***
Refined grains	−0.01	109±6.4	136±9.9*	−0.14	128±7.7	111±9.5	**0.71**	60.9±4.4	197±9.5***
Protein foods (g/d)									
Poultry	0.22	30.4±7.4	119±12.3***	−0.12	88.2±13.1	64.1±8.6	**0.42**	18.9±3.9	135±12.1***
Unprocessed red meat	−0.13	46.4±8.0	25.2±5.0*	−0.25	63.3±9.3	11.2±3.0***	0.06	22.9±4.6	36.0±6.5
Processed meat	−0.07	8.5±3.1	3.9±1.7	0.21	0.3±0.2	12.4±3.1***	0.05	3.5±1.5	4.8±2.1
Fish/shellfish	0.04	15.6±4.7	18.5±5.5	0.04	12.5±4.5	25.7±6.6	−0.31	48.6±9.4	1.8±0.8***
Legumes	0.02	10.1±3.3	10.6±2.1	−0.03	6.3±1.3	7.7±2.7	0.10	6.0±2.8	18.2±3.9*
Dairy products (g/d)									
Full fat	−0.03	150±22.0	130±17.9	**−0.41**	244±30.0	48.2±6.0***	−0.19	169±24.7	117±17.1
Low fat	0.06	37.6±11.3	56.1±20.4	−0.01	37.3±14.2	44.0±17.0	−0.15	57.7±15.6	22.4±7.4
Fast food (g/d)									
Burgers/sandwiches	−0.13	49.4±7.7	10.3±3.1***	**0.63**	1.8±1.6	61.4±9.7***	−0.20	40.5±7.7	9.3±2.8***
French fries	−0.15	25.1±3.3	9.8±2.4***	**0.62**	1.1±0.6	39.2±4.2***	−0.08	19.0±4.0	9.6±2.0*
Sugar-sweetened beverages	−0.19	385±50.7	188±26.2***	**0.61**	74.5±16.0	509±41.0***	−0.05	339±38.2	210±21.1**

Table 2. Factor loading for 3 dietary pattern in aged 40–64 years men using by the KoGES

Food groups	Factors		
	Food group 1	Food group 2	Food group 3
Vegetables	0.691	−0.025	0.087
Fats and oils	0.627	0.155	0.274
Colored vegetables	0.619	−0.022	−0.003
Fish	0.375	−0.113	−0.137
Legumes	0.251	−0.137	−0.026
Red meats	0.232	0.080	0.187
Sweet potatoes and potatoes	0.229	0.124	−0.136
Other mixed grains	0.186	−0.175	−0.119
Nuts and seeds	0.140	0.061	−0.077
White rice	0.204	−0.670	−0.052
Kimchi	0.126	−0.513	0.076
Dairy products	−0.002	0.508	−0.042
Wheat/bread	0.028	0.499	−0.002
Noodles	0.049	0.369	−0.042
Cereals and snacks	0.020	0.258	0.037
Coffee and leaf tea	0.108	0.247	0.021
Fruits	0.125	0.167	−0.121
Pizza, hamburger, sandwich	−0.058	0.150	0.007
Alcohol	−0.007	0.121	0.068
Sugars	0.060	0.095	0.061
Rice cakes	−0.049	0.086	0.077
Eggs	−0.031	0.050	0.812
Ramen	−0.285	−0.029	0.688
Processed foods	−0.006	0.149	0.222
Poultry	−0.071	0.082	−0.170
Variance explained (21.338)	2.391	1.724	1.433

Statistical analysis used factor analysis varimax method. The shadows indicated coefficient factor load greater than 0.2.
KoGES, Korean Genome and Epidemiology Study.

Cluster analysis

In contrast to factor analysis, cluster analysis aggregates individuals into relatively homogeneous subgroups (clusters) with similar diets.

Food-group	All reporters (n=187)			p value§
	Cluster 1: Mixture food (n=27)	Cluster 2: Unhealthy food (n=125)	Cluster 3: Healthy food (n=35)	
Grain	13.3 (9.6-17)	12.4 (10.3-14.4)	22.0 (15.4-28.7)	0.001
Potato	13.8 (8.3-19.3)	8.9 (7.3-10.6)	15.2 (9.3-21.0)	0.01
Green vegetable	16.6 (7.4-25.8)	8.1 (6.4-9.8)	18.1 (13.0-23.3)	0.0001
Other vegetables	134.2 (103.0-165.4)	83.1 (76.3-90.0)	148.9 (126.2-171.6)	0.0001
Tomato	70.6 (34.4-106.7)	59.8 (51.7-67.9)	100.2 (77.9-122.5)	0.002
Fruits	248.2 (174.5-321.9)	159.2 (146.4-172.0)	389.1 (345.3-432.8)	0.0001
Dry fruits	8.2 (3.9-12.4)	5.4 (4.4-6.4)	10.5 (7.1-13.9)	0.001
Fish	2.7 (1.4-4.1)	3.6 (3.1-4.2)	5.2 (3.3-7.0)	0.03
Poultry	7.7 (5.6-9.7)	6.0 (5.1-6.9)	9.3 (7.2-11.5)	0.004
Nuts	4.3 (2.2-6.3)	2.7 (2.2-3.1)	4.4 (2.1-6.6)	0.03
Low-fat dairy	184.2 (115.9-252.4)	78.9 (66.8-91.1)	159.5 (114.1-204.9)	0.0001
Yogurt drink	48.4 (24.8-72.0)	44.3 (33.9-55.7)	122.0 (78.8-165.2)	0.0001
Sauce	11.0 (5.7-16.4)	12.9 (10.0-15.9)	23.6 (13.1-34.0)	0.01
Tea	746.0 (674.7-817.3)	242.9 (217.1-266.8)	319.7 (175.6-363.8)	0.0001

Dietary indices

1) Healthy eating index (HEI)
2) Mediterranean-Style Dietary Pattern Score (MSDPS)
4) The diet quality index (DQI)
5) Dietary diversity score (DVS)

TABLE 1 Components of the MSDPS

Food group components	Criteria for maximum score of 10[1]	Score[2]
	servings/d	*points/serving*
Whole grains	8	1.25
Fruits	3	3.33
Vegetables	6	1.67
Dairy	2	5.0
Wine		
Men	3	3.33
Women	1.5	6.67
	servings/wk	
Fish and other seafood	6	1.67
Poultry	4	2.5
Olives, legumes, and nuts	4	2.5
Potatoes and other starchy roots	3	3.33
Eggs	3	3.33
Sweets	3	3.33
Meat	1	10.0
Olive oil	Use only olive oil	0 (for no use of olive oil) 5 (for use of olive + other vegetable oils)

Mediterranean-Style Dietary Pattern Score (MSDPS)

$$MSDPS = \left[\left(\frac{\sum_{i=1}^{13} Si}{130} \right) x\, 100 \right] x\, P,$$

where S_i is the individual item score and P is the proportion of total energy intake from Mediterranean diet pyramid foods

با تشکر از شما