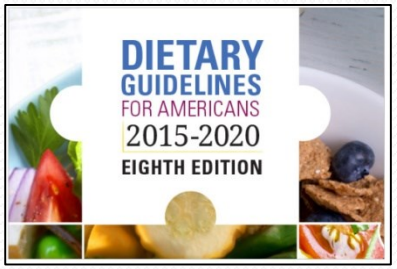
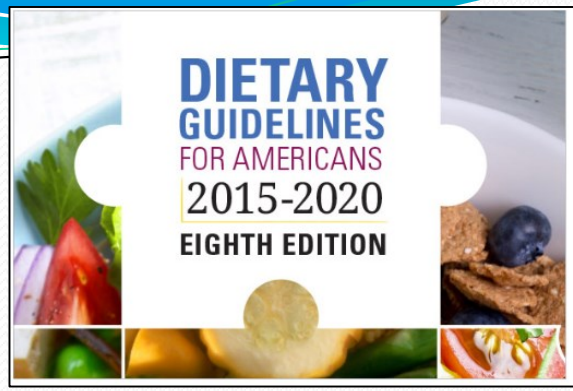
Data mining to find protective or risky dietary patterns for common complex diseases: implications on devising dietary guidelines

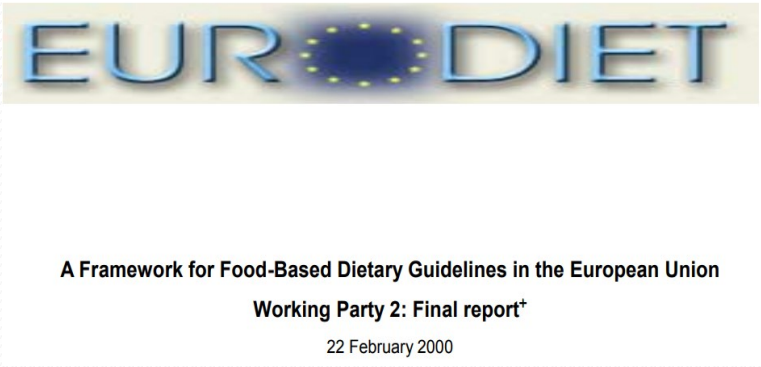


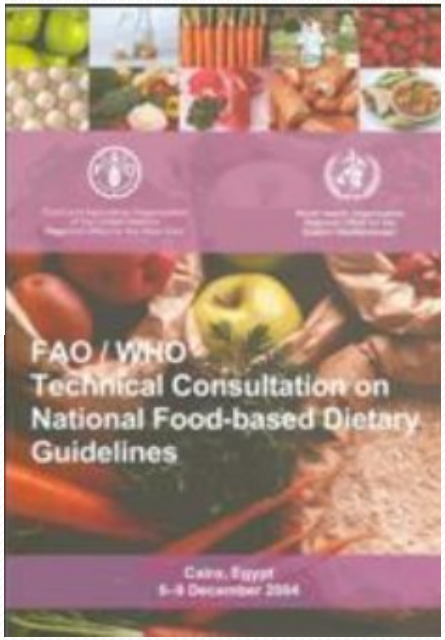
Wen-Harn Pan, PhD, FAHA
Distinguished Professor
Institute of Biomedical Sciences
Academia Sinica
Taipei, Taiwan

Food-based guidelines

- Crucial for promoting healthy eating







- Comprehensible
- Prudent & versatile
- Easy to implement

US Dietary Guideline

1. Follow a healthy eating pattern
   - Appropriate calorie, healthy BW,
2. Focus on variety, nutrient dens
   - Nutrient needs, nutrient-dense f
3. Limit calories from added suga reduce sodium intake.
   - Eating pattern, foods, beverages
4. Shift to healthier food and beve
   - Cultural and personal preference
5. Support healthy eating pattern
   - Everyone has a role, multiple sett

2011

Taiwanese Food guides by 7 caloric levels, 2011

Whole grains (bowl)

Whole Grains
Refined grains

Bean fish meat egg (S)

Low fat dairies (glass)

Vegetables (100 g)

Fruits (100 g)

Oils (t) & nuts (T))

Bean fish **egg meat** (S)

Dairies (glass)

	1200 大卡	1500 大卡	1800 大卡	2000 大卡	2200 大卡	2500 大卡	2700 大卡
全穀根莖類(碗)	1.5	2.5	3	3	3.5	4	4
全穀根莖類(未精製)(碗)	1	1	1	1	1.5	1.5	1.5
全穀根莖類(其他)(碗)	0.5	1.5	2	2	2	2.5	2.5
		4	5	6	6	7	8
		1.5	1.5	1.5	1.5	1.5	2
蔬菜類(碟)	3	3	3	4	4	5	5
水果類(份)	2	2	2	3	3.5	4	4
油脂與堅果種子類(份)	4	4	5	6	6	7	8

2011 Taiwanese Dietary guidelines

1. Following food guides
   - Balanced 6 food groups &
   - prioritizing foods in individual food groups
2. Individualized caloric level
3. Sufficient physical activity
4. Active living
5. Plant-based whole foods
6. Diversity/Local foods
7. Nutrient-dense foods

全穀根莖
Whole grains
豆魚蛋肉
Bean, fish, egg, meat
油脂/核果
Oils& nuts

Taiwanese Dietary guidelines

8. Portion size control
9. Limit energy-dense and added sugar-rich foods
10. Breast feeding for 6 months or more
11. Alcohol beverage in moderation
12. Food hygiene and safety

2011 (2017 revision)
Taiwan Food Guide & Dietary Guideline

- Identify Current Diet-related health problems in Taiwanese
  - Considering dietary pattern-disease relations
- Evidence-Based from nutrient point-of-view
  - To fulfill DRIs and macro-nutrient composition (DASH composition) (24-hour recall data from NAHSIT is used.)
  - Low in Mg & B6 with previous recommendation
- Multiple caloric levels
- Food-Based /cultural-sensitive
- Stressing plant foods, local foods, and nutrient dense foods
- Diversity

Pan & Hung. Evidenced-based recommendation for the 2011 Taiwan Food guide. Nut Science J 2015.

Guidelines focusing on dietary pattern

Well-known beneficial dietary patterns

- Mediterranean diet
- DASH diet
- Japanese diet
- Vegetable & fruit rich dietary pattern

Vs. Traditional western pattern

Healthy dietary pattern throughout lifespan

How shall we improve it with new dietary pattern-health relationship findings?

Well-known beneficial dietary patterns

- Mediterranean diet
- DASH diet
- Japanese diet
- Vegetable & fruit rich dietary pattern

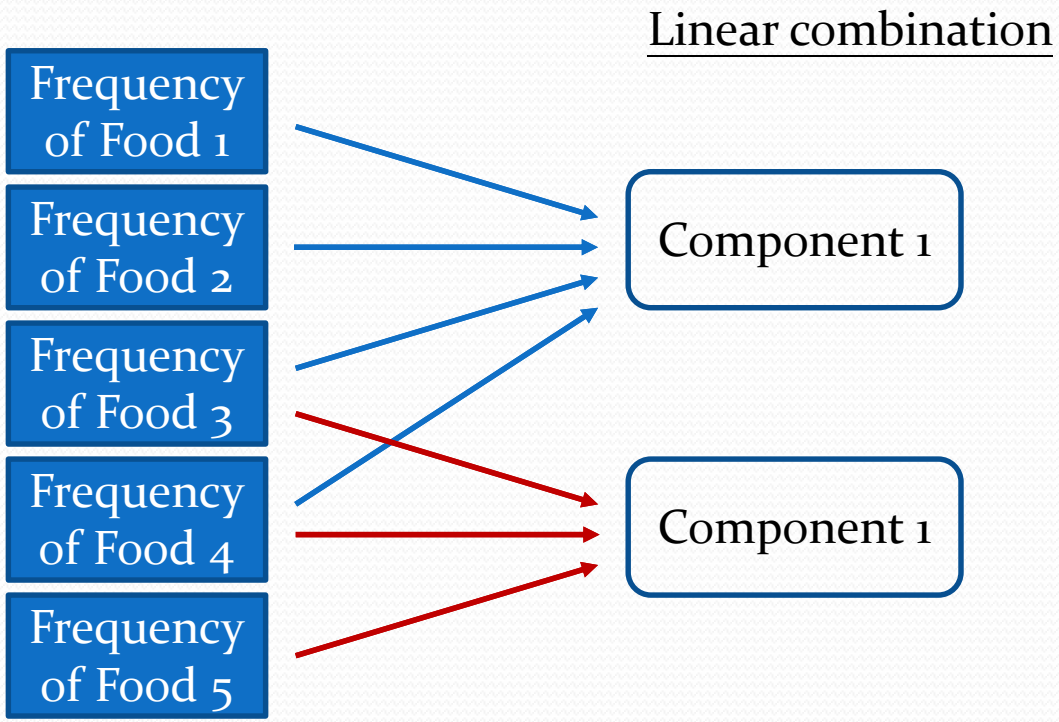
Traditional western dietary pattern

More should be learned from "Data-Mining Results of the Dietary pattern-Disease relationships" in devising dietary guideline

FFQ data for data mining of dietary pattern-disease relationship

Methods	Food frequency questionnaire
Faults	Can not provide accurate estimates of nutrient /or food intake
Merits	for ranking people to study diet-disease associations

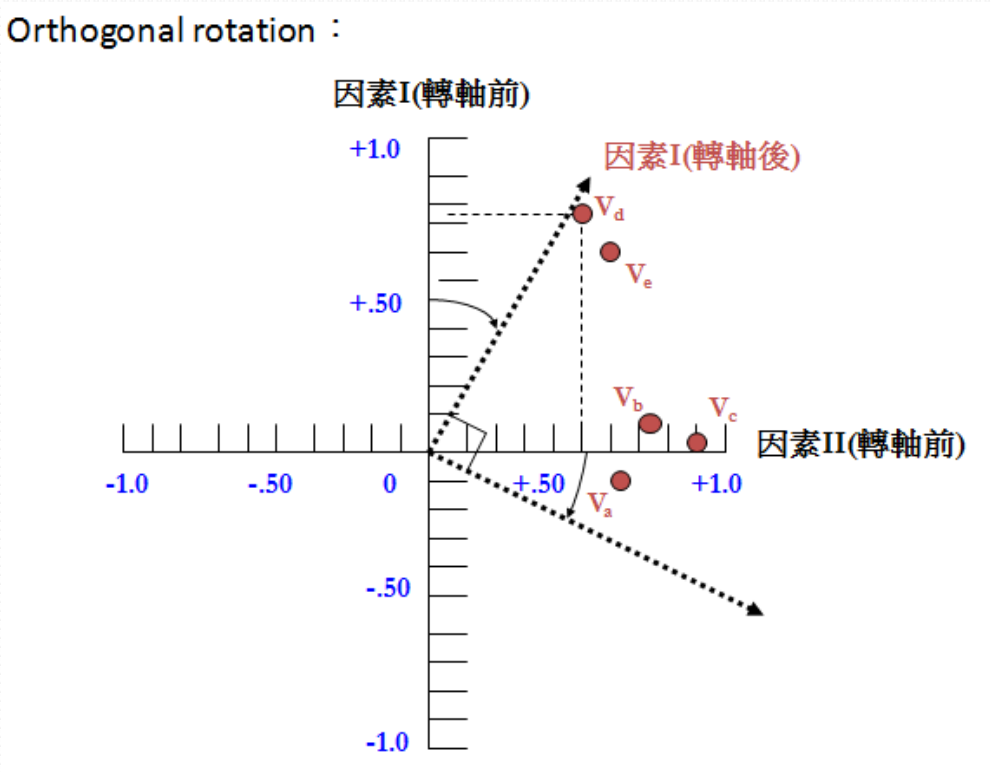
Conceptual Model for Factor Analysis



Factor analysis

- Orthogonal rotation：to make factors independent from one another

Orthogonal rotation：



Association between Unhealthful Eating Patterns and Unfavorable Overall School performance in Children Fuh & Pan JADA 2007

- Nutrition and Health Survey in Taiwan (NAHSIT) for elementary school children, 2001-2002

- 2222 students
  - 7 questions to assess overall school performance
  - 22 items in FFQ

Factor analysis groups 22 items into 5 dietary factors (facets)

Factor loading scores[b]	Factor 1: Sweets and fried foods	Factor 2: Highly nutrient-dense foods	Factor 3: Icy foods	Factor 4: Dairy products	Factor 5: Traditional Taiwanese foods
High-fat snacks	**0.71**[c]	—	—	—	—
Cookies	**0.66**	—	—	0.16	—
Candy and chocolate	**0.66**	—	—	—	—
Instant noodles	**0.57**	−0.18	0.18	—	0.28
Sugary drinks	**0.54**	—	0.23	−0.29	—
Fried foods	**0.41**	—	0.24	—	0.24
Sugary, high-fat foods	**0.37**	0.28	—	0.25	—
Meat	—	**0.69**	—	−0.15	—
Fish	—	**0.61**	—	—	—
Vegetables	—	**0.55**	—	—	—
Fruit	—	**0.54**	—	0.29	—
Eggs	0.15	**0.40**	—	—	0.35
Ice cream	0.17	—	**0.84**	—	—
Shaved-ice desserts	0.22	—	**0.82**	—	—
Yogurt	—	—	—	**0.68**	0.15
Milk	—	0.31	—	**0.52**	—
Cheese	—	—	—	**0.46**	—
Yogurt milk	0.16	—	—	**0.42**	0.32
Internal organs[d]	—	—	0.16	—	**0.59**
Other seafood	—	0.18	—	0.22	**0.52**
Soy milk	—	—	—	0.19	**0.50**
Other soy products	—	0.25	—	—	**0.39**
Proportion of variability explained (%)	14	10	7	6	5

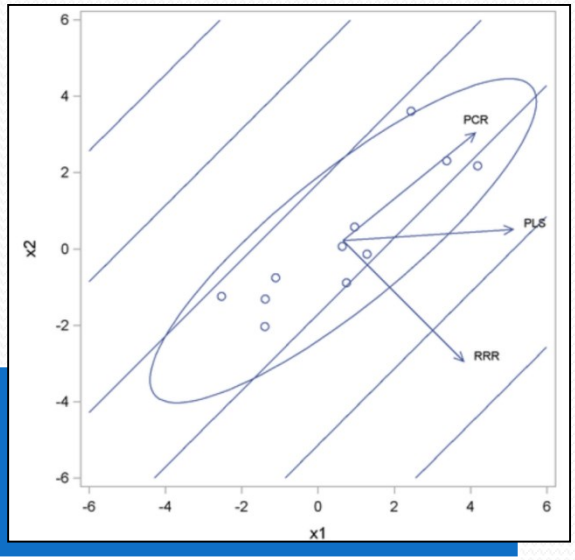
Dimension reduction approaches

Simple linear regression

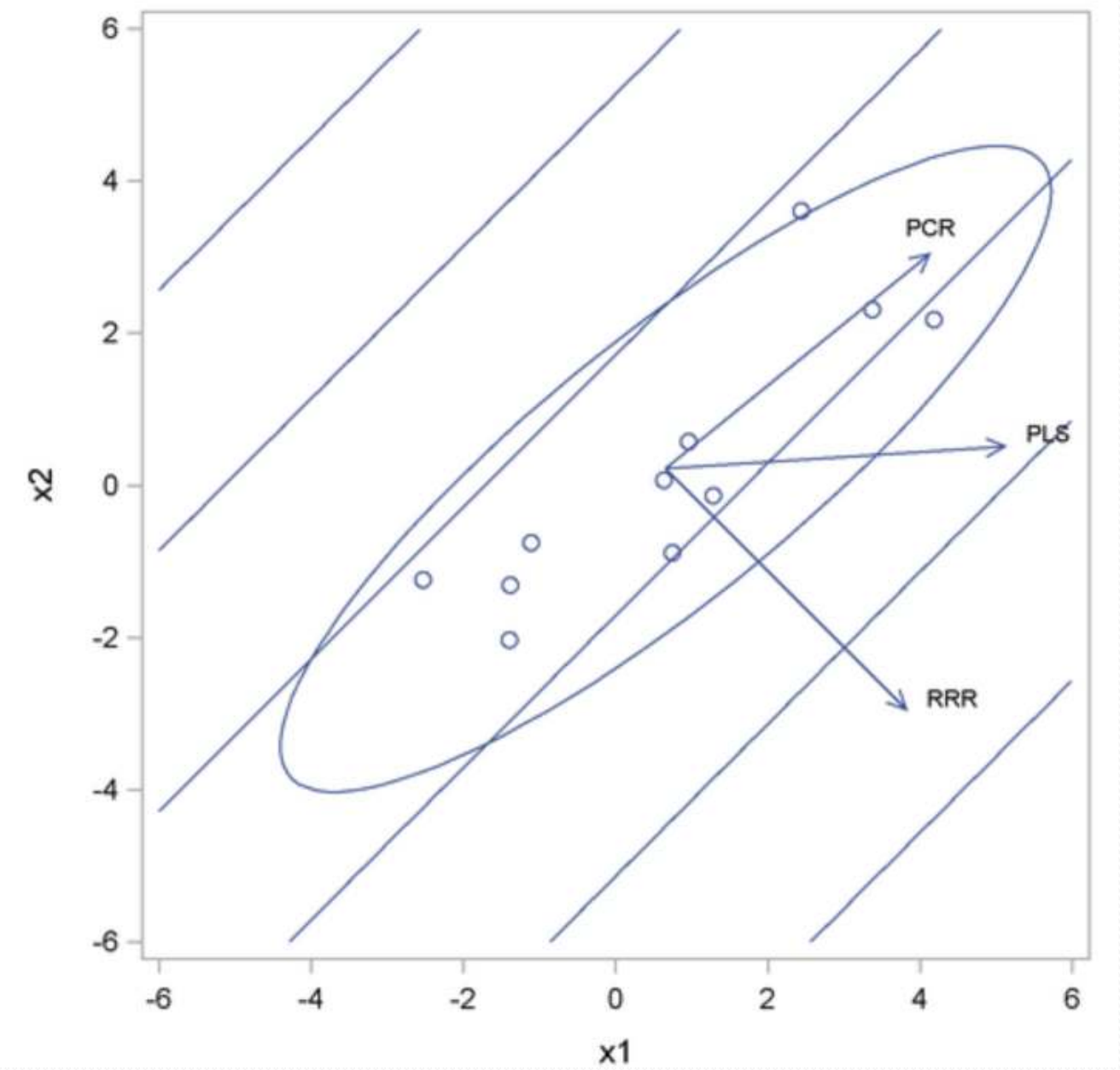
$Y=a_1X+a_2X+a_3X+\ldots. a_nX+b+E$

X：predictor

Y：response



Statistical methods	Objective
Principal component analysis/factor analysis (PCA)	Explaining as much **predictor** variation as possible
Reduced-rank regression for continuous response variables (RRR)	Explaining as much **response** variation as possible
Partial least squares-discriminant analysis for categorical response variables	partial least squares balances the two objectives, seeking for factors that explain both response and predictor variation


6
4
2
0
-2
-4
-6
x2
-6
-4
-2
0
2
4
6
x1
PCR
PLS
RRR

Endpoints of interests

- School children and youth
  - Asthma
  - Teacher rated school performance
- Elderly
  - Hyperuricemia
  - Nasopharyngeal cancer
  - Frailty

Dietary frequency information

- Vegetable
- Pickled vegetable
- Fresh fruit
- Whole grains
- Rice, noodle and products
- Breakfast cereals
- Roots and tubers
- Nuts and seeds
- Milk, yogurt, cheese
- Flavored milk
- Soybean products
- Egg
- Fish
- Shell fish
- Deep-sea fish
- Seafood products
- Poultry
- Red meat
- Processed meat products
- Innards
- Fried foods
- Snacks
- Coffee
- Tea
- Sweetened beverage

Partial-least-square discriminant analysis discovered a dietary pattern inversely associated with nasopharyngeal carcinoma risk

(PLos One 2016)

- Yen-Li Lo, Wen-Harn Pan*, Wan-Lun Hsu, Yin-Chu Chien,Jen-Yang Chen, Mow-Ming Hsu, Pei-Jen Lou, I-How Chen, Allan Hildesheim, Chien-Jen Chen*

Comparing 258 NPC cases & controls

Characteristic/category	Cases n (%)	Controls n (%)	P^1
Gender			
Male	258 (69.5)	222 (69.2)	0.91
Female	113 (30.5)	99 (30.8)	
Age (mean ±SD), years	45.6±11.6	46.0±11.7	0.62
Age, years			
<35	64 (17.3)	55 (17.1)	0.99
35– 44	120 (32.4)	101 (31.5)	
45– 54	95 (25.6)	84 (26.2)	
55– 64	72 (19.4)	62 (19.3)	
≧65	20 (5.4)	19 (5.9)	

Factor loading values obtained by PLS discriminant analysis, the Spearman correlation coefficients between food groups and factor scores

Food group	Factor loading	Correlation with factor scores
Fruits	-0.43	-0.43***
Milk	-0.40	-0.41***
Fresh fish	-0.35	-0.38***
Vegetables	-0.32	-0.27***
Tea	-0.27	-0.28***
Eggs	-0.24	-0.29***

Dietary pattern score

- PLS or RRR was applied to find a dietary factor score associated uric acid, from food frequency questionnaire.
- A score was calculated for each participant for each dietary pattern as a sum of the food groups, each weighted according to the factor loadings.
  - Score = Dietary Pattern Loadings x Food Intake Frequency
- Participant scores were categorized into quartiles.

Odds ratios (ORs) of nasopharyngeal carcinoma by quartiles of factor score

Anti-EBV seropositive	Q1 adj. OR (95% CI)	Q2 adj. OR (95% CI)	Q3 adj. OR (95% CI)	Q4 adj. OR (95% CI)	*p* for trend
Cases/Controls	116/13	92/34	81/25	73/27	
Crude	1.00 (ref.)	0.36 (0.18-0.74)	0.35 (0.17-0.74)	0.32 (0.15-0.67)	0.004
M1[1]	1.00 (ref.)	0.35 (0.17-0.72)	0.33 (0.16-0.70)	0.30 (0.14-0.63)	0.002
M2[2]	1.00 (ref.)	0.31 (0.14-0.66)	0.30 (0.13-0.66)	0.24 (0.10-0.56)	0.002
M3[3]	1.00 (ref.)	0.30 (0.14-0.64)	0.29 (0.13-0.66)	0.25 (0.10-0.62)	0.006

Bullet points

- An NPC protective diet is indicated with more
  - fruits, vegetables
  - milk, protein-rich foods (in particular fresh fish and eggs)
  - tea
- This information may be used to design potential dietary regimen for NPC prevention (dietary guideline?).

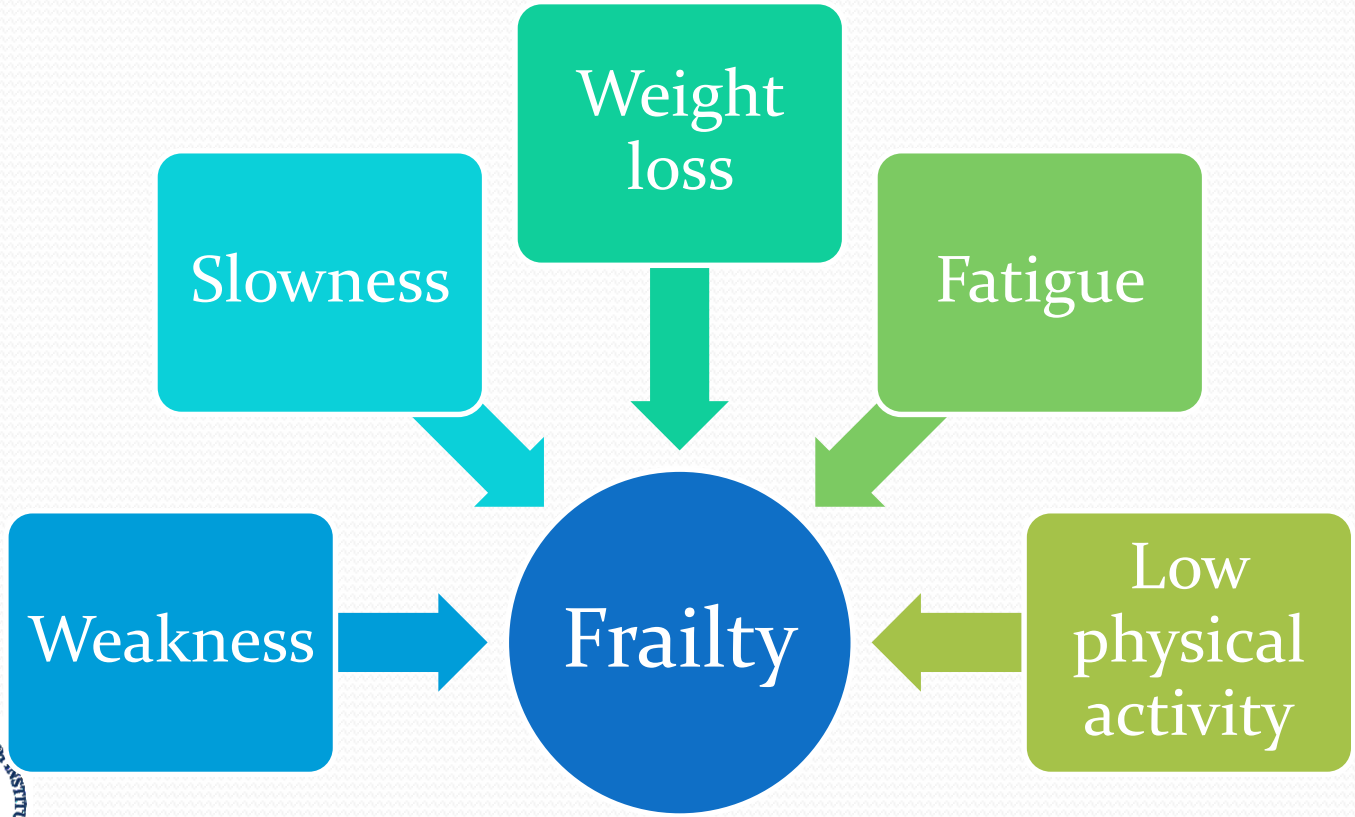
Using data mining approach to find dietary pattern associated with frailty: results from Nutrition and Health Survey in Taiwan, 2014-2016

Journal of Geriatrics Society, 2017

- Yen-Li Lo,Yao-Te Hsieh,Li-Lin Hsu,Shao-Yuan Chuang,Hsing-Yi Chang,Chih-Cheng Hsu,Ching-Yu Chen[3],Wen-Harn Pan*

Phenotype of frailty (Fried, 2001)

Nonfrail	Prefrail	Frailty
0	1-2	3-5



Factor loading values obtained by RRR and the Spearman correlation coefficients between food frequency and factor score

Food group	Factor loading	Correlation with factor score
Vegetable	**0.41**	**0.59*****
Tea	**0.37**	**0.15***
Shell fish	**0.30**	**0.34*****
Whole grains	**0.30**	**0.46*****
Snacks	**0.26**	**0.49*****
Deep-sea fish	**0.26**	**0.41*****
Nuts and seeds	**0.26**	**0.33*****
Poultry	**0.21**	**0.13***
Sweetened beverage	**-0.29**	**-0.25*****

Characteristics by tertiles of dietary pattern score in 274 participants from NAHSIT 2013

	Tertiles of dietary pattern scores			
	Tertile 1	Tertile 2	Tertile 3	p^b
Age, years	74.4 ± 6.5	73.8 ± 7.4	72.6 ± 6.4	0.076
BMI, kg/m^2	24.2 ± 3.5	24.2 ± 3.5	25.0 ± 3.6	0.967
Recent weight loss, n (%)				
No	70 (81.8)	81 (91.0)	84 (93.3)	0.037
Yes	16 (18.2)	8 (9.0)	6 (6.7)	
Exhaustion, n (%)				
No	47 (64.4)	51 (89.5)	41 (78.9)	0.003
Yes	26 (35.6)	6 (10.5)	11 (21.1)	
Grip strength[a], kg	21.1 ± 8.2	23.6 ± 8.4	26.6 ± 9.0	<.0001
Lean mass[a], kg	37.8 ± 6.9	38.9 ± 7.1	40.8 ± 7.6	0.009
Hemoglobin[a], mg/dL	13.0 ± 1.7	13.2 ± 1.5	13.6 ± 1.6	0.014

Odds ratios on frailty by tertiles of dietary pattern score in 480 participants NAHSIT 2014

	Tertiles of dietary patternscores			
	Tertile 3 as reference	Tertile 2 adj. OR (95% CI)	Tertile 1 adj. OR (95% CI)	*p* for trend
Frail vs. robust				
N	3/86	9/64	13/55	
Model 1	1.00	3.90 (0.91-16.77)	6.17 (1.49-25.59)	0.011
Model 2	1.00	5.02 (1.08-23.30)	6.28 (1.41-27.94)	0.017
Pre-&frail vs robust				
N	74/86	93/64	102/55	
Model 1	1.00	1.58 (0.99-2.52)	1.90 (1.18-3.07)	0.008
Model 2	1.00	1.74 (1.08-2.80)	2.04 (1.25-3.34)	0.004

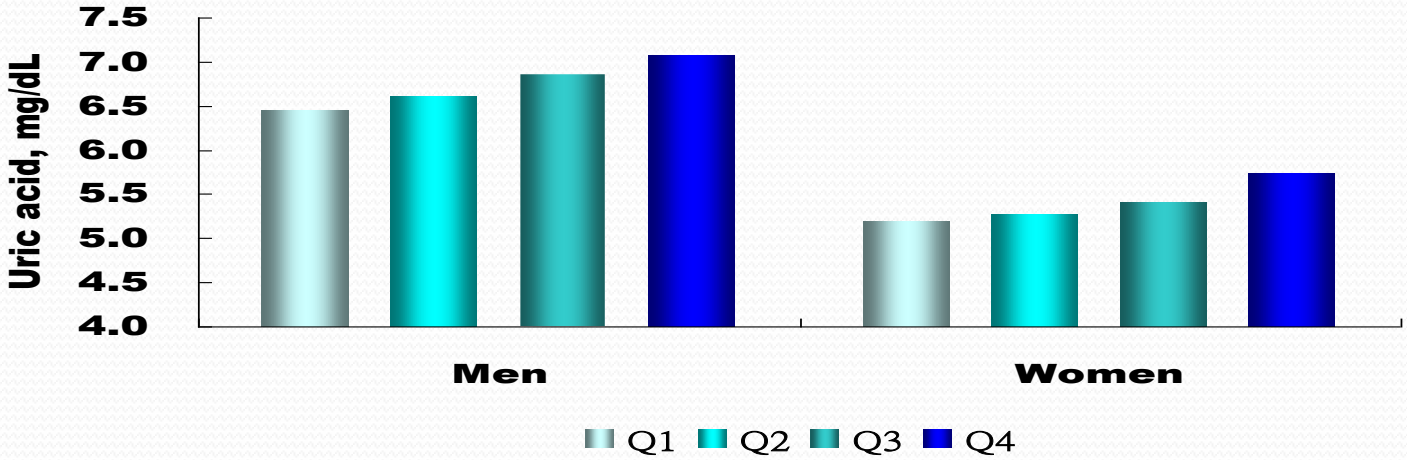
Bullet points

- A dietary pattern was associated with lower risk of frailty.
  - More phytonutrient-rich plant foods (vegetable, whole grains, nuts/seeds), tea, deep-sea fish, other protein-rich foods with low-saturated fat, discretionary calories from between-meal snack;
  - Less sweeten beverage.
- This information may be used to design potential dietary regimen for frailty prevention. (dietary guideline?)

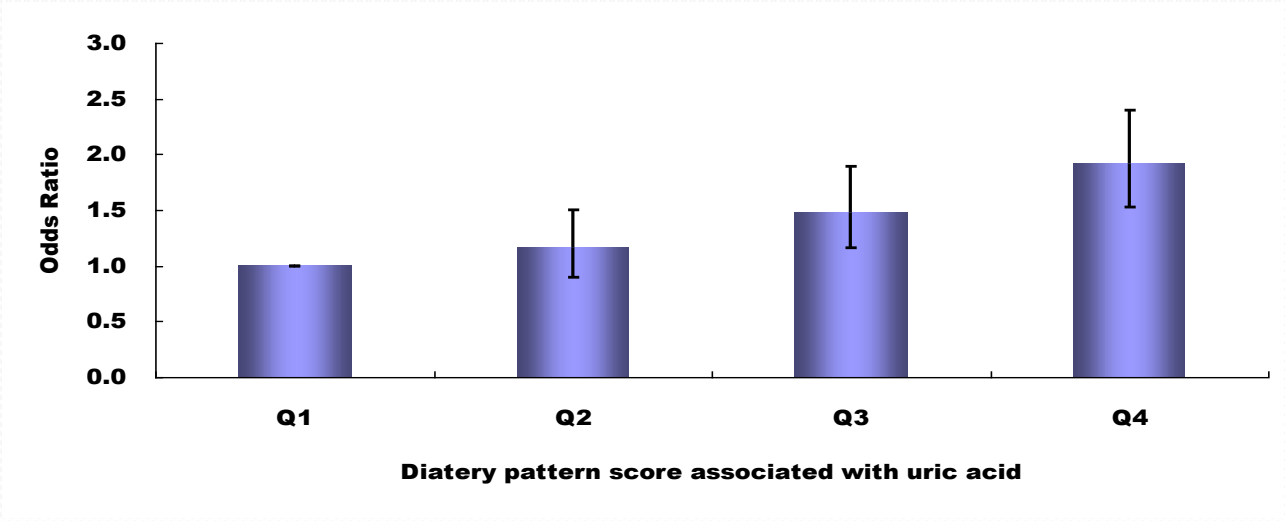
The association between Dietary and Hyperuricemia among adults in Taiwan

(Chuang SY & PanWH. APJCN 2011)

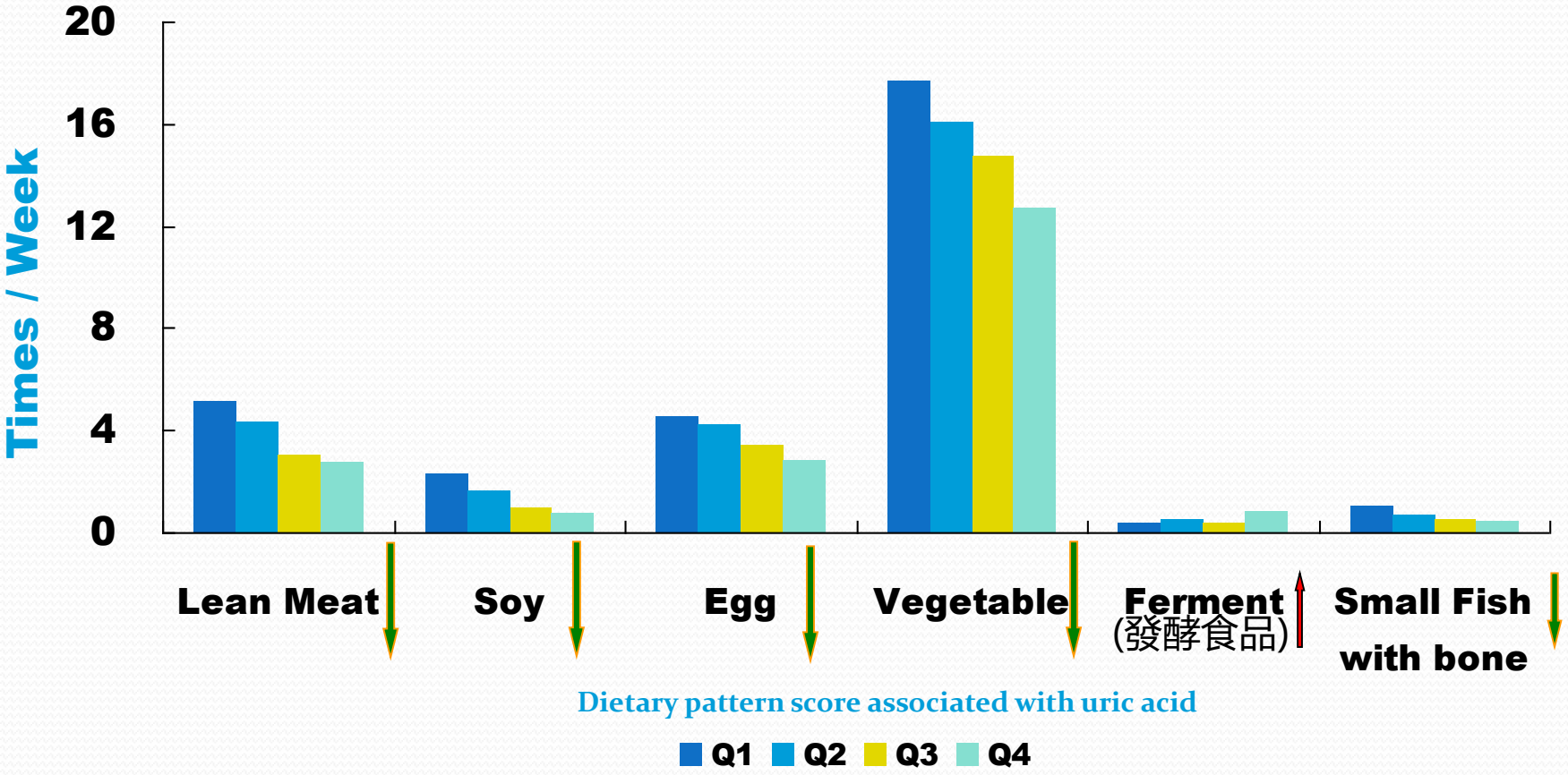
Dietary pattern score associating with uric acid and levels of uric acid



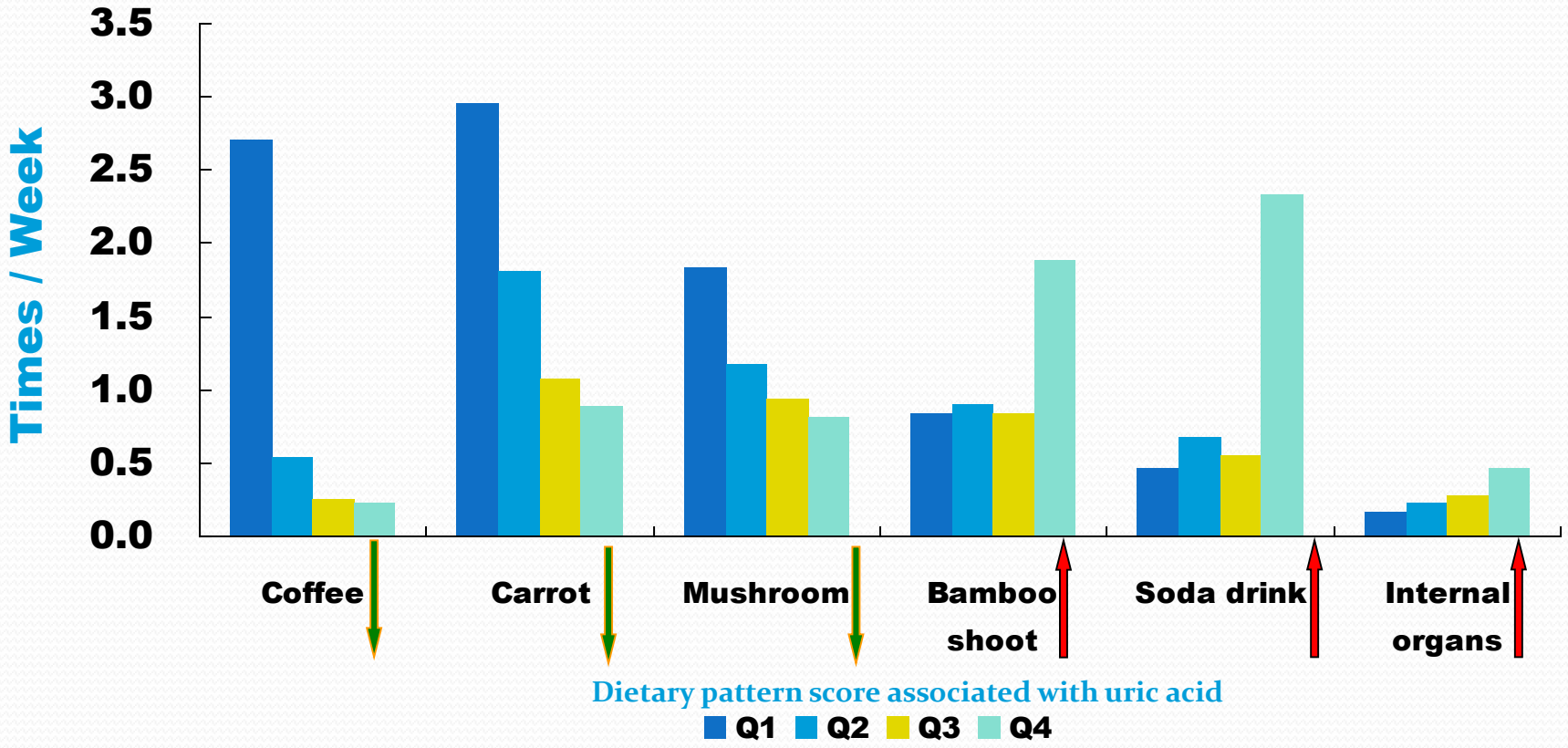
Hyperuricemia



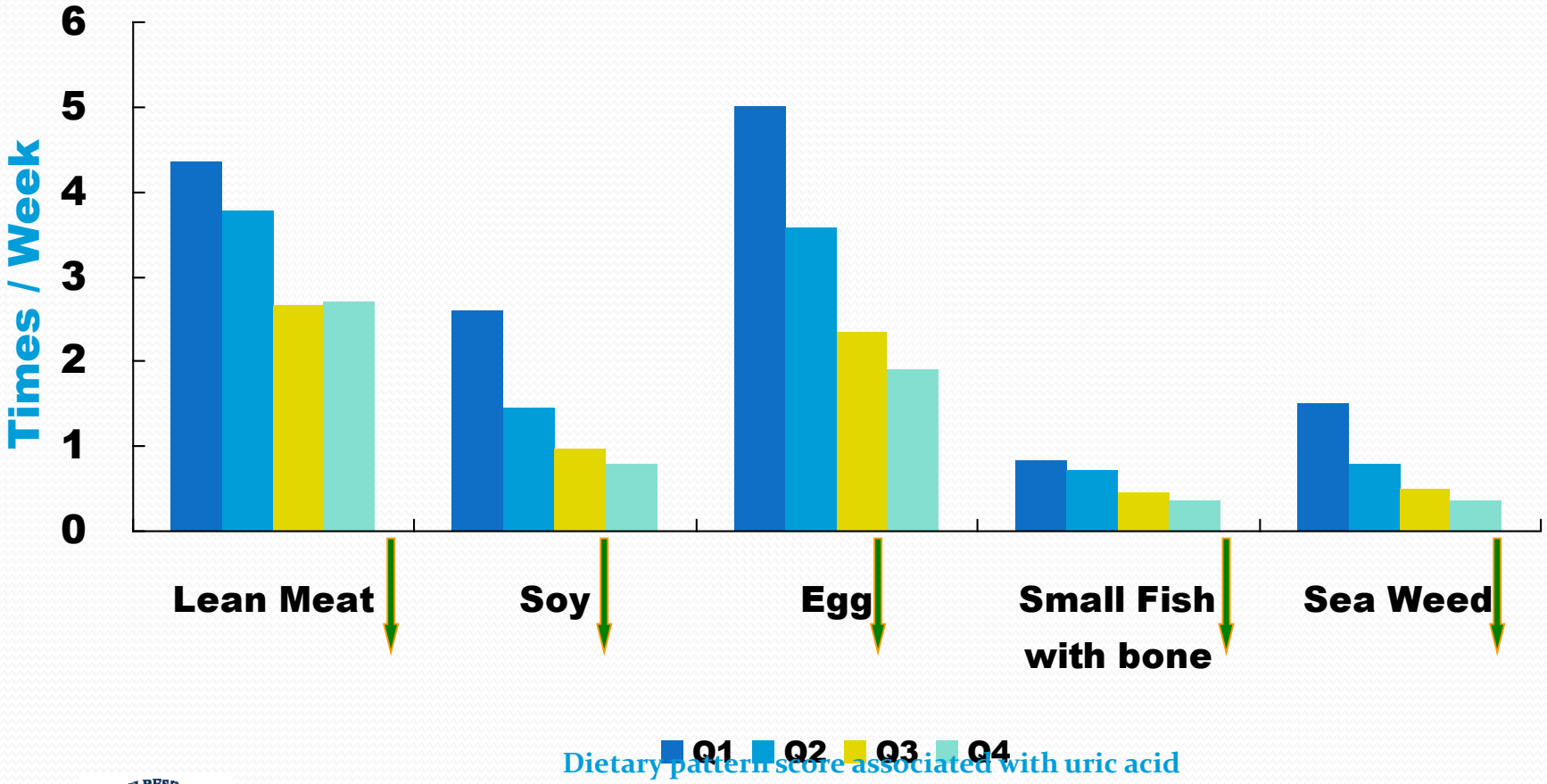
The food pattern associated uric acid and frequency of food intake in men



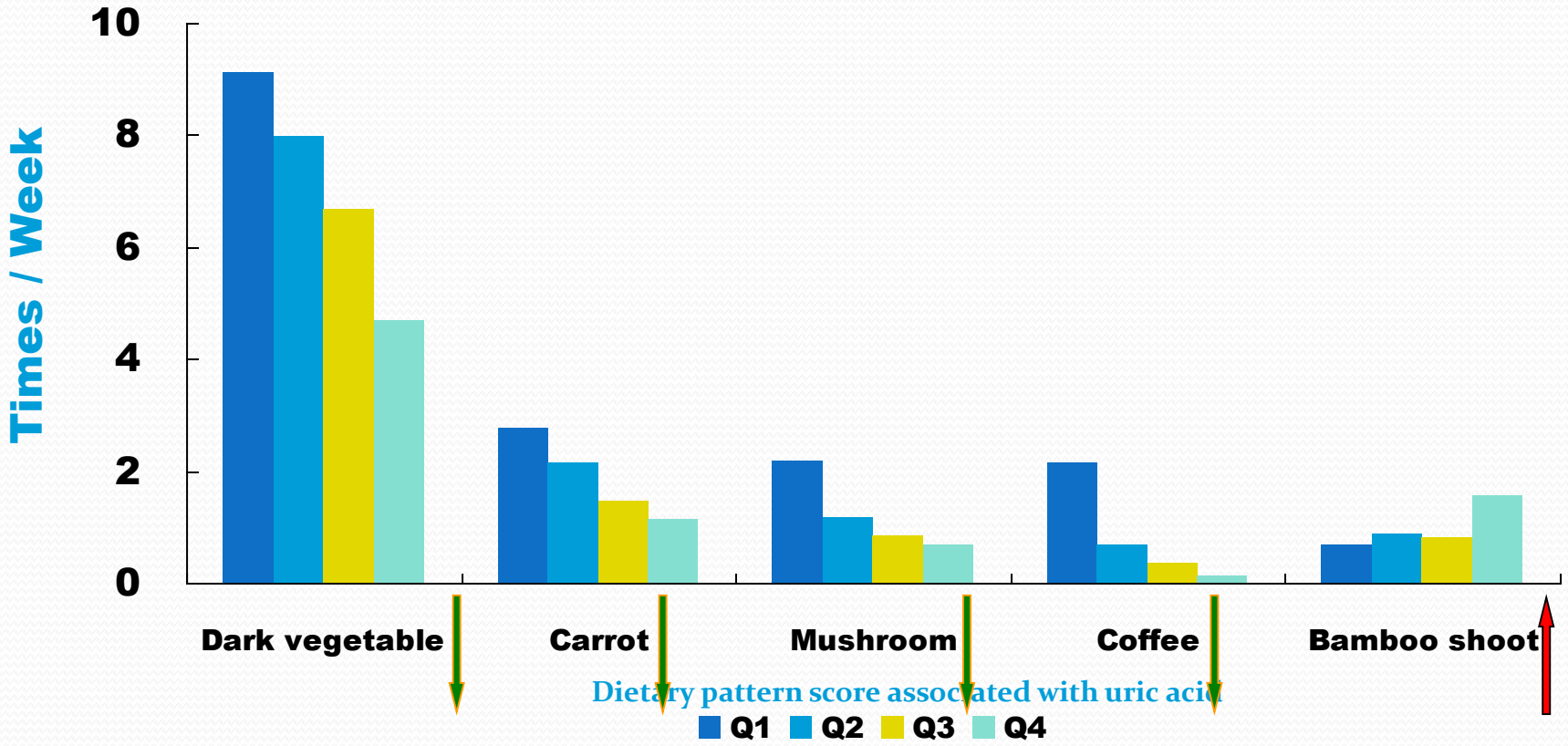
The food pattern associated uric acid and frequency of food intake in men (count's)



The food pattern associated uric acid and frequency of food intake in women



The Dietary pattern associated uric acid and frequency of food intake in women (count's)



Bullet points

- Food "+" associated with hyperuricemia
  - Soda drink (sweet drinks)
  - Internals organs (high fat)
  - Bamboo shoot (high purine)

- Foods "-" associated with hyperuricemia
  - Vegetable, carrot, mushroom,
  - Lean meat, soy, egg
  - Coffee

Risk of **Asthma** associated with Energy-dense but Nutrient-poor dietary pattern in Taiwanese Children

Lee SC & WH Pan. APJCN 2012

2082 students
With ISAAC questionnaire
With FFQ data
In NAHSIT elementary student survey
(2001-2002)

ISAAC: International Study of Asthma and Allergies in Children

The International Study of Asthma and *Allergies* in Childhood: *ISAAC*

- a unique worldwide epidemiological research programme established in 1991 to investigate asthma, rhinitis and eczema in children due to considerable concern that these conditions were increasing in western and developing countries .

- http://isaac.auckland.ac.nz/

7. Study instruments for 13/14 year olds

7.1 Instructions for completing questionnaire and demographic questions

Examples of instructions for completing questionnaires and demographic questions are given below. **The questionnaire content is fixed.** *(see pages 72–73 for 'office use only' boxes example)*

On this sheet are questions about your name, school, and birth dates. Please write your answers to these questions in the space provided.

All other questions require you to tick your answer in a box. If you make a mistake put a cross in the box and tick the correct answer. Tick only one option unless otherwise instructed.

Examples of how to mark questionnaires: Age [13] years

To answer Yes/No, put a tick in the appropriate box as per example	YES	NO
	[ ]	[✓]

SCHOOL: [ ]

TODAY'S DATE: [ ] Day [ ] Month [ ] Year

YOUR NAME: [ ]

YOUR AGE: [ ] years

YOUR DATE OF BIRTH: [ ] Day [ ] Month [ ] Year

(Tick all your answers for the rest of the questionnaire)

Are you: MALE [ ] FEMALE [ ]

Optional questions on ethnicity here

7.2 Core questionnaire for asthma

7.2.1 Questionnaire for 13/14 year olds

1 Have you ever had wheezing or whistling in the chest at any time in the past?
- Yes ☐
- No ☐

IF YOU HAVE ANSWERED "NO" PLEASE SKIP TO QUESTION 6

2 Have you had wheezing or whistling in the chest in the past 12 months?
- Yes ☐
- No ☐

IF YOU HAVE ANSWERED "NO" PLEASE SKIP TO QUESTION 6

3 How many attacks of wheezing have you had in the past 12 months?
- None ☐
- 1 to 3 ☐
- 4 to 12 ☐
- More than 12 ☐

4 In the past 12 months, how often, on average, has your sleep been disturbed due to wheezing?
- Never woken with wheezing ☐
- Less than one night per week ☐
- One or more nights per week ☐

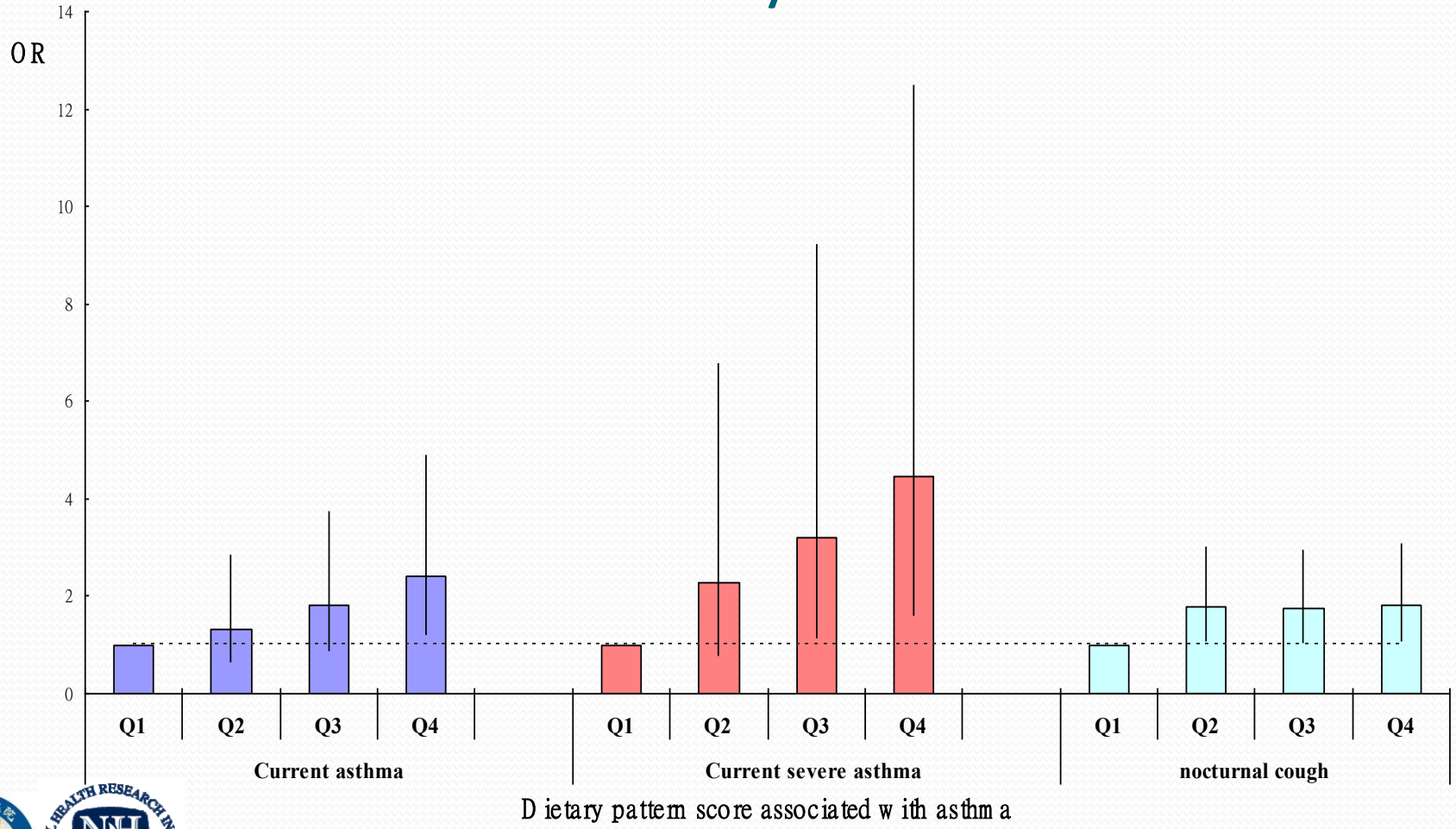
5 In the past 12 months, has wheezing ever been severe enough to limit your speech to only one or two words at a time between breaths?
- Yes ☐
- No ☐

6 Have you ever had asthma?
- Yes ☐
- No ☐

7 In the past 12 months, has your chest sounded wheezy during or after exercise?
- Yes ☐
- No ☐

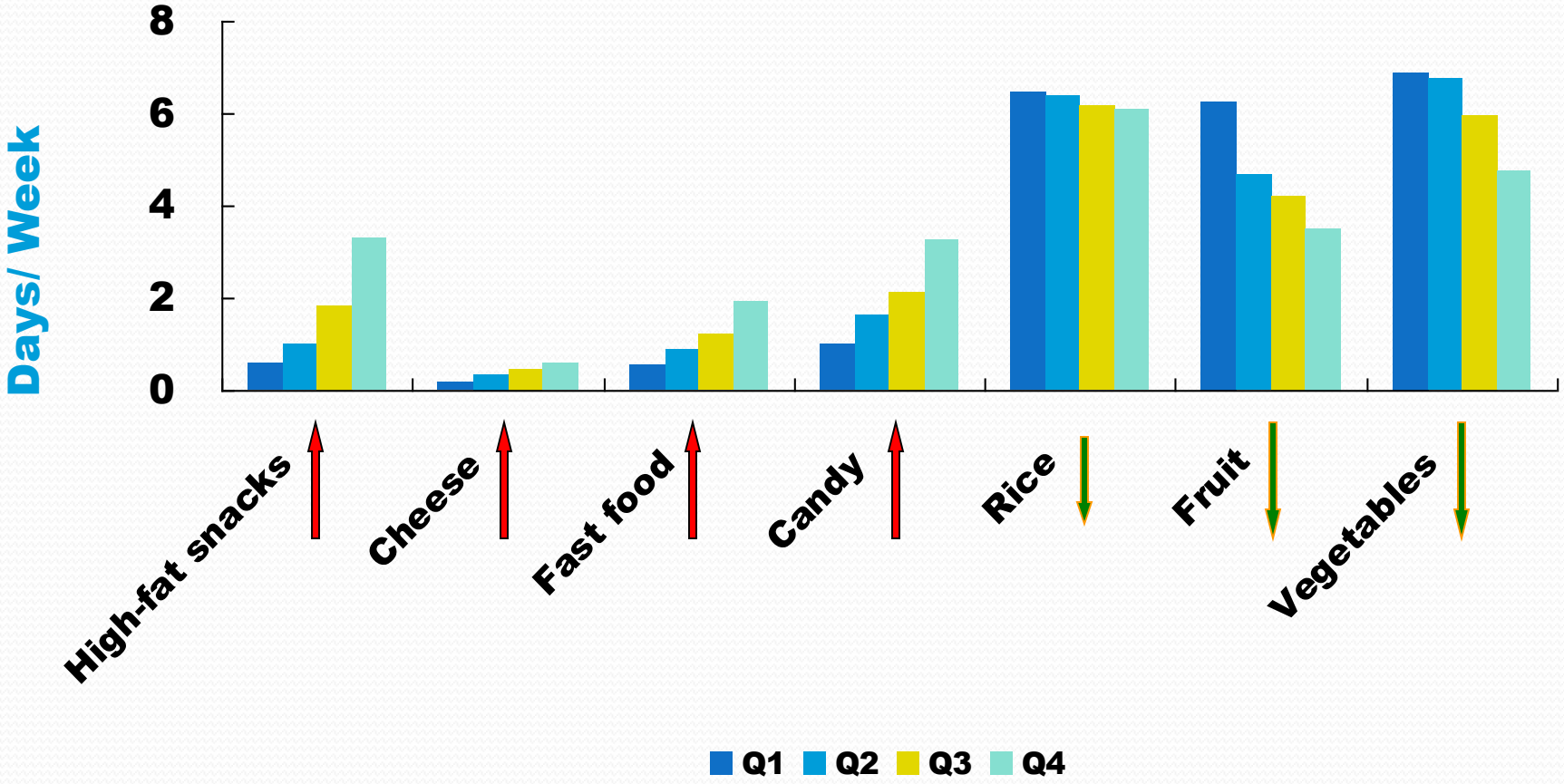
8 In the past 12 months, have you had a dry cough at night, apart from a cough associated with a cold or chest infection?
- Yes ☐
- No ☐

RRR-derived Dietary pattern score associated with asthma in elementary school children



Diet score associated with asthma symptom score

The food frequency pattern & diet score associated with asthma in elementary school children



Diet score associated with asthma symptom score

Summary of dietary patternstudies

Food groups	School performance, asthma, UA, NPC, frailty
Vegetables	Vegetable group (all), carrot-seaweed-dark green-mushroom-bamboo shoot (UA)
Fruits	Fruit group (all)
Protein rich foods	Lean meat-soy-egg-bony small fish-internal organ (hyperuricemia), fish-egg (NPC), Shell fish-Deep sea fish-poultry (frailty)
Dairy	Dairy group (school performance, NPC), Cheese/fast food (asthma)
Carbohydrate	Rice-candy-sweetened beverage (asthma), instant noodle-cookie-candy-sweetened beverage (school performance), sweetened beverage (UA), whole grain-sweetened beverage (frailty) Whole grain (frailty)
Fats/Oils	High fat/sweet snack-fried food (school performance), high fat snack-fast food (asthma)
Others	Coffee (UA, frailty), tea (NPC, frailty)

Summary

- We used data mining approach to find wellbeing-related dietary patterns
  - Protectively associated
    - Vegetables, fruit, dairy
    - High quality protein-rich food and whole grain
    - Nuts/seeds
    - Natural beverage such as tea or coffee
  - Adversely associated
    - Candy-sweet drinks, fatty /fried/fast foods

Elaborations

- Current dietary guidelines and food guides focus recommend general healthy eating pattern to follow across lifespan
- People will experience some changing needs in different periods of life cycle, such as women at childbearing age, men susceptible to hyperuricemia and gout, and elders susceptible to frailty and dementia.

- More and more dimension reduction tools are made available to find dietary patterns associated with various disease conditions. Among them RRR or PLSD facilitates finding dietary patterns which maximize the degree of variation explained not only for outcomes of interest but also for food items.
-

- We employed RRR/PLSD method to find dietary pattern inversely associated with asthma, hyperuricemia, nasopharyngeal cancer, frailty, and mild cognitive decline.
- Most of the discovered dietary patterns confer with the current dietary guidelines and food guides
- Certain individual foods or drinks stand out to show their potential protective functions (or harmful effects) to health conditions.

- Dietary patterns associated with disease risks may contain more detailed information on foods of choice which can be used to enrich dietary guidelines tailored to needs of different stages of lifecycle or subgroups.

Conclusion

- Precision nutrition
  - Fine tuning for
    - Different outcomes
    - Individuals
- Comprehensive food frequency data should be valued.
  - Natural beverage
  - Plant foods with different phytonutrients
  - Cooking method data included
- Dimension reduction methods properly employed

Acknowledgement

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- Dr. Hsin-Chou Yang, Ins Statistics, Academia Sinica

Thank you very much for your attention!

Mediterranean Diet

- 含豐富而多量之植物性食物（穀類、蔬菜、水果豆類、堅果種子與橄欖）
- 以橄欖油為油脂來源
- 適量至高量攝取魚類與海鮮、適量攝取蛋、禽肉與乳製品（乳酪與優格yogurt）、適量紅酒伴餐，但很少吃紅肉與肉製品。
- 流行病學與介入研究結果指出，此種飲食方式可降低代謝症候群、第二型糖尿病、心血管疾病、某些神經退化性疾病、癌症、衰弱症之風險。

DASH Diet 得舒飲食

Dietary Approach to Stop Hypertention

Goal for a 2000 kcal Diet

Total fat	27% of calories
Saturated fat	6% of calories
Protein	18% of calories
Carbohydrate	55% of calories
Cholesterol	150 mg
Sodium	2,300 mg*
Potassium	4,700 mg
Calcium	1,250 mg
Magnesium	500 mg
Fiber	30 g

- 高鉀
- 高鈣
- 高鎂
- 高纖
- 稍高蛋白質
- 中脂飲食

* 1,500 mg of sodium was a lower goal tested and found to be even better for lowering blood pressure. It worked very well for people who already had high blood pressure, African Americans, and middle-aged and older adults.

Evidence-based processes

1. Recommendation for multiple caloric levels
   - 7 Caloric level derivation (1200-2700 Kcal)
     - Caloric requirement for sex- and age-specific BMI levels (25^{th} & 75^{th}) levels modified by degree of PA (low and heavy)
2. Estimating nutrient density for one standard portion of 6 food groups
3. Calculating the level of nutrients in average Taiwanese diet and in previously recommended guide
4. Cross-check with national & international nutrition recommendations
5. Modify dietary content to fit the item "4"

National & international recommendations

- Meeting DRI
  - Vitamin A, B1, B2, niacin, B6, B12, C, E, Ca, P, Mg, Fe, Zn
  - K, dietary fiber, CSI (cholesterol saturated fat index), P/S ratio
- Meeting macronutrient composition of DASH
  - Protein: fat: CHO= 17-18%: 28-29%: 54-55%

Consensus approach

- Dietary pattern/calories
- Quality of foods (plant-based, nutrient-dense, non-refined)
- Physical expenditure

Stroke
JOURNAL OF THE AMERICAN HEART ASSOCIATION

Is Ischemic Stroke Risk Related to Folate Status or Other Nutrients Correlated With Folate Intake?

Lu-Chen Weng, Wen-Ting Yeh, Chyi-Huey Bai, Hsin-Jen Chen, Shao-Yuan Chuang, Hsing-Yi Chang, Bi-Fong Lin, Kuan-Ju Chen and Wen-Harn Pan*

Stroke. 2008;39:3152-3158; originally published online November 6, 2008;

Hazard ratios on Ischemic Stroke by folate status

Table 2. Hazard Ratios and 95% CIs for Incident IS Event by Quartiles of Folate Status

	Quartiles of Folate			
	Q4+Q3 High	Q2	Q1 Low	*P* for Trend*
Dietary level, μg/d†	<369.45	297.33–369.45	<297.33	
Event/n‡	50/886	44/443	38/443	
Model 1	1	1.77 (1.18–2.67)	1.46 (0.95–2.26)	0.034
Model 2	1	1.83 (1.21–2.78)	1.59 (1.02–2.47)	0.014
Plasma concentration, ng/mL	>7.77	5.88–7.77	<5.88	
Event/n‡	62/843	31/422	34/422	
Model 1	1	1.00 (0.65–1.56)	0.91 (0.58–1.42)	0.736
Model 2	1	0.90 (0.57–1.42)	0.78 (0.49–1.25)	0.323

**P* for trend based on the 3-group data (Q1, Q2, and Q3+Q4).

†Dietary folate was calorie-adjusted.

‡No. of people at risk in the category.

Model 1 was adjusted for age (40–50, 50–60, 60–70, ≥70), sex, age*sex.

Model 2 was adjusted for the covariates in model 1 plus hypertension (yes, no), use of antihypertensive drugs (yes, no), diabetes mellitus (yes, no), area (Chu-Dong and Pu-Tzu), central obesity (yes, no), alcohol consumption habits (never, ex-drinker, current drinker), smoking habit (never, ex-smoker, current smoker), sex-smoking habit interaction, BMI (≤24, 24–27, ≥27 kg/m^2), self-report heart disease (yes, no), hypercholesterolemia (yes, no), hypertriglyceridemia (yes, no), physical activity (yes, no), fibrinogen (tertiles), apolipoprotein B (tertiles), and plasminogen (tertiles).

Table 3. Factor Loading for Nutrient Intake Levels Estimated From FFQ*

	Plant Food Factor	Mineral-Rich Factor	Fatty Acid Factor	B Vitamin Factor	Vegetable Oil Factor	Animal Foo Factor
Dietary fiber	0.83	...	...	...	...	...
Vitamin C	0.82	...	...	...	...	...
Folate	0.79	...	...	...	...	...
Vitamin A of plant origin	0.73	...	...	...	...	...
Magnesium	0.46	0.83	...	...	...	...
Calcium	0.53	0.75	...	...	...	...
Sodium	...	0.72	...	...	...	...
Potassium	0.57	0.72	...	...	...	...
Phosphorus	...	0.69	...	...	...	...
Iron	0.47	0.68	...	...	...	...
Saturated fatty acid	...	...	0.95	...	...	...
Oleic acid	...	...	0.95	...	...	...
Niacin	...	...	...	0.72	...	...
Vitamin B1	...	...	...	0.65	...	...
Vitamin B6	...	...	...	0.64	...	...
Polyunsaturated fatty acid	...	...	...	...	0.87	...
PS ratio	...	...	...	...	0.77	...
Vitamin E	...	...	...	...	0.69	...
Vitamin A of animal origin	...	...	...	...	...	0.85
Vitamin B2	0.49	...	...	...	...	0.51
Vitamin B12	...	...	...	...	...	0.48
Cholesterol	...	...	...	...	...	0.47

Bullet points

- Folate is highly associated with other plant food containing nutrients
  - Dietary fiber
  - Vitamin C & carotenoins
  - Various minerals

- It is likely that plant food intake is the protective factor for ischemic stroke.

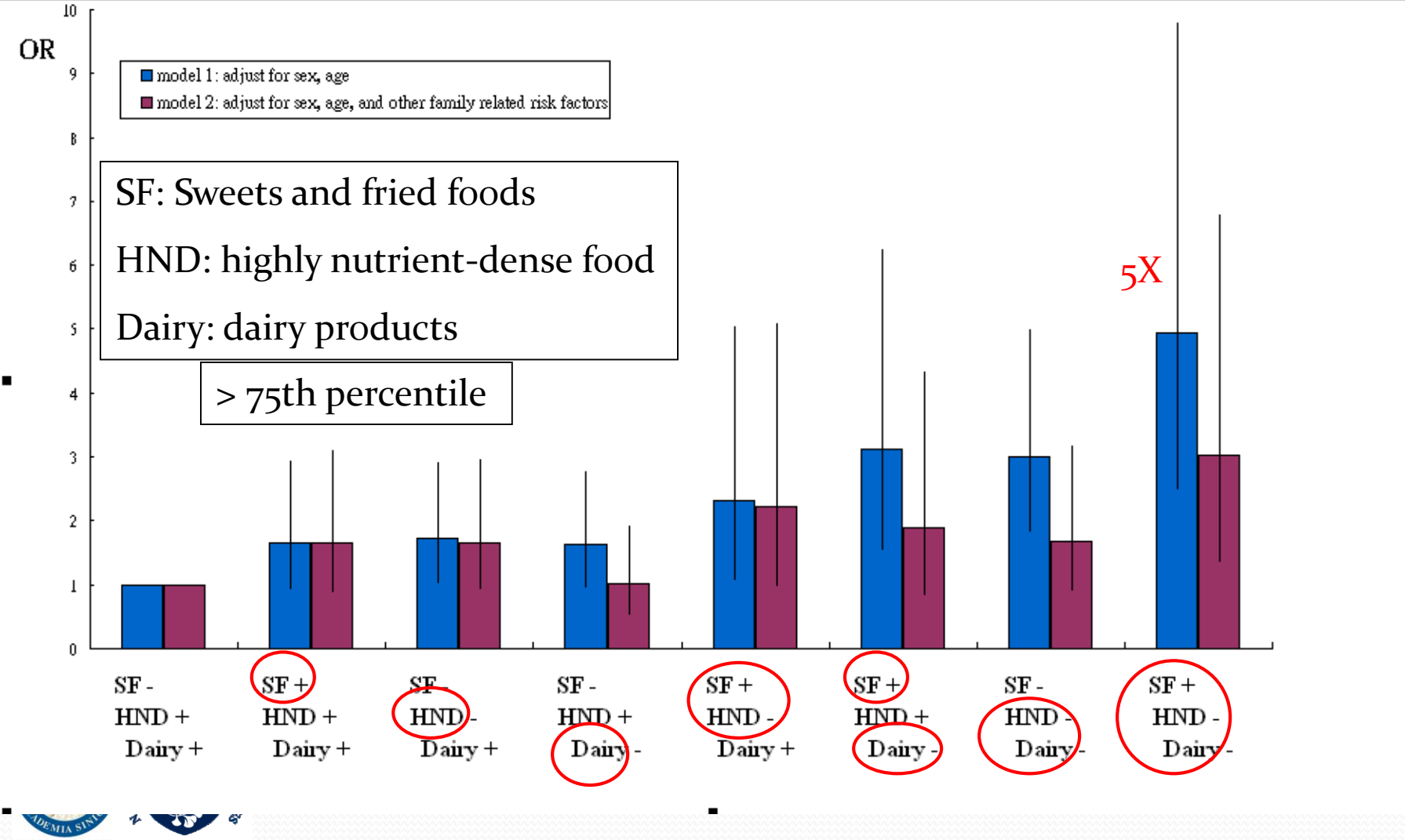
Scale for assessing

Children's school performance	Far Above Average	Above Average	Average	Below Average	Far below Average
1. Intellectual functioning	**4**	**3**	**2**	**1**	**0**
2. Family support	**4**	**3**	**2**	**1**	**0**
3. Academic functioning	**4**	**3**	**2**	**1**	**0**
4. Motivation for school work	**4**	**3**	**2**	**1**	**0**
5. Peer support	**4**	**3**	**2**	**1**	**0**
6. Personal hygiene	**4**	**3**	**2**	**1**	**0**
7. Interest in activities outside of school	**4**	**3**	**2**	**1**	**0**

OC>=14: Normal, **OC<14: Not good**

- A score was calculated for each participant as a sum of the food groups, each weighted according to the factor loadings.
  - Score = Dietary Pattern Loadings x Food Intake Frequency
- Participant scores were categorized into quartiles (Q1, Q2, Q3, Q4).

Dietary pattern associated with poor overall school performance in school children



Bullet points

- Dietary factors associating with poorer school performance
  - Less (dislike) nutrient dense foods (vegetables, fruit, protein-rich foods) and dairies

Involved at least 6 food groups and 1 cooking method

•More deep-fried foods (fat)
•More sweetened foods (simple carbohydrate)
•Low on vegetables and fruit
•Low on dairy and protein-rich foods

- Data mining to find protective or risky dietary patterns for common complex diseases: implications on devising dietary guidelines
-
- Wen-Harn Pan, PhD, FAHA
- Institute of Biomedical Sciences
- Academia Sinica
-
- ABSTRACT
- Current dietary guidelines and food guides focus primarily on adequate levels of caloric intake, healthy eating patterns (balanced among the 6 food groups), and selecting nutrient dense foods from varieties of sources. While it is important to recommend general healthy eating pattern to follow across lifespan, people will experience some changing needs in different periods of life cycle, such as women at childbearing age, men susceptible to hyperuricemia and gout, and elders susceptible to frailty and dementia.
-
- More and more dimension reduction tools are made available to find dietary patterns associated with various disease conditions. Among them, reduced rank regression (RRR) facilitates finding dietary patterns which maximize the degree of variation explained not only for outcomes of interest but also for food items.
-
- Recently we employed RRR method to find dietary pattern inversely associated with asthma, hyp
nasopharyngeal cancer, frailty, and mild cognitive decline. Not only most of the discovered dieta
the current dietary guidelines and food guides, but certain individual foods or drinks stand out t
protective functions (or harmful effects) to health conditions.
-
- Dietary patterns associated with disease risks may contain more detailed information on foods o
used to enrich dietary guidelines tailored to needs of different stages of lifecycle.

Content

- Principles on devising “Food Guide” & ”Dietary Guideline”

- Comprehensive data mining for
  - Dietary patterns associated with various health & wellbeing parameters