

Planetary Health Diet Score and Temporal Trends in Chinese Adults

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Background

- In 2019, the EAT-Lancet Commission proposed Planetary Health Diet (PHD) with higher intake of plant-based foods and limited consumption of animal-sourced foods^[1]
- Substantial scientific evidence indicate the close links of the PHD with human health and environmental sustainability. The higher the PHD score (PHD-S), the more beneficial to health and environment
- However, the PHD-S in Chinese adults remains unclear

Objectives

- To assess the PHD-S and its temporal trends in Chinese adults by using the China Health and Nutrition Survey (CHNS) data

Results

Tab. 1 Baseline characteristics of the study population by survey year of the CHNS

Characteristic	1997 (n=9288)	2000 (n=10158)	2004 (n=9513)	2006 (n=9330)	2009 (n=9669)	2011 (n=12436)	P for trend
Age, years	42.9±15.9	44.4±15.6	47.4±15.3	48.8±15.2	49.6±15.5	50.5±15.3	<0.001
PHD-S	27.85±9.4	28.6±9.7	29.5±10.8	30.6±11.4	32.7±12.0	36.9±13.0	<0.001
Sex							0.008
Men	4548(49.0)	4964(48.9)	4577(48.1)	4471(47.9)	4656(48.2)	5884(47.3)	
Women	4740(51.0)	5194(51.1)	4936(51.9)	4859(52.1)	5013(51.8)	6552(52.7)	
Age group, years							<0.001
<30	2218(23.9)	1964(19.3)	1248(13.1)	987(10.6)	1080(11.2)	1283(10.3)	
30-39	1985(21.4)	2285(22.5)	1877(19.7)	1703(18.3)	1550(16.0)	1809(14.5)	
40-49	2126(22.9)	2368(23.3)	2185(23.0)	2151(23.1)	2169(22.4)	2898(23.3)	
50-59	1334(14.4)	1649(16.2)	2105(22.1)	2202(23.6)	2279(23.6)	2896(23.3)	
≥60	1625(17.5)	1892(18.6)	2098(22.1)	2287(24.5)	2591(26.8)	3550(28.5)	
Income level							
Low	1028(13.2)	966(12.0)	1197(17.1)	1245(18.8)	1029(14.4)	1269(13.4)	
Lower-middle	3018(38.7)	2422(30.2)	2898(41.5)	2837(42.8)	3541(49.7)	4187(44.3)	
Middle	3249(41.6)	3684(45.9)	2491(35.7)	2249(33.9)	2260(31.7)	3558(37.6)	
Upper-middle	264(3.4)	478(6.0)	192(2.7)	121(1.8)	126(1.8)	194(2.1)	
High	249(3.2)	476(5.9)	209(3.0)	180(2.7)	171(2.4)	253(2.7)	
Urban/Rural areas							<0.001
Urban	3112(33.5)	3391(33.4)	3285(34.5)	3203(34.3)	3246(33.6)	5080(40.8)	
Rural	6176(66.5)	6767(66.6)	6228(65.5)	6127(65.7)	6423(66.4)	7356(59.2)	

Data presented as mean ±SD for continuous variables or count (percentage) for categorical variables

Methods

- Study population
 - 60,394 adult participants of the CHNS, a longitudinal study conducted in China
 - Excluding those without dietary data or having implausible intake of food items (more than 3-SD of the consumption in the populations)
- Calculation of the PHD-S
 - A scoring system developed by Ye et al^[3]
 - All 14 dietary components classified into 3 categories based on their health effects: adequacy, optimum, and moderation^[3]
 - Food weight equivalent: using the most frequently consumed food item as reference^[2]
- Statistical analysis
 - Temporal trends of total and individual PHD-S of dietary components described by age and sex
 - Overall intake of dietary components presented using radar chart and heat map
 - Associations of potential influencing factors with the PHD-S evaluated using univariate linear regression analysis and linear mixed model

	1997	2000	2004	2006	2009	2011	
2.18	2.10	2.11	1.99	1.91	1.66	8	Total grains
1.07	1.08	1.25	1.18	1.16	1.40	6	Starchy vegetables
1.40	1.50	1.63	1.59	1.62	1.68	6	Vegetables
0.11	0.13	0.17	0.34	0.41	0.62	4	Fruits
0.02	0.07	0.09	0.09	0.08	0.18	4	Dairy foods
5.83	6.62	6.34	7.04	7.59	8.53	2	Livestock
0.51	0.56	0.56	0.59	0.78	1.04	2	Poultry
2.40	2.80	2.82	3.17	3.42	3.99	2	Eggs
1.26	1.22	1.38	1.53	1.72	1.96	2	Fish
0.31	0.30	0.33	0.31	0.33	0.33	2	Legumes
0.06	0.08	0.07	0.07	0.10	0.17	2	Nuts
0.79	0.92	0.90	1.02	1.08	1.25	2	SFA
0.45	0.52	0.44	0.49	0.53	0.60	2	UFA

Fig. 2 The ratios of average and recommended intakes of each dietary component in Chinese adults during 1997-2011

Data standardized by sex and age using the participants of the 2011 survey as the standard population
^aSFA, saturated fatty acid; ^bUFA, unsaturated fatty acid.



Fig. 1 Adherence to PHD-S for each dietary component in Chinese adults during 1997-2011. The radar chart plots the values of each dietary component along a separate axis that starts in the center of the chart (0% compliance) and ends at the outer ring (100% compliance). The values presented as the percentage of subjects who adhered to each dietary recommendation.

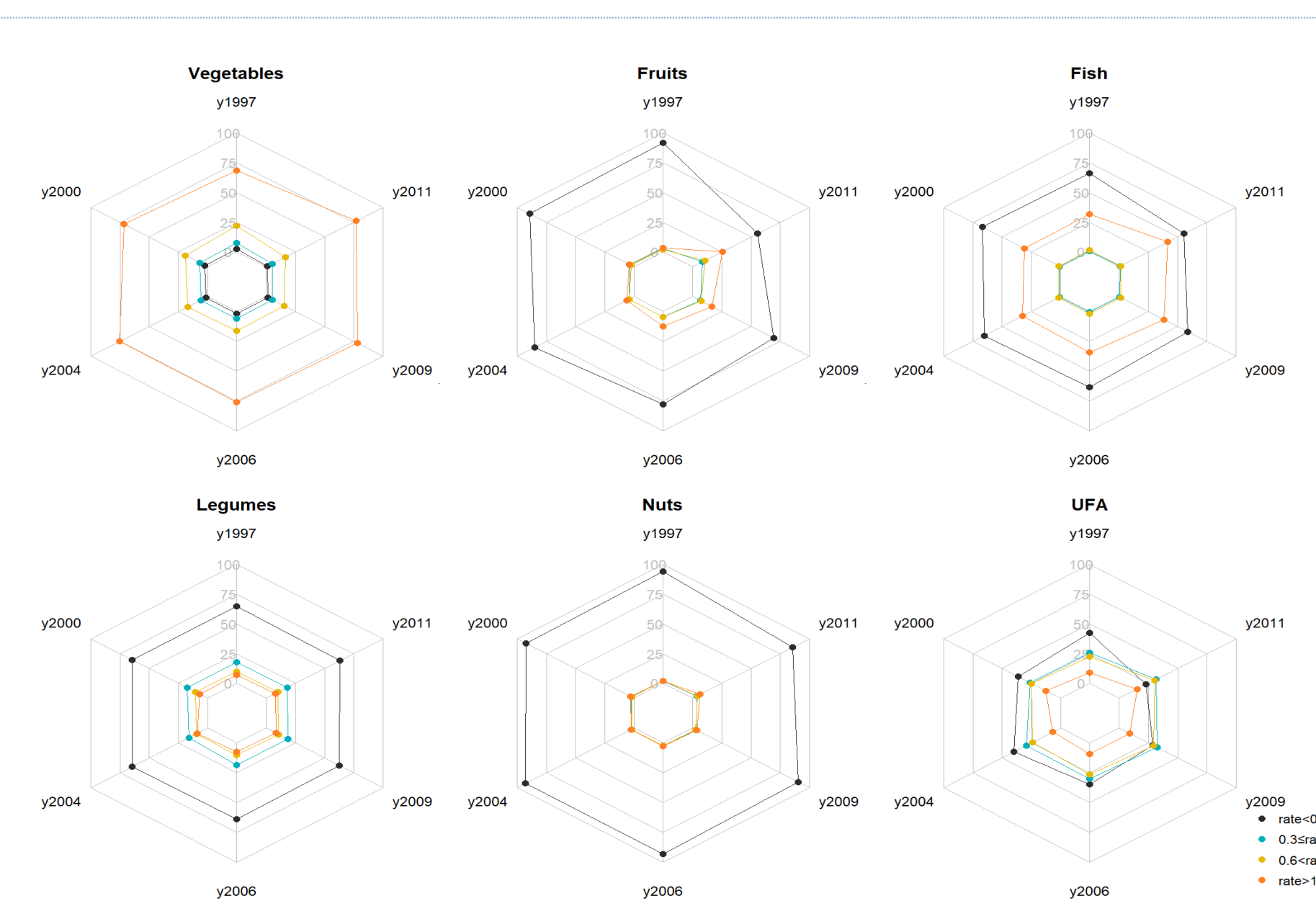


Fig. 3 Intake levels of adequacy components during 1997-2011

The radar chart plots the ratio of actual to recommended intake of each food item. For adequacy components, no consumption scored as 0 point, equal to or exceeding the recommended intake as 10 points, intakes of 0 to recommended levels scored proportionally by the ratio of actual to recommended intake: <0.3 as low intake, 0.3-0.6 as medium intake, 0.7-1.0 as high intake, and >1 as the full mark intake, with corresponding PHD-S of <3, 3-6, 7-10, and 10.

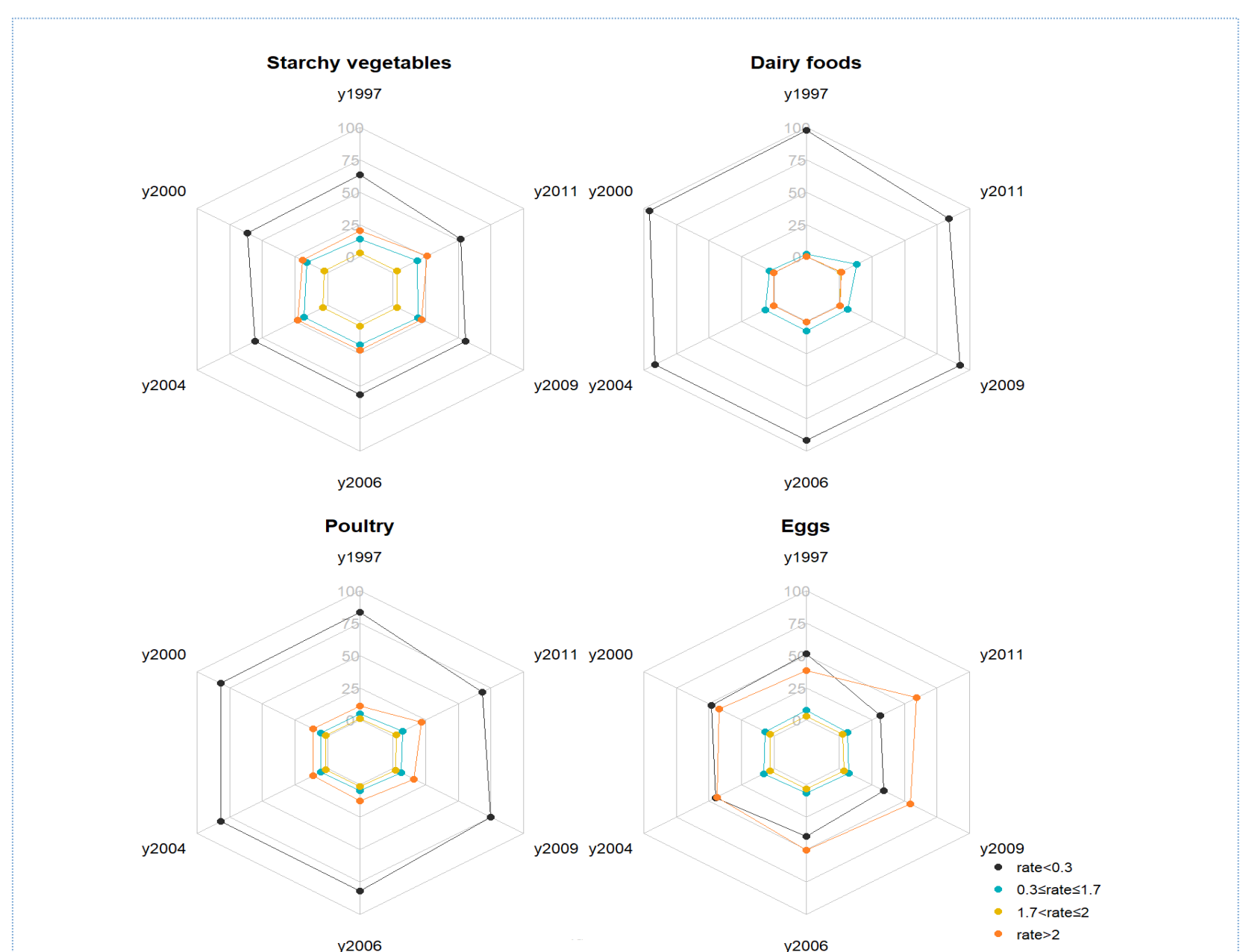


Fig. 4 Intake levels of optimum components during 1997-2011

The radar chart plots the ratio of actual to recommended intake of each food item. For optimum components, beyond the recommended range scored as 0 points; the ratio of actual to recommended intakes <0.3 as low intake, 0.3-1.7 as medium intake, 1.8-2.0 as high intake, and >2.0 as excessive intake, with corresponding PHD-S of <3, 3-10 and 0.

Tab. 2 Total and individual PHD-S for dietary components by survey year of the CHNS

	1997	2000	2004	2006	2009	2011	P value
Total PHD-S	27.94	28.71	29.55	30.60	32.71	36.91	0.013
Dietary components							
Total grains	1.04	1.35	1.47	2.09	2.40	4.04	0.020
Starchy vegetables	0.98	1.14	1.29	1.27	1.35	1.35	0.005
Vegetables	9.04	9.11	9.25	9.25	9.34	9.33	0.001
Fruits	0.70	0.87	1.24	1.89	2.62	3.82	0.006
Dairy foods	0.14	0.28	0.51	0.50	0.43	0.89	0.025
Livestock	0.24	0.21	0.25	0.25	0.25	0.28	0.105
Poultry	0.32	0.36	0.38	0.31	0.46	0.53	0.060
Eggs	0.47	0.45	0.50	0.41	0.48	0.41	0.540
Fish	3.33	3.25	3.40	3.58	4.03	4.37	0.016
Legumes	2.77	2.72	2.79	2.70	2.90	2.87	0.143
Nuts	0.48	0.60	0.57	0.56	0.74	1.21	0.072
SFA ^a	4.15	3.57	3.61	3.08	2.63	2.17	0.003
UFA ^b	4.29	4.80	4.30	4.72	5.07	5.65	0.063

Total and individual PHD-S of dietary components standardized by age and sex.
^aSFA, saturated fatty acid; ^bUFA, unsaturated fatty acid.

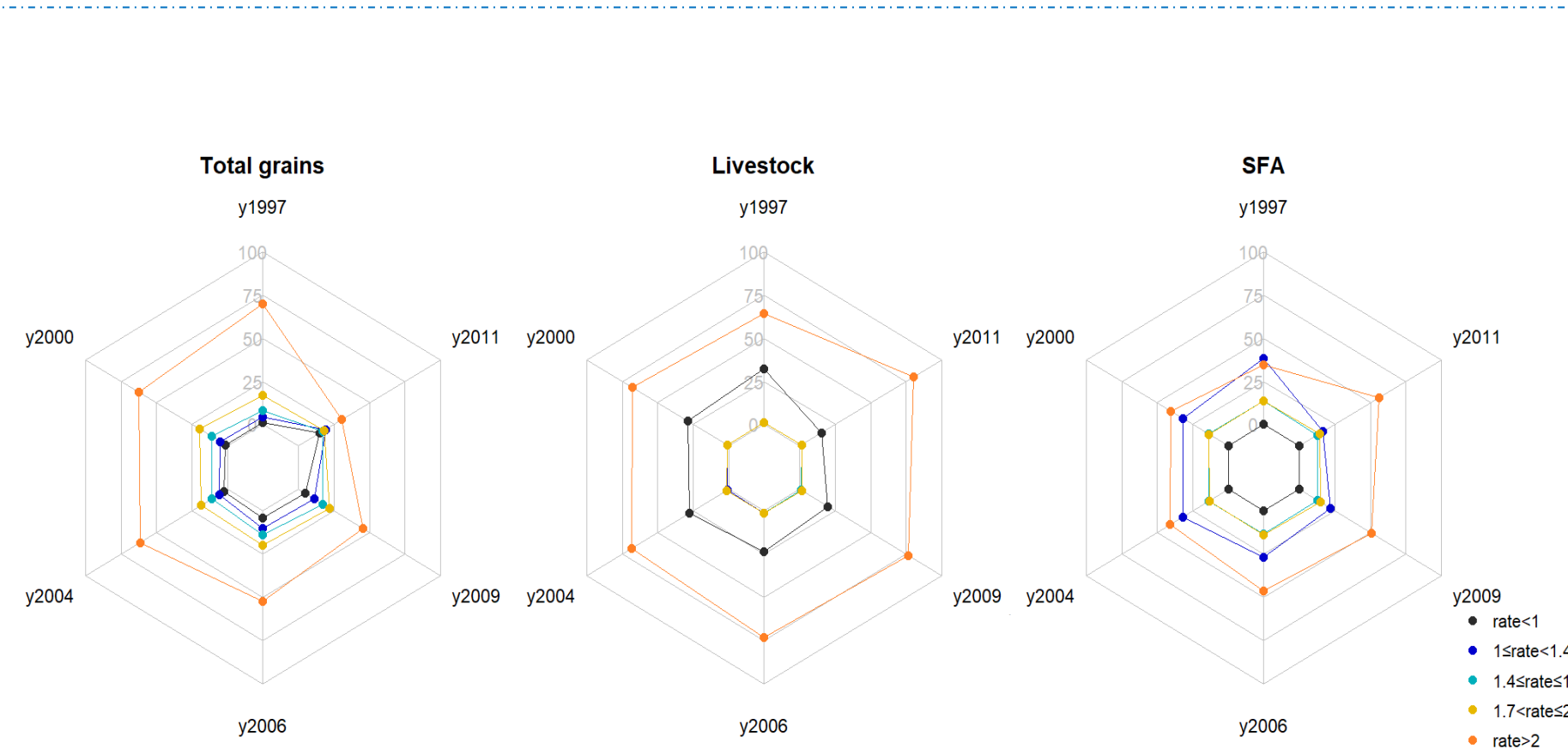


Fig. 5 Intake levels of moderation components during 1997-2011

The radar chart plots the ratio of actual to recommended intake of each food item. For moderation components, below the lower limit scored as 10 points, above the upper limit score as 0 points, and within the recommended intake range decreased proportionally. According to the ratio of actual to recommended intake: <1 as full mark intake, 1-1.3 as low intake, 1.4-1.7 as medium intake, 1.8-2.0 as high intake, >2 as excessive intake (corresponding to PHD-S of 10, >6, 3-6, <3, and 0). For comparison, the ratio of actual to recommended intake for SFA group presented as ratio +1.

Variable	β(95%CI)	P value
Age	-0.00(-0.00,0.00)	0.563
Sex		
Men		
Women	0.02(0.01,0.03)	<0.001
Income level		
Low		
Lower-middle	0.04(0.04,0.05)	<0.001
Middle	0.10(0.09,0.11)	<0.001
Upper-middle	0.13(0.12,0.15)	<0.001
High	0.14(0.12,0.16)	<0.001
Urban/Rural areas		
Urban		
Rural	-0.20(-0.24,-0.16)	<0.001
Survey year.y		
1997		
2000	0.00(-0.00,0.01)	0.339
2004	0.04(0.03,0.05)	<0.001
2006	0.08(0.07,0.09)	<0.001
2009	0.14(0.13,0.15)	<0.001
2011	0.21(0.20,0.22)	<0.001

Fig. 6 Associations of potential influencing factors PHD-S β(95%CI) mutually adjusted.

Conclusions

- Adherence to PHD was low but increased in Chinese adults over the past decades, with the increasing total and individual PHD-S for whole grains, fruits and fish, and a decreasing PHD-S for saturated fatty acids
- Sex, income level, and living in urban areas may influence the adherence to PHD in the populations
- The results indicate that the adherence to PHD in Chinese adults can be improved through taking more fruits, fish, legumes, nuts and dairy products, and reducing the consumption of total grains, starchy vegetables, livestock and eggs

Reference

- Willett, W., et al., Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet*, 2019; 393(10170):447-492.
- He, P., et al., The environmental impacts of rapidly changing diets and their nutritional quality in China. *Nature Sustainability*, 2018; 1(3): 122-127.
- Ye, Y.X., et al., Adherence to a Planetary Health Diet, Environmental Impacts, and Mortality in Chinese Adults. *JAMA Netw Open*, 2023; 6(10): e2339468.