

Eastern healthy diet derived from regional food culture is associated with lower long-term health risks in Chinese adults

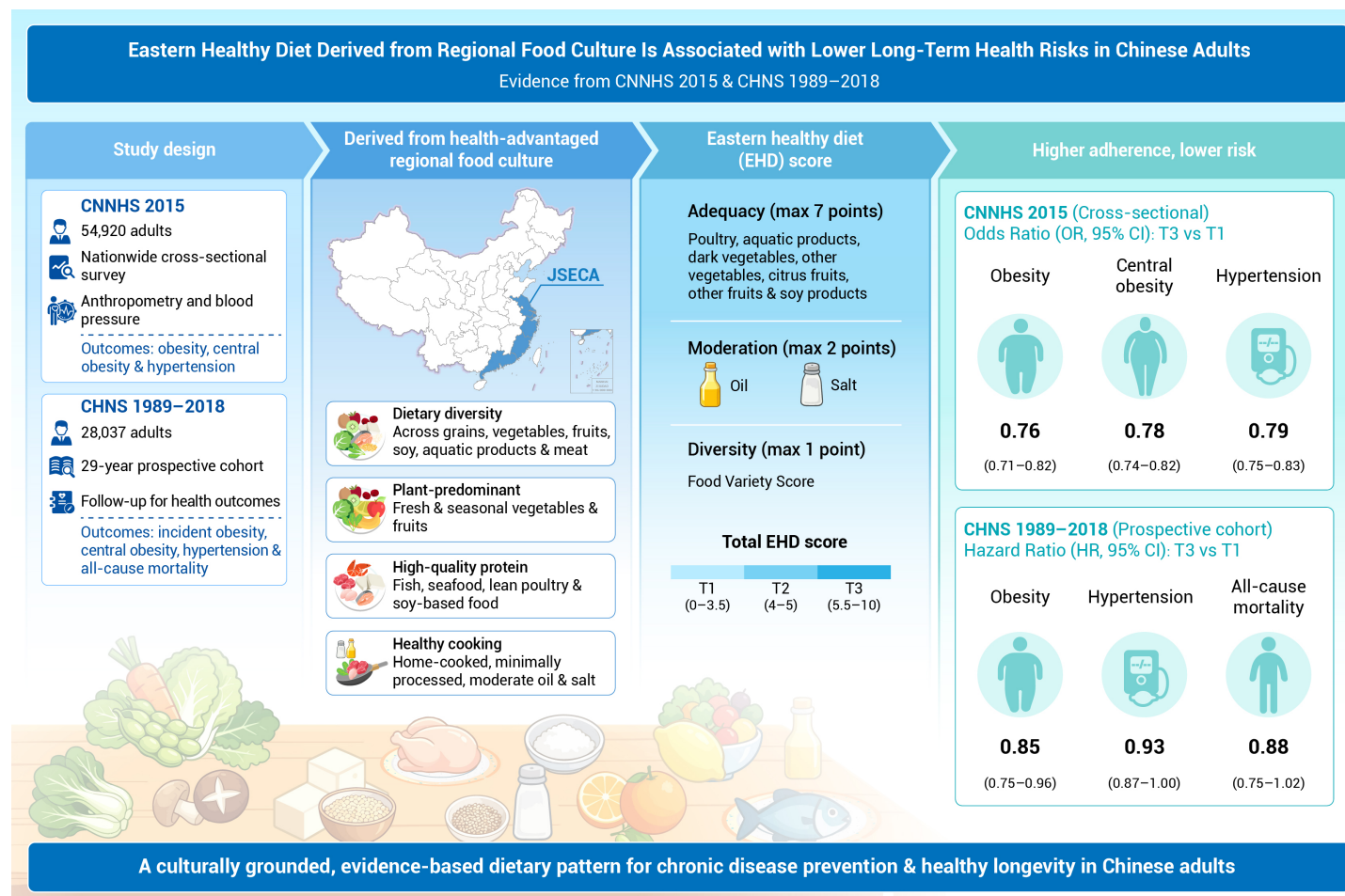
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GRAPHICAL ABSTRACT



PUBLIC SUMMARY

- The Eastern Healthy Diet (EHD) is derived from the Jiangnan and Southeast Coastal Area (JSECA) of China.
- The EHD features dietary diversity, plant-predominant, high-quality protein, and healthy cooking.
- Higher EHD adherence was associated with lower obesity, central obesity, hypertension and long-term health risks.
- The EHD provides a practical, evidence-based strategy for chronic disease prevention in China.

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Sustainable and healthy dietary patterns require alignment with regional food cultures to promote long-term adherence and health benefits. The Jiangnan and Southeast Coastal Area (JSECA) of China, characterized by its dietary health advantages and exceptional longevity, provides a compelling foundation for a culturally grounded dietary framework. Using data from the China National Chronic Non-Communicable Disease and Nutrition Surveillance (CNNHS 2015), a nationally representative cross-sectional survey of 54,920 adults, this study derived the Eastern Healthy Diet (EHD) from the characteristic dietary patterns of the JSECA. The EHD was defined by high dietary diversity, high intake of dark-colored vegetables, other vegetables, citrus fruits, other fruits, aquatic products, poultry, and soy-based foods, and cooking methods that use less oil and salt. In fully adjusted logistic regression models, participants in the highest EHD tertile had had lower odds of obesity (odds ratio [OR] = 0.76, 95% confidence interval [CI]: 0.71–0.82), central obesity (OR = 0.78, 95% CI: 0.74–0.82), and hypertension (OR = 0.79, 95% CI: 0.75–0.83) than those in the lowest tertile. In the China Health and Nutrition Survey (CHNS 1989–2018), an independent prospective cohort, time-dependent Cox proportional hazards models showed that greater EHD adherence was associated with lower risks of selected adverse health outcomes. The EHD provides a practical, evidence-based strategy for chronic disease prevention in China.

INTRODUCTION

Over the past four decades, China has undergone a profound dietary transition. Economic growth has driven a rapid shift toward higher consumption of animal-source foods and lower intakes of whole grains, vegetables and fruits.^{1–2} These changes have been accompanied by a sharp rise in diet-related chronic diseases: the prevalence of obesity among adults increased from 7.1% in 2002 to 16.4% during 2015–2019,³ diabetes prevalence rose from 7.53% in 2005 to 13.7% in 2023 (approximately 233 million affected),⁴ and by 2021, cardiovascular diseases accounted for 43.5% of all deaths.⁵ The scale of this epidemiological transition highlights the urgent need for dietary guidance that is not only evidence-based but also culturally relevant to the Chinese population.

Healthy dietary patterns are central to preventing malnutrition and reducing the burden of diet-related non-communicable diseases (NCDs).^{6–7} Several evidence-based dietary frameworks have achieved broad international recognition, including Mediterranean diet and the Japanese diet. These dietary patterns were developed and validated in their regions of origin but were not designed specifically for the Chinese dietary context. Staple components of the Mediterranean and the Dietary Approaches to Stop Hypertension (DASH) diets, such as olive oil, low-fat dairy, and nuts, are consumed at low levels in China, limiting adherence and complicating the application of these models for both research and public health purposes.^{8–10} While healthy diet principles may be universal, dietary patterns are shaped by local geography, culinary tradition, food systems, and socioeconomic conditions; effective dietary guidance must therefore be grounded in local evidence. This challenge is particularly acute in China, given its pronounced regional dietary heterogeneity. A well-documented north-south divide along the Qinling-Huai River line¹¹ sepa-

rates southern rice-based diets, which are rich in vegetables and aquatic products, from northern wheat-based diets characterized by high consumption of preserved and salted foods. Regional protein sources further reflecting local farming traditions and ecological conditions.^{12–14}

Against this context, the dietary pattern of the Jiangnan and Southeast Coastal Area (JSECA, encompassing Shanghai, Zhejiang, Jiangsu, Guangdong, and Fujian) stands out for its consistent association with superior population health outcomes. Compared with other areas, JSECA has been shown to have the lowest diet-attributable cardiovascular burden and the highest life expectancies in China.¹⁵ For example, residents exhibit lower prevalence of hypertension (20.0–27.9% vs. 33.3% in northern China) and better overall cardiovascular health status, as reflected by the 2023 China Cardiovascular Health Index, relative to other areas in China (Shanghai, 81.6; Zhejiang, 78.6; Jiangsu, 73.3; vs. the national mean, 58.2).^{16–17} These observations raise the possibility that the JSECA dietary pattern embodies a set of food practices with broad protective relevance for Chinese populations, and potentially provides the empirical foundation for a culturally grounded dietary framework.

We therefore hypothesized that the JSECA dietary pattern captures food practices associated with health benefits applicable to the broader Chinese population. The objectives of this study were to define the food components of the Eastern Healthy Diet (EHD) based on JSECA dietary characteristics; develop and validate a standardized adherence score, the EHD score; and to evaluate associations between EHD adherence and the risks of obesity, hypertension, and all-cause mortality using nationally representative cross-sectional data and a 29-year prospective longitudinal cohort.

MATERIALS AND METHODS

Study design

Data from the 2015 China National Chronic Non-Communicable Disease and Nutrition Surveillance (CNNHS 2015) were used to develop the Eastern Healthy Diet. The CNNHS 2015 was a nationwide cross-sectional study, conducted by the National Institute for Nutrition and Health (NINH), the National Centre for Chronic and Non-Communicable Disease Control and Prevention (NCNCD), and Chinese Centre for Disease Control and Prevention (CDC), using a multistage, stratified cluster random sampling design to recruit approximately 400,000 residents aged ≥ 18 years from all 31 provincial-level administrative divisions in the Chinese mainland. Data collection encompassed structured interviews, 24-hour dietary recall, anthropometric measurements, and laboratory tests; full methodological details have been reported elsewhere.¹⁸ For the present analyses, after excluding individuals with incomplete records and implausible energy intakes (<800 or >5,000 kcal/day), we included 54,920 adults (26,033 men [47.4%]; 28,887 women [52.6%]), including 7,745 participants with obesity, 17,845 participants with central obesity and 21,283 participants with hypertension.

Dietary assessment

Dietary intake was assessed using three consecutive 24-hour dietary recalls (one weekend day and two weekdays), covering all meals and snacks. According to a standardized protocol, trained field investigators used food photographs and portion models to facilitate accurate recall. Participants

Table 1. Characteristics of the study participants

Characteristics	Overall	JSECA	Other areas	P value ^a
Sample size, n(%)	54,920 (100.0)	11,073 (20.2)	43,847 (79.8)	
Age, years, mean $\pm$ SD	53.1 $\pm$ 14.1	54.0 $\pm$ 14.2	52.8 $\pm$ 14.1	<0.001
Energy intake, kcal/d, mean $\pm$ SD	1,774.2 $\pm$ 468.6	1,807.4 $\pm$ 460.6	1,765.9 $\pm$ 470.2	<0.001
Residential area, n(%)				<0.001
Urban	22,977 (41.8)	5,635 (50.9)	17,342 (39.6)	
Rural	31,943 (58.2)	5,438 (49.1)	26,505 (60.4)	
Sex, n(%)				0.351
Men	26,033 (47.4)	5,205 (47.0)	20,828 (47.5)	
Women	28,887 (52.6)	5,868 (53.0)	23,019 (52.5)	
Smoke, n(%)				<0.001
Current smoker	14,229 (25.9)	2,614 (23.6)	11,615 (26.5)	
Non-smoker	40,691 (74.1)	8,459 (76.4)	32,232 (73.5)	
Physical activity, n(%)				<0.001
Low	27,955 (50.9)	6,545 (59.1)	21,410 (48.8)	
Medium	21,709 (39.5)	3,831 (34.6)	17,878 (40.8)	
High	5,256 (9.6)	697 (6.3)	4,559 (10.4)	
Family annual income, n(%)				<0.001
Low	15,472 (28.2)	3,303 (29.8)	12,169 (27.8)	
Medium	23,833 (43.4)	4,547 (41.1)	19,286 (44.0)	
High	15,615 (28.4)	3,223 (29.1)	12,392 (28.3)	
Education level, n(%)				<0.001
Primary school and below	26,492 (48.2)	4,967 (44.9)	21,525 (49.1)	
Middle and high school	24,326 (44.3)	4,996 (45.1)	19,330 (44.1)	
College and above	4,102 (7.5)	1,110 (10.0)	2,992 (6.8)	
Hypertension, n(%)	21,283 (38.8)	4,229 (38.2)	17,054 (38.9)	0.175
Obesity, n(%)	7,745 (14.1)	1,590 (14.4)	6,155 (14.0)	0.385
Central obesity, n(%)	17,845 (32.5)	3,928 (35.5)	13,917 (31.7)	<0.001

^a Wilcoxon rank sum test for continuous variables; Pearson's Chi-squared test for categorical variables.

additionally completed structured paper meal records to further reduce recall bias. Household consumption of edible oils and condiments was quantified by weighing them during the same three-day period. Energy intake was calculated using the Chinese Food Composition Table, and food-specific intakes were energy-adjusted using the residual method to account for between-individual variation in total energy consumption.

Developing the EHD Score

EHD components were identified by systematically comparing food intake and dietary diversity between JSECA residents and residents of other Chinese areas, using data from the CNNHS 2015. We then developed the EHD score by integrating national dietary guideline recommendations with median consumption levels observed among JSECA consumers. The Food Variety Score (FVS) was used to assess dietary diversity. It was constructed from four food groups defined in the Chinese Dietary Guidelines: (1) grains, starchy foods, and legumes; (2) vegetables and fruits; (3) livestock and fish products, and eggs; and (4) dairy and beans, and nuts. Detailed FVS scoring criteria are provided in Table S1. For categorization, an FVS of 12 was selected as the upper cut-point based on both the mean FVS among consumers from the JSECA (12.4) and the recommendation in the Chinese Dietary Guidelines to consume at least 12 different types of foods per day. An FVS of 2 was used

as the lower cut-point to identify individuals with very limited dietary variety.

Chronic disease measurement

Height and weight were measured in the morning after an overnight fast. Body mass index (BMI) was calculated as the weight (kg) divided by the square of height (m²). Blood pressure was measured three times by a qualified internist, with an interval of at least one minute between each measurement; the mean of the three measurements was used as the final value. Outcomes were defined according to Chinese diagnostic criteria:

Obesity: BMI $\geq$ 28 kg/m²;

Central obesity: waist circumference $\geq$ 90 cm in men and $\geq$ 85 cm in women;

Hypertension: systolic blood pressure $\geq$ 140 mmHg and/or diastolic blood pressure $\geq$ 90 mmHg, or self-reported physician-diagnosed hypertension.

Assessment of covariates

To control potential confounding, we accounted for covariates of demographic and dietary factors, socio-economic status, and behavioral lifestyle factors.

Demographic and dietary factors included age (continuous, years), sex (men/women), and total dietary energy intake (continuous, kcal/d).

Table 2. Characteristics of dietary patterns in the JSECA and other areas^a [Mean (SE)].

Food components	JSECA (n = 11,073)	Other areas (n = 43,847)	P value ^e
Rice and wheat flour	249.2 (0.7)	252.7 (0.4)	0.057
Other Cereals	20.5 (0.5)	27.1 (0.3)	<0.001
Soybean and soy products	13.8 (0.2)	11.6 (0.1)	<0.001
Red meat	85.2 (0.6)	83.4 (0.3)	<0.001
Poultry	23.9 (0.4)	20.2 (0.2)	<0.001
Milk	34.9 (0.6)	29.7 (0.2)	<0.001
Eggs	36.5 (0.3)	27.7 (0.1)	<0.001
Aquatic products	60.8 (0.7)	32.0 (0.2)	<0.001
Oil	39.7 (0.2)	44.1 (0.1)	<0.001
Salt	8.1 (0.0)	9.6 (0.0)	<0.001
Citrus fruits	14.2 (0.3)	13.4 (0.2)	<0.001
Other fruits	49.5 (0.7)	43.4 (0.3)	<0.001
Dark color vegetables ^b	179.4 (1.1)	167.7 (0.5)	<0.001
Other vegetables	261.2 (1.3)	240.0 (0.6)	<0.001
Food Variety Score	13.8 (0.2)	11.5 (0.1)	<0.001

^aTo eliminate the impact of energy intake on food consumption, the daily average food intakes are presented as adjusted means after adjustment for total energy intake, age, sex, and residential area using the residual method. Adjusted values are standardized to a reference participant (male, 50 years old, urban resident, with a total energy intake of 2,000 kcal/day). ^bDark color vegetables include dark green, dark red, and dark purple vegetables, etc., which typically contain carotenoid levels $\geq 500 \mu\text{g}/100 \text{ g}$. ^cStatistical significance was assessed using design-based Wilcoxon rank-sum test.

Table 3. Assignment Method of the Eastern Healthy Diet

Food Item	Highest score quantity ^a	Lowest score quantity ^a	Weight
Poultry (g/d)	≥ 50	0	1
Aquatic products (g/d)	≥ 50	0	1
Dark color vegetables (g/d)	≥ 150	0	1
Other vegetables (g/d)	≥ 200	0	1
Citrus fruits (g/d)	≥ 50	0	1
Other fruits (g/d)	≥ 100	0	1
Soybean and soy products (g/d)	≥ 15	0	1
Oil (g/d)	≤ 30	> 50	1
Salt (g/d)	≤ 5	> 10	1
Food Variety Score	≥ 12	< 2	1
Total ^b			10

^aFor each component, an intake meeting the highest score threshold was assigned 1 point, an intake meeting the lowest score threshold was assigned 0 points, and an intake between the two thresholds was assigned 0.5 points. ^bThe overall EHD score was the sum of the ten component scores, ranging from 0 to 10.

Behavioral lifestyle factors included smoking status (current smoker/non-smoker) and physical activity level. Physical activity was categorized into low, medium, or high levels according to the occupation of participants.

Socio-economic status was evaluated at both provincial and individual levels. At the provincial level, we adjusted for the provincial gross domestic product (GDP, continuous, 100 million yuan) in 2015 and residential area (urban/rural). At the individual level, annual family income was included as tertiles (low/medium/high) and educational level was categorized as primary school and below, middle and high school, college and above.

China Health and Nutrition Survey

The China Health and Nutrition Survey (CHNS 1989–2018) was used as an independent prospective cohort to evaluate the longitudinal associations between EHD score and incident obesity, central obesity, hypertension, and all-cause mortality. The CHNS was initiated in 1989 and represents the longest-running nutrition and health cohort study in China. Across eleven survey rounds conducted between 1989 and 2018, approximately 15,000 participants from 15 provinces provided repeated data on diet, anthropometric measurements, blood biochemistry, and vital status.¹⁹ Participants

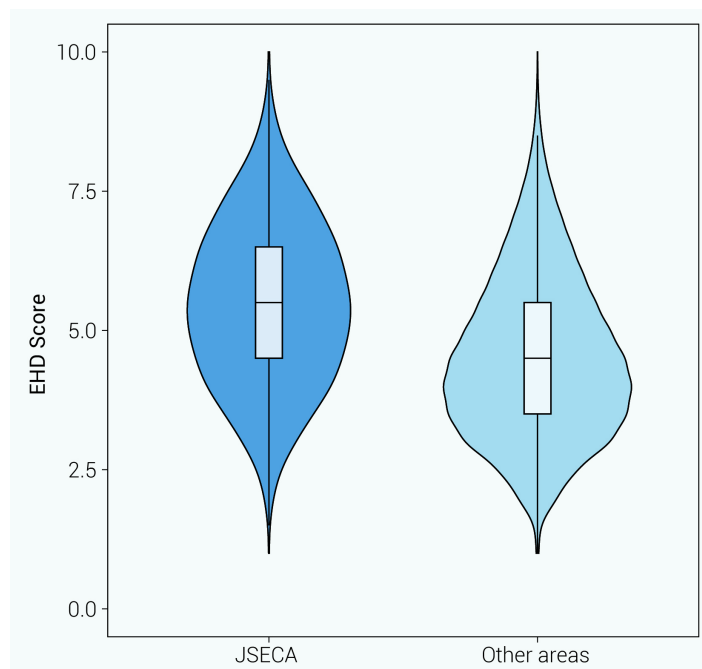


Figure 1. Distribution of EHD score in different areas JSECA, Jiangnan and South-east Coastal Area.

contributed person-time from baseline until the first occurrence of the outcome, loss to follow-up, death, or the end of follow-up, whichever came first. Participants with valid dietary data, outcome information, covariates and at least one follow-up visit were included. Participants with implausible energy intake, pregnancy/lactation, baseline disease for incident analyses, or missing key variables were excluded. Detailed information on study design, dietary and covariates assessment, and ascertainment of chronic disease and death is provided in the Supplemental Information. Flow charts are shown in [Figure S1](#), and participant characteristics are shown in [Table S2](#).

Statistical analysis

The characteristics of the study population were presented as mean (standard deviations [SDs]), median (interquartile ranges [IQRs]), or *n* (percentage [%]), as appropriate. For CNNHS dietary intake comparisons, post-stratification sampling weights based on the 2010 Chinese Population Census were applied to account for the multistage stratified sampling design; weighted means and standard errors (SEs) were reported. Differences between JSECA and other areas residents were assessed using design-based Wilcoxon rank-sum test. Multivariable logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for associations between EHD score and obesity, central obesity, and hypertension. To evaluate the robustness of our findings to the complex survey design, we performed a sensitivity analysis using survey-weighted logistic regression ([Table S3](#)).

For CHNS, time-dependent Cox proportional hazards models were used. Follow-up time was divided into consecutive intervals according to the survey waves using the counting-process formulation of the Cox model. EHD score and time-varying covariates were updated at each survey wave, and cumulative average EHD score up to each interval was used to represent long-term dietary exposure. Other covariates that varied over time were similarly updated when available. We did not rely on baseline values or last observation carried forward. Dose-response trends were assessed by entering the median EHD score of each category as a continuous term. Sequential models were fitted: Model A adjusted for age, sex, dietary energy intake, enrolment time, baseline BMI, smoking status and physical activity level; Model B additionally adjusted for GDP, urban/rural residence, annual family income, and education; for the all-cause mortality analysis, Model C further adjusted for chronic diseases status, including hypertension, diabetes, myocardial infarction, stroke, and cancer. The proportional hazards assumption was assessed using Schoenfeld residuals, and no substantial violation was observed for the primary exposure variable.

All analyses were performed in SAS version 9.4 (SAS Institute, Cary, NC) and R version 4.3.1. A two-sided $P < 0.05$ was considered statistically significant.

RESULTS

Characteristics of study participants

Demographic characteristics are summarized in [Table 1](#). This study included 54,920 participants, of whom 11,073 (20.2%) resided in the JSECA. Compared to residents in other areas, JSECA residents were significantly older (mean age 54.0 vs. 52.8 years, $P < 0.001$) and more likely to reside in urban areas (50.9% vs. 39.6%, $P < 0.001$). No significant difference was observed in the sex distribution between the two groups ($P = 0.351$). In terms of lifestyle and socioeconomic status, JSECA participants exhibited a lower prevalence of current smoking (23.6% vs. 26.5%, $P < 0.001$) and a higher proportion of attaining a college education and above (10.0% vs. 6.8%, $P < 0.001$). The prevalence of hypertension and obesity did not differ significantly between the two regions, whereas central obesity was significantly more prevalent among JSECA residents.

Dietary patterns of the Jiangnan and Southeastern Coastal Areas

Dietary characteristics of JSECA residents are presented in [Table 2](#). JSECA residents exhibited a distinctive dietary pattern marked by significantly higher intakes of aquatic products, soybean and soy products, dark vegetables, citrus and other fruits, with lower consumption of oil and salt and greater overall dietary diversity. Specifically, the mean intake of aquatic products was 60.8 g/day in the JSECA, approximately 1.9 times that observed in other areas (32.0 g/day), plausibly reflecting the region's geographic proximity to both marine and freshwater resources. Intake of soybean and soy products was 19.0 % higher in the JSECA (13.8 vs. 11.6 g/day). Dietary diversity, as measured by FVS, was also greater in the JSECA (mean 13.8 vs. 11.5 out of 18, $P < 0.001$).

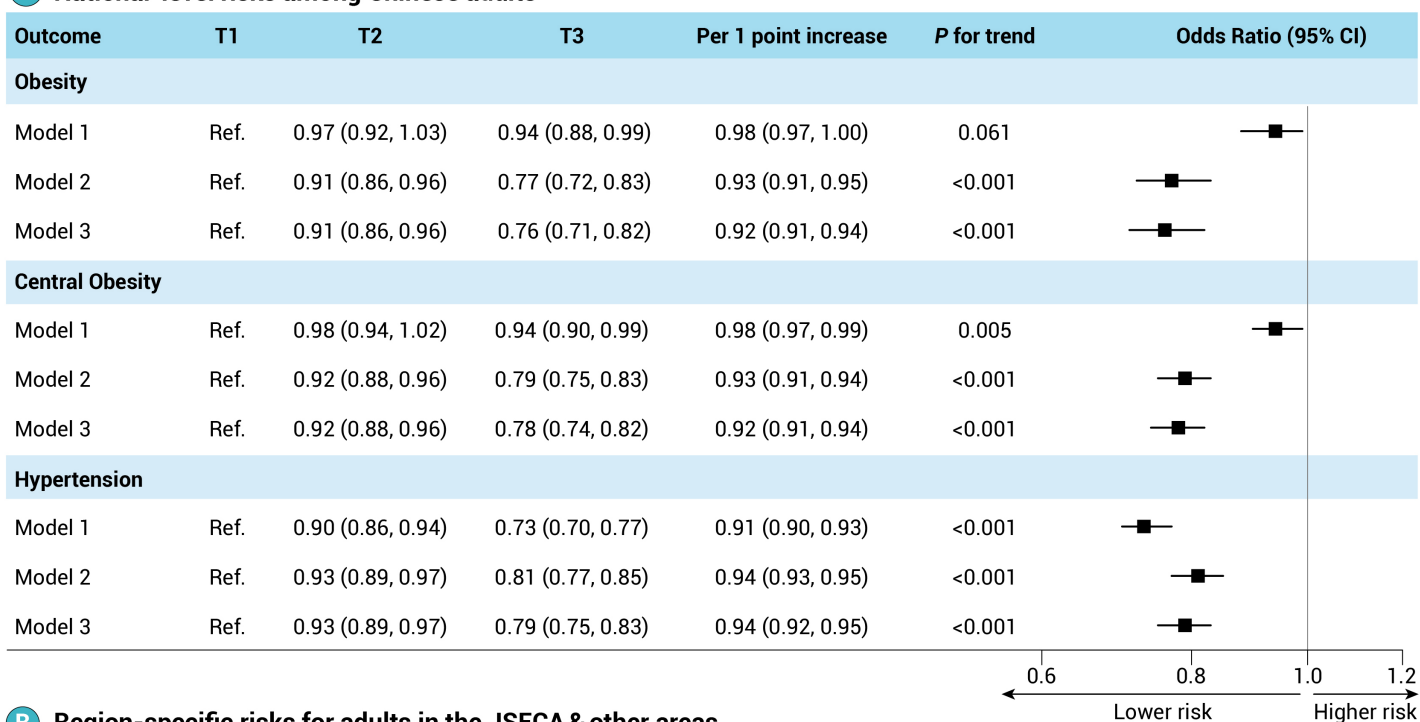
EHD food component framework and EHD score

Based on the dietary contrasts identified above, 10 food components were selected and classified into three functional categories: adequacy components (poultry, aquatic products, dark vegetables, other vegetables, citrus fruits, other fruits, and soy products), moderation components (oil and salt), and a diversity component (Food Variety Score). Each component was assigned an equal unit weight and scored as 0, 0.5, or 1. Vegetables and fruits were further divided into specific subgroups (i.e., dark versus other vegetables and citrus versus other fruits) to capture their distinct consumption patterns and dietary characteristics identified in the regional comparisons, rather than to preferentially weight these food groups. Scoring thresholds were established by integrating national dietary guideline recommendations with median consumption levels observed among JSECA consumers ([Table S4](#)). Detailed component definitions, thresholds, and weights are presented in [Table 3](#). The distributions of the EHD score in JSECA and other areas are presented in [Figure 1](#). Residents in the JSECA showed higher EHD scores compared to those in other areas.

Associations between EHD score and health outcomes

Associations between EHD score and health outcomes in the CNNHS 2015 are presented in [Figure 2](#). Higher EHD scores were associated with lower odds of obesity, central obesity, and hypertension across all sequential adjustment models (P for trend < 0.001). Comparing the highest tertile (5.5–10 points) with the lowest tertile (0–3.5 points) of the EHD score, the odds ratio (ORs) of obesity, central obesity, and hypertension were 0.76 (95% CI: 0.71–0.82), 0.78 (95% CI: 0.74–0.82), and 0.79 (95% CI: 0.75–0.83), respectively. Each 1 point increment in the EHD score was associated with an 8% lower risk of both obesity and central obesity and 6% lower risk of hypertension. Stratified analyses revealed consistent protective trends across different regions. In the JSECA, individuals in the highest tertile (6.0–10.0 points) exhibited significantly lower odds of central obesity (OR = 0.86; 95% CI: 0.77–0.96), and hypertension (OR = 0.87; 95% CI: 0.77–0.97) compared with those in the lowest tertile (0–4 points). In other areas, health benefit of EHD was also observed, the highest tertile (5.0–10.0 points) was associated with a 19% lower obesity odds (OR = 0.81; 95% CI: 0.75–0.86), a 20% lower

A National-level risks among Chinese adults



B Region-specific risks for adults in the JSECA & other areas

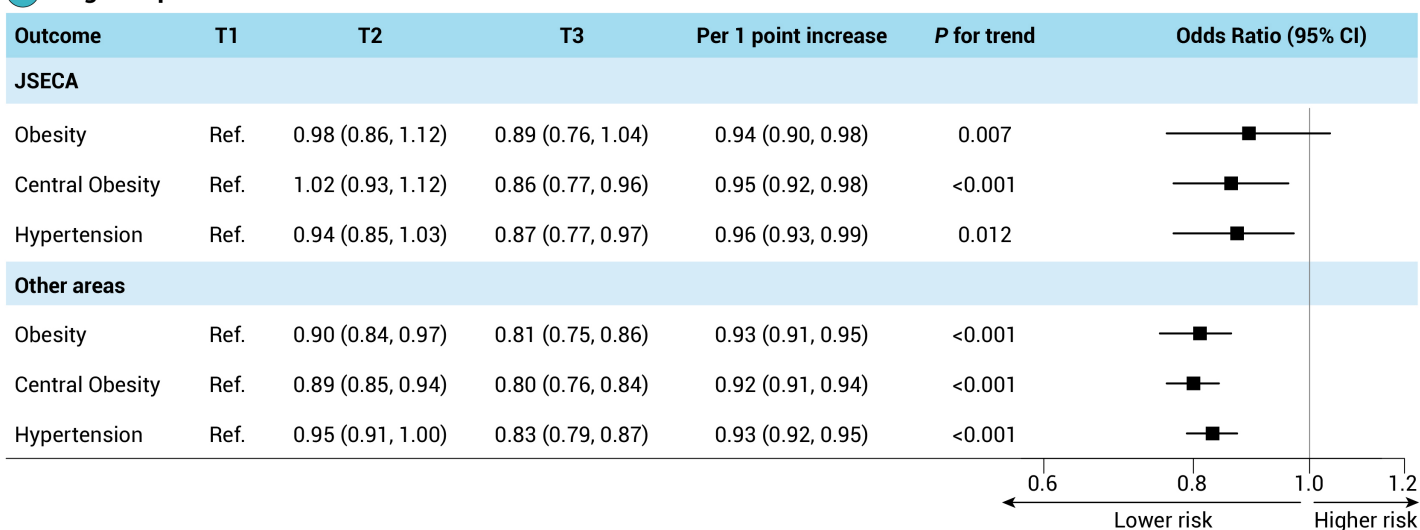


Figure 2. Associations of Eastern Healthy Diet (EHD) score with main health outcomes in China and different regions (A) Forest plots illustrate the odds ratios (ORs) and 95% confidence intervals (CIs) for Tertile 3 versus Tertile 1 (reference) across three sequential models. Model 1 adjusted for age, sex, and dietary energy intake. Model 2 additionally adjusted for socio economic status, including provincial gross domestic product (GDP), urban/rural area, annual family income, and educational level. Model 3 further adjusted for lifestyle factors including smoking status and physical activity level. (B) Forest plots illustrate region-specific risks using the adjusted model (Model 3) for populations in the JSECA and other areas.

central obesity odds (OR = 0.80; 95% CI: 0.76–0.84), and a 17% lower hypertension odds (OR = 0.83; 95% CI: 0.79–0.87) compared to the lowest tertile (0–3.5 points).

Associations between EHD score and health outcomes in CHNS 1989–2018

Associations between EHD score and health outcomes were examined in a prospective study (CHNS 1989–2018), and results were shown in Table 4. Compared with participants with low EHD score, those with high EHD score had lower risks of incident obesity (HR = 0.83; 95% CI: 0.73–0.93), hypertension (HR = 0.91; 95% CI: 0.85–0.97), and all-cause mortality (HR = 0.76; 95% CI: 0.66–0.88) in the model adjusted for demographic and behavioral lifestyle factors. After further adjustment for socioeconomic status, the association with incident obesity (HR = 0.85; 95% CI: 0.75–0.96) and hypertension (HR = 0.93; 95% CI: 0.87–1.00) remained statistically significant, whereas the cate-

gorical associations with all-cause mortality were attenuated and no longer statistically significant.

Sensitivity analysis

To evaluate the stability of our findings and ensure that the observed protective associations were not driven by any single dietary component of the EHD, sensitivity analysis was performed by sequentially excluding each individual component from the total score. The multivariable-adjusted ORs (per 1 point increase) remained remarkably stable across all exclusion iterations (Table S5).

DISCUSSION

Based on nationally representative cross-sectional data, this study defined the EHD and quantified adherence using a scoring system (EHD score, 0–10).

Table 4. Prospective associations between EHD score and risk of main health outcomes

Outcomes		HR (95% CI) by tertiles of EHD score ^b			HR for each additional EHD score point (95% CI) ^a	P for trend
		0–3.5	4–5	5.5–10		
Obesity	Model A ^c	1.00	0.96 (0.87,1.05)	0.83 (0.73,0.93)	0.96 (0.93,0.99)	0.003
	Model B ^d	1.00	0.96 (0.87,1.06)	0.85 (0.75,0.96)	0.96 (0.93,1.00)	0.014
Central Obesity	Model A ^c	1.00	0.94 (0.89,0.99)	0.95 (0.88,1.02)	0.98 (0.97,1.01)	0.199
	Model B ^d	1.00	0.94 (0.88,0.99)	0.94 (0.87,1.01)	0.98 (0.96,1.01)	0.131
Hypertension	Model A ^c	1.00	0.96 (0.90,1.02)	0.91 (0.85,0.97)	0.96 (0.94,0.98)	0.006
	Model B ^d	1.00	0.97 (0.91,1.03)	0.93 (0.87,1.00)	0.97 (0.95,0.99)	0.061
All-cause mortality	Model A ^c	1.00	0.87 (0.79,0.96)	0.76 (0.66,0.88)	0.91 (0.88,0.95)	<0.001
	Model B ^d	1.00	0.91 (0.83,1.01)	0.87 (0.75,1.02)	0.95 (0.91,0.99)	0.039
	Model C ^e	1.00	0.92 (0.83,1.02)	0.88 (0.75,1.02)	0.95 (0.91,0.99)	0.049

^aThis column presents the HR (95% CI) per 1 point increase in the EHD score. ^bThe values in the table represent the hazard ratios (HR) of the corresponding health outcomes in CHNS 1989–2018, with the EHD score < 3.5 group set as the reference value (1.00). The 95% confidence intervals (CI) are shown in parentheses. ^cModel A adjusted for age, sex, dietary energy intake, enrolment time, baseline BMI, smoking status and physical activity level. ^dModel B additionally adjusted for gross domestic product (GDP), urban/rural residential area, annual family income, and educational level to account for socio-economic status. ^eModel C additionally adjusted for baseline chronic diseases status, including hypertension, diabetes, myocardial infarction, stroke, and cancer in all-cause mortality analyses.

In the 29-year prospective cohort, higher EHD scores were associated with lower risks of obesity, hypertension, and all-cause mortality among Chinese adults, with each 1 point increment corresponding to a 2%–4% reduction in cardiometabolic risk and a 5% reduction in all-cause mortality. These findings support the EHD as an evidence-based, culturally grounded dietary framework for chronic disease prevention in China.

The EHD is characterized by high intakes of vegetables, fruits, aquatic products, and soy foods, while limiting unhealthy fats and excess sodium, and is structurally similar to other well-established healthy dietary patterns. These similarities are supported by previous epidemiological and clinical studies.^{20–22} Its component framework is consistent with both the *Chinese Dietary Guidelines* and WHO recommendations for healthy diets. What distinguishes the EHD, however, is not simply what it recommends, but the precision and cultural provenance of its recommendations.

Several features set the EHD apart from existing frameworks. Rather than advocating dietary diversity in broad terms, the EHD operationalizes this principle through a minimum target of 12 food types daily, a criterion that is both more specific and more achievable within China's food supply system than abstract diversity recommendations. The traditional Chinese diet is a plant-predominant diet, with more than 70% of daily food intake derived from plant sources. Traditional composite foods in JSECA (e.g., steamed dumplings, wonton, fried oyster pancakes, and steamed vermicelli rolls) exemplify dietary diversity by combining grains, vegetables, soybeans, aquatic products and meats. This diversity is further promoted by the cultural tradition of family-style dining, which encourages the consumption of multiple food groups. With respect to vegetables and fruits, the EHD moves beyond aggregate quantity to specifically highlight fresh vegetables (e.g., choy sum, water spinach, shepherd's purse, water bamboo, water shield, and water chestnut), citrus and other fruits, reflecting the elevated consumption of these nutrient-dense foods among JSECA residents and the associated population health advantages. JSECA residents emphasize the consumption of seasonal fresh vegetables and fruits that follow traditional agricultural practices for optimal freshness and flavor, such as malantou and strawberries in spring, bitter melon and lychee in summer, lotus root and pomelos in autumn, and bamboo shoots and mandarins in winter. For high-quality protein, the EHD highlights regular consumption of aquatic products, poultry, and soy-based foods as primary protein sources. JSECA residents show relatively high intake of soy-based foods (e.g., tofu knots, dried tofu, and hakka stuffed tofu) which offer significant cardiometabolic and nutritional benefits.^{23–24} Aquatic products, valued for their omega-3 fatty acid content, are regularly consumed by JSECA residents due to the region's abundant water resources, including

freshwater species (e.g., whitefish, grass carp, Chinese mitten crab, river shrimp, and Asian swamp eel) and marine seafood (e.g., large yellow croaker, hairtail, pomfret, and marine shrimp). Poultry, which provides high-quality lean protein with lower saturated fat than red meat, also accounts for a significant portion of the JSECA protein supply. Given that total protein intake among Chinese residents has remained broadly stable at 60.4–65.9 g/capita/day over the past 15 years,²⁵ this reorientation toward aquatic products and poultry represents a qualitative rather than quantitative dietary shift, consistent with sustainable dietary principles outlined in the EAT–Lancet framework.²⁶ The EHD also emphasizes home cooking, minimally processed foods and cooking methods that use less oil and salt. Oils commonly used in the JSECA, including tea seed oil, rapeseed oil, and sunflower oil, are rich in unsaturated fatty acids and are well integrated into Chinese culinary practice.

The EHD score provides a practical tool for translating these principles into measurable dietary targets in China. Higher adherence was associated with significant protection against hypertension and obesity, two metabolic risk factors that collectively account for the greatest burden of attributable mortality in China.^{27–29} The national median EHD score is currently 4.5. Although indices such as the alternative Mediterranean diet score (aMED) are associated with clear health benefits, median adherence scores in Chinese cohorts typically range from 3 to 5^{30–31} and are often lower among rural residents.^{32–33} This gap largely reflects a mismatch in design: aMED rewards or penalizes foods that are uncommon in most Chinese households, such as low-fat dairy, nuts, and sugar-sweetened beverages.^{34–35} As a result, achieving the health-benefit of aMED is difficult and costly for much of the Chinese public.³⁶ The EHD was built to address this problem. Its components and scoring cutoffs are based on foods that are part of everyday Chinese diets, lowers barriers to adherence and may make the associated health benefits more attainable.

The present findings extend and complement earlier work. Randomized controlled trial evidence has demonstrated the metabolic benefits of the traditional Jiangnan dietary pattern,^{37–38} a geographically defined subset of the broader JSECA. But those studies were limited to the Jiangnan region and did not provide a standardized adherence scoring system suitable for broader epidemiological use. By formalizing these regional findings into the EHD score, this study makes the pattern applicable at a national scale. The risk reduction associated with EHD score is similar to the established global dietary indices in Chinese populations.^{33,39–40} For example, a Chinese adaptation of the Mediterranean–DASH diet was associated with a 4% reduction in hypertension incidence per 1 point increase among older adults,³⁹ while a meta-analysis of aMED reported approximately a 5% reduction in all-cause

mortality per 2 point increment.⁴¹ These earlier estimates are close to the per 1 point associations observed for the EHD score in this study.

Several strengths need to be emphasized. The EHD is the first dietary scoring framework derived from the eating practices of a health-advantaged Chinese region, with component definitions and scoring thresholds grounded in both national dietary guideline recommendations and empirically observed consumption patterns from provincially representative surveillance data. Critically, its validity was evaluated not in a single dataset but across two complementary study designs, a nationwide cross-sectional survey of nearly 55,000 adults and a 29-year prospective cohort, providing convergent epidemiological evidence that higher EHD adherence is associated with meaningfully reduced risks of obesity, hypertension, and all-cause mortality. This dual-study design substantially strengthens confidence in the robustness and generalizability of the associations observed.

Several limitations warrant consideration. The observational design of both component studies precludes causal inference, and residual confounding cannot be excluded despite comprehensive covariate adjustment. Dietary intake was assessed by self-report, introducing potential measurement error, though the use of three-day 24-hour recalls and standardized interviewer training mitigates this concern. The CHNS cohort, while longitudinal and geographically diverse, may not fully capture dietary practices in the most remote regions of China. Although we leveraged the largest nationally representative Chinese nutrition surveillance dataset and the longest available longitudinal cohort data in China to strengthen our analyses, external validation in independent cohorts from other populations is still lacking. This may limit the generalizability and robustness of our findings. Finally, the EHD was derived from JSECA dietary data and validated in Chinese national cohorts; its generalizability to non-Chinese Asian populations warrants further investigation.

CONCLUSION

In summary, the EHD is a dietary pattern derived from the JSECA, a health-advantaged Chinese area, and is characterized by dietary diversity, plant-predominant foods, high-quality protein, and healthy cooking. Higher EHD adherence was associated with lower obesity, central obesity, hypertension, and long-term health risks based on both cross-sectionally and prospective analyses. Its local derivation, quantifiable components, and attainable adherence thresholds collectively may position it as a practical and policy-relevant tool for dietary counseling and chronic disease prevention in China. These findings support future intervention trials to establish causality and clarify the biological mechanisms behind EHD-associated health benefits.

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AUTHOR CONTRIBUTIONS

HYN and YYX initiated and conceived the study. HYN, WHJ, YXG, LAD, DGQ, and YYX designed the overall project. HYN, WHJ and GX designed the research methodology and analytical framework. DGQ and LAD led the population-based field projects. FYH, FHY, DWW, GQY, HYN, and DGQ collected, analyzed and interpreted the cross-sectional data; ZXF, SC, ZJG, JXF, GFX, LYY, WHJ, and LAD collected, analyzed and interpreted the cohort data. HYN, WHJ, FYH, and ZXF wrote the initial draft of the paper. LAD, DGQ, and YYX supervised the study, interpreted the results, and critically revised the manuscript. All authors contributed to and approved the manuscript.

DECLARATION OF INTERESTS

The authors declare no competing interests.

ETHICAL STATEMENT AND PATIENT CONSENT

The CNNHS 2015 was approved by the Medical Ethics Committee at the Chinese Center for Disease Control and Prevention and National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention (Approval Numbers 201519-B). The CHNS was approved by the Institutional Review Board of the University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, United States (No. 07-1963), and the Institutional Review Committee of the National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention, Beijing, China (No. 2018-012 and No. 201524). All participants provided informed consent prior to the investigation.

DATA AND CODE AVAILABILITY

Data are available from the corresponding author upon reasonable request.

SUPPLEMENTAL INFORMATION

It can be found online at <https://doi.org/10.59717/j.xinn-nutri.2026.100038>