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# Mediterranean diet lowers risk of new-onset diabetes: a nationwide cohort study in China

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## Abstract

**Background** The Mediterranean diet (MD) has shown promising results in preventing type 2 diabetes, particularly in Mediterranean and European populations. However, the applicability of these benefits to non-Mediterranean populations is unclear, with contradictory findings in the literature.

**Methods** In this study, we included 12,575 participants without diabetes at baseline from the China Health and Nutrition Survey (CHNS). Dietary intake was measured by three consecutive 24-h dietary recalls. The Mediterranean diet adherence (MDA) was measured by a score scale that included nine components of vegetables, legumes, fruits, nuts, cereals, fish, red meat, dairy products, and alcohol. New-onset diabetes was defined as self-reported physician-diagnosed diabetes during the follow-up.

**Results** During a median follow-up of 9.0 years, 445 (3.5%) subjects developed diabetes. Overall, there was an inverse association between the MDA score and new-onset diabetes (per score increment, HR 0.83, 95% CI 0.76–0.90). Moreover, age, sex, BMI, and energy intake significantly modified the association between the MDA score and the risk of new-onset diabetes (all P interactions $< 0.05$). Greater fruit, fish, and nut intake was significantly associated with a lower risk of new-onset diabetes.

**Conclusion** There was an inverse association between Mediterranean diet adherence and new-onset diabetes in the Chinese population.

**Keywords** Mediterranean diet, New-onset diabetes, Chinese, Health

## Introduction

The global prevalence of type 2 diabetes underscores the critical importance of effective dietary strategies for its prevention and management [1]. Among various dietary patterns, the Mediterranean diet (MD) has emerged as particularly beneficial [2–4]. Characterized by a high intake of olive oil, nuts, cereals, fruits, and vegetables; moderate consumption of fish, poultry, and wine; and minimal reliance on red and processed meats, dairy products, and sweets [5, 6], the MD has demonstrated significant preventive effects against diabetes, particularly in Mediterranean and European populations, as evidenced by the PREDIMED study and several prospective cohorts [7–11].

Despite these promising findings, the applicability of the benefits of MD across non-Mediterranean

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populations remains an open question. In fact, there are contradictions in the current evidence regarding the diabetes benefits of the MD among non-Mediterranean populations. Although certain studies indicate the potential of MD to mitigate diabetes risk [12], a recent cross-sectional analysis revealed no association between MDA and T2D in a non-Mediterranean population [13]. Several studies have indicated that there are racial/ethnic disparities in the association between a Mediterranean diet and incident diabetes [14, 15]. This ambiguity underscores the need to investigate the impact of MD on diverse population groups, including those outside the Mediterranean region. Therefore, we plan to explore the effects of the Mediterranean diet on diabetes in the Chinese population.

Diabetes is one of the most serious chronic diseases in China, with approximately 140.9 million adults having diabetes in 2021 [16, 17]. Accompanied by rapid economic changes, the dietary pattern in China is changing from a high intake of cereals and vegetables and a low intake of animal food to a Western pattern with a high intake of animal foods and other high-energy–density foods [18, 19]. Meanwhile, diabetes prevalence in Chinese adults aged 20–79 years was projected to increase from 8.2% to 9.7% during 2020–2030 [20, 21]. Few studies have assessed the health benefits of the Mediterranean diet in China [22–24], and the relationship between MD and the development of diabetes in the general Chinese population is unclear.

In this study, we aimed to investigate (1) the association between MDA and new-onset diabetes, (2) the association between different populations and the risk of developing diabetes, and (3) the association of food components of the Mediterranean diet with diabetes risk in the China Health and Nutrition Survey (CHNS).

## Methods

### Study design and participants

Details of the study design and some major results of the CHNS have been described elsewhere [25–28]. Briefly, the CHNS is an ongoing, national, multipurpose, longitudinal, open cohort study initiated in 1989 and has been followed up every 2–4 years. By 2011, the provinces included in the CHNS constituted 47% of China's population [26]. The present study was based on 6 rounds of CHNS data from 1997 to 2011 (1997, 2000, 2004, 2006, 2009, and 2011), including a total of 82,343 person-waves. We first excluded participants who were pregnant or < 18 years old. Among the remaining participants (including 65,611 person-waves), those with missing diabetes diagnoses (including 3895 person-waves) or with only one survey wave (including 8841 person-waves) were further excluded. Therefore, a cohort based on 13,500 participants (including 52,875 person-waves) with two or more survey waves was identified, and the first survey round was considered as the baseline. Of the 13,500 participants, 213 participants with self-report diabetes at baseline and 712 with extreme dietary energy data (males: > 4200 or < 800 kcal/day; females: > 3600 or < 600 kcal/day) [29] were further excluded. Ultimately, a total of 12,575 participants were included in the final analysis (Fig. 1).

The characteristics of the included (n = 12,575) and excluded (n = 8061) populations are shown in Table S1. The institutional review boards of the University of North Carolina at Chapel Hill, the National Institute of Nutrition and Food Safety, and the Chinese Center for Disease Control and Prevention approved the study. Each participant provided written informed consent. The data and study materials that support the findings of this study can be found on the official CHNS website.

### Assessment of the Mediterranean Diet

The dietary intake of each participant was assessed using 24-h recalls for three consecutive days (2 weekdays and 1 weekend day). Researchers at the CHNS recorded the types and amounts of food consumed at each meal during the previous day. Detailed information on the data collection has been reported previously [30, 31]. In the analyses, 3-day average intakes of dietary intake in each round were calculated. Repeated 3-day dietary recalls may reduce the day-to-day variation in dietary intake, and collect more complete food information. Moreover, all values of each nutrient in the analyses, if not specified, were presented as the cumulative averages, using all results from baseline to the last visit or the date of new-onset diabetes, to represent long-term dietary intake status and minimize within-person variation.

We used the MDA score scale proposed by Trichopoulou [24, 32]. This scale includes nine components: vegetables, legumes, fruits, nuts, cereals, fish, meat, dairy products, and alcohol. Values of 0 or 1 were assigned to each of the components, using the sex-specific median values for the participants as cutoffs for all components except for alcohol and dairy. For the six components presumed to be beneficial (vegetables, legumes, fruits, nuts, cereals, and fish), participants whose intake was at or above the sex-specific medians were assigned a value of 1, while those whose intake was below these medians were assigned a value of 0. For meat, a value of 0 was assigned to participants whose intake was above the median, while those whose intake was below the sex-specific median were assigned a value of 1. For alcohol intake, a value of 1 was assigned to men who consumed 10–50 g/day and women who consumed 5–25 g/day. For dairy products, a value of 1 was assigned to those whose daily intake

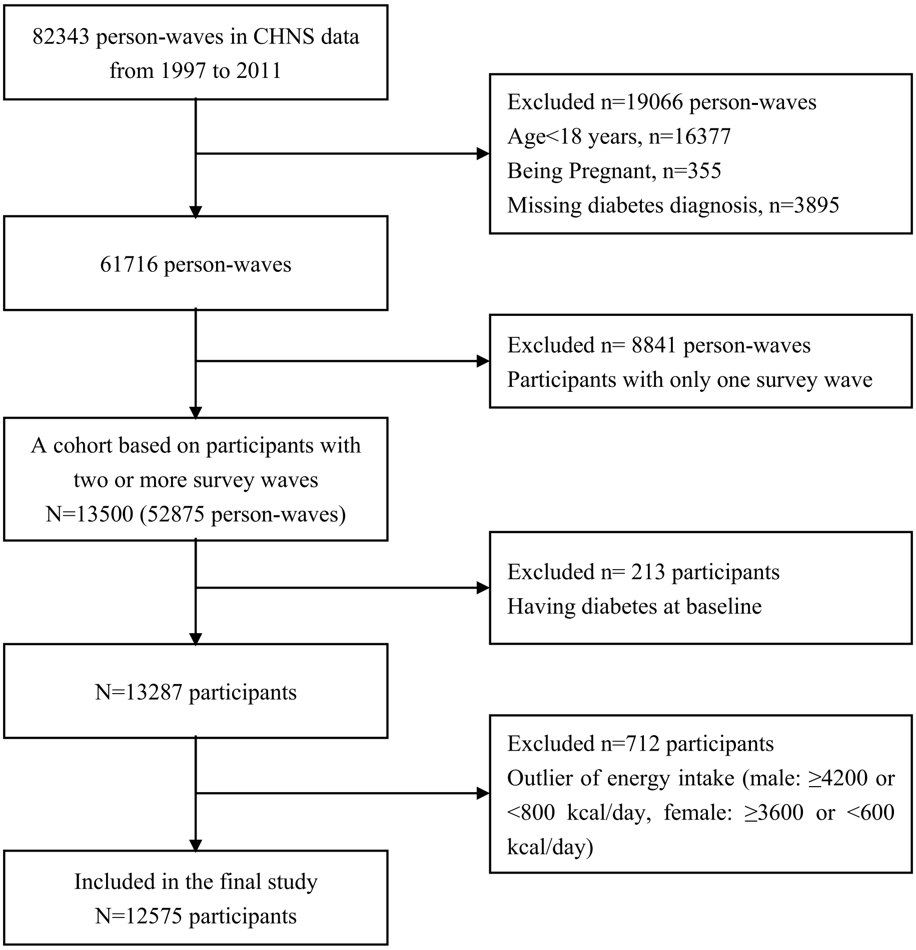


**Fig. 1** Flow chart of the study participants

was between 5 and 25 g. The scores of the nine categories were summed. The total range of the MDA score was from 0 to 9. The MDA score was calculated for all individuals upon recruitment. MDA was categorized into three levels, below the median (score 0–3), median (score 4), or above the median (score 5–9) [33], using the low level as the reference level.

### Assessment of other covariates

Information on age, sex, body mass index (BMI), urban or rural residence, region, education level, occupation, income, physical activity, smoking status and cumulative average total energy intake was obtained from the questionnaires at each follow-up survey. Height and weight were measured following a standard procedure with calibrated equipment. BMI was calculated as weight (kg) by height squared ($m^2$). The level of physical activity was the product of the self-reported time spent in each activity multiplied by specific metabolic equivalent (MET) values [34]. For all the nondietary covariates, we used the baseline year measurements. The cumulative average total energy intake was calculated using 3-day average intakes of dietary intake in each round.

### Study outcome

Diabetes status was identified by a questionnaire-based interview at each follow-up. In the physical examination questionnaire, two questions were used to collect diabetes diagnosis data: (a) Has the doctor ever told you that you suffer from diabetes? If yes, (b) did you use any of the following treatment methods? (1) special diet, (2) weight control, (3) oral medicine, (4) injection of insulin, (5) Chinese traditional medicine, (6) home remedies, and (7) Qi Gong (Spiritual). The participants who answered yes to the question “a” were classified as diabetes cases in the primary analysis. In CHNS, data of blood glucose and HbA1c were only available in the wave of 2009. To test the reliability of self-reported diagnosis, we used two more criteria defining diabetes cases in sensitivity analysis, which were (1) self-reported cases based on the question "a" and cases identified based on blood glucose and HbA1c (fasting blood glucose ≥ 7.0 mmol/L or HbA1c ≥ 6.5%) in the wave of 2009, and 2) cases using oral hypoglycemic medicine or insulin injection based on question "b" [35].

### Statistical analysis

The population characteristics are presented as the means ± standard deviations (SDs) or medians (IQRs) for continuous variables and proportions for categorical variables. Differences in population characteristics by MDA scores were compared using one-way ANOVA tests, Kruskal–Wallis test, or chi-square tests, accordingly.

The year of each participant's first entry into the survey was considered as a baseline. The follow-up person-time for each participant was calculated from baseline until the first new-onset diabetes diagnosis, the last survey round before the participant departed from the survey, or the end of the latest survey (2011), whichever came first. Participants were censored on the date of the last survey round before the participant departed from the survey or the end of the latest survey. The incidence rates of new-onset diabetes, expressed as person-years, were calculated as the sum of follow-up years for participants.

Variables that are known to be traditional or suspected risk factors for diabetes or variables that showed significant differences among different MDA score levels were chosen as the covariates in the adjusted models. The relationships between the MDA score and new-onset diabetes were estimated using Cox proportional hazards models. Model 1 included adjustments for age and sex. Model 2 included the adjustments in Model 1 plus BMI, occupation, education level, region, smoking status, urban or rural residence, income, physical activity (low, moderate, high) at baseline, and cumulative average total energy intake. We also used restricted cubic splines (RCS) with 3 knots to explore the potentially non-linear relationship of MDA score with new-onset diabetes with adjustments in Model 2. Moreover, possible modifications of the association between MDA score and new-onset diabetes were evaluated by stratified analyses and interaction testing. Those with missing values of covariates were excluded from the main analysis. A series of sensitivity analyses were conducted to test the robustness of our findings, such as (1) both self-reported cases and cases diagnosed by blood glucose and HbA1c in the wave of 2009 were defined as diabetes cases, (2) only cases taking oral hypoglycemic medicines or insulin injection were defined as diabetes cases, (3) multiple imputations were also used to handle missing covariates.

A two-sided $P$ value $< 0.05$ was considered to indicate statistical significance in all analyses. All the statistical analyses were conducted using Stata 17 and R version 3.6.3.

## Results

### Characteristics of the study population

As demonstrated in Table S1, the final analysis cohort included a total of 12,575 participants. The mean age of the participants was 42.5 (15.2) years, and 51.4% were females. The mean MDA score of the participants was 2.9 (1.3), and they were categorized into below-median (MDA scores 0–3), median (MDA scores 4), and above-median (MDA scores 5–9) groups based on their MDA scores. Table 1 suggests that participants within the above median MD (scores 5–9) were more likely to be younger, to be farmers, less likely to live in urban and southern regions, and had a higher BMI, physical activity levels, and energy intake, as well as lower educational levels.

### Relationships between the MDA score and new-onset diabetes

Among the 12,575 participants included, during a median follow-up duration of 9.0 years (interquartile range: 5 to 14 years), 445 participants (3.5%) developed new-onset diabetes. Overall, there was an inverse association between the MDA score and new-onset diabetes (per score increment, Model 2 HR 0.83, 95% CI 0.76–0.90) (Fig. 2**,** Table 2). Accordingly, when the MDA score was assessed by quartile, compared with those in the first quartile (< 3), a significantly lower risk of new-onset diabetes was found in participants in quartiles 2–4 (Q2: Model 2 HR 0.69, 95% CI 0.54–0.89; Q3: Model 2 HR 0.65, 95% CI 0.50–0.86; Q4: Model 2 HR 0.48, 95% CI 0.34–0.69; P for trend < 0.001) (Table 2). In addition, Cox regression analysis revealed that a higher MDA score (median and above median) was significantly associated with a risk of new-onset diabetes (Table 2). High MDA was still associated with a reduced risk of new-onset diabetes after the exclusion of early new-onset diabetes that occurred within the first 2 years after enrollment (Table S2). Sensitivity analyses using different criteria for diabetes case identification and multiple imputations to handle missing covariates showed consistent findings, underscoring the reliability of our findings (Table S3).

### Subgroup analysis

We included interaction terms for the MDA score and age, sex, BMI, and energy intake in our models (Table S4). The results indicated that age, sex, BMI, and energy intake significantly modified the association between the MDA score and the risk of new-onset diabetes (all P interactions < 0.05). Therefore, we conducted a stratified analysis to explore the association between

**Table 1** Baseline population characteristics in different Mediterranean diet score groups

| | MDA (Below Median) (Score 0–3) | MDA (Median) (Score 4) | MDA (Above Median) (Score 5-9) | *P value* |
|---|---|---|---|---|
| **N** | 8577 | 2621 | 1377 | |
| **Age, years** | 43.0 (15.9) | 41.4 (13.7) | 41.8 (12.9) | <0.001 |
| **Female, No. (%)** | 4506 (52.5%) | 1278 (48.8%) | 681 (49.5%) | <0.001 |
| **Body mass index, kg/m$^2$** | 22.16 (20.24, 24.57) | 22.13 (20.37, 24.63) | 22.47 (20.51, 24.66) | 0.008 |
| **Physical activity, MET-hours/week** | | | | <0.001 |
| Low | 3156 (36.8%) | 764 (29.1%) | 347 (25.2%) | |
| Moderate | 2861 (33.4%) | 865 (33.0%) | 414 (30.1%) | |
| High | 2560 (29.8%) | 992 (37.8%) | 616 (44.7%) | |
| **Urban residents, No. (%)** | 5552 (64.7%) | 1705 (65.1%) | 844 (61.3%) | 0.035 |
| **Smoking status, No. (%)** | | | | 0.46 |
| Never | 5876 (68.7%) | 1755 (67.1%) | 936 (68.1%) | |
| Former | 127 (1.5%) | 34 (1.3%) | 17 (1.2%) | |
| Current | 2555 (29.9%) | 826 (31.6%) | 422 (30.7%) | |
| **Regions, No. (%)** | | | | <0.001 |
| Central | 3611 (42.1%) | 1264 (48.2%) | 783 (56.9%) | |
| North | 1627 (19.0%) | 617 (23.5%) | 357 (25.9%) | |
| South | 3339 (38.9%) | 740 (28.2%) | 237 (17.2%) | |
| **Occupation, No. (%)** | | | | <0.001 |
| Unemployed | 2413 (28.5%) | 529 (20.3%) | 245 (17.9%) | |
| Farmer | 2969 (35.0%) | 1167 (44.9%) | 685 (50.1%) | |
| Worker | 1573 (18.6%) | 458 (17.6%) | 209 (15.3%) | |
| Other | 1521 (17.9%) | 447 (17.2%) | 228 (16.7%) | |
| **High school or above, No. (%)** | 2044 (24.4%) | 575 (22.4%) | 290 (21.4%) | 0.013 |
| **Income** | | | | 0.36 |
| Low | 2799 (33.0%) | 871 (33.4%) | 477 (34.9%) | |
| Moderate | 2823 (33.3%) | 858 (32.9%) | 467 (34.2%) | |
| High | 2847 (33.6%) | 877 (33.7%) | 422 (30.9%) | |
| **Dietary intake** | | | | |
| Energy, kcal/day | 2154.8(1771.5,2568.0) | 2360.9(1920.0, 2792.8) | 2344.9(1970.8,2766.9) | <0.001 |

Values are presented as mean (standard deviation) or median (interquartile range [IQR]) for continuous variables, and proportions for categorical variables, respectively

median MDA score and new-onset diabetes in different subgroups. The results revealed that the association between median MDA score and new-onset diabetes remained statistically significant only among people with BMI $< 24$ kg/m$^2$ (Model 2 HR 0.63, 95% CI,0.41–0.98) and energy intake $< 2220$ kcal/day (Model 2 HR 0.60, 95% CI 0.41–0.87), while the association between above median MDA score and new-onset diabetes was not statistically significant among women (Model 2 HR 0.62, 95% CI 0.38–1.01) and energy intake $\geq 2220$ kcal/day (Model 2 HR 0.68, 95% CI 0.42–1.08). Furthermore, we also used restricted cubic splines (RCS) with 3 knots to explore the potentially non-linear relationship of MDA score with new-onset diabetes in different subgroups. Overall, there was no non-linear relationship between MDA score with new-onset diabetes in all subgroups (All non-linearity $P > 0.05$). Notably, an inverse association between the MDA score and new-onset diabetes was observed in all subgroups (Fig. 3).

### Associations of individual food components of the Mediterranean diet with new-onset diabetes

To examine in depth the association between Mediterranean diet components and new-onset diabetes, Cox regression analysis was utilized. Among the components of the MED diet, greater fruit, fish, and nut intake was significantly associated with a lower risk of new-onset diabetes after adjustment for age, sex, BMI, occupation, education level, region, smoking status, urban or rural residence, income, physical activity (low, moderate, high) at baseline, and cumulative average total energy intake. (Fig. 4).

**Table 2** The association between MDA and new-onset diabetes

| | No. of case | Person-years | Model 1 HR (95%CI) | *P value* | Model 2 HR (95%CI) | *P value* |
|---|---|---|---|---|---|---|
| **Continuous (per score increment)** | 445 | 114184 | 0.91 (0.84,0.98) | 0.009 | 0.83 (0.76,0.90) | <0.001 |
| **Quartile** | | | | | | |
| Q1(<3) | 171 | 36798 | Ref | | Ref | |
| Q2(3) | 126 | 35528 | 0.81 (0.64,1.02) | 0.070 | 0.69 (0.54,0.89) | 0.004 |
| Q3(4) | 102 | 26409 | 0.89 (0.70,1.14) | 0.371 | 0.65 (0.50,0.86) | 0.002 |
| Q4(>4) | 46 | 15449 | 0.65 (0.47,0.90) | 0.010 | 0.48 (0.34,0.69) | <0.001 |
| *P* for trend | | | | 0.023 | | <0.001 |
| **Categories** | | | | | | |
| MDA (below median) | 297 | 72326 | Ref | | Ref | |
| MDA (median) | 102 | 26409 | 0.99 (0.79,1.24) | 0.906 | 0.79 (0.62,1.01) | 0.059 |
| MDA (above median) | 46 | 15449 | 0.72 (0.52,0.98) | 0.037 | 0.59 (0.42,0.82) | 0.002 |

Model 1: Adjusted for age, and sex

Model 2: Adjusted for age, sex, BMI, occupations, education level, region, smoking status, urban or rural residents, income, physical activity (low, moderate, high) at baseline, as well as cumulative average total energy intake

*CI* Confidence interval, *HR* Hazard ratio, *MDA* Mediterranean diet adherence

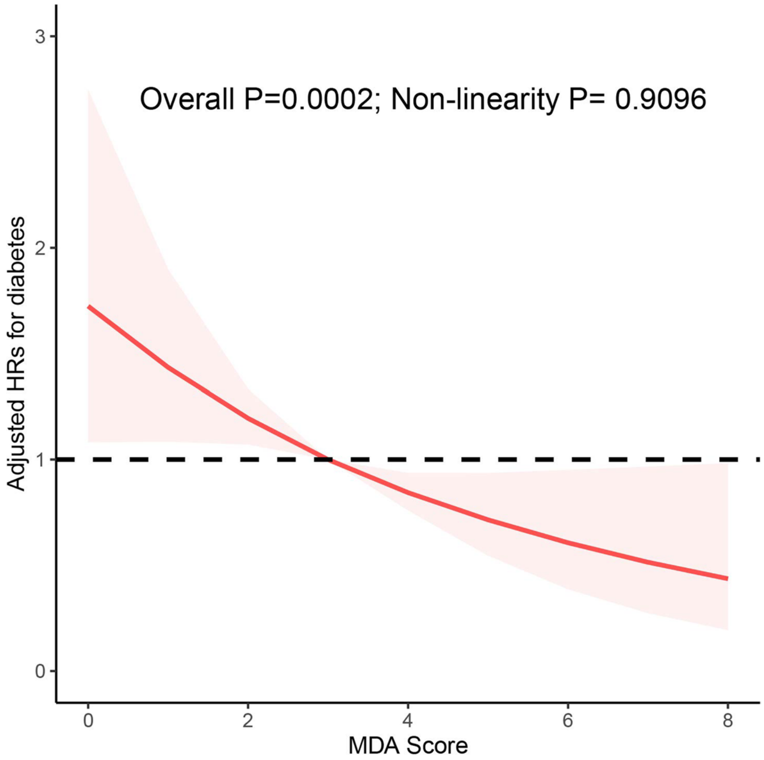


**Fig. 2** The association between the MDA score and new-onset diabetes. Adjusted for age, sex, BMI, occupation, education level, region, smoking status, urban or rural residence status, income, physical activity (low, moderate, high) at baseline, and cumulative average total energy intake. Overall *P* = 0.0002; Nonlinearity *P* = 0.9096

## Discussion

Our findings suggested an inverse association between the Mediterranean diet score and the risk of new-onset diabetes in the general Chinese population. Additionally, our results indicated that age, sex, BMI, and energy intake significantly modify the association between the MDA score and the risk of new-onset diabetes. An inverse association between the MDA score and new-onset diabetes was observed in all subgroups, but the association between above-median MDA score and new-onset diabetes was not statistically significant among women. Among the components of the MDA diet, greater fruit, fish, and nut intake was significantly associated with a lower risk of new-onset diabetes.

Our study utilized the CHNS database, a large-scale national cohort covering multiple provinces and cities in China, to confirm and explore the relationship between MDA and diabetes risk in the Chinese population. The Mediterranean diet, a healthy eating pattern, has been proven to be associated with a reduced risk of diabetes [10]. However, most studies assessing the health benefits of the Mediterranean diet have been conducted in Mediterranean countries [7, 8], with few focusing on the Chinese population. Research in the Singaporean Chinese population suggests that the Mediterranean diet can lower diabetes risk [12], but due to dietary variations resulting from geographical and social environmental differences [36], it is debatable whether these findings can be generalized to the mainland Chinese population. The metabolic benefits of the Mediterranean diet in mainland China are also controversial. An RCT showed that an energy-restricted Mediterranean diet could reduce weight and improve glycemic control in adults with prediabetes [22]. There are also studies indicating that greater MDA in Chinese adults is associated with protective correlations with bone mineral density (BMD) [23] and hypertension [24]. However, a multiethnic case–control study revealed no association between the first acute myocardial infarction (FAMI) Mediterranean diet score and the incidence of ST-elevation myocardial infarction (STEMI) in the Chinese population [37]. In a cross-sectional study targeting the suburban population of Shanghai, no significant correlation was detected between MD and metabolic syndrome (MetS) [38]. Therefore, our study, using a large Chinese prospective cohort, confirmed that the Mediterranean diet could reduce the risk of diabetes in the Chinese population and has greater significance for the prevention of diabetes.

We found that although an inverse relationship between MDA scores and the incidence of new-onset diabetes was observed in both men and women, in women, MDA scores above the median did not show a significant association with new-onset diabetes. This suggests potential sex-specific responses to the Mediterranean diet intervention in the Chinese population. Similar phenomena have also been observed in studies from other countries. Research indicates that, compared to a Mediterranean diet, a Mediterranean diet has more favorable effects on men's weight [39], waist circumference [39, 40], glucose-insulin balance [41, 42], TAG levels, and high-density lipoprotein cholesterol [39, 40]. Moreover, adherence to the Mediterranean diet leads to a significant decrease in adiponectin concentration [43] and a more favorable redistribution of LDL subclasses from smaller to larger LDL in men only [44]. Our findings, highlighting the interplay between diet and sex-specific responses, may help personalize dietary interventions and contribute to overall health and well-being.

Our study revealed that greater fruit, fish, and nut intake was significantly associated with a lower risk of new-onset diabetes. Fruits are rich in fiber and antioxidants and may prevent type 2 diabetes by reducing the risk of weight gain and improving insulin sensitivity [45–48]. Nuts and seeds, which are recommended daily snacks in the Mediterranean diet, reduce oxidative stress and improve vascular endothelial function [45, 49], thereby improving the lipid profile and reducing insulin resistance [50]. The ability of unsaturated fatty acids such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) to prevent diabetes in fish may be due to improvements in insulin function [51, 52]. Considering the relative lack of intake of these foods in the Chinese population, our findings could help to promote the use of such foods, thereby reducing the risk of diabetes.

Our study involved a relatively large-scale, nationally prospective cohort of the Chinese general population. Repeated measurements of 3 days of 24-h recall data were used to represent long-term dietary intake status and minimize within-person variation, and adjustments were made for a comprehensive range of covariates and multiple sensitivity analyses and subgroup analyses to ensure the robustness of the study findings. However, some limitations need to be mentioned. First, diabetes cases were self-reported in the CHNS, which may underestimate diabetes incidence. Although two sensitivity analyses using different diagnostic criteria for

(See figure on next page.)

**Fig. 3** The association between the MDA score and new-onset diabetes in different subgroups. Adjusted for age, sex, BMI, occupation, education level, region, smoking status, urban or rural residence status, income, physical activity (low, moderate, high) at baseline, and cumulative average total energy intake. **a** Male: overall $P = 0.0076$; nonlinearity $P = 0.3544$; **b** female: overall $P = 0.0170$; nonlinearity $P = 0.3528$; **c** age < 60: overall $P = 0.0107$; nonlinearity $P = 0.8596$; **d** age ≥ 60: overall $P = 0.0115$; nonlinearity $P = 0.7829$; **d** BMI < 24 kg/m$^2$: overall $P = 0.0047$; nonlinearity $P = 0.3841$; **d** BMI ≥ 24 kg/m.$^2$: overall $P = 0.0160$; nonlinearity $P = 0.1940$; **g** energy intake < 2220 kcal/d: overall $P = 0.0183$; nonlinearity $P = 0.3235$; **d** energy ≥ 2220 kcal/d: overall $P = 0.0023$; nonlinearity $P = 0.2545$

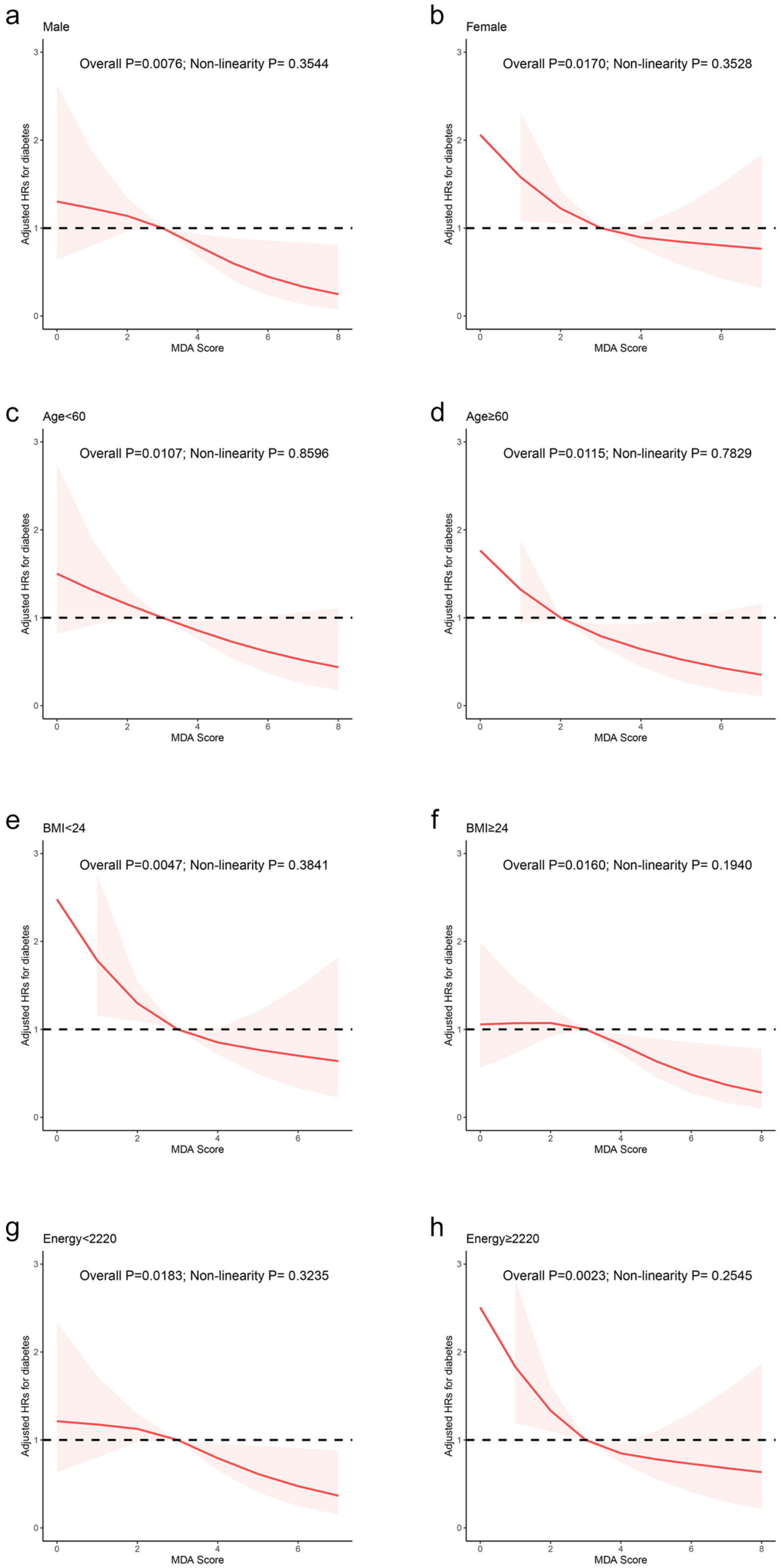
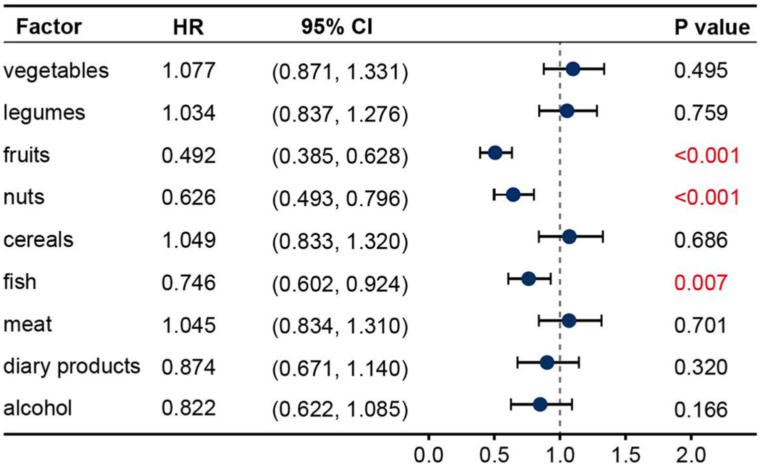


**Fig. 3** (See legend on previous page.)



| Factor | HR | 95% CI | P value |
|---|---|---|---|
| vegetables | 1.077 | (0.871, 1.331) | 0.495 |
| legumes | 1.034 | (0.837, 1.276) | 0.759 |
| fruits | 0.492 | (0.385, 0.628) | <0.001 |
| nuts | 0.626 | (0.493, 0.796) | <0.001 |
| cereals | 1.049 | (0.833, 1.320) | 0.686 |
| fish | 0.746 | (0.602, 0.924) | 0.007 |
| meat | 1.045 | (0.834, 1.310) | 0.701 |
| diary products | 0.874 | (0.671, 1.140) | 0.320 |
| alcohol | 0.822 | (0.622, 1.085) | 0.166 |

**Fig. 4** Forest plot of Cox regression analysis of Mediterranean diet components and new-onset diabetes

diabetes showed consistent findings, the bias caused by self-reported diabetes cannot be ignored. Second, compared with excluded individuals, those included in the current study (Table S1) seemed to have greater physical activity and energy intake, lower education levels, greater likelihood of being current smokers, and lived in urban areas. Although we fully adjusted for these potential covariates and did not find any significant modification effects, unmeasured and residual confounding factors remain possible. Third, information about the family history of diabetes was unavailable in the CHNS; therefore, we could not examine whether the history of diabetes may have affected our findings. Overall, further studies are still needed to confirm these results.

## Conclusion

In summary, this study demonstrates that there is an inverse association between adherence to the Mediterranean diet and new-onset diabetes in general Chinese adults. If further confirmed, these findings are beneficial for promoting the prevalence of the Mediterranean diet in the Chinese population and have the potential to identify populations better suited to the Mediterranean diet, enabling personalized nutritional support and contributing to the primary prevention of diabetes mellitus.

## Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12937-024-01036-x.

Supplementary Material 1.

### Authors' contributions

ZY, MF and JL designed the research. FZ, PW, and YX provided data analysis support. ZY and MF wrote the manuscript and revised the paper. All authors read and approved the final manuscript.

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### Data availability

No datasets were generated or analysed during the current study.

## Declarations

### Ethics approval and consent to participate

The institutional review boards of the University of North Carolina at Chapel Hill, the National Institute of Nutrition and Food Safety, and the Chinese Center for Disease Control and Prevention approved the study. Each participant provided written informed consent.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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