· Investigation ·

A cross-sectional study of the association between dietary inflammatory index and glaucoma prevalence in a US population

Wen-Li Chen[1], *Li-Xia Zhang*[2]

[1]Department of Ophthalmology, Zhejiang Chinese Medical University Affiliated Wenzhou Hospital of Integrated Traditional Chinese and Western Medicine, Wenzhou 325000, Zhejiang Province, China

[2]Eye Hospital, China Academy of Chinese Medical Sciences, Beijing 100040, China

Correspondence to: Li-Xia Zhang. Eye Hospital, China Academy of Chinese Medical Sciences, No.33 Lugu Road, Shijingshan District, Beijing 100040, China. zhanglixia77@126.com

Received: 2024-01-16 Accepted: 2024-04-12

Abstract

● **AIM:** To assess the relationship between dietary inflammatory index (DII) and prevalence of glaucoma among individuals aged 40y and above in the United States.

● **METHODS:** Participants were drawn from 2 cycles of the National Health and Nutrition Examination Survey (NHANES, 2005-2008) for a cross-sectional study. DII was calculated from 24-hour dietary recall questionnaire conducted by experienced researchers and data analyzed in R according to the NHANES user guide, “Stratified Multi-stage Probability Sampling”. The relationship between DII and glaucoma was evaluated by multi-factor logistic regression analysis and the existence of a non-linear association examined by restricted cubic spline (RCS) analysis.

● **RESULTS:** A total of 5359 subjects were included and the cross-sectional analysis weighted to represent the US population of 109 million. DII was elevated in glaucoma patients (P<0.001) and smoking and alcohol use contributed to significant differences (P<0.001). DII correlated negatively with Healthy Eating Index (HEI)-2015 (Spearman rank correlation coefficient, r=-0.49). RCS analysis showed a linear relationship between DII and glaucoma risk (P of non-linear relationship =0.575).

● **CONCLUSION:** An increased DII is strongly associated with high risk of glaucoma and diet-induced inflammation should be controlled to delay glaucoma progression.

● **KEYWORDS:** glaucoma risk factors; dietary inflammatory index; National Health and Nutrition Examination Survey; restricted cubic spline regression; cross-sectional study

DOI:10.18240/ijo.2025.01.17

Citation: Chen WL, Zhang LX. A cross-sectional study of the association between dietary inflammatory index and glaucoma prevalence in a US population. *Int J Ophthalmol* 2025;18(1):139-145

INTRODUCTION

Glaucoma involves progressive loss of retinal ganglion cells (RGCs) and axons and is characterized by changes to the optic nerve head and shrinking visual fields, leading to irreversible blindness[1]. Meta-analysis suggests that the number of glaucoma patients will expand from the current 76.5 million to 111.8 million by 2040 due to aging of the global population[2]. The precise pathogenesis of visual loss due to glaucoma remains uncertain but increased intraocular pressure (IOP) has been confirmed by basic and clinical research as a risk factor for disease progression[3-4]. Treatment for IOP fails to halt the progression of optic nerve damage in some patients, and the search for treatments to reduce damage due to glaucoma remains urgent[5].

Inflammatory factors are thought to influence optic nerve damage due to glaucoma and inflammation of ocular structures from the ocular surface to the posterior segment of the eye and along the visual pathway may be involved[6]. Neuroinflammation may influence the initial stages of glaucoma and its progression, being exacerbated by chronic high IOP[7]. Increased expression of retinal pro-inflammatory factors, tumor necrosis factor (TNF)-α, interleukin (IL)-1β, IL-6 and IL-12, is a consequence of optic nerve damage and disease management and prevention strategies designed to delay inflammatory changes to the glaucomatous optic nerve are appropriate[8].

No previous study of glaucoma risk factors has assessed the association with dietary inflammatory index (DII), although retinal neuropathy is known to be linked to inflammatory status. A text mining analysis of the publicly available National

Health and Nutrition Examination Survey (NHANES) database has been undertaken to evaluate the association between dietary inflammatory potential and glaucoma. A positive relationship between glaucoma and DII is hypothesized.

PARTICIPANTS AND METHODS

Ethical Approval The NCHS research Ethics Review Board (ERB) approved the NHANES study protocol, and participants provided written informed consent at enrollment. The NCHS IRB/ERB protocol numbers of 2005-2008 National Health and Nutrition Survey are "Protocal#2005-06" and "Continuation of Protocal#2005-06" (https://www.cdc.gov/nchs/nhanes/irba98.htm).

Study Design and Population NHANES is a multistage, nationally representative cross-sectional study of the health and nutritional status of adults and children in the US. Representative participants were screened out by the stratified multistage probability sampling method described on the NHANES website. Information was compiled from in-home interviews and mobile examination center visits and released by the Centers for Disease Control and Prevention in 2-year cycles starting in 1999[9]. Participants (2005-2008) gave information on first-day total nutrient intake and glaucoma diagnosis. Subjects under the age of 40 were excluded.

Demographic information, age, sex, race, education, poverty and smoking status, was collated by computer-assisted personal interview system administered by trained interviewers and body mass index (BMI), blood pressure (BP) and total cholesterol calculated from examination center data.

Dietary Inflammatory Index The DII was calculated from 24h dietary data collected on day one and types and amounts of foods and beverages consumed during the previous 24-hour period (midnight to midnight) collected by the mobile examination center. A higher positive DII value indicated a pro-inflammatory diet and a lower negative value an anti-inflammatory diet.

Shivappa *et al*'s[10] scheme, which examines 45 nutrients of known inflammatory impact, was used to calculate the DII. The current study used 28 of the 45 NHANES dietary parameters, including intakes of carbohydrates, protein, total fat, alcohol, dietary fiber and cholesterol. Previous studies have shown that the predictive power of the DII is not impaired by the inclusion of fewer than 30 food parameters[11]. A pro-inflammatory diet may increase circulating levels of IL-1β, IL-6, TNF-α or C-reactive protein or decrease levels of IL-4 and IL-10. DII was first analyzed as a continuous variable and quartile ranking performed. Participants were divided into Q1: DII≤0.41, Q2: 0.41<DII≤1.86, Q3: 1.86<DII≤3.05 and Q4: DII>3.05. The Healthy Eating Index (HEI) was also calculated to assess the alignment of the diet with the key recommendations of the public health initiative, Dietary Guidelines for Americans[12]. HEI values range from 0 (poor diet) to 100 (good diet).

Definition of Glaucoma The study outcome was a diagnosis of glaucoma, assessed by questionnaire and ophthalmic imaging[13]. Self-reported glaucoma prevalence was assessed in subjects >40y *via* the question: "Have you ever been told by an eye doctor that you have glaucoma, sometimes called high pressure in your eyes?". Respondents answering "Yes" were included. Considering the limitations of self-reported, ophthalmic imaging were later included as an effective supplement for glaucoma diagnosis. Digital images with a cup-to-disc ratio greater than or equal to 0.6 were re-read by ophthalmologists from Johns Hopkins University with attention to glaucoma features in 2012 and graded: no, possible, probable, definite or unable to assess. Grades were assigned to an image if at least 2 of 3 graders provided the same grade and the third grader was within 1 level. Subjects with probable or definite glaucoma in either eye were categorized as having disc-defined glaucoma[14]. Visual field abnormality (eye-specific) was defined using a 2-2-1 algorithm, incorporating reliability indices, to identify subjects as normal or positive or with insufficient or unreliable data for assessment[15]. Self-reported use of topical glaucoma treatments in the 30d prior to the interview, including topical beta-blockers, was also recorded. In summary, subjects with a test report indicating the risk of glaucoma were regarded as likely to have glaucoma.

Study Covariates Continuous covariates of age, BMI, poverty, total cholesterol, DII, energy intake and HEI, and categorical covariates of sex, educational status, race, hypertension and diabetes mellitus (DM), were identified as relevant to the association between glaucoma risk and DII. Race was categorized as Mexican American, non-Hispanic Black, non-Hispanic White, other Hispanic and other race. DM was defined as a self-reported history of diabetes, including use of oral hypoglycemic drugs or insulin with standardized indicators of hemoglobin A1c (HbA1c) ≥6.5%, and fasting blood glucose ≥126 mg/dL[16].

Statistical Analysis The analysis was weighted according to the guidance given by the official NHANES website. Complex multistage cluster survey designs were taken into account. Continuous and categorical variables are presented as mean±standard error (SE) and number/percentage (%), respectively. Intergroup differences in baseline characteristics were compared using the weighted Student's *t*-test (continuous variables) or weighted Chi-squared test (categorical variables). Three models were constructed. Model 1 included no adjustment for covariates. Model 2 was adjusted for race/ethnicity, poverty, sex, age and education in addition to the covariates. Model 3 included further adjustment for DM, smoking and alcohol intake in addition to the covariate adjustment of model 2. Any association between DII and HEI was assessed using the Spearman method with a marginal effects model and results visualized by "ggplot2" package. Restricted cubic spline (RCS) analysis was used to assess dose-response relationships between continuous variables and outcomes. All analyses were performed with R version 4.2.3 using the "survey" package. A value of P<0.05 was considered statistically significant.

RESULTS

Baseline Characteristics A total of 5359 participants from NHANES (2005-2008) were included to represent the 109 million inhabitants of the United States of whom 771 (14.39%) had a diagnosis of glaucoma (Figure 1 and Table 1).

Totally 2662 (49.67%) were female, non-Hispanic whites made up the highest proportion of 2935 (54.77%) and mean age was 56.68±0.42y. Significant differences in demographic and baseline clinical characteristics between glaucoma patients and non-glaucoma controls were observed. Those with glaucoma-related optic nerve damage were older than controls (64.02 *vs* 55.80y), had lower economic status (2.86 *vs* 3.34) and lower educational level. Glaucoma patients also had higher systolic blood pressure (131.23 *vs* 125.72 mm Hg) and lower diastolic blood pressure (68.43 *vs* 72.26 mm Hg). Chronic smokers and drinkers had an increased risk of glaucoma (all P<0.001).

Glaucoma patients had higher DII of 1.75±0.10 *vs* 1.42±0.06 and were more likely to develop visual field impairment.

Characteristics According to DII Quartiles Mean DII was +1.45±0.06 with range from -5.10 (most anti-inflammatory) to +5.07 (most pro-inflammatory). A higher DII score was associated with higher BMI, systolic blood pressure (SBP), greater likelihood of poor lifestyle habits, lower percentage of males, college education level, lower household income and lower energy intake (P<0.05). Age, total cholesterol and DM did not show significant associations (P>0.05; Table 2).

Trends in the Association Between DII and Glaucoma Risk Logistic regression analysis showed that the continuous DII variable was associated with glaucoma incidence. DII correlated positively with glaucoma risk in Q3 [odds ratio (OR): 1.42; 95% confidence interval (CI): 1.07-1.89] to Q4 [OR: 1.64 (95%CI: 1.30-2.07)] compared with Q1 in model 1. DII also correlated positively with glaucoma risk in Q4 compared with Q1 in model 2 [OR: 1.39 (95%CI: 1.01-1.92)]. However, DII adjusted for model-related covariates did not show a significant positive correlation with glaucoma prevalence in model 3. A significant dose-response relationship was found in models 1 and 2 (P-trend<0.05), suggesting a significant increase in glaucoma-related visual impairment due to an increasingly pro-inflammatory dietary intake.

Spearman Correlation Analysis Between DII and HEI The correlation between DII and the metric of dietary quality, HEI, were analyzed (Figure 2). Spearman correlation analysis showed a negative correlation between DII and HEI (r=-0.49, P<0.001). Multivariate logistic regression analysis using DII as a risk factor showed correlation with glaucoma prevalence after adjustment for confounders (Table 3). DII is known to have an impact on inflammatory outcomes and changes in dietary structure may constitute a predictor and controllable indicator of glaucoma.

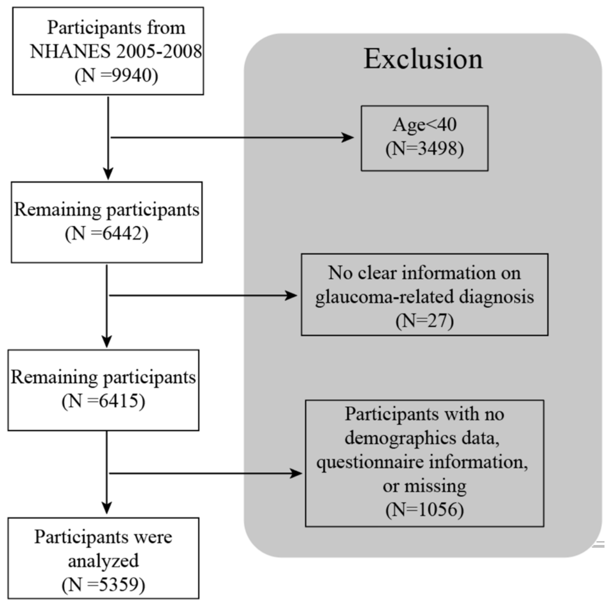

Figure 1 Flow chart of participant inclusion.

RCS Analysis of the Association of DII with Glaucoma Risk RCS analysis showed a linear association between DII and glaucoma prevalence (P for non-linear=0.575; Figure 3). A DII value of less than 0 was associated with low glaucoma risk; a DII value between 0 and 2.5 with increased risk and a DII value of more than 2.5 with stable high glaucoma risk. In conclusion, a positive correlation between DII value and occurrence of glaucomatous events was shown.

DISCUSSION

A total of 5359 participants were included in the current cross-sectional, longitudinal study, of whom 771 patients were identified as having glaucoma. The involvement of chronic inflammation in pathology is increasingly recognized and inflammatory activation of microglia promotes retinal neuroinflammation[17]. The DII indicates dietary inflammatory potential and its relationship with glaucoma prevalence in the large NHANES population was assessed. The main findings may be summarized as follows: 1) glaucoma patients had significantly higher DII values than controls; 2) a linear positive correlation between DII and glaucoma prevalence existed showing the association of higher DII values with increased glaucoma risk; 3) smoking, alcohol consumption and economic status were also strongly associated with glaucoma risk. In addition, significant differences in blood pressure levels were also found between glaucoma patients and controls. However, conclusions are limited by the cross-sectional nature of the current study and prospective studies are needed

Table 1 Weighted baseline characteristics *n* (%)

Variables	All participants (*n*=5359)	Diagnosed glaucoma (*n*=771)	Non-glaucoma (*n*=4588)	*P*
Age, y, mean±SE	56.68±0.42	64.02±0.91	55.80±0.41	<0.0001
Sex				0.87
Female	2662 (49.67)	383 (52.85)	2279 (52.32)	
Male	2697 (50.33)	388 (47.15)	2309 (47.60)	
Education				<0.0001
Less than 9th grade	756 (14.11)	160 (12.31)	596 (6.27)	
9-11th grade (includes 12th grade with no diploma)	823 (15.36)	136 (14.51)	687 (10.76)	
High school graduation or equivalent	1314 (24.52)	178 (28.01)	1136 (25.82)	
College or AA degree	1354 (25.27)	182 (26.64)	1172 (28.47)	
College graduate or above	1112 (20.75)	115 (18.53)	997 (28.68)	
Race				<0.0001
Mexican American	817 (15.25)	102 (5.11)	715 (5.36)	
Non-Hispanic black	1085 (20.25)	222 (16.47)	863 (8.62)	
Non-Hispanic white	2935 (54.77)	373 (72.22)	2562 (78.35)	
Other Hispanic	352 (6.57)	58 (2.97)	294 (3.00)	
Other race	170 (3.17)	16 (3.23)	154 (4.66)	
BMI, kg/m^2, mean±SE	29.13±0.15	29.21±0.27	29.12±0.17	0.8
Total cholesterol, mg/dL, mean±SE	203.44±0.71	197.40±1.55	204.16±0.74	<0.001
Poverty, mean±SE	3.29±0.07	2.86±0.09	3.34±0.07	<0.0001
Energy intake, kcal/d, mean±SE	2095.90±22.57	1857.26±51.20	2124.43±21.95	<0.0001
SBP, mm Hg, mean±SE	126.31±0.38	131.23±0.87	125.72±0.42	<0.0001
DBP, mm Hg, mean±SE	71.85±0.31	68.43±0.85	72.26±0.31	<0.0001
DM				<0.0001
Yes	4407 (82.24)	547 (74.53)	3860 (88.15)	
No	952 (17.76)	224 (25.47)	728 (11.85)	
Smoker				<0.001
Former	1748 (32.62)	290 (37.22)	1458 (30.44)	
Never	2561 (47.79)	369 (48.57)	2192 (49.01)	
Current	1050 (19.59)	112 (14.20)	938 (20.55)	
Alcohol user				<0.0001
Former	1393 (25.99)	251 (28.57)	1142 (20.61)	
Heavy	659 (12.3)	67 (9.76)	592 (13.03)	
Mild	1838 (34.3)	223 (33.13)	1615 (40.44)	
Moderate	694 (12.95)	89 (13.23)	605 (15.04)	
Never	775 (14.46)	141 (15.31)	634 (10.89)	
HEI, mean±SE	51.51±0.42	52.10±0.87	51.44±0.41	0.38
DII, mean±SE	1.45±0.06	1.75±0.10	1.42±0.06	<0.001

DBP: Diastolic blood pressure; SBP: Systolic blood pressure; DM: Diabetes mellitus; HEI: Healthy eating index; DII: Dietary inflammatory index; SE: Standard error; AA degree: Associate of Arts degree.

to confirm the association between DII and glaucoma prevalence.

The role of dietary habits in systemic inflammation has been widely explored. The high fat and high calorie intake characteristic of the Western diet may predispose to increased systemic or local inflammation[18]. Such a diet has been associated with hyperlipidemia, hyperglycemia and activation of non-enzymatic glycosylation and inflammation-related pathways (NF-κB), excessive reactive oxygen species production and oxidative stress, leading to systemic inflammation[19]. A recent review indicated disruption of the gut microbial ecosystem by Western pro-inflammatory dietary patterns and the Mediterranean diet has been shown to be anti-inflammatory by comparison, ameliorating age-related diseases[20-21]. A negative correlation was found between DII and HEI. Pro-inflammatory diets are increasingly thought to affect cognitive and psychiatric function *via* the microbial-gut-brain axis and to exacerbate neurodegenerative diseases[22]. Improvements to dietary quality may have a significant impact on the prevention of neurodegenerative pathologies.

Table 2 Participant characteristics by DII quartile *n* (%)

Variables	Quartiles of DII				*P*
	Q1	Q2	Q3	Q4	
Age (y, mean±SE)	56.42±0.60	56.20±0.55	56.79±0.50	67.44±0.53	0.35
Sex					<0.0001
Female	520 (41.81)	582 (46.15)	721 (56.78)	839 (67.85)	
Male	821 (58.19)	757 (53.85)	618 (43.22)	501 (32.15)	
Education					<0.0001
Less than 9th grade (Includes uneducated participants)	143 (5.14)	167 (6.39)	196 (7.03)	250 (9.59)	
9-11th grade (Includes 12th grade with no diploma)	158 (9.10)	190 (9.37)	220 (12.44)	255 (14.39)	
High school grad or equivalent	302 (22.68)	310 (23.83)	335 (26.37)	367 (32.44)	
College or AA degree	362 (27.61)	354 (30.13)	343 (29.71)	295 (25.41)	
College graduate or above	376 (35.48)	318 (30.29)	245 (24.45)	173 (18.18)	
Race					0.01
Mexican American	204 (5.25)	218 (5.89)	197 (4.94)	198 (5.24)	
Non-Hispanic black	209 (6.80)	247 (8.62)	296 (10.77)	333 (12.31)	
Non-Hispanic white	803 (80.97)	739 (78.17)	713 (75.75)	680 (75.21)	
Other Hispanic	76 (2.54)	91 (3.19)	90 (3.24)	95 (3.07)	
Other race	49 (4.44)	44 (4.13)	43 (5.30)	34 (4.18)	
BMI, kg/m^2, mean±SE	28.56±0.24	29.05±0.22	29.38±0.23	29.66±0.18	0.01
Total cholesterol, mg/dL, mean±SE	200.74±1.40	204.38±1.37	203.07±1.16	206.09±1.34	0.05
Poverty, mean±SE	3.61±0.07	3.39±0.08	3.20±0.07	2.86±0.09	<0.0001
Energy intake, kcal/d, mean±SE	2701.81±44.00	2224.44±33.63	1821.20±19.19	1494.62±31.53	<0.0001
SBP, mm Hg, mean±SE	124.61±0.68	126.34±0.66	126.37±0.54	128.35±0.75	0.005
DBP, mm Hg, mean±SE	72.33±0.41	72.44±0.39	71.49±0.55	70.79±0.55	0.02
DM					0.07
Yes	1149 (88.79)	1096 (86.48)	1095 (85.96)	1067 (85.13)	
No	192 (11.21)	243 (13.52)	244 (14.04)	273 (14.87)	
Smoker					<0.0001
Former	495 (36.81)	453 (32.01)	409 (27.78)	391 (26.87)	
Never	650 (50.14)	651 (50.25)	628 (47.65)	632 (47.46)	
Current	196 (13.06)	235 (17.71)	302 (24.57)	317 (25.67)	
Alcohol user					<0.0001
Former	280 (16.24)	306 (19.79)	364 (23.16)	443 (28.00)	
Heavy	183 (12.61)	187 (14.09)	159 (13.28)	130 (10.50)	
Mild	567 (48.02)	485 (39.70)	424 (35.94)	362 (33.25)	
Moderate	166 (14.23)	173 (14.88)	199 (16.65)	156 (13.62)	
Never	145 (8.90)	188 (11.54)	193 (10.98)	249 (14.63)	
HEI, mean±SE	60.32±0.47	52.59±0.51	49.15±0.32	41.92±0.33	<0.0001
DII, mean±SE	-0.95±0.04	1.18±0.01	2.45±0.01	3.67±0.02	<0.0001

Q1 to Q4: Quartiles 1 to 4; BMI: Body mass index; DM: Diabetes mellitus; DBP: Diastolic blood pressure; SBP: Systolic blood pressure; HEI: Healthy eating index; DII: Dietary inflammatory index; SE: Standard error; AA degree: Associate of Arts degree.

RCS is used to analyze non-linear relationships between variables and outcomes. It constitutes a segmented polynomial, generally required to be continuous and second order derivable at each segmented point, to ensure the smoothness of the curve[23]. RCS analysis showed a positive association between DII and glaucoma risk. Glaucoma risk increased rapidly for DII values above 0 and maintenance of very low DII values to prevent glaucoma may be worthy of the attention of health policy makers. A traditional Mediterranean dietary pattern, characterized by a high intake of fruits, vegetables, legumes, and grains, has shown anti-inflammatory effects in comparison to typical dietary patterns consumed in North America and Northern Europe. For people at high risk of glaucoma, more vitamin C supplementation, green leafy vegetables and dietary nitrate intake can reduce the risk of glaucoma to a certain extent[24]. At the same time, adhering to a Mediterranean diet

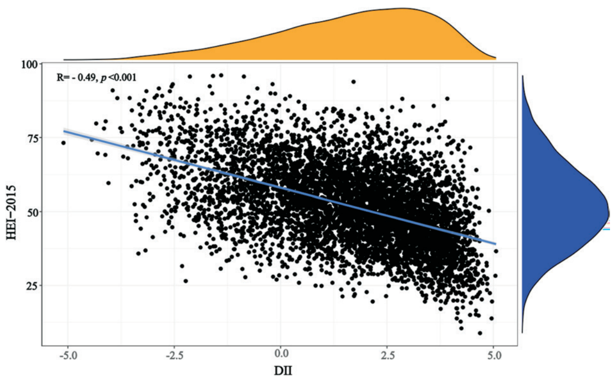

Figure 2 Visualization of Spearman correlation analysis of DII and HEI-2015.

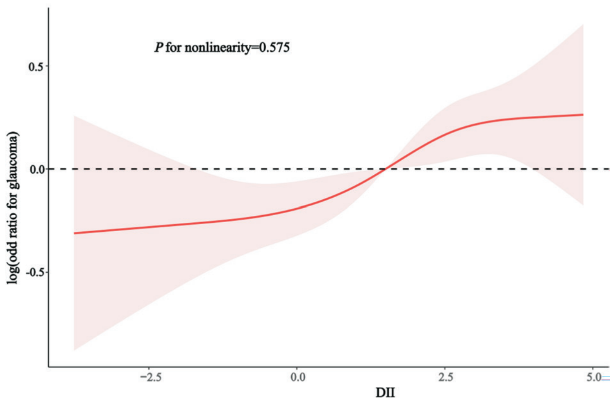

Figure 3 RCS models of the associations of DII with glaucoma risk across the entire cohort.

Table 3 Glaucoma risk by DII quartile

DII quartile (range)	OR (95%CI), weighted		
	Model 1	Model 2	Model 3
Q1 (-5.10, 0.41)	Reference		
Q2 (0.41, 1.86)	1.28 (0.98, 1.68)	1.25 (0.92, 1.69)	1.24 (0.90, 1.71)
Q3 (1.86, 3.05)	1.42 (1.07, 1.89)	1.30 (0.96, 1.76)	1.30 (0.92, 1.82)
Q4 (3.05, 5.07)	1.64 (1.30, 2.07)	1.39 (1.01, 1.92)	1.40 (0.97, 2.00)
P for trend	<0.001	0.031	0.05

Model 1: No covariate adjustment; Model 2: Adjusted for race/ethnicity, poverty, sex, age and education; Model 3: Adjusted for smoked, smoking and alcohol use in addition to adjustments given for model 2; CI: Confidence interval; OR: Odds ratio; DII: Dietary inflammatory index; Q1 to Q4: Quartiles 1 to 4.

can reduce the incidence of glaucoma, mainly because this diet is rich in nutrients (such as folic acid, vitamin E, lutein-zeaxanthin, flavonoids), which have anti-inflammatory properties and Oxidation properties[25].

We acknowledge several strengths and weaknesses to the current study. First, two cycles of the NHANES database were used giving a larger sample size than previous studies, combining a glaucoma questionnaire and imaging determination data. Second, weighted data estimation was used to overcome selection bias. Third, a novel relationship between DII and glaucoma risk was revealed. Limitations included: 1) a causal relationship between variables could not be confirmed due to the cross-sectional nature of the study; 2) a possibility of data bias arose due to the use of subjective questionnaires rather than objective measures of blood chemistry; 3) although the relationship between DII and glaucoma was established, pathogenic mechanisms remain unknown.

In conclusion, diets with a high pro-inflammatory potential, giving high DII values, are associated with increased risk of glaucoma. The current study was cross-sectional and prospective cohort studies are necessary to confirm the findings.

ACKNOWLEDGEMENTS

Foundations: Supported by the National Natural Science Foundation of China (No.82074500); CACMS Innovation Fund (No.CI2021A02605); Administration of Traditional Chinese Medicine of Zhejiang Province (No.2024ZR029); Science and Technology Program of Wenzhou City (No. Y2023210).

Conflicts of Interest: Chen WL, None; **Zhang LX,** None.

REFERENCES

1 Stein JD, Khawaja AP, Weizer JS. Glaucoma in adults-screening, diagnosis, and management: a review. *JAMA* 2021;325(2):164-174.

2 Tham YC, Li X, Wong TY, Quigley HA, Aung T, Cheng CY. Global prevalence of glaucoma and projections of glaucoma burden through 2040:a systematic review and meta-analysis. *Ophthalmology* 2014;121(11):2081-2090.

3 Mansouri K, Tanna AP, De Moraes CG, Camp AS, Weinreb RN. Review of the measurement and management of 24-hour intraocular pressure in patients with glaucoma. *Surv Ophthalmol* 2020;65(2):171-186.

4 Hoguet A, Chen PP, Junk AK, Mruthyunjaya P, Nouri-Mahdavi K, Radhakrishnan S, Takusagawa HL, Chen TC. The effect of anti-vascular endothelial growth factor agents on intraocular pressure and glaucoma: a report by the American academy of ophthalmology. *Ophthalmology* 2019;126(4):611-622.

5 Gazzard G, Konstantakopoulou E, Garway-Heath D, Adeleke M, Vickerstaff V, Ambler G, Hunter R, Bunce C, Nathwani N, Barton K, LiGHT Trial Study Group. Laser in glaucoma and ocular hypertension (LiGHT) trial: six-year results of primary selective laser trabeculoplasty versus eye drops for the treatment of glaucoma and ocular hypertension. *Ophthalmology* 2023;130(2):139-151.

6 Baudouin C, Kolko M, Melik-Parsadaniantz S, Messmer EM. Inflammation in glaucoma: from the back to the front of the eye, and beyond. *Prog Retin Eye Res* 2021;83:100916.

7 Quaranta L, Bruttini C, Micheletti E, Konstas AGP, Michelessi M, Oddone F, Katsanos A, Sbardella D, de Angelis G, Riva I. Glaucoma and neuroinflammation: an overview. *Surv Ophthalmol* 2021;66(5):693-713.

8 Socodato R, Rodrigues-Santos A, Tedim-Moreira J, Almeida TO, Canedo T, Portugal CC, Relvas JB. RhoA balances microglial reactivity and survival during neuroinflammation. *Cell Death Dis* 2023;14(10):690.

9 Dantzer J, Wood R, Buckley JP. Organophosphate pesticide exposure and atopic disease in NHANES 2005-2006. *J Allergy Clin Immunol Pract* 2021;9(4):1719-1722.e3.

10 Shivappa N, Steck SE, Hurley TG, Hussey JR, Hébert JR. Designing and developing a literature-derived, population-based dietary inflammatory index. *Public Health Nutr* 2014;17(8):1689-1696.

11 Hariharan R, Odjidja EN, Scott D, Shivappa N, Hébert JR, Hodge A, de Courten B. The dietary inflammatory index, obesity, type 2 diabetes, and cardiovascular risk factors and diseases. *Obes Rev* 2022;23(1):e13349.

12 Ertuglu LA, Demiray A, Afsar B, Ortiz A, Kanbay M. The use of healthy eating index 2015 and healthy beverage index for predicting and modifying cardiovascular and renal outcomes. *Curr Nutr Rep* 2022;11(3):526-535.

13 Qiu M, Boland MV, Ramulu PY. Cup-to-disc ratio asymmetry in U.S. adults: prevalence and association with glaucoma in the 2005-2008 national health and nutrition examination survey. *Ophthalmology* 2017;124(8):1229-1236.

14 Gupta P, Zhao D, Guallar E, Ko F, Boland MV, Friedman DS. Prevalence of glaucoma in the United States: the 2005-2008 national health and nutrition examination survey. *Invest Ophthalmol Vis Sci* 2016;57(6):2905-2913.

15 Taechameekietichai T, Chansangpetch S, Peerawaranun P, Lin SC. Association between daily niacin intake and glaucoma: national health and nutrition examination survey. *Nutrients* 2021;13(12):4263.

16 Gangat N, Szuber N, Tefferi A. JAK2 unmutated erythrocytosis: 2023 Update on diagnosis and management. *Am J Hematol* 2023;98(6):965-981.

17 Wei X, Cho KS, Thee EF, Jager MJ, Chen DF. Neuroinflammation and microglia in glaucoma: time for a paradigm shift. *J Neurosci Res* 2019;97(1):70-76.

18 Staller K, Song MY, Grodstein F, Whitehead WE, Matthews CA, Kuo B, Chan AT. Increased long-term dietary fiber intake is associated with a decreased risk of fecal incontinence in older women. *Gastroenterology* 2018;155(3):661-667.e1.

19 Christ A, Lauterbach M, Latz E. Western diet and the immune system: an inflammatory connection. *Immunity* 2019;51(5):794-811.

20 Malesza IJ, Malesza M, Walkowiak J, Mussin N, Walkowiak D, Aringazina R, Bartkowiak-Wieczorek J, Mądry E. High-fat, western-style diet, systemic inflammation, and gut microbiota: a narrative review. *Cells* 2021;10(11):3164.

21 Gao V, Long MT, Singh SR, Kim Y, Zhang XH, Rogers G, Jacques PF, Levy D, Ma JT. A healthy diet is associated with a lower risk of hepatic fibrosis. *J Nutr* 2023;153(5):1587-1596.

22 Mou Y, Du Y, Zhou LX, Yue JR, Hu XL, Liu YX, Chen S, Lin XF, Zhang GC, Xiao HY, Dong BR. Gut microbiota interact with the brain through systemic chronic inflammation: implications on neuroinflammation, neurodegeneration, and aging. *Front Immunol* 2022;13:796288.

23 Zhao FC, Li X, Wang YX, Zhou SJ, Lu Y. Relationship between acrylamide and glycidamide hemoglobin adduct levels and osteoarthritis: a NHANES analysis. *Environ Sci Pollut Res Int* 2023;30(30):75262-75272.

24 Vergroesen JE, de Crom TOE, Blekkenhorst LC, Klaver CCW, Voortman T, Ramdas WD. Dietary nitrate intake is associated with decreased incidence of open-angle glaucoma: the Rotterdam study. *Nutrients* 2022;14(12):2490.

25 Valero-Vello M, Peris-Martínez C, García-Medina JJ, Sanz-González SM, Ramírez AI, Fernández-Albarral JA, Galarreta-Mira D, Zanón-Moreno V, Casaroli-Marano RP, Pinazo-Duran MD. Searching for the antioxidant, anti-inflammatory, and neuroprotective potential of natural food and nutritional supplements for ocular health in the Mediterranean population. *Foods* 2021;10(6):1231.