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The association between dietary fiber intake and osteoarthritis: a cross-sectional study from the 1999–2018 U.S. National Health and Nutrition Examination Survey

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Abstract

Objective The relationship between dietary fiber intake and osteoarthritis (OA) remains unclear. This cross-sectional study, using data from the National Health and Nutrition Examination Survey (NHANES), aimed to examine the association between dietary fiber intake and OA.

Methods A cross-sectional analysis was conducted using NHANES data from 1999 to 2018 to assess the association between dietary fiber intake and OA. Univariate and multivariate weighted logistic regression models, along with restricted cubic spline (RCS) curves, were used to evaluate the relationship.

Results A total of 30,620 participants were included in this study, of whom 1,864 were diagnosed with OA, yielding a prevalence of 5.74%. Multivariate weighted logistic regression revealed a consistent inverse association between dietary fiber intake and OA (OR = 0.99, 95% CI: 0.97–0.99, $P = 0.018$). When dietary fiber was treated as a categorical variable, the highest quartile of intake (Q4) was associated with a 27% lower risk of OA compared to the lowest quartile (Q1) (OR = 0.73, 95% CI: 0.58–0.92, $P = 0.007$). The RCS analysis indicated a non-linear association between dietary fiber intake and OA risk (non-linear $P = 0.013$). The threshold effect interval suggested that dietary fiber intake in the range of 14.4–26.7 g was associated with a reduced risk of OA, while intake above this level did not provide significant additional protection.

Conclusion The findings demonstrate a negative linear association between dietary fiber intake and OA risk. Increasing dietary fiber consumption may reduce the risk of OA, offering potential strategies for its prevention and management. Further studies are needed to confirm these findings.

Keywords Dietary fibe, Osteoarthritis, NHANES, Cross-sectional study, RCS

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Introduction

Osteoarthritis (OA) is a degenerative joint disease primarily affecting articular cartilage, subchondral bone, and synovial membranes [14]. It is characterized by joint pain, stiffness, and functional limitations, which can significantly reduce the quality of life [12]. OA is one of the most common musculoskeletal disorders worldwide, affecting millions of adults, especially those over the age of 60 [29]. With the global population aging and obesity rates rising, the incidence of OA is expected to increase gradually [13]. By 2050, the number of people with OA is projected to nearly double, with approximately 642 million people expected to suffer from knee OA, representing a 74.9% increase [29]. The etiology of OA is multifactorial, involving genetic predisposition, mechanical stress, and systemic inflammation [10]. Several clinical studies have provided evidence that long-term consumption of ultra-processed foods can predispose individuals to a range of chronic diseases [6, 28], whereas dietary fiber intake may help reduce the inflammatory response associated with chronic inflammation [24]. Despite its prevalence and significant impact, effective preventive and therapeutic strategies for OA remain an ongoing challenge.

Diet is closely linked to a variety of diseases, and numerous studies have investigated the relationship between diet and arthritis [22, 33]. A longitudinal cohort study of 2375 patients with OA using dietary questionnaires found a significant association between specific dietary patterns and reduced knee pain, as well as improved quality of life [35]. Recent research has shown that high dietary fiber intake can modulate the gut microbiome and reduce systemic inflammation, which in turn alleviates osteoarthritic lesions through the gut-bone axis [32]. Dr. Dai et al. conducted an 8-year prospective study and found that high dietary fiber intake plays an important role in knee protection in people with a high prevalence of osteoarthritis [3]. Furthermore, obesity is a well-established risk factor for arthritis, and dietary fiber may reduce the risk of arthritis by modulating the gut microbiota to facilitate weight loss [30]. However, the relationship between dietary fiber intake and OA risk remains poorly understood, largely due to the challenges in accurately quantifying dietary fiber intake and the limited sample sizes of previous studies.

In this study, we aim to explore the association between dietary fiber intake and the prevalence of OA in U.S. adults. We analyze data from the National Health and Nutrition Examination Survey (NHANES) from 1999 to 2018 to examine this relationship.

Materials and methods

Study population and design options

NHANES is a series of cross-sectional surveys conducted by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC) [2]. The study is designed to collect data on the health, nutritional status, and behaviors of non-institutionalized adults and children in the U.S. NHANES collects this data through personal interviews, physical examinations, and laboratory assessments on demographics and dietary habits. For more information about the survey and related research data, visit the official NHANES website (https://www.cdc.gov/nchs/nhanes/). NHANES is widely used for the analysis of various diseases.

A total of 135,310 participants were enrolled in this study, and 10 NHANES data cycles (NHANES 1999–2000, 2001–2002, 2003–2004, 2005–2006, 2007–2008, 2009–2010, 2011–2012, 2013–2014, 2015–2016, 2017–2018 cycles) in which the survey was completed. Of these, we excluded 67,842 participants who lacked OA, 8201 who lacked dietary fiber, 153 for whom educational attainment was unavailable, 435 for whom marital status was unavailable, 4899 for whom poverty-to-income ratios were unavailable, 585 for whom body mass index (BMI) information was unavailable, 10 for whom diabetes mellitus (DM) history was not missing at this time, 10 for whom blood pressure information, 17 were unable to obtain smoking status, and 7191 were unable to obtain alcohol consumption status. Therefore, a total of 32,484 participants were ultimately included in this study. A flowchart detailing the study design can be seen in Fig. 1. The NHANES data were approved by the National Center for Health Statistics Research Ethics Review Board, and all participants provided informed consent [7].

Data collection

Exposure variable

We exposed data using dietary fiber intake, and this data source was collected primarily through two recall interviews. Participants were asked to recall what they had eaten in the past 24 h, with the first interview taking place at a mobile examination center (MEC) and the second follow-up visit taking place by telephone 3–10 days later [15]. Detailed information on all foods and beverages consumed by participants in the past 24 h was collected through the dietary recall method. To obtain detailed nutritional content of each diet, the researchers used the USDA's Food and Nutrition Dietary Studies database (FNDDS) [23]. This database summarizes individual nutrient intakes, and dietary fiber intake was assessed according to the NHANES guidelines, with the

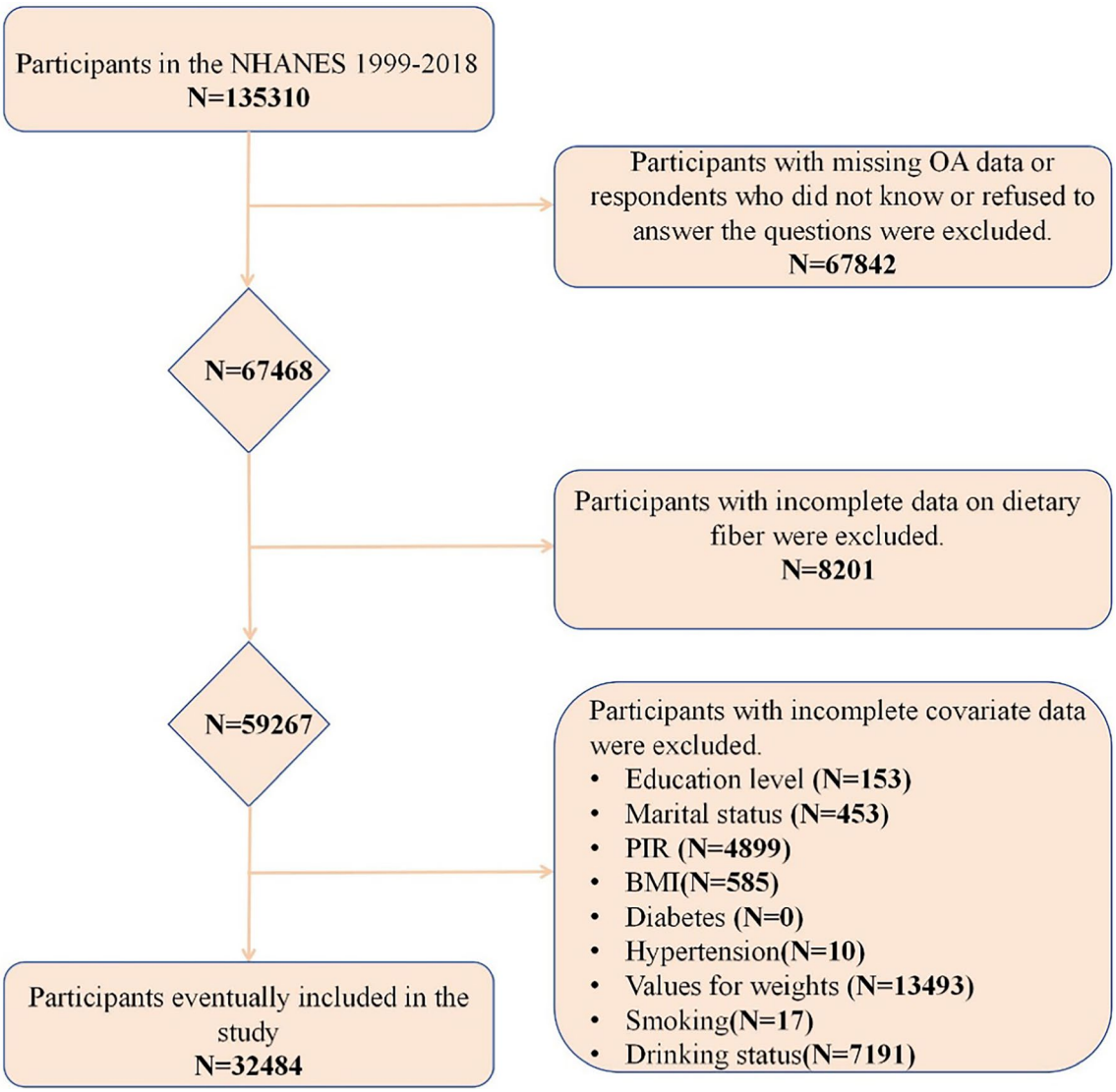

Fig. 1 Flowchart of participant selection procedure

final dietary fiber intake being the average of the two dietary interviews that were calculated.

Outcome variable

To assess whether a patient had OA, all participants were asked two questions about osteoarthritis. Firstly, if they answered "yes" to the question "Your doctor said you have arthritis" then they were considered to have arthritis (MCQ160A). However, there are many types of arthritis, and to further differentiate between the types of arthritis suffered, participants who answered "yes" to the first question were asked, "What type of arthritis" (MCQ195). Response options included "rheumatoid arthritis", "osteoarthritis", "psoriatic arthritis", "other ", "refused" and "don't know", and only those who answered "osteoarthritis" were considered to have OA.

Covariates

Covariates were selected based on prior literature and OA risk assessment and included age, gender, race, marital status, education level, body mass index (BMI), smoking and alcohol use, PIR, and baseline medical history status (hypertension and diabetes). We categorized race into four total: Mexican American, non-Hispanic white, non-Hispanic black, and other. Marital status was categorized into two categories, widowed/divorced/separated/never married or married/living with partner. The PIR is calculated as the ratio of household income to the federal

poverty threshold, adjusted for family size and inflation. PIR is categorized as < 1.30, 1.31–3.49, or ≥ 3.50, corresponding to low income, middle income, and high income, respectively. Educational level was categorized using high school as the dividing line into less than a high school degree, a high school degree, and more than a high school degree (which includes college graduates or higher).BMI was measured offline by height and weight measurements at the first interview, and was categorized as normal weight (BMI < 25 kg/m^2), overweight (25 $kg/m^2 \leq$ BMI < 30 kg/m^2), and obese (BMI ≥ 30 kg/m^2) based on BMI. Smoking status was categorized into three types, never smoked/previously smoked/currently smoked. Alcohol consumption was defined as at least 12 drinks per year.

Standardized diagnoses were used for both hypertension and diabetes. Higher than normal systolic and diastolic blood pressure or a self-reported diagnosis of hypertension or currently taking antihypertensive medication were considered to be hypertension. Diabetes mellitus was defined as a physician diagnosis of diabetes mellitus or higher than normal values of glycosylated hemoglobin, fasting glucose, random glucose, or being on glucose-lowering medications or insulin. Measurement details for these variables are available at https://www.cdc.gov/nchs/nhanes/.

Statistical analysis

To mitigate the effects associated with the intricate multi-stage sampling design employed by NHANES, we utilized the Day 1 dietary sample weight (WTDRD1) as delineated by the guidelines established by NHANES and performed weighted analyses to augment the precision of the data. Continuous variables are presented as weighted means with standard errors, and categorical variables are presented as counts with corresponding percentages. Subsequently, Subsequently, participants' baseline features were assessed based on OA status using the Kruskal–Wallis and chi-square tests. To estimate the adjusted odds ratio (OR) and their 95% confidence interval (CI) for dietary fiber quartiles, weighted logistic regression models were employed. The study constructed three weighted logistic regression models: Model 1 had no adjustments; Model 2 was adjusted for age, race, marital status, education level, and PIR; and Model 3 included further adjustments for BMI, hypertension, diabetes, smoking status, and alcohol consumption. Additionally, the study applied weighted restricted cubic splines (RCS) to clarify the dose–response relationship between dietary fiber and OA risk, adjusting for potential confounders. In order to investigate any potential differential connections between subgroups, we subsequently stratified the patients by age, race, BMI, smoking status, alcohol intake, hypertension, and diabetes and performed interaction analyses. Multicollinearity among the covariates was assessed using the Variance Inflation Factor (VIF). A VIF value below 10 was considered acceptable and indicative of no severe multicollinearity. Finally, the results were analyzed again based on different genders and RCS curves were plotted. Statistical analyses were performed using R software (version 4.4.1; R Foundation, Vienna, Austria; http://www.R-project.org), with statistical significance set at a two-sided P-value of less than 0.05.

Results

Baseline population characteristics

A total of 32,484 eligible participants, aged between 20 and 85 years, were included in the final analysis. As shown in Table 1, of these participants, 1,864 self-reported having osteoarthritis and 30,620 reported normal joint function, resulting in a prevalence of OA of 5.74%. In the OA group, approximately 56.17% of the subjects were ≥ 60 years of age, 7.66% had less than high school education, 30.29% had low household income, 46.45% had a body mass index ≥ 30 kg/m^2, 65.92% had a history of smoking, and 79.59% had a background of alcohol consumption. In addition, in the OA group, 17.02% of the subjects were diagnosed with diabetes and 62.03% with hypertension. Statistically significant differences were found between the two groups of subjects in terms of age, race, gender, PIR, education, BMI, smoking status, drinking status, and prevalence of hypertension, diabetes mellitus, and dietary fiber ($P < 0.05$). The VIF analysis revealed that all covariates had VIF values between 1 and 3, indicating no significant multicollinearity. Detailed results of the VIF analysis are provided in Table 2.

Association between dietary fiber and OA

We used weighted multivariate logistic regression analysis to investigate the relationship between dietary fiber levels and OA risk in different models. The results, as shown in Table 3, showed a negative association between dietary fiber levels and OA risk. Both univariate and multivariate weighted logistic regression models showed a negative association between dietary fiber and lower OA risk. In addition, we transformed dietary fiber into a categorical variable expressed in quartiles to enhance analytic scrutiny. In Model 3, after adjusting for all possible covariates, participants in the highest quartile of dietary fiber (Q4) had a 27% lower risk of developing OA compared with those in the lowest quartile (Q1) (Q4 vs. Q1, OR: 0.73; 95% CI: 0.58–0.92; $P = 0.007$, trend $P = 0.006$). Finally, we analyzed the association between dietary fiber intake and OA by gender. In the female population, dietary fiber intake

Table 1 Characteristics of the study participants

Variable	Total 32,484 (100%)	Non-OA 30,620 (94.26%)	OA 1,864 (5.74%)	*P* value
Age				
16–59	22,846 (70.33%)	22,029 (71.94%)	817 (43.83%)	< 0.001
60 +	9,638 (29.67%)	8,591 (28.06%)	1,047 (56.17%)	
Gender				
Male	17,094 (52.62%)	16,205 (52.92%)	889 (47.69%)	< 0.001
Female	15,390 (47.38%)	14,415 (47.08%)	975 (52.31%)	
Race				
MexiCAn AmeriCAn	5,421 (16.69%)	5,160 (16.85%)	261 (14.00%)	< 0.001
Non-Hispanic White	15,655 (48.19%)	14,820 (48.40%)	835 (44.80%)	
Non-Hispanic Black	6,402 (19.71%)	5,854 (19.12%)	548 (29.40%)	
Other Race	5,006 (15.41%)	4,786 (15.63%)	220 (11.80%)	
Marital status				
Married/Living with partner	12,486 (38.44%)	11,658 (38.07%)	828 (44.42%)	0.2
Widowed/Divorced/Separated/ Never married	19,998 (61.56%)	18,962 (61.93%)	1,036 (55.58%)	
Education level				
< High school	2,855 (8.789%)	2,602 (8.498%)	253 (13.57%)	< 0.001
Completed high school	4,559 (14.03%)	4,196 (13.70%)	363 (19.47%)	
> High school	25,070 (77.18%)	23,822 (77.80%)	1,248 (66.95%)	
PIR				
Low income	9,055 (27.88%)	8,354 (27.28%)	701 (37.61%)	< 0.001
Middle income	12,397 (38.16%)	11,669 (38.11%)	728 (39.06%)	
High income	11,032 (33.96%)	10,597 (34.61%)	435 (23.34%)	
BMI				
Normal	9,734 (29.97%)	9,310 (30.40%)	424 (22.75%)	< 0.001
Heavy	11,051 (34.02%)	10,477 (34.22%)	574 (30.79%)	
Overweight	11,699 (36.01%)	10,833 (35.38%)	866 (46.46%)	
Diabetes				
No	28,862 (88.85%)	27,430 (89.58%)	1,432 (76.82%)	< 0.001
Yes	3,622 (11.15%)	3,190 (10.42%)	432 (23.18%)	
Hypertension				
No	18,506 (56.97%)	17,890 (58.43%)	616 (33.05%)	< 0.001
Yes	13,978 (43.03%)	12,730 (41.57%)	1,248 (66.95%)	
Smoke status				
Never	16,025 (49.33%)	15,342 (50.10%)	683 (36.64%)	< 0.001
Former	8,847 (27.23%)	8,182 (26.72%)	665 (35.68%)	
Now	7,612 (23.43%)	7,096 (23.17%)	516 (27.68%)	
Drinking status				
No	5,394 (16.61%)	4,936 (16.12%)	458 (24.57%)	< 0.001
Yes	27,090 (83.39%)	25,684 (83.88%)	1,406 (75.43%)	
Dietary fiber (Continuous)	22 (15, 31)	22 (16, 31)	19 (14, 27)	< 0.001
Dietary fiber (Categorical)				
Q1	8,935 (27.51%)	8,279 (27.04%)	656 (35.19%)	< 0.001
Q2	8,258 (25.42%)	7,749 (25.31%)	509 (27.31%)	
Q3	7,672 (23.62%)	7,274 (23.76%)	398 (21.35%)	
Q4	7,619 (23.45%)	7,318 (23.90%)	301 (16.15%)	

Table 2 Variance inflation factor values for the covariates of the relationship between dietary fiber and OA

Category	Age	Race	Gender	Education level	PIR	BMI	Hypertension	Diabetes	Drinking status	Smoking status
Value	1.77	2.55	1.45	2.10	2.22	1.72	1.69	1.26	1.39	1.76

Table 3 The association between dietary fiber and OA

Characteristics	Model1		Model2		Model3	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Dietary fiber intake and OA (*All sexes*)						
Dietary fiber (Continuous)	0.98 (0.97, 0.99)	< 0.0001	0.99 (0.98, 0.99)	0.003	0.99 (0.97, 0.99)	0.0175
Dietary fiber (Quartile)						
Q1	Ref	Ref	Ref	Ref	Ref	Ref
Q2	0.81 (0.67, 0.98)	0.0316	0.85 (0.69, 1.04)	0.110	0.89 (0.72, 1.10)	0.281
Q3	0.68 (0.56, 0.81)	< 0.0001	0.73 (0.60, 0.89)	0.002	0.79 (0.65, 0.96)	0.020
Q4	0.58(0.47, 0. 72)	< 0.0001	0.66 (0.53, 0.83)	0.0005	0.73 (0.58, 0.92)	0.007
P for trend		< 0.0001		0.0005		0.006
Dietary fiber intake and OA (*Male*)						
Dietary fiber (Continuous)	0.99 (0.97, 1.00)	0.0323	0.99 (0.98, 1.00)	0.217	0.99 (0.98, 1.01)	0.374
Dietary fiber (Quartile)						
Q1	Ref	Ref	Ref	Ref	Ref	Ref
Q2	0.95 (0.71, 1.28)	0.745	1.01 (0.76, 1.36)	0.923	1.04 (0.77, 1.40)	0.799
Q3	0.71 (0.53, 0.93)	0.014	0.78 (0.59, 1.03)	0.084	0.82 (0.62, 1.10)	0.190
Q4	0.69 (0.51, 0.93)	0.015	0.81 (0.59, 1.11)	0.194	0.87 (0.64, 1.19)	0.387
P for trend		< 0.0001		0.0003		0.0022
Dietary fiber intake and OA (*Female*)						
Dietary fiber (Continuous)	0.97 (0.96, 0.99)	0.0005	0.98 (0.97, 1.00)	0.014	0.99 (0.97, 1.00)	0.079
Dietary fiber (Quartile)						
Q1	Ref	Ref	Ref	Ref	Ref	Ref
Q2	0.76 (0.61, 0.94)	0.012	0.79 (0.63, 0.99)	0.037	0.86 (0.68, 1.08)	0.186
Q3	0.72 (0.56, 0.92)	0.010	0.81 (0.62, 1.05)	0.113	0.90 (0.70, 1.17)	0.425
Q4	0.45 (0.31, 0.65)	< 0.0001	0.52 (0.36, 0.76)	0.0009	0.60 (0.41, 0.88)	0.009
P for trend		< 0.0001		0.0007		0.006

showed a negative association with OA after multivariate adjustment (OR: 0.60; 95% CI: 0.41–0.88; $P = 0.009$) (Table 3).

Dose–response curve analyses using the RCS showed a nonlinear relationship between dietary fiber intake and OA risk, with OA risk decreasing with increasing dietary fiber intake within a certain range (total $P < 0.001$; nonlinear $P = 0.013$; Fig. 2). By calculating the threshold interval for the restricted cubic sample plot, it was found that dietary fiber intake in the range of 14.4–26.7 g was a reduction in the risk of OA, and intake above this dose was not significantly protective. In addition, we performed RCS analysis for different genders, and the results showed a linear relationship between dietary fiber intake and the risk of OA in the female population, in contrast to a nonlinear relationship in the male population (Fig. 3).

Subgroup analysis

We performed stratified analyses to assess whether the relationship between dietary fiber and OA differed across subgroups (Fig. 4). Our findings showed no significant difference in the relationship between dietary fiber and OA risk in the subgroup analysis (interaction $P > 0.05$). No significant gender difference was found in the association between dietary fiber intake and OA.

Discussion

Our study conducted a national cross-sectional analysis of the association between dietary fiber intake and risk of osteoarthritis (OA) using data from the NHANES surveys from 1999 to 2018. It was found that both univariate and multivariate models indicated an inverse relationship between dietary fiber levels and OA risk, regardless of whether dietary fiber was quantified as a continuous

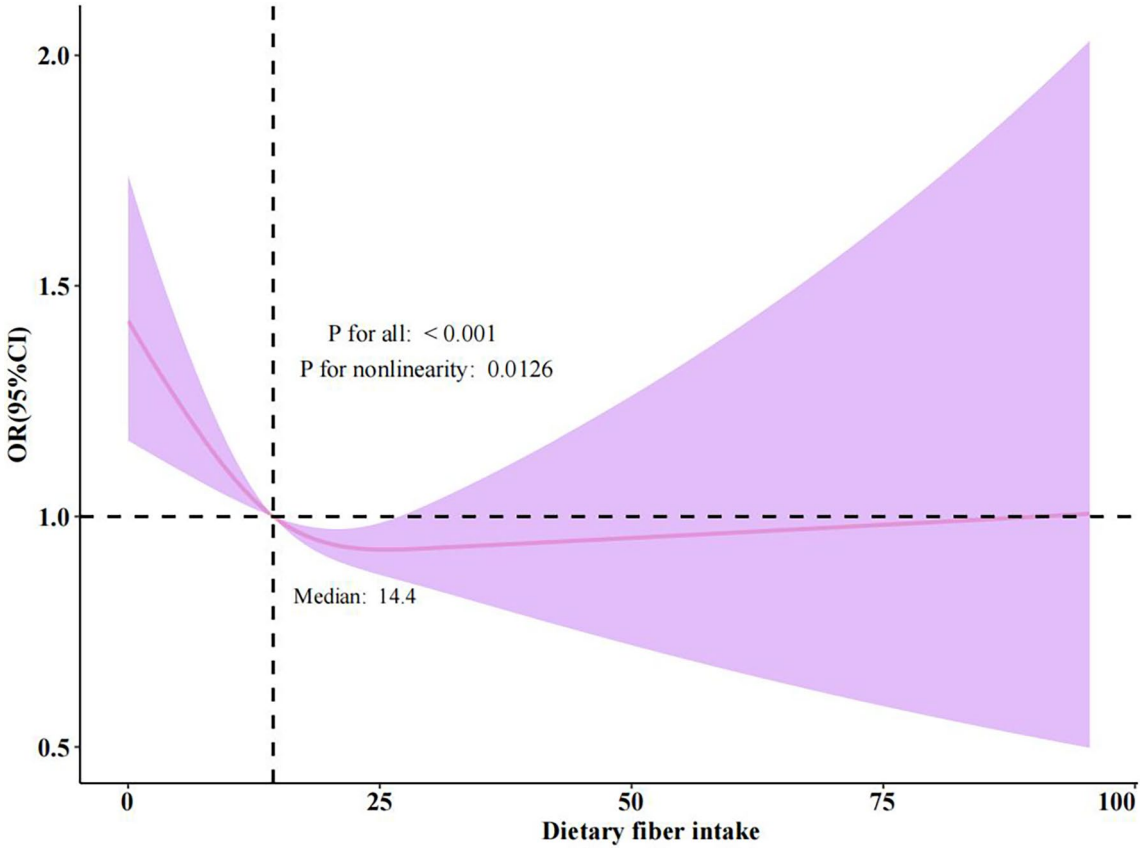

Fig. 2 The dose–response relationship of the dietary fiber with the risk of OA

variable or in quartiles. These findings suggest that increased dietary fiber intake plays a protective role in preventing OA. By calculating the threshold interval for the restricted cubic sample plot, it was found that dietary fiber intake in the range of 14.4–26.7 g was a reduction in the risk of OA, and intake above this dose was not significantly protective.

Different dietary patterns are closely related to the physical health of the human body. Dietary fiber is an important component of foods such as vegetables, fruits and grains [31]. Dietary fiber in food contains a variety of organic polymers, which play important physiological roles through the small intestine to the large intestine [16].Previous studies have confirmed that dietary fiber can positively regulate intestinal flora and metabolically form beneficial products such as short-chain fatty acids, which have significant advantages in reducing the risk of gastrointestinal diseases such as inflammatory bowel disease and irritable bowel syndrome [8, 11]. In addition, dietary fiber intake plays a positive role in cardiovascular disease [27], liver disease [25], and dyslipidemia [17].

OA belongs to the list of culprits that affect the health of most people's lives and its prevalence is increasing every year. In studying the pathogenesis of OA, we have found that aging, inflammation and weight gain are very important influencing factors. With the concept of the gut-skeletal axis, studies have shown that aging and obesity in the body have a great impact on the composition of the gut microbiota and that gut flora modulates joint inflammation [32]. Dietary fiber is an easily overlooked nutrient, but most studies have shown that it has a positive impact on the health of the organism. Studies have confirmed that consuming a certain amount of dietary fiber can help slow down aging or reduce the risk of obesity [5, 19]. However, an analysis of ten years of data on dietary fiber intake among adults in the United States showed that bread and cereals were their main sources of dietary fiber, with low levels of both overall intake [20]. A large-sample prospective cohort study through 4,796 participants found that higher total dietary fiber intake was associated with a lower risk of osteoarthritis [4].

More previous studies on the relationship between diet and arthritis exist, and a number have found that specific dietary intake can slow arthritis symptoms [18, 21, 22]. However, there is a lack of analyzing the elements of the diet that work to get more precise access to

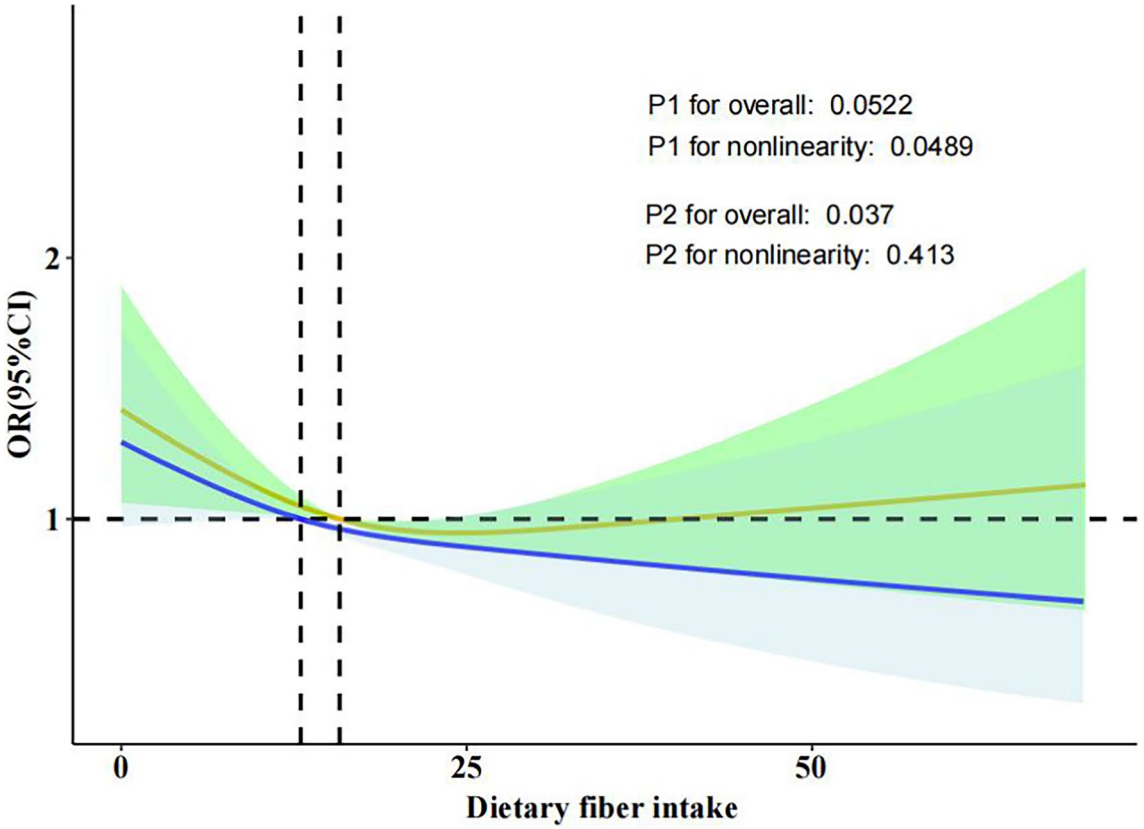

Fig. 3 Dose–response relationship between dietary fiber and risk of OA by gender. P1 and the orange line and green confidence interval are the results of the RCS curves for dietary fiber intake and OA in the male population. P2 and the blue line and light blue confidence interval are the results of the RCS curves for dietary fiber intake and OA in the female population

beneficial foods. The present study, for example, found that increased dietary fiber intake was associated with a reduced risk of OA through a large sample. Our study provides insight into the health benefits of dietary fiber and helps raise awareness of the need for dietary fiber intake. This provides ideas for clinicians in the treatment of OA, as well as prevention for patients with joint pain and OA. More studies between dietary fiber and OA should be added in the future, which will also reduce the NHS burden of OA.

The exact mechanism by which rational dietary fiber intake prevents OA is unknown, but dietary fiber may prevent arthritis through the following mechanisms. Increased dietary fiber intake helps maintain the diversity and stability of the gut microbiota. Changes in intestinal flora induced by increased dietary fiber intake modulate the development of OA by promoting the upregulation of SESN2 expression in the knee joint to maintain chondrocyte activity and reduce synovial inflammation [26]. In addition, obesity is an important factor in the development of OA, and dietary fiber intake stimulates gastrointestinal-related signals that feed back to brain regions involved in appetite regulation, thereby preventing obesity by reducing hunger and prolonging satiety [1]. Inflammatory factors play a critical role throughout the development of OA, and fiber is fermented in the gut to produce short-chain fatty acids (SCFAs), such as butyrate, which reduce joint inflammation by inhibiting pro-inflammatory cytokines like TNF-α and IL-6, while also modulating immune responses [9, 34]. Moreover, increased dietary fiber intake can activate inflammatory pathways such as the NF-kB pathway, promoting a healthy balance in the gut microbiome and reducing the production of pro-inflammatory metabolites, thus playing a crucial role in reducing systemic inflammation.

In future studies, to better understand the long-term effects of dietary fiber on OA, a longitudinal cohort study design could be used to track the progression of dietary fiber intake and OA over time. Moreover, whether dietary intake of specific dietary fiber is better protective against OA and what the optimal dose is still needs to be validated in large-scale clinical trials. The molecular biological mechanism of the protective effect of dietary fiber on OA still needs more in-depth studies in animal

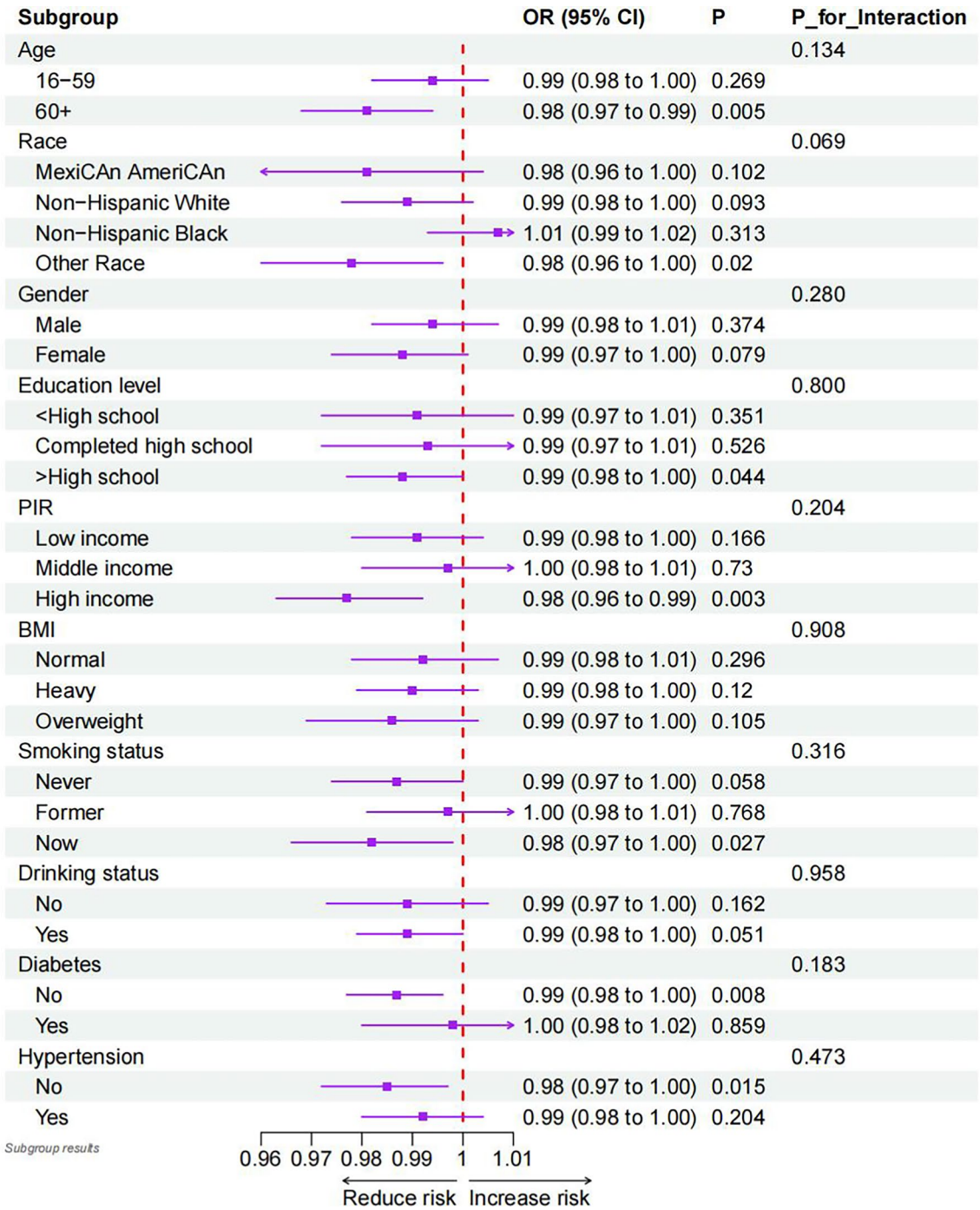

Fig. 4 Relationship between dietary fiber and OA in each subgroup. Each subgroup was adjusted for all factors except the grouping factor itself

experiments, especially in terms of how dietary fiber-induced changes in the gut microbiota affect the development of OA.

The strength of this study is that it focuses on the relationship between dietary fiber intake and OA and is supported by a large sample. There are then some limitations to the study. First, the diagnosis of OA that we used was self-reported from participants, and although this method allows for rapid data collection from a large population, there is a risk of lack of accuracy. And, because the study was retrospective in design, it was not possible to confirm a causal relationship between exposure

and outcome. Second, although we adjusted for common confounders affecting OA, there may still be residual confounders, which could potentially affect the relationship between dietary fiber and OA. Third, the population we studied was the US population, and further, larger-sample studies are needed to determine whether the benefits of dietary fiber intake can be generalized to other populations.

Conclusions

In conclusion, this cross-sectional study based on NHANES data (1999–2018) found a negative association between dietary fiber intake and OA risk in the U.S. population after adjusting for potential confounders. Our findings provide new insights into dietary interventions that may help reduce OA incidence. Future randomized controlled trials are necessary to confirm these results and identify optimal dietary fiber intake levels for OA prevention and treatment.

Author contributions

All authors contributed to the study conception and design. Study design, data collection and statistical analysis, XFL, XMD, RL, Writing-original draft, XFL, XMD, RL; Writing-review & editing, XFL, XMD, RL, SSL ZHZ, YLL, XCD, QY, YL; Supervision: QY, YL.

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Availability of data and materials

All datasets used during the current study can be found on the NHANES website (https://www.cdc.gov/nchs/nhanes).

Declarations

Ethics approval and consent to participate

NHANES is a publicly available, free database that has been approved by the NCHS Research Ethics Review Board and agreed to by all participants.

Competing interests

None of the authors has any conflicts of interest.

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