



Impact of dietary live microbes and non-dietary prebiotic/probiotic intake on osteoarthritis and rheumatoid arthritis development: Stratified findings from NHANES data

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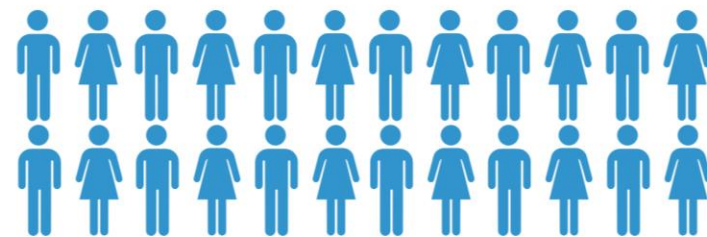
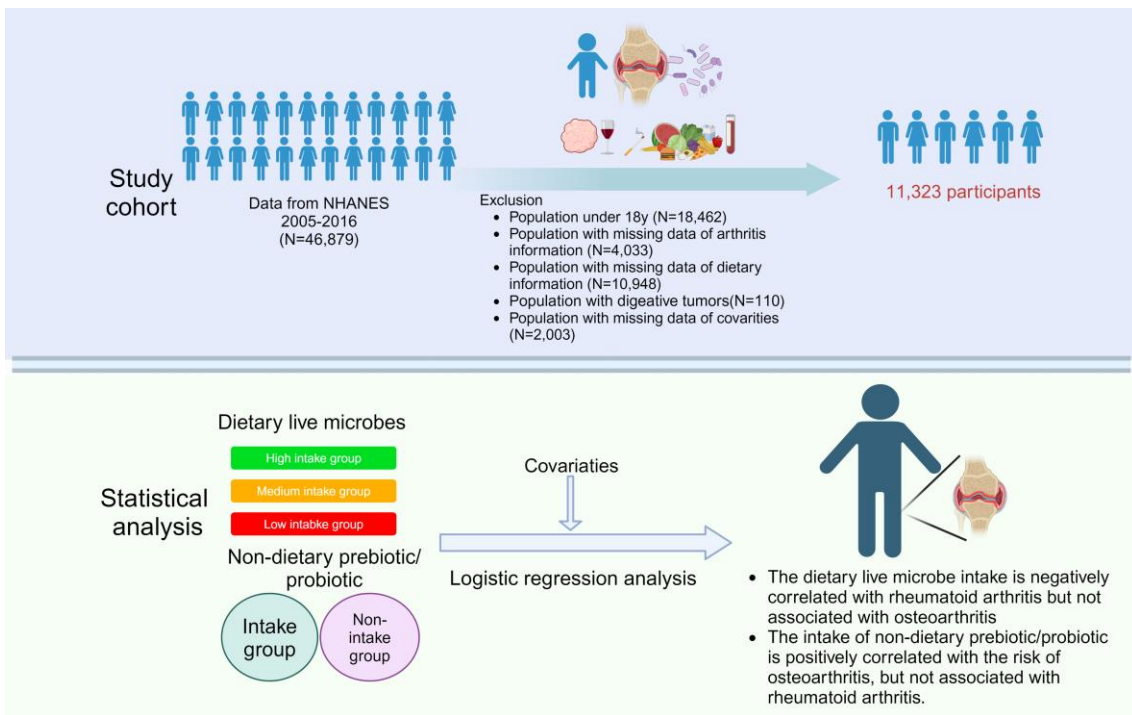
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Introduction

Osteoarthritis (OA) and rheumatoid arthritis (RA) are diseases influencing the joints, their surrounding tissues, and other connective tissues, with the etiology still not fully understood. Some studies suggest that the gut microbiota may play a key role in the occurrence and development of these diseases.

This study conducted a cross-sectional analysis using data from the NHANES database from 2005 to 2016. The subjects were individuals aged 18 and above with complete demographic and arthritis diagnosis information. Researchers used logistic regression and other analytical methods to analyze the relationship between the intake of dietary live microbes and non-dietary prebiotic/probiotic and the prevalence of OA and RA.



Data from NHANES
2005-2016
(N=46,879)

Study cohort



Exclusion

- population under 18y (N=18,462)
- population with missing data of arthritis information (N=4,033)
- population with missing data of dietary information (N=10,948)
- population with digestive tumors (N=110)
- population with missing data of covariates (N=2,003)



11,323 participants



Highlights

- Intake of non-dietary prebiotics/probiotics was positively associated with the risk of developing osteoarthritis.
- Higher intake of live dietary microbes was negatively associated with the risk of rheumatoid arthritis (RA).
- A mediating effect of neutrophil count and leukocyte count was observed in the association between dietary live microbes intake and RA.



Results

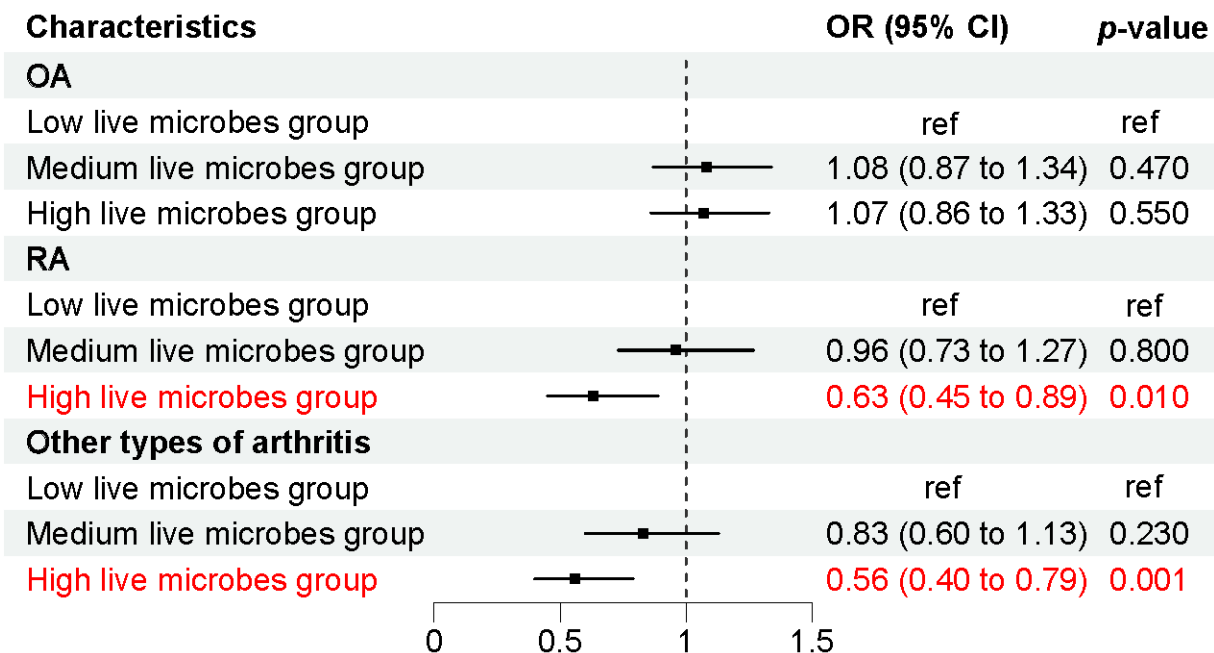
Characteristics		Healthy (N=8397)	OA (N=1724)	RA (N=712)	Other types of arthritis (N=490)	P
Age (years)						< 0.0001
Gender (%)	Mean(SE)	45.99(0.32)	63.28(0.45)	59.56(0.65)	55.98(0.98)	< 0.0001
	Female	4473(52.46)	1165(68.30)	431(61.81)	288(61.46)	
	Male	3924(47.54)	559(31.70)	281(38.19)	202(38.54)	
Education level (%)						< 0.0001
	Higher than high school	5415(71.37)	1075(67.17)	340(52.40)	252(57.10)	< 0.0001
	High school or equivalent	1704(19.55)	374(20.95)	179(26.60)	133(28.20)	
	Under high school	1278(9.08)	275(11.88)	193(21.00)	105(14.70)	
Marital status (%)						< 0.0001
	Married/cohabiting	5472(67.73)	1025(64.38)	400(63.58)	303(63.14)	< 0.0001
	Divorced/separated/widowed	1544(15.91)	586(29.75)	258(29.99)	135(27.03)	
	Never married	1381(16.36)	113(5.87)	54(6.43)	52(9.83)	
Race/ethnicity (%)						< 0.0001
	Mexican-American	1126(6.54)	105(2.47)	90(6.27)	40(3.00)	< 0.0001
	Non-Hispanic Black	1382(7.51)	239(5.63)	183(12.58)	79(7.20)	
	Non-Hispanic White	4275(74.26)	1192(85.80)	354(74.40)	293(80.56)	
	Other race	1614(11.69)	188(6.11)	85(6.74)	78(9.23)	
PIR (%)						< 0.0001
	Low(<1.31)	1879(14.57)	369(12.86)	251(25.94)	133(20.79)	< 0.0001
	Medium(1.31-3.5)	3091(32.60)	684(36.49)	282(41.27)	215(43.91)	
	High(>3.5)	3427(52.82)	671(50.66)	179(32.79)	142(35.31)	
BMI (kg/m ²) (%)						< 0.0001
	Underweight/normal (<25)	2710(33.95)	374(23.15)	163(26.50)	99(19.17)	< 0.0001
	Overweight (25-29.9)	2939(35.21)	547(32.94)	202(25.45)	145(28.23)	
	Obese (>29.9)	2748(30.84)	803(43.91)	347(48.05)	246(52.60)	
Smoke (%)						< 0.0001
	No	4923(58.37)	845(49.44)	325(43.15)	217(41.50)	< 0.0001
	Yes	3474(41.63)	879(50.56)	387(56.85)	273(58.50)	
Alcohol use (%)						< 0.0001
	No	2209(20.55)	530(26.37)	231(29.71)	149(26.49)	< 0.0001
	Yes	6188(79.45)	1194(73.63)	481(70.29)	341(73.51)	
Neutrophil (1000 cells/ul)						0.001
	Mean(SE)	4.28(0.03)	4.36(0.06)	4.63(0.11)	4.55(0.12)	0.03
	WBC (1000 cells/ul)					
	Mean(SE)	7.21(0.04)	7.25(0.08)	7.55(0.17)	7.51(0.15)	0.13
	AMED(%)					
	Q1	2347(28.62)	426(25.07)	233(33.37)	144(31.39)	< 0.001
	Q2	1490(17.05)	286(17.52)	120(15.45)	97(19.59)	
	Q3	1560(19.13)	331(18.05)	122(18.83)	100(21.20)	
	Q4	1350(15.70)	285(16.87)	112(16.76)	66(12.33)	
	Q5	1650(19.50)	396(22.49)	125(15.59)	83(15.49)	
AHEI(%)						< 0.001
	Q1	1083(12.05)	172(9.75)	96(14.72)	58(14.21)	< 0.0001
	Q2	1267(14.68)	205(11.32)	130(19.18)	98(19.87)	
	Q3	1509(17.24)	310(16.75)	132(15.59)	93(19.64)	
	Q4	1725(20.01)	376(21.36)	171(22.20)	99(20.38)	
	Q5	2813(36.02)	661(40.81)	183(28.31)	142(25.91)	
DII(%)						< 0.0001
	Q1	2663(35.06)	510(30.94)	159(24.35)	122(27.91)	< 0.0001
	Q2	1924(22.89)	409(23.76)	144(21.40)	94(19.72)	
	Q3	1568(18.00)	255(14.16)	146(19.75)	112(24.30)	
	Q4	1273(14.31)	285(17.90)	134(19.93)	79(15.59)	
	Q5	969(9.75)	265(13.25)	129(14.57)	83(12.48)	
HEI(%)						0.01
	Q1	1240(14.94)	194(12.20)	113(15.02)	73(13.08)	< 0.001
	Q2	1395(16.12)	257(15.15)	130(18.76)	88(19.58)	
	Q3	1548(18.99)	300(17.72)	152(23.44)	100(26.08)	
	Q4	1758(20.79)	374(21.47)	143(17.53)	107(18.58)	
	Q5	2456(29.16)	599(33.46)	174(25.25)	122(22.68)	
Dietary live microbe (%)						0.01
	Low	2608(28.22)	468(26.74)	264(32.39)	181(35.62)	< 0.001
	Medium	3562(40.65)	771(41.72)	321(45.01)	214(42.39)	
	High	2227(31.13)	485(31.54)	127(22.60)	95(21.98)	
Prebiotic/probiotic ^a (%)						< 0.001
	No	7908(92.91)	1583(88.64)	684(94.47)	460(92.38)	< 0.001
	Yes	489(7.09)	141(11.36)	28(5.53)	30(7.62)	

1.Descriptive characteristics:

- There are significant differences in demographic characteristics between the healthy control group and the OA and RA patient groups.
- RA patients have a reduced intake of dietary live microbes and non-dietary prebiotic/probiotic.
- OA patients have an increased intake of dietary live microbes and non-dietary prebiotics/probiotics.

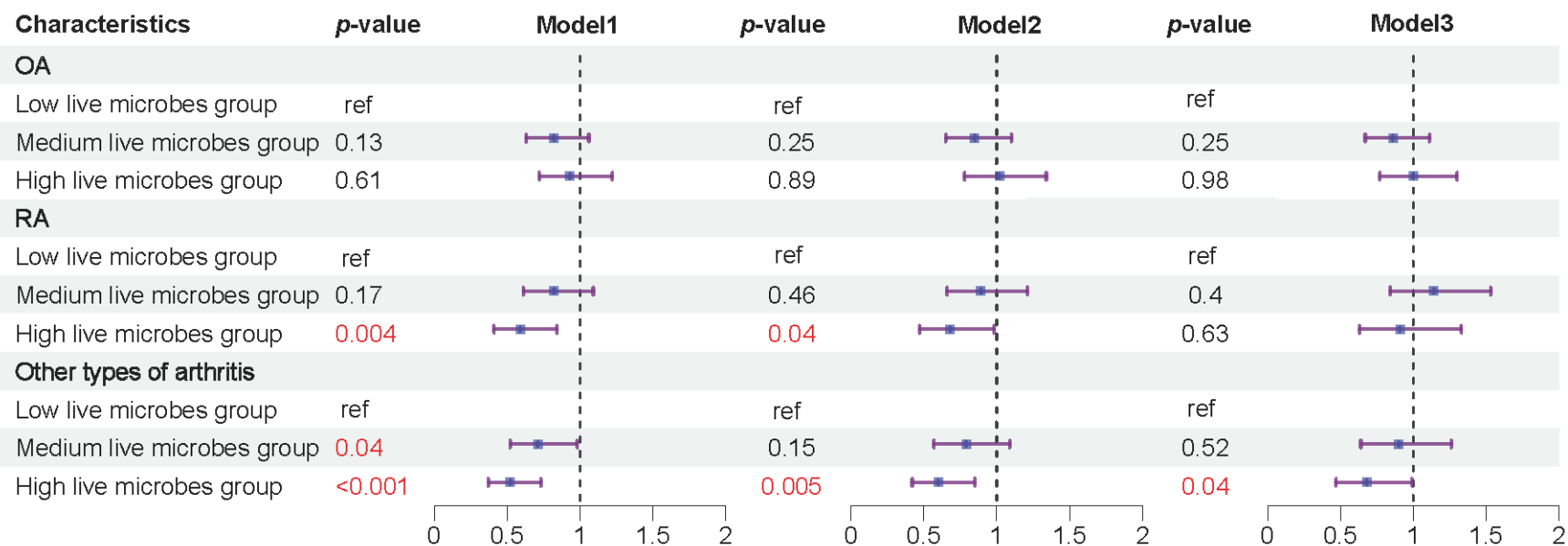


Results



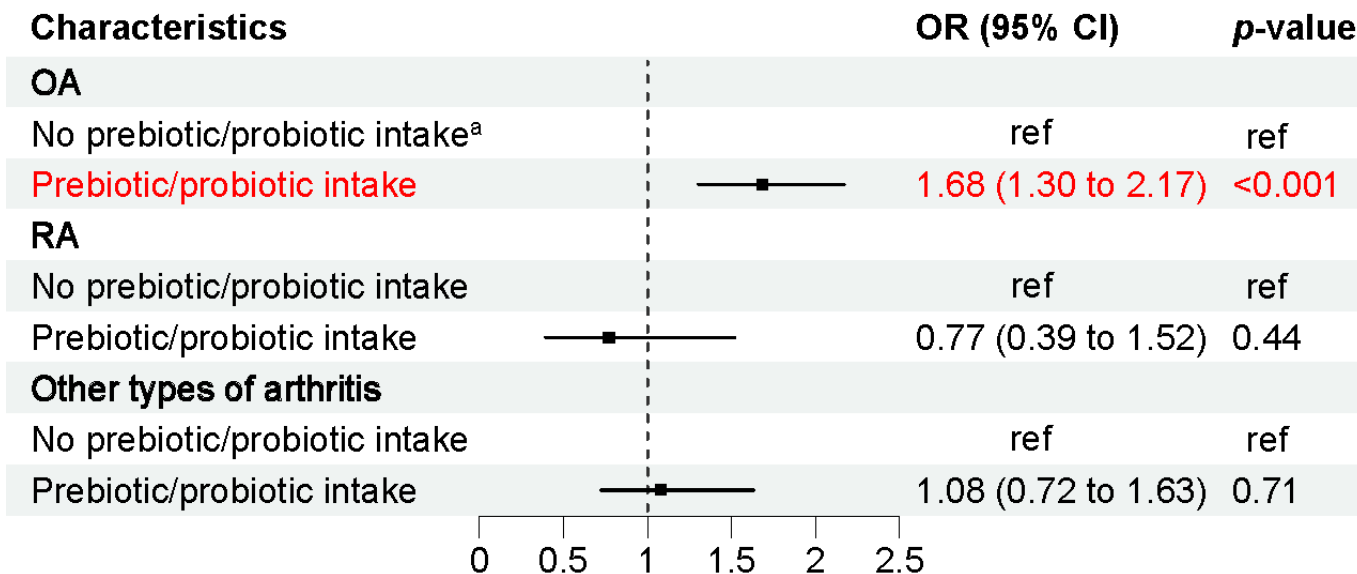
2. Association Analysis:

- The intake of dietary live microbes does not show a statistically significant correlation with the prevalence of OA.
- The intake of dietary live microbes is negatively correlated with the risk of rheumatoid arthritis and other non-OA joint diseases.



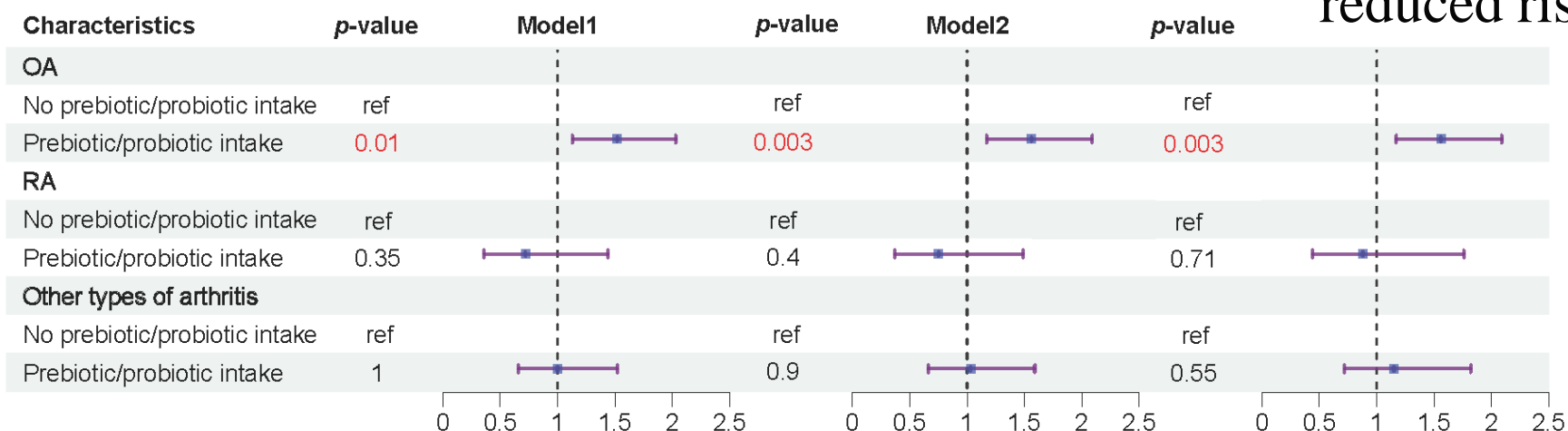


Results



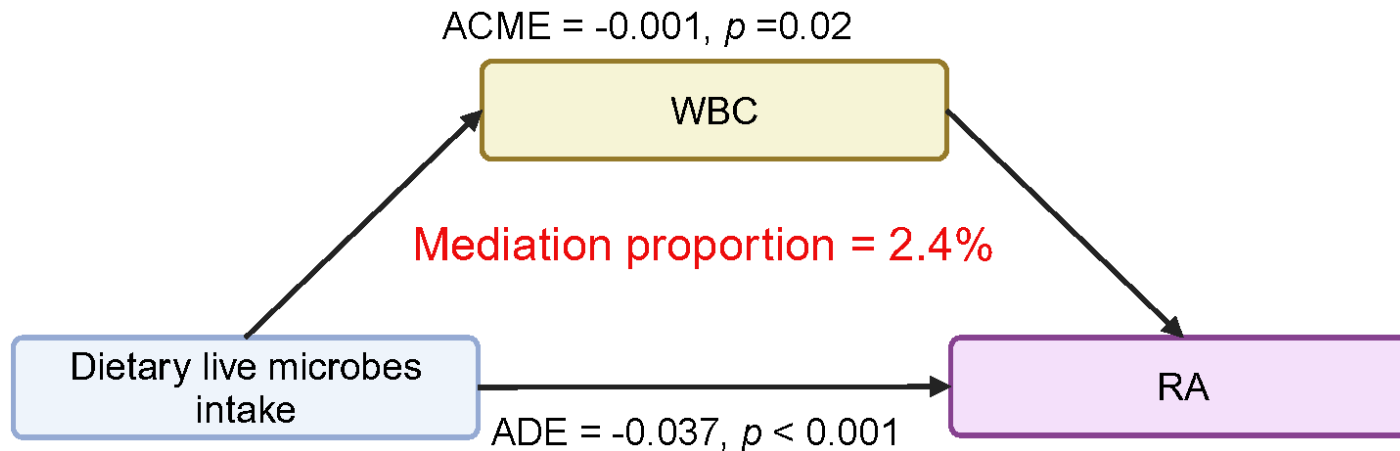
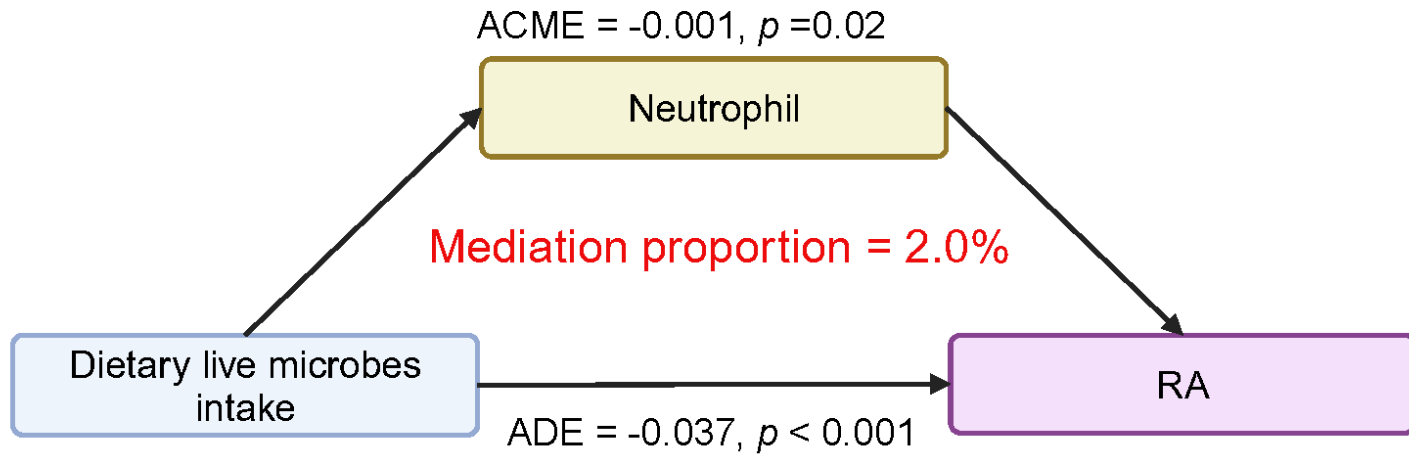
2. Association Analysis:

- The intake of non-dietary prebiotic/probiotic is associated with a significant increase in the prevalence of OA.
- There is no statistically significant correlation between the intake of non-dietary prebiotic/probiotic and the reduced risk of RA.





Results



3. Mediation analyses:

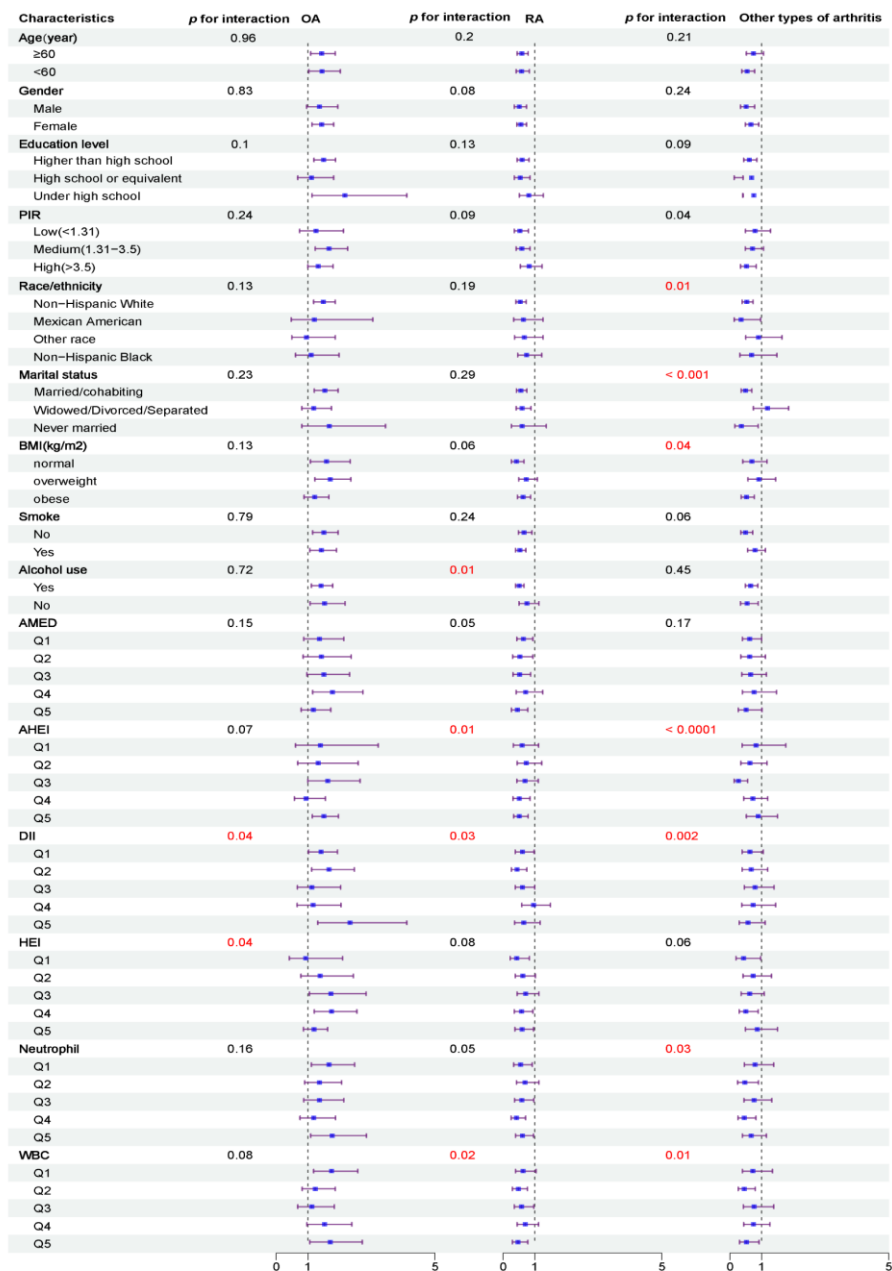
- Neutrophils and leukocytes have been shown to mediate the impacts of dietary live microbes on RA.
- Mediation analyses showed that neutrophil number and leukocytes count mediated by 2.0% and 2.4 %, respectively.



Results

4. Subgroup Analysis

- Dietary inflammatory index(DII) and the healthy diet index(HEI) may influence the association between the intake of non-dietary prebiotic/probiotic and the risk of OA.
- Alcohol consumption, the alternative healthy eating index(AHEI), DII, and white blood cells may affect the association between the intake of dietary live microbes and the risk of RA.
- Race/ethnicity, marital status, BMI, AHEI, DII, neutrophils, and white blood cells may influence the association between the intake of dietary live microbes and the risk of other types of arthritis.





Results

Characteristics	OR (95%CI)	P
RA		
Low live microbes group	ref	ref
Medium live microbes group	0.99(0.80,1.22)	0.91
High live microbes group	0.65(0.50,0.84)	0.001
Other types of arthritis		
Low live microbes group	ref	ref
Medium live microbes group	0.96(0.75,1.22)	0.72
High live microbes group	0.62(0.45,0.85)	0.003

5. Sensitivity Analysis :

Due to the high number of missing values for intake of non-dietary prebiotic/probiotic, this study further conducted an analysis excluding this variable and the relationship between dietary live microbes and RA and other types of arthritis remained consistent with previous findings.

Characteristics	Model 1		Model 2		Model 3	
	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P
RA						
Low live microbes group	ref	ref	ref	ref	ref	ref
Medium live microbes group	0.80(0.63,1.02)	0.07	0.89(0.69,1.14)	0.34	1.09(0.84,1.42)	0.49
High live microbes group	0.58(0.44,0.76)	<0.001	0.67(0.51,0.88)	0.005	0.89(0.67,1.19)	0.43
Other types of arthritis						
Low live microbes group	ref	ref	ref	ref	ref	ref
Medium live microbes group	0.78(0.61,1.01)	0.06	0.87(0.68,1.12)	0.27	0.97(0.75,1.25)	0.82
High live microbes group	0.55(0.40,0.76)	<0.001	0.63(0.45,0.88)	0.01	0.69(0.50,0.97)	0.03



Summary

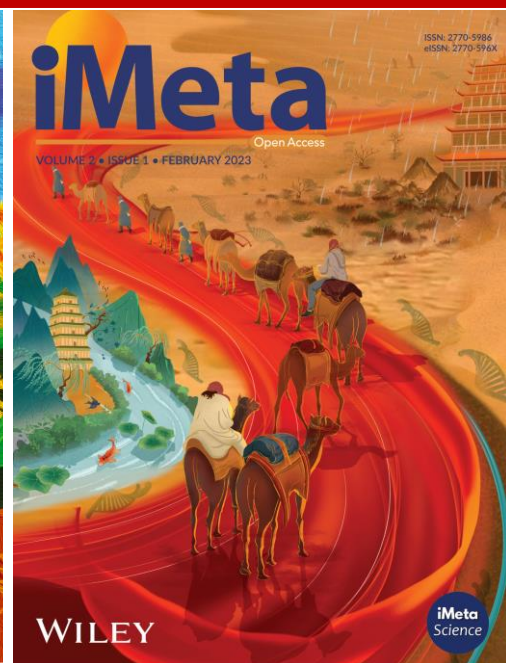
- ❑ Intake of non-dietary prebiotics/probiotics was positively associated with the risk of developing osteoarthritis.
- ❑ Higher intake of live dietary microbes was negatively associated with the risk of RA.
- ❑ A mediating effect of neutrophil count and leukocyte count was observed in the association between dietary live microbes intake and RA.
- ❑ Race/ethnicity, alcohol consumption, marital status, BMI, different dietary patterns, and neutrophils and white blood cells may influence the correlation between the intake of dietary live microbes and non-dietary prebiotics/probiotics and the risk of arthritis.

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